Lessons from Australia – the Case of the Murray-Darling Basin

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Rationalizing the Allocation of California Water

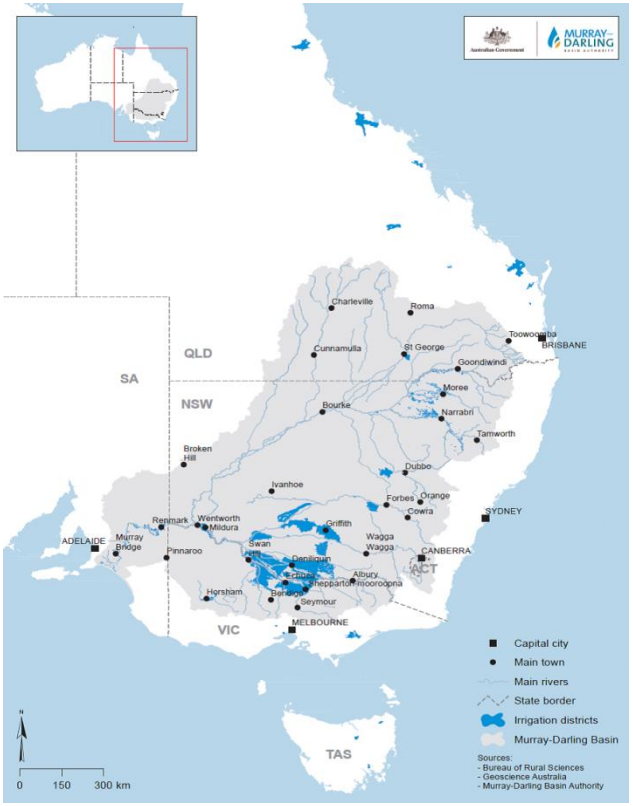
Caltech

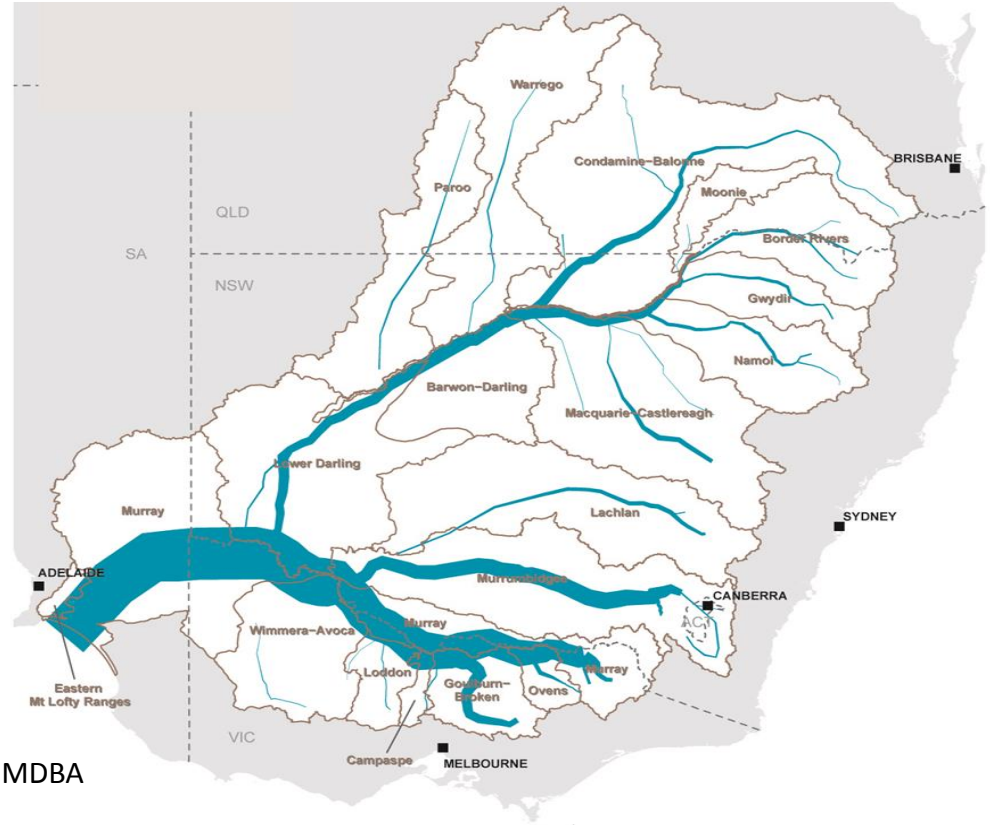
21st April 2016

Introduction to the MDB

- 1,000,000 km^2
- 14% of Australia (1.5 size of Texas)
- 5 jurisdictions
- 80% of basin is agriculture
- 60% of Australia's irrigation with 40% of Australia's farmers
- "Food Bowl" of Australia

