Submission
No 147

INQUIRY INTO IMPACT OF RENEWABLE ENERGY ZONES (REZ) ON RURAL AND REGIONAL COMMUNITIES AND INDUSTRIES IN NEW SOUTH WALES

Organisation: Farmers for Climate Action

Date Received: 5 June 2025

Farmers for Climate Action

5 June 2025

Legislative Council
Portfolio Committee No.4 Regional NSW
Parliament of New South Wales
Sydney NSW 2000

Dear Committee Secretary,

Re: Farmers for Climate Action submission to the inquiry into the impact of Renewable Energy Zones (REZ) on rural and regional communities and industries in New South Wales

Farmers for Climate Action (FCA) welcomes the opportunity to provide this submission to the inquiry. We represent more than 8,400 Australian farmers, including 3,200 in NSW, and 85,000 community supporters advocating for strong climate policies that protect and benefit farming communities.

The inquiry's Terms of Reference note interest in alternatives to traditional renewables. FCA notes policy proposals currently under public discussion include overturning state and federal laws prohibiting nuclear power generation.

Farmers for Climate Action's firm position is that consideration of any power generation source must consider water use and impacts on farmers, their water, and the impacts of removing farming water on local communities and economies. As such, Farmers for Climate Action commissioned Professor Andrew Campbell, the former CEO of Land and Water Australia, to research and develop our submission to this inquiry. The issue of agricultural water access, price and impacts must be addressed transparently in consultation with agricultural communities prior to any overturning of moratoria on nuclear power generation.

Polling consistently shows a quiet majority of regional Australians support renewables when done right because these projects deliver drought-proof income for farmers and shared benefits for communities.

Recent polling of regional areas by CSIRO, 89 Degrees East and Porter Novelli has continued to find more than two-thirds support and around 18 per cent opposition to projects on local farmland. All farmers who host renewable energy projects have done so voluntarily - they have made this choice because it works for them, unlike other forms of energy generation which do not require landholder consent, such as coal seam gas on farmland without the owner's permission.

FCA offers to (virtually) connect the Committee with our farmer members who are successfully hosting renewables, with clean energy making their land more profitable and productive, and the drought-proof income making their family farms more financially sustainable.

Farmers are leading the clean energy shift. We urge the Committee to centre farmer voices in shaping REZs because this is a once in a generation opportunity for farmers and farming communities. We welcome further engagement and thank you for considering our submission.

Yours sincerely,

Natalie Collard
CEO
Farmers for Climate Action

Nuclear Power – a new competitor for high-security water?

Professor Andrew Campbell

May 2025

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Title:	**Nuclear Power – a new competitor for high-security water?**
Client:	Farmers for Climate Action
Author:	Professor Andrew Campbell
Version:	1.2
Date:	30 May 2025
Status:	Final

Triple Helix
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About the Author

Professor Andrew Campbell is one of Australia's most respected agricultural leaders, with a distinguished career spanning science, policy, and practice. With professional training in forestry and agricultural knowledge systems, he served as the CEO of Land & Water Australia from 2000-2007 and was most recently CEO of the Australian Centre for International Agricultural Research (ACIAR), where he strengthened global science partnerships and championed sustainable farming solutions across the Indo-Pacific.

Andrew Campbell played a key role in developing Landcare as Australia's first National Landcare Facilitator and has held senior executive positions in the Australian Government, and board roles including the Future Farm Industries CRC, the Peter Cullen Trust and the Terrestrial Ecosystem Research Network. He is an elected Fellow of the Australian Academy of Technological Sciences and Engineering, a non-executive director of AgriFutures Australia and an Honorary Professorial Fellow at the ANU Fenner School of Environment and Society.

Importantly, Andrew is also a fifth-generation farmer, with first-hand experience managing a family grazing property in southeast Australia. This practical connection to the land continues to shape his pragmatic, evidence-based approach to key agricultural challenges—from drought resilience to climate-smart farming.