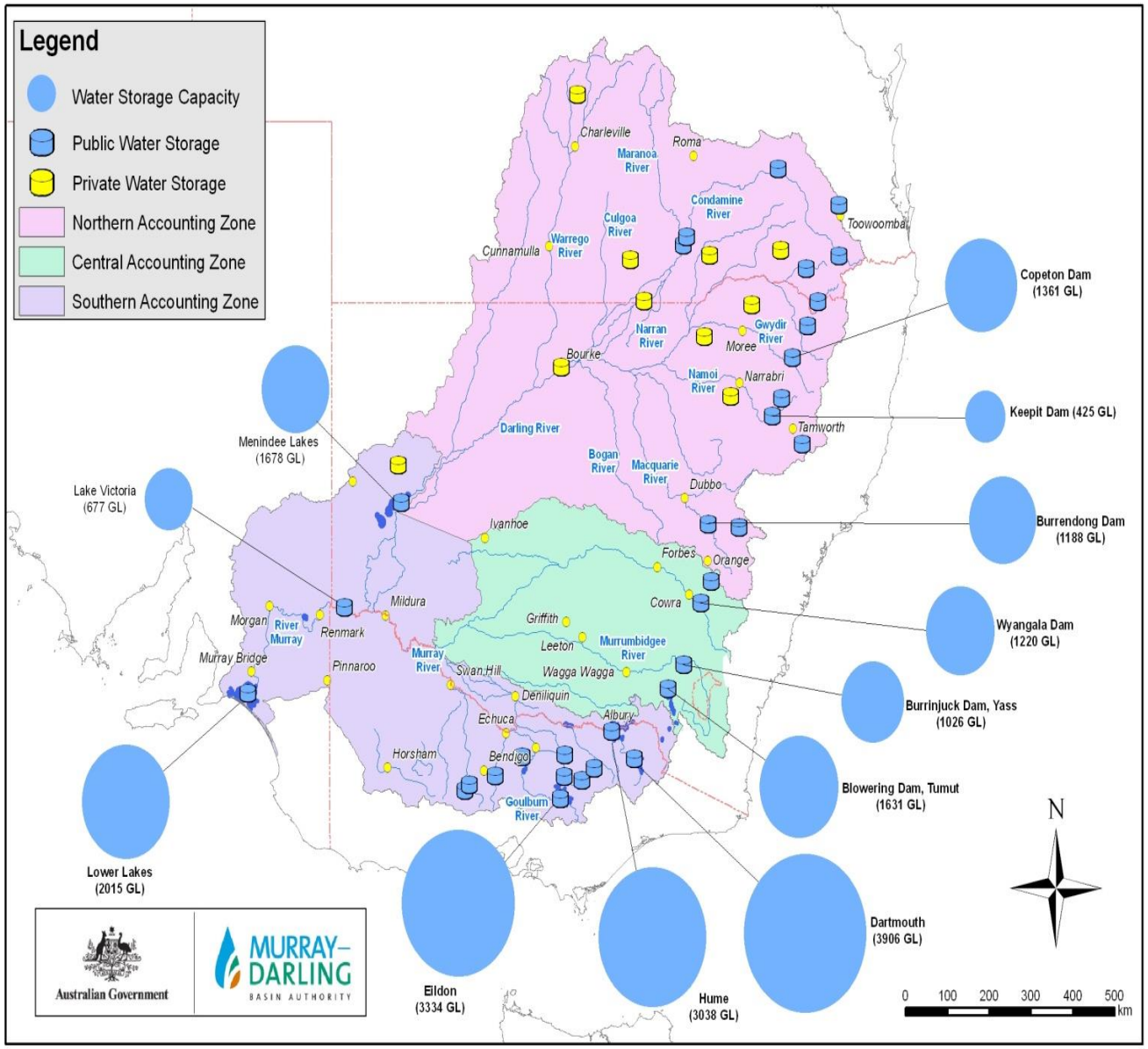
- Population 2,000,000, supports 20 mill
- Significant environmental values
- Australia's three longest rivers
- Home to 34 major Indigenous groups
- 30,000 wetlands; 2,442 key environmental assets, 106 hydrological indicator sites