Nuclear Power – a new competitor for high-security water?

Executive Summary

This paper explores the implications of establishing nuclear power stations at seven proposed sites in Australia, specifically focusing on the impact on high-security water – a resource vital for irrigated agriculture and regional communities.

Key Findings

Water Competition: Most of the proposed sites are inland, where water is already scarce and/or fully allocated. Nuclear power plants require large volumes of high-security water to maintain 90% capacity operation—around 25 GL per year per 1100MW reactor.

Agricultural Water: At five of the six inland sites, up to 200 GL/year of additional water would need to be acquired or reallocated from existing users, including irrigators. This could compromise agricultural productivity, environmental flows, and regional water security.

Climate Context: With intensifying climate variability and reduced inflows projected, especially in southern Australia, future competition for water will likely increase.

Policy Implication: Planning for nuclear energy must fully account for long-term water availability and demand, and implications for other critical sectors like food production and ecosystem health.

Summary Table

Location	Reactor size & type	Current annual water use by coal	Annual water use needed for nuclear	Additional water allocation required
Loy Yang VIC	AP1000 x 5 5500 MW	Up to 102 GL/year (Loy Yang A & B; Yallourn W, Hazelwood)	Up to 125 GL/year	Up to 125 GL/year (Existing allocations fully committed for minesite rehab). Irrigation buybacks and/or reduced transfers to Melbourne catchments.
Liddell NSW	AP1000 x 4 4400 MW	61 GL/year (Liddell plus Bayswater)	Up to 100 GL/year	Up to 39 GL/year: may require irrigation buybacks or reallocation of industrial water licences
Mt Piper NSW	AP1000 x 1 1100 MW	14 GL/year (some from mine dewatering)	25 GL/year	Up to 25 GL/year: irrigation buybacks from Macquarie system, and/or reduced transfers to Sydney Basin
Callide QLD	AP1000 x 1 1100 MW	20 GL/year Awoonga-Callide Scheme	25 GL/year	5 GL/year: borderline, manageable with irrigation recovery or industrial water savings

Tarong QLD	AP1000 x 1 1100 MW	30 GL/year	25 GL/year	Nil for 1100MW, insufficient water for 2200MW
Muja WA	AP300 SMR 330 MW	10 GL/year (Muja and Collie A, from mine dewatering)	7 GL/year	7 GL/year (mine dewatering not an option after coal closure)
Port Augusta SA	AP300 SMR 330 MW		Seawater cooling, once-through	Nil from a quantity perspective.
TOTAL	**13,860 MW**		**~300 GL/yr**	**~200 GL/year**