Source: MDBA

Water Policy in the Expansionary Phase to the 1980s

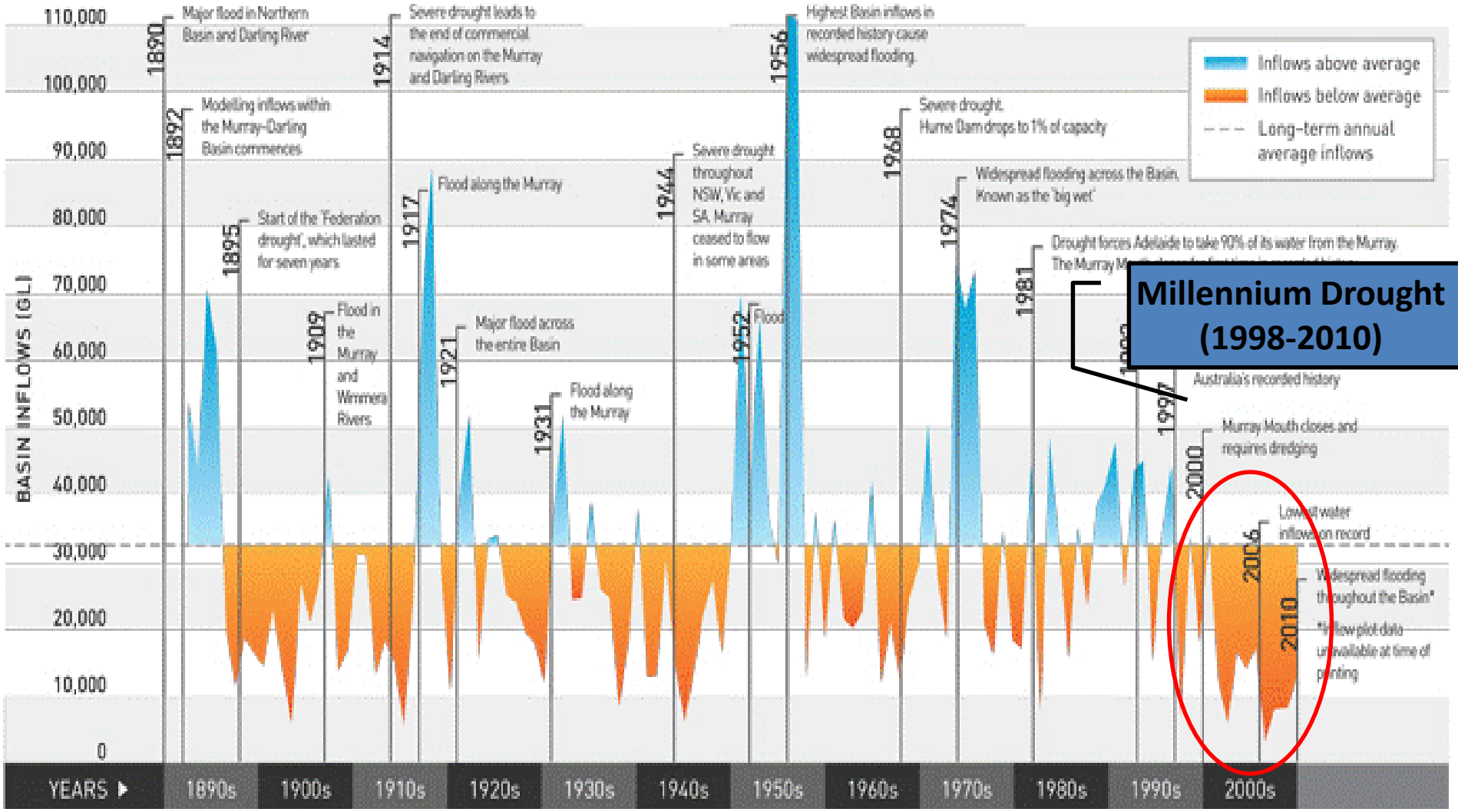


- Irrigation areas across the MDB

- Constructed new dams, weirs and locks: Lake Victoria (1926), Burrinjuck (1928), Eildon/Sugarloaf (1929), Hume (1936), Snowy Mountains Scheme (1974) and Dartmouth (the last in 1979)

- Tenfold increase in capacity of major dams between 1940 and 1990

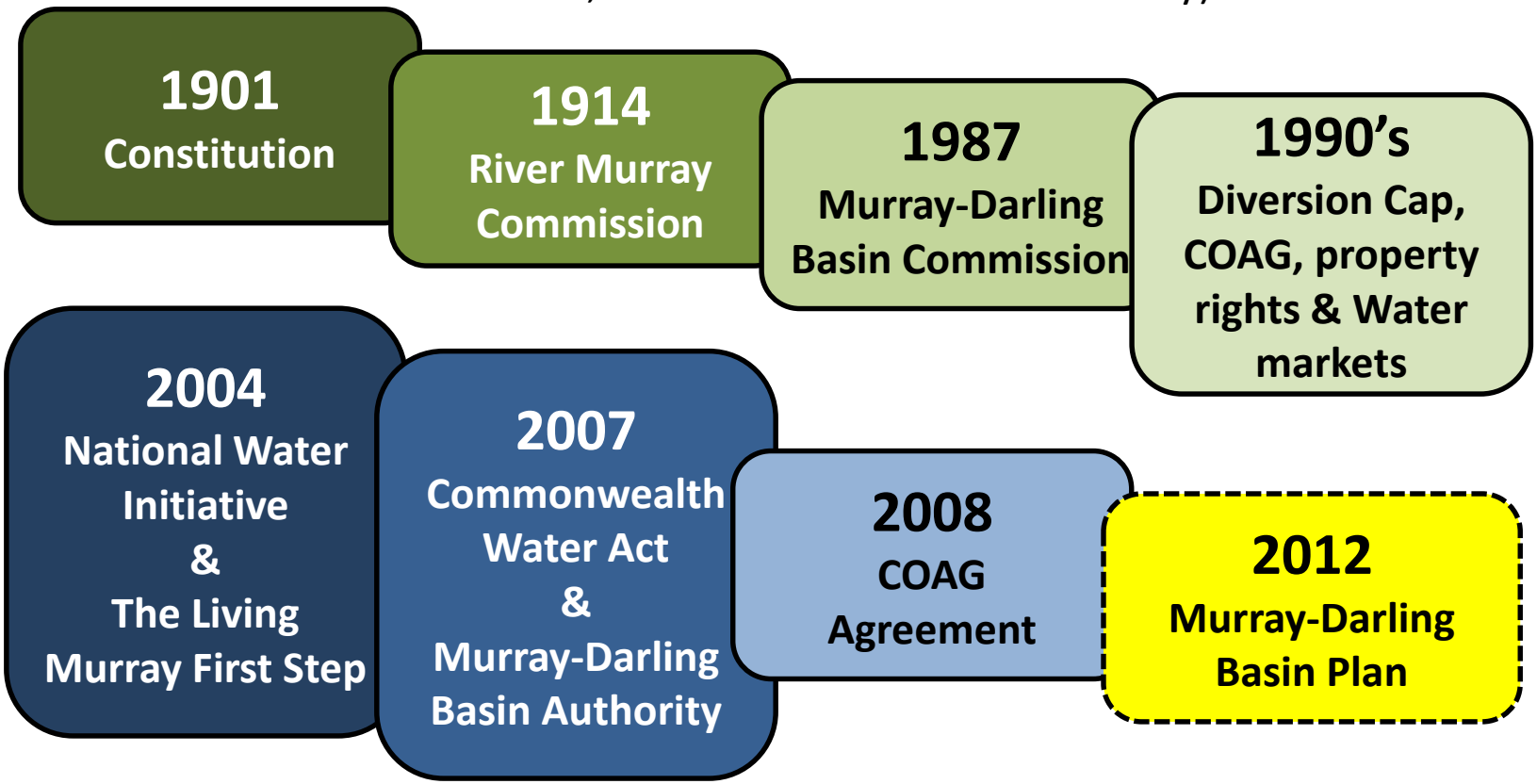
Flows in the MDB over time



Source: MDBA (2012)