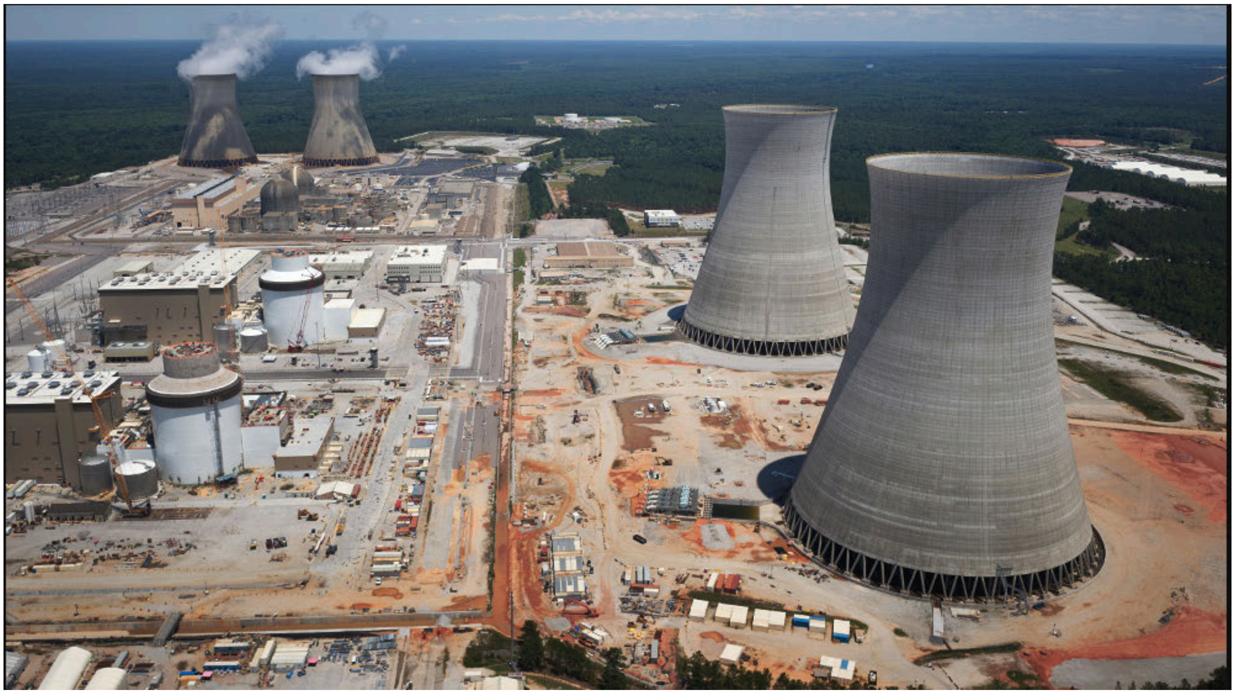
Red shading: insufficient water now; Orange: likely future shortages; Green: sufficient available water

Key Assumptions

The June 2024 policy proposal for seven new nuclear power stations on the sites of current or recently decommissioned coal-fired power stations stated that 'off the shelf' proven technologies would be used at five of the seven sites. The specific example cited was the Westinghouse AP-1000 Pressurised Water Reactor.

Two new AP-1000 units were commissioned in 2024 at the Vogtle site on the Savannah River in Georgia, USA (units 3&4 right foreground in the picture below). At 90% capacity, these units would consume 25 Gigalitres of water per year, so that is the figure used in this paper for each 1100MW unit of nuclear power generation. The Savannah River gets as warm as 27 degrees C in summer, so it is a valid comparator for an inland power station in Australia.

Vogtle Nuclear Power Plant, Waynesboro, Georgia USA



While this analysis focuses on water consumption rather than cost, it is worth noting that the final construction cost of the new AP-1000 units at Vogtle equated to AUD$25 Billion per Gigawatt, whereas Frontier Economics assumed that Australia would be able to build such power plants for $10B/GW.

This paper assumes that recirculating wet-tower freshwater cooling systems would be constructed at all sites except for Port Augusta, which would use a once-through system drawing sea water from Spencer Gulf. It also assumes that small modular reactors similar to the Westinghouse AP300 SMRs will exist and can be deployed from the late 2030s, with similar water consumption per unit of power generated.

Water requirements for Emergency Core Cooling Systems (ECCS), an additional requirement for nuclear power stations in the event of meltdown or any major problems with primary cooling, are not explicitly quantified here.

Given these assumptions, the numbers in this table are at the lower end of the probable range of water requirements for nuclear power in Australia.

This paper does not assess claims around transmission, build times, expense or the cost of electricity produced by any form of power generation.

Nuclear Power – a new competitor for high-security water?

Andrew Campbell

May 2025

This paper seeks to assess the amount of high security water required to run nuclear power plants at seven sites: Collie, Port Augusta, Gippsland, Lithgow, Hunter, Callide and Tarong. Six of the seven sites are inland, and one, Port Augusta, is on the coast. A policy proposal modelled by Frontier Economics assumed that almost 14 GW of nuclear generation capacity would be built across the seven sites, which currently host 8 GW of coal-fired power capacity.

The Frontier Economics modelling has been used as the basis for this paper.