Water Reform Took time in the MDB

- 1990s saw strong agreement that states could not manage water policy, and in 1992 a Murray-Darling Basin Agreement was established, included in 1994 in COAG framework
  - After an audit of water resources, a cap was officially put in place in 1997
  - Again, recognition of state failure to manage the MDB meant the National Water Initiative was established in 2004
- The NWI led to large-scale government programs to address over-extraction (Water Act, MDB Plan, National Plan for Water Security)



2012 MDB Plan

- The development and implementation of the MDB plan has caused significant unrest
- MDB Plan was passed into law in 2012, with all states finally signed up Feb 2014
- Overall objective of the Plan is to coordinate water policy across 4 states and one territory
- Target set at 2,750 GL reduction in consumptive use
- 450 GL of additional water for the environment is also to be recovered through infrastructure investment expenditure, bringing total water recovery to 3,200 GL
- The Commonwealth has committed billions of dollars since 2007-08 to funding water recovery
- Australia since held up to be leading example to world of returning water to environment via market mechanisms

Irrigated Farm Differences across the MDB

VICTORIA

- Small irrigated farms, medium water entitlements (low and high security)
-Mainly permanent pasture (dairy)

NSW

•annual croppers (cotton, rice)
• have larger farm sizes
• have much larger water entitlements (mainly general security)

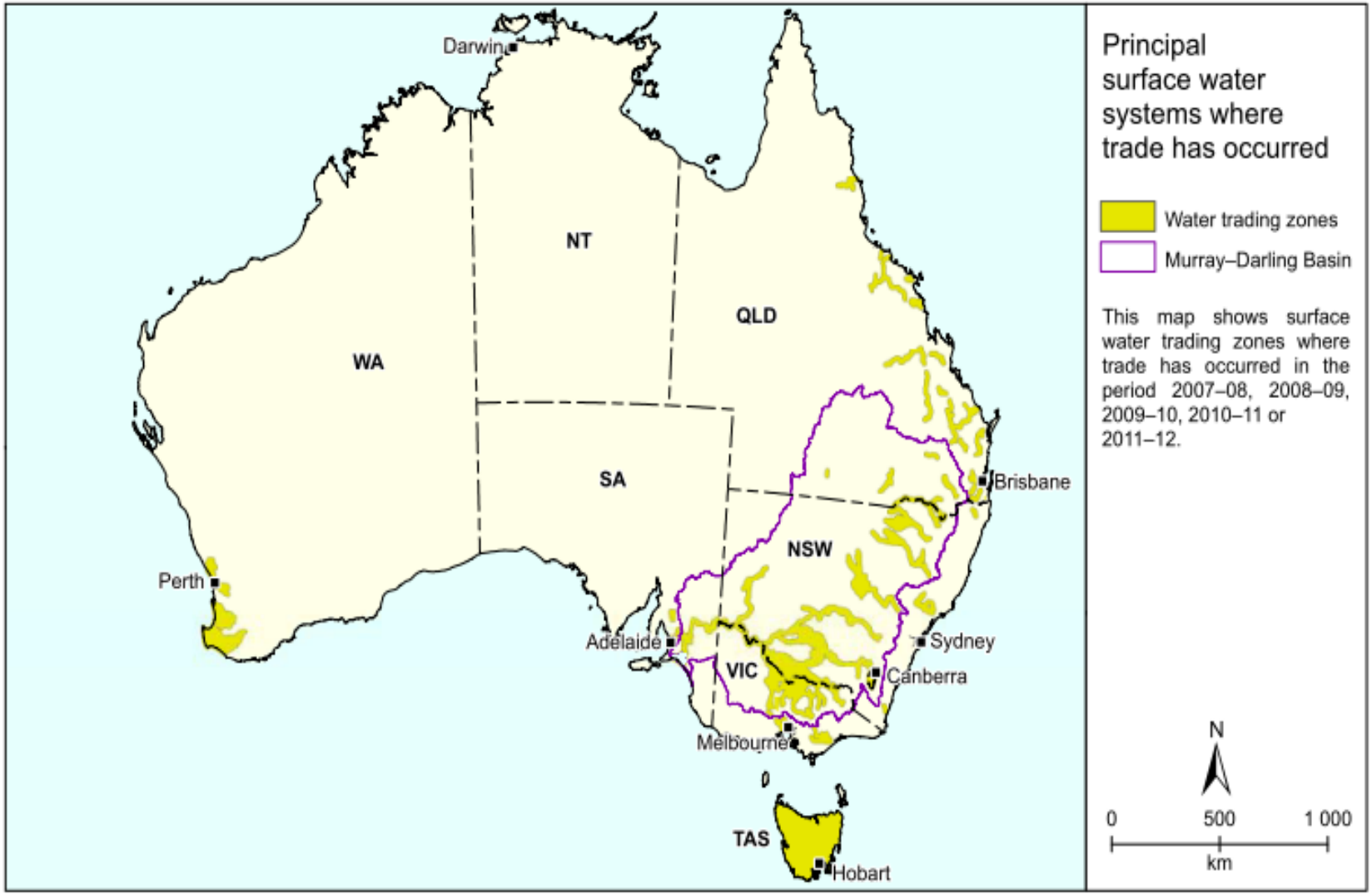
SA

•Permanent plantings (hort)
•Small farms, small water entitlements (but high security)

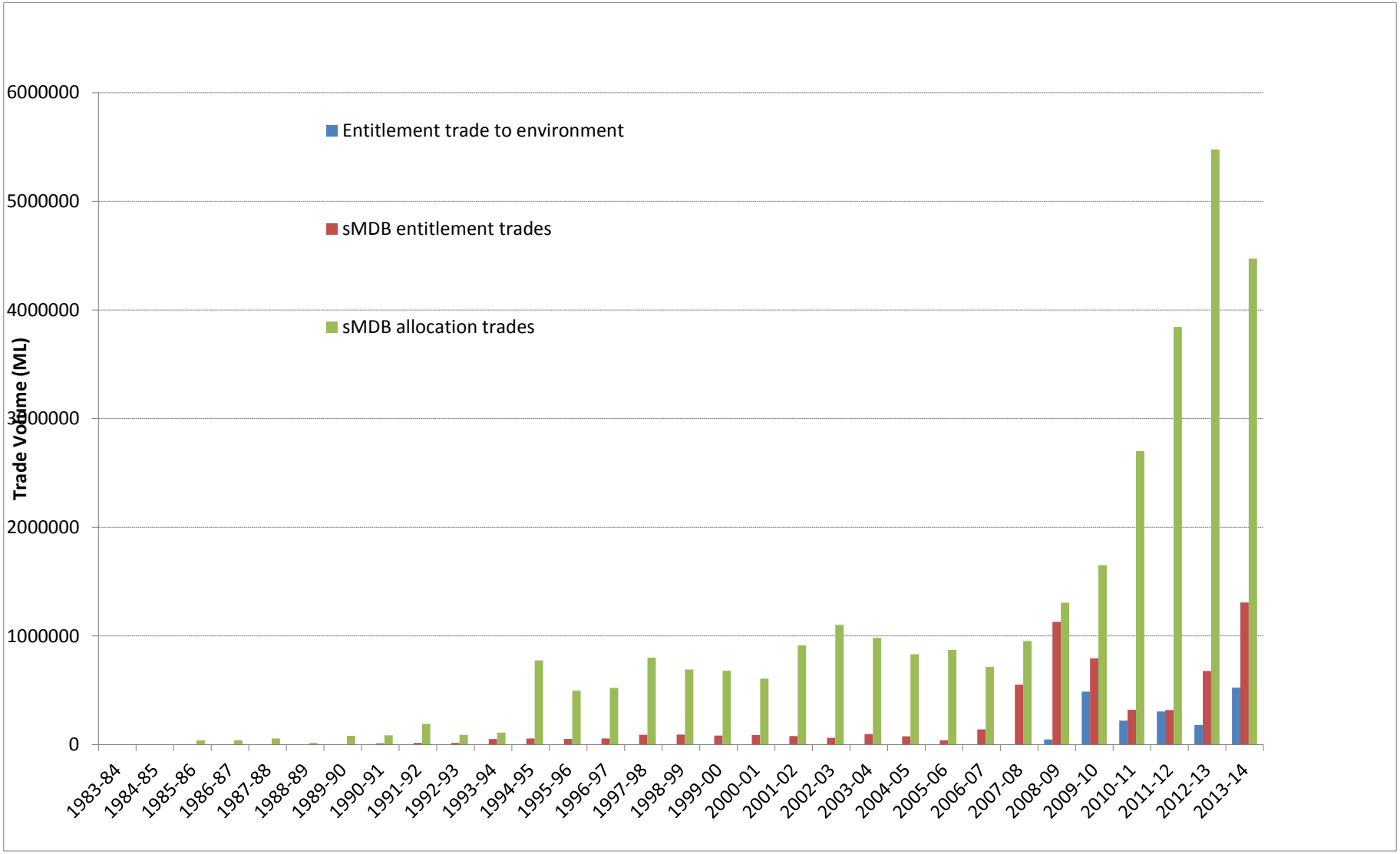
Final Seasonal Water Allocations in the Southern Murray-Darling Basin

	High reliability entitlements					Lower reliability entitlements			
Year	Vic Goulburn	Vic Murray	NSW Murray	NSW Murrumbidgee	SA Murray	Vic Goulburn (low)	Vic Murray (low)	NSW Murray (general)	NSW Murrumbidgee (general)
1998-99	100%	100%	100%	100%	100%	0%	100%	93%	85%
1999-00	100%	100%	100%	100%	100%	0%	90%	35%	78%
2000-01	100%	100%	100%	100%	100%	0%	100%	95%	90%
2001-02	100%	100%	100%	100%	100%	0%	100%	105%	72%
2002-03	57%	100%	100%	100%	100%	0%	29%	10%	38%
2003-04	100%	100%	100%	95%	95%	0%	0%	55%	41%
2004-05	100%	100%	97%	95%	95%	0%	0%	49%	40%
2005-06	100%	100%	97%	95%	100%	0%	0%	63%	54%
2006-07	29%	95%	69%	90%	60%	0%	0%	0%	10%
2007-08	57%	43%	50%	90%	32%	0%	0%	0%	13%
2008-09	33%	35%	95%	95%	18%	0%	0%	9%	21%
2009-10	71%	100%	97%	95%	62%	0%	0%	27%	27%
2010-11	100%	100%	100%	100%	67 %	0%	0%	100%	100%
2011-12	100%	100%	100%	100%	100%	0%	0%	100%	100%
2012-13	100%	100%	100%	100%	100%	0%	0%	100%	100%
LTAAY	**0.95**	**0.95**	**0.95**	**0.95**	**0.9**	**0.35**	**0.24**	**0.81**	**0.64**