Commercial nuclear power plants internationally are mostly in cold, wet locations, on the coast or on large lakes or rivers, for very good reasons. Thermal power plants, whether nuclear or fossil-fuelled, require large volumes of preferably cold water for cooling and for generating steam to drive turbines. The efficiency of any thermal power plant is proportional to the temperature difference between the internal heat source and the external water source, which is why most thermal power plants have higher net outputs in winter than summer.

By international standards, Australian rivers are small, sluggish and have huge variability in annual flows – four times the global average – and its air and inland waters are relatively warm.

In April this year, I analysed how much additional water would need to be acquired each year at each of the seven sites to operate a nuclear power plant reliably at 90% capacity, as proposed by the Coalition and modelled by Frontier Economics. The detailed report can be found here.

At each of the seven sites the report examined catchment hydrology, the current water entitlement regime and existing water allocations, to assess how much water would be available for a big new consumer of high security water like a nuclear power station. The results are summarised in Appendix 1.

At three of the six sites (**Loy Yang**, **Mt Piper** and **Muja**), shaded red in Appendix 1, there is insufficient spare water even now to sustain a nuclear power plant running at 90% capacity in a very dry year. In part, this is because existing water licences for coal plants are required well into the future for mine site rehabilitation (at least 30 years in the case of Loy Yang). At Mt Piper and Muja, existing water licences include water sourced from dewatering coal mines, which won't be available when those mines close.

At two further sites (**Callide** and **Liddell**), shaded orange in Appendix 1, there is arguably sufficient water now for the amount of nuclear generation proposed. But with climate change over the period to 2120, there is a high risk that in sustained dry periods there would be a need to turn the plants off or down because there would not be enough water available to run them – known as curtailment - i.e. the plants would not be able to run at 90% reliably. (In overseas places subject to occasional extended periods of hot weather and low flows, such as in southern France, Texas, Tennessee and Georgia, nuclear power is dialled down when there is not enough cold water for cooling plants at high capacity.)

At these five inland sites, to sustain nuclear power generation at 90% capacity, which is crucial for the business case modelled by Frontier Economics, up to 200 Gigalitres per year of additional water would need to be acquired or reallocated from other users: irrigation, industrial or urban.

These five sites together represent 90% of the amount of power generation proposed.

At **Tarong** in Queensland, there is sufficient available water for cooling an 1100MW reactor (smaller than the current output from coal-fired generation), but not for 2200MW, which would be closer to the current coal-fired capacity at the site. Only at **Port Augusta** on the Spencer Gulf in South Australia is there sufficient available water now and projected over coming decades to provide adequate cooling water for a proposed nuclear power station of the capacity suggested by the policy proposal. These two sites, shaded green in Appendix 1, represent 10% of the amount of power generation proposed.

In short, inland Australia is not a prospective location for nuclear power generation at 90% capacity for 80 years as modelled by Frontier Economics.

The best available climate science suggests that in southern Australia we will need to adjust to catchments and basins having less water most of the time, punctuated by intense rainfall events (often unseasonal) and consequent floods. We already have a highly variable climate with even more variable streamflows, and this seems likely to exacerbate over coming decades. We need to be planning for worst-case scenarios, and if the planning horizon is 80-100 years, then we need to allow for scenarios that are worse than anything previously experienced. Just as 20th Century notions like 1-in-100-year floods are no longer valid, so too with drought, heat and the seasonality of extreme weather events (heat, frost, rainfall, fire). Shifting baselines mean that 20th Century data is increasingly misleading in estimating extremes this century, let alone into the 2120s.

The value proposition for nuclear power generation depends on it being ‘always on’. The Frontier Economics analysis contends that, under the AEMO Progressive scenario for the National Energy Market (NEM), the adoption of the nuclear policy proposal would see nuclear generating 38% of electricity in the NEM with just 13% of total installed capacity. Crucially, this depends on those plants operating at 90% capacity for 80 years. That means always having sufficient water.