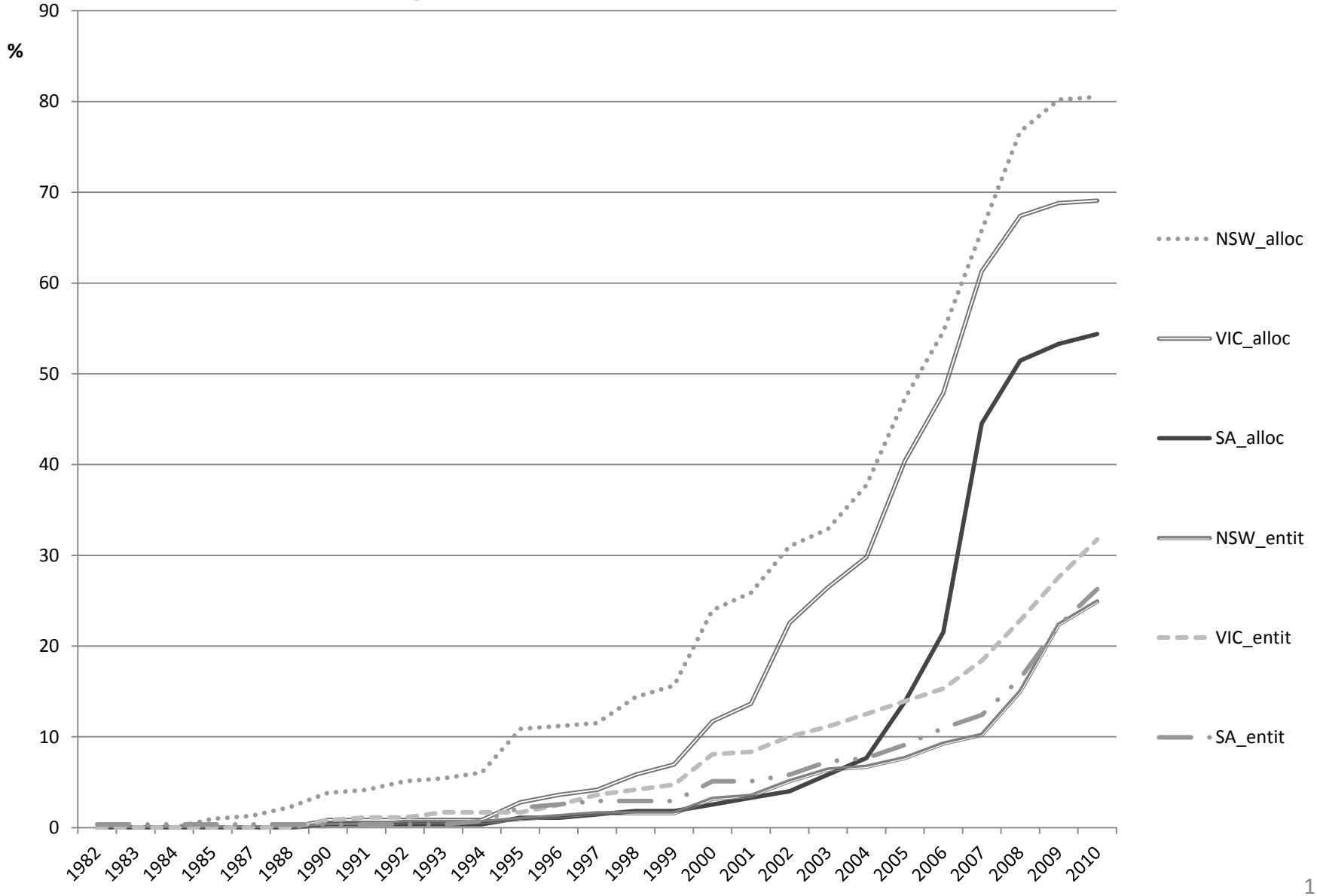
Water Market Areas in Australia



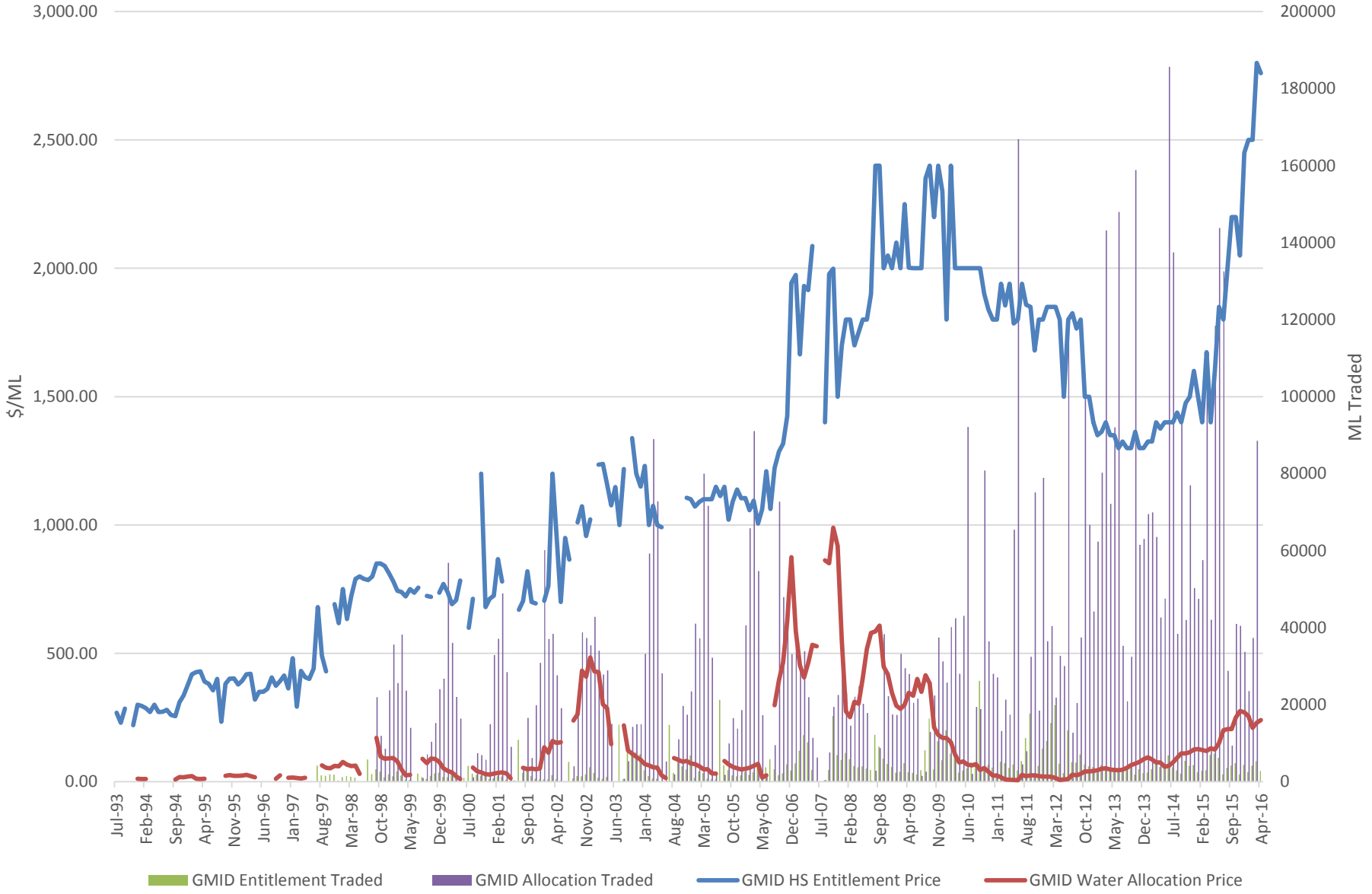
Water Trade In the southern MDB has increased over time



Water Markets are a commonly used strategy by all irrigators in the southern MDB



Water market Dynamics – Goulburn Irrigation District



Benefits and Costs of Water Markets? Some Studies at at the Basin Wide Level…

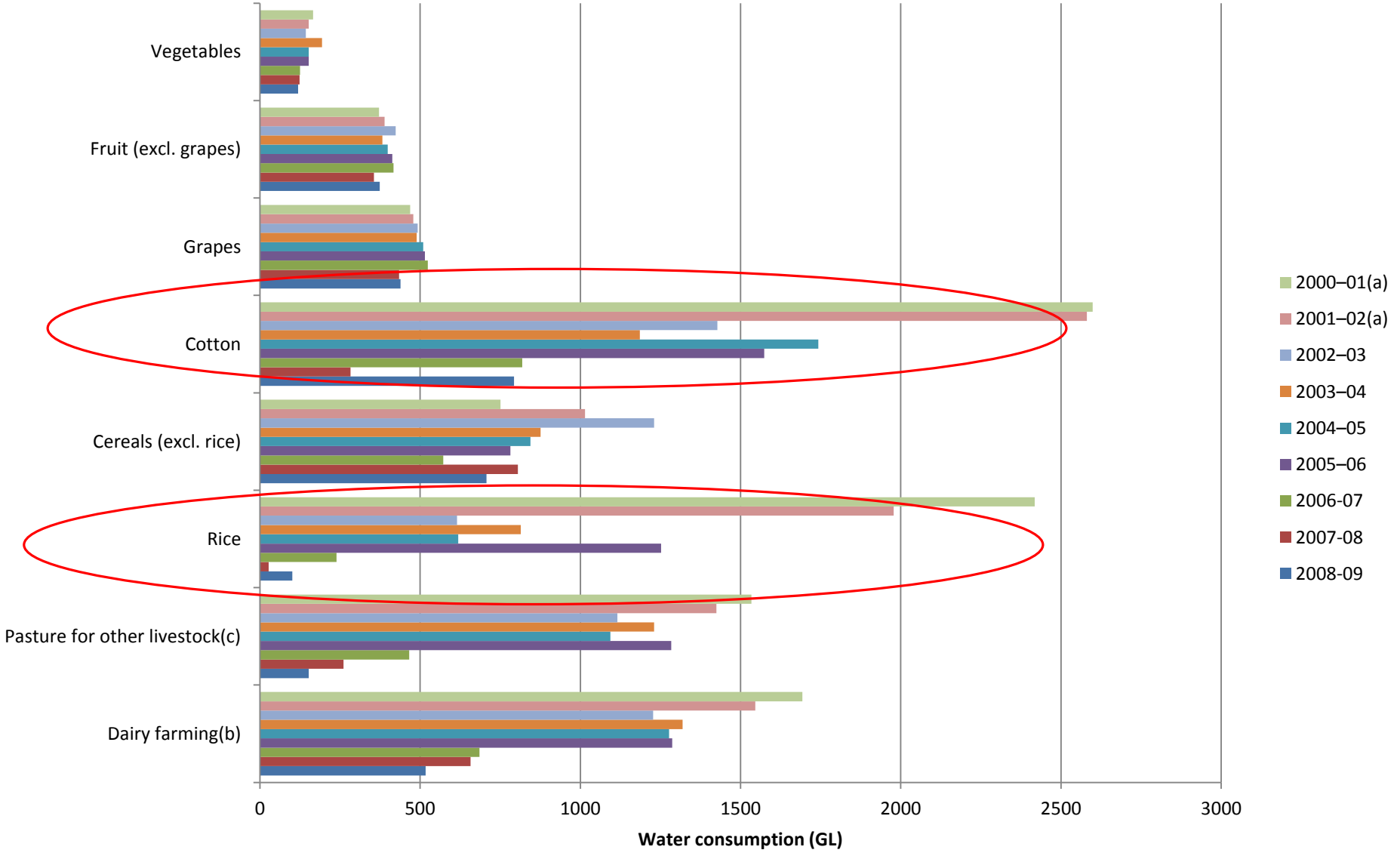
- NWC (2012) modelled the period 2006-07 to 2010-11 and found water trade increased the regional domestic product of the MDB by some AUD$4.3 billion while in the driest year of the drought, in 2007-08, the total benefits were some AUD$1.5 billion.
- Kirby et al. (2014) found that despite a more than 70% decline in irrigated surface water from 2000-01 to 2007-2008 as a result of much reduced inflows, the adjusted gross value of irrigated production fell by just 10% in the Basin.
- NWC (2012) found that the environmental impacts from water trade between 1998-99 and 2010-11 were small and largely positive; due to the downstream movement of water during the drought and reduced summer flow stress
- Water markets are at least four times cheaper than using infrastructure to return water to the environment.