A nuclear power plant would need to bank on guaranteed access to the highest security water, especially during dry seasons, to operate at 90% capacity for 80 years, with a significant buffer to allow for drying climates and amplified variability.

The impacts of water consumption for nuclear power on other water users need to be planned for, well ahead of any infrastructure investment. Water consumption for energy production should be more prominent in current debates.

The timeframe modelled by Frontier Economics, based on the first Australian nuclear power plants being operational from 2035, appears not to allow for negotiation of new Commonwealth-State water agreements to guarantee high-security water for taxpayer-funded and Commonwealth-owned nuclear facilities.

Just prior to the election, in response to media questions about the likely water needs of the proposed seven nuclear power stations, the Opposition spokesperson asserted that *"I have looked at how much water is already allocated to power generation and am confident that there will be little difference."* In the televised leaders' debate hosted by the ABC, the then Opposition Leader reiterated his confidence that there is sufficient water for the proposed seven nuclear power stations.

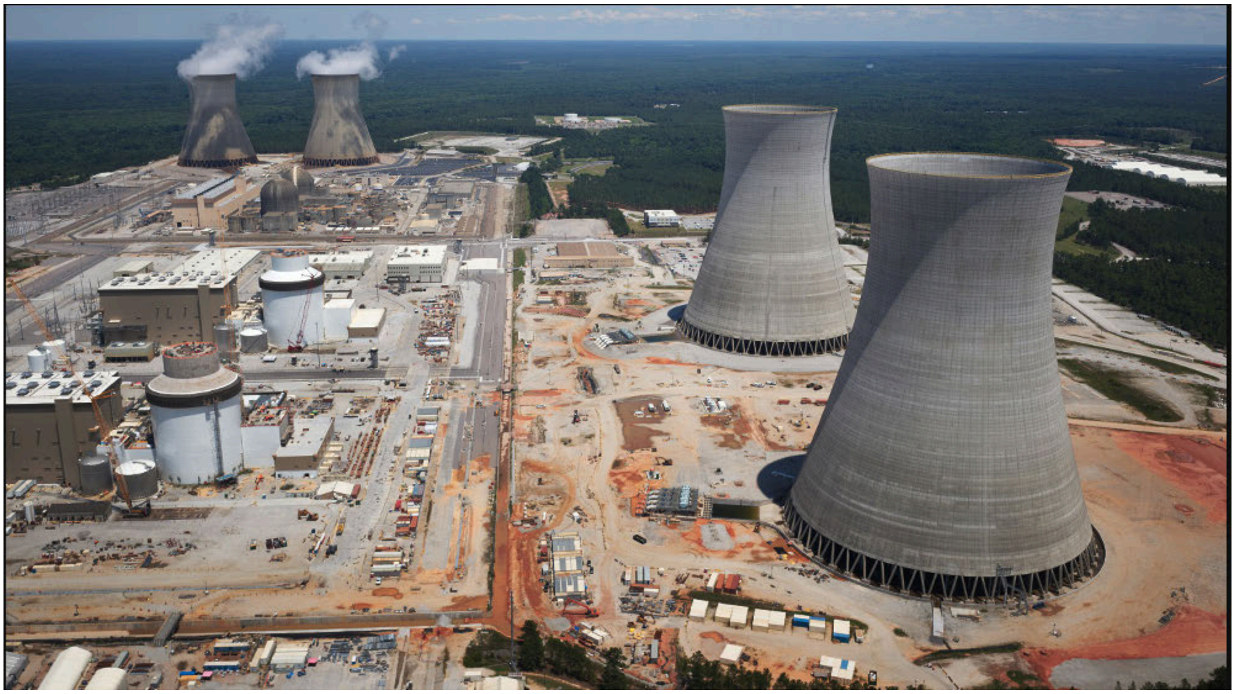
The nuclear energy proposal and subsequent claims make several assumptions:

1. That 'modern' nuclear plants are more efficient in their water use, comparable to existing coal-fired power stations;
2. That the existing water licences for coal-fired power stations have sufficient volume for cooling proposed nuclear power stations; and
3. That those licences are able to be transferred across from coal to nuclear as coal plants close - i.e. that there is no on-going requirement for water at those former coal-fired power stations or open-cut coal mines.

These assumptions are flawed.

A crucial point is that it is proposed that these power stations will operate at 90% capacity, whereas current and recently retired coal plants have typically operated at much lower capacities (CSIRO Gen Cost generously assumes 59%). Frontier Economics modelled and costed the proposal on the basis of 90% operating capacity for 80 years. There is a linear relationship between power generation and water use. More power generated equals more water consumed. There are no economies of scale.

Nuclear advocates acknowledge that nuclear pressurised water reactors use 10-20% more water per unit of power generated than coal-fired plants. Rather than work from a multiple of existing coal-fired water consumption, I looked for a working example of the type of nuclear power plant proposed: the Westinghouse AP-1000 Pressurised Water Reactor.



As it happens, two new AP-1000 units were commissioned in 2024 at the Vogtle site (pictured above) on the Savannah River in Georgia, USA. At 90% capacity, these units would consume 25 Gigalitres of water per year, so that is the figure used for each 1100MW unit of nuclear power generation. The Savannah River warms up to 27 degrees C in summer, so it is a valid comparator for an inland power station in Australia. While this analysis focused on water use rather than cost, it is worth noting that the final construction cost of the new AP-1000 units at Vogtle equated to AUD$25 Billion per Gigawatt, whereas Frontier Economics assumed that Australia would be able to build such power plants for $10B/GW.

There are alternative nuclear reactor designs in development around the world, promising significant advantages in safety and water efficiency, including Thorium-based reactors and Small Modular Reactors (SMRs) including molten salt reactors. They are still in the R&D phase in most countries outside China and Russia, although some have reached initial regulatory assessment. None have yet been constructed and connected to the grid in a western industrialised democracy, so it is not possible to evaluate costs, benefits and risks. The lead times for such technologies in Australia, even if proven operationally overseas, would seem to be well beyond the late 2030s, long after the last coal-fired power plants have been decommissioned.

There have been some suggestions that air-cooled reactors (that work on the same principle as a car radiator and require less water) could be an option for Australia. The only such plant in the world is inside the Arctic Circle, and very small. This cooling method has been ruled out in the UK and the US for safety, efficiency and cost reasons, and was not explored further in this analysis.

It was proposed that SMRs would be built at Muja in Western Australia and Port Augusta in South Australia. The problem with SMRs at the other sites (apart from SMRs not yet being operational), is that as the name suggests, they are small. The biggest SMRs in the pipeline internationally are a few hundred Megawatts (most designs are smaller than 100MW). Replacing Australia's coal fleet within the existing grid, especially big power stations like Loy Yang and Liddell, requires multiple Gigawatts.

Other critical issues relevant to a radical policy shift to adopt nuclear power in Australia, (including cost over-runs, construction time blow-outs, regulatory complexity, workforce constraints, security and waste management) were outside the scope of this analysis.

Appendices

Appendix 1: Summary of projected water use and constraints for proposed nuclear sites

Location	Reactor size & type	Current water use by coal-fired power production	Water needed for nuclear power production	Additional water allocation required	Water allocation regime	Socio-economic implications	Environmental implications
Loy Yang VIC	AP1000 x 5 5500 MW	Up to 102 GL/year (Loy Yang A & B; Yallourn W and Hazelwood)	Up to 125 GL/year	Up to 125 GL/year (Existing water allocations are committed to open cut pit remediation for 30 years)	Surface Water and Groundwater Bulk Entitlements and subsidiary water entitlements.	Up to 125 GL/year required during 30-year period of open cut pit lake filling. Most realistic option would be to acquire~50% of entitlements in the Latrobe and Macalister irrigation districts. Compulsory acquisition probably needed. Climate projections for reduced rainfall/runoff in the Latrobe, if realised, may require future closure of irrigation system to sustain nuclear power generation over 80-year lifespan	Increased utilisation of water entitlements in the Latrobe-Thomson reduces environmental flows to Gippsland Lakes Ramsar site. Increased difficulty in rehabilitating large open cut pits unless additional water entitlements are acquired.
Liddell NSW	AP1000 x 4 4400 MW	61 GL/year (Liddell plus Bayswater)	Up to 100 GL/year	Up to 39 GL/year	Hunter Regulated River Water Sharing Plan	May require recovery of General Security water entitlements by irrigation buyback and/or closure of additional Hunter Valley coal mines	Potential increase in thermal pollution at Lake Liddell

Mt Piper NSW	AP1000 x 1 1100 MW	14 GL/year	25 GL/year	Up to 25 GL/year	Dependent upon Springvale coal mine lifespan. May require reverting to Coxs River/Fish River supply.	If Springvale coal mine dewatering ceases, then 25 GL increase. Implications for higher Sydney desalination plant use to offset Coxs River supply, or Macquarie River irrigation water entitlement purchase	Reduced flow in upper Hawkesbury-Nepean and/or upper Macquarie, especially if mine dewatering ceases
Callide QLD	AP1000 x 1 1100 MW	20 GL/year Awoonga-Callide Scheme plus Callide local water sources inc groundwater (variable, max 5 GL/year estimated)	25 GL/year	5 GL/year from either Awoonga-Callide Scheme or Callide Scheme	Awoonga-Callide Scheme augmented by water recycling including groundwater seepage recovery from Callide Dam	Modest (15%) additional water demand – could be sourced from irrigation water recovery in local Callide Scheme or industrial water use savings in the Awoonga-Callide Scheme. Doable, but not trivial.	No significant water-related environmental concerns
Tarong QLD	AP1000 x 1 1100 MW	30 GL/year	25 GL/year	Nil	Boyne River and Tarong Scheme, augmented by Western Corridor Recycled Water Scheme in drought conditions	No significant water-related issues provided nameplate capacity is reduced to 1100 MW. If two 1100MW units were built, Tarong would move to the red category.	No significant additional environmental impacts provided nameplate capacity reduced to 1100 MW

Muja WA	AP300 x 1 330 MW	10 GL/year (Muja and Collie A power stations, from mine dewatering)	7 GL/year	7 GL/year. Mine dewatering expected to cease as soon as coal-fired power stations close.	Groundwater pumping most likely. Significant decline in rainfall has caused major declines in surface water runoff and groundwater recharge, reducing water security for all users.	Southwest WA experiencing major water shortages due to declining rainfall. Full retirement of coal-fired power station water demand by 2040 won't reverse this situation. Continuous water supply for power station cooling over 80 years is likely incompatible with other water demands (e.g. potable water supply) over that period.	Threats to groundwater-dependent ecosystems.
Port Augusta SA	AP300 x 1 330 MW		Seawater cooling, once-throug h	Nil	Not applicable	Nil freshwater-related	Renewed thermal pollution risks in upper Spencer Gulf, but lower than that caused by historical coal power generation
TOTAL	**13.86 GW**	**237GL/year**	**~307 GL/year**	**Up to ~200GL/yr**			

Assumptions

1. "Off-the-shelf" technology is used as the Coalition has publicly stated: Westinghouse AP-1000 Pressurised Water Reactors. Recirculating wet-tower freshwater cooling systems at all sites except for Port Augusta, which would use a once-through system drawing sea water from Spencer Gulf.
2. Small modular reactors similar to the Westinghouse AP300 SMRs will exist and can be deployed from the late 2030s, with pro-rata water consumption.
3. Water requirements for Emergency Core Cooling Systems (ECCS), an additional requirement for nuclear power stations in the event of meltdown or any major problems with primary cooling, are not explicitly quantified here.

   Given these assumptions, the numbers in this table are at the lower end of the probable range of water requirements for nuclear power in Australia.