Benefits and Costs of Water Markets. Some Studies at the Farm level….

- Previous research indicates that of the farmers that sold water to the federal Government:
  - 30% sold all water and left farming
  - 10% sold all water and stayed farming
  - 60% sold some water and stayed farming
- Of the farmers that sold part of their surface water – 50% said there was no impact on farm production
- Of the farmers that sold 100% of their surface water – 70% said there was impact on their farm production
- Regression modelling of thousands of farms finds no significant evidence of a negative outcome on farm viability from selling water
- Very strong evidence from two recent studies that using water markets is a risk-reducing strategy, especially for horticultural farmers

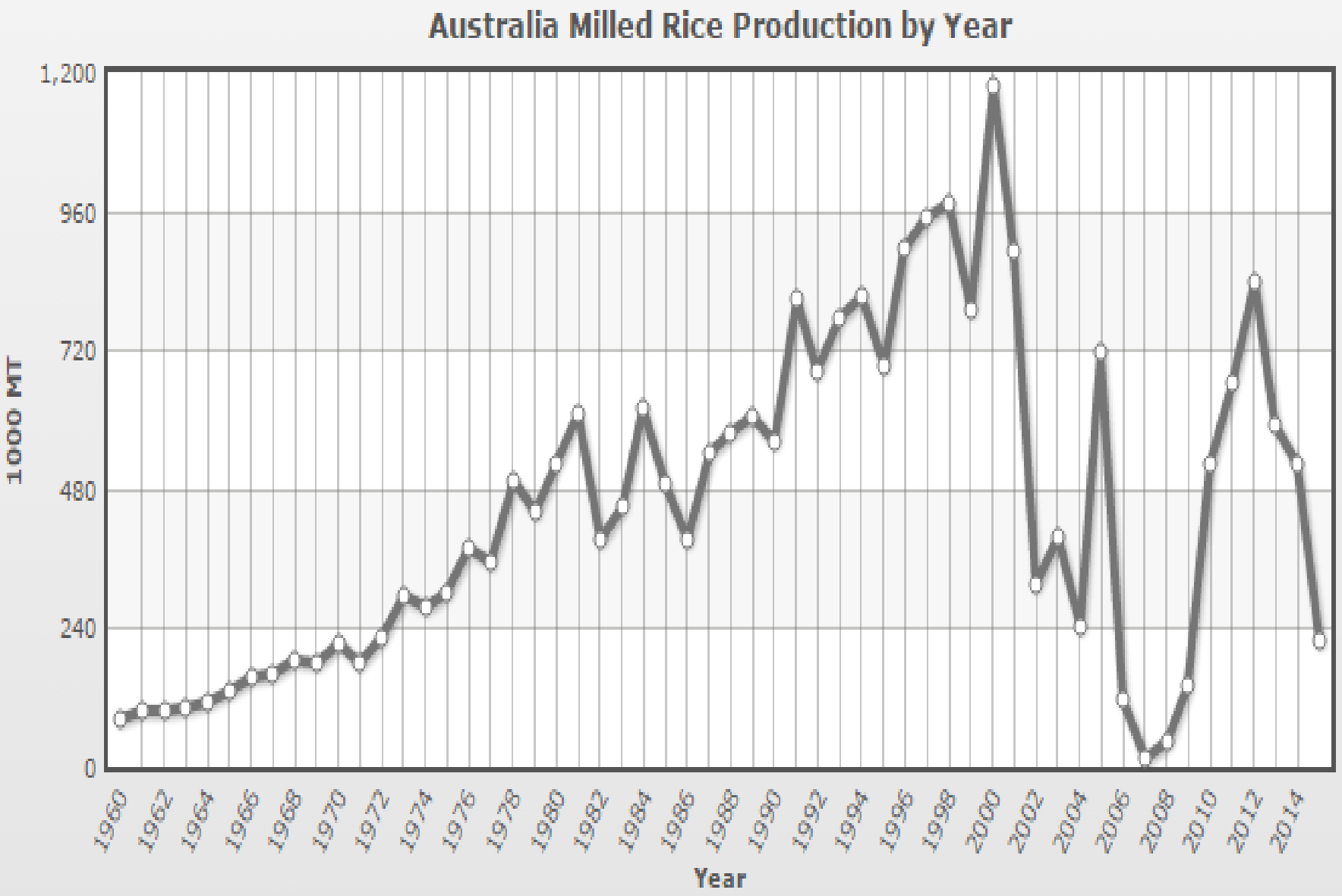
Zuo A, Nauges C, Wheeler S (2014) Farmers' exposure to risk and their temporary water trading. Europ Rev Agric Econ, 42: 1-24
Nauges C, Wheeler S, Zuo A (2016) Elicitation of irrigators' risk preferences from observed behaviour, *Aust. J. Agric. Res. Econ*.
Wheeler S., Zuo A., Hughes N. (2014) "The impact of water ownership and water market trade strategy on Australian irrigators' farm viability" *Agricultural Systems,* 129, 81–92.
Wheeler S., Zuo A., Bjornlund H. (2014) "Investigating the delayed on-farm consequences of selling water entitlements in the Murray-Darling Basin" *Agricultural Water Management*, 145, 72-82
Wheeler S, Cheesman J. (2013) "Key findings from a Survey of Sellers to the Restoring the Balance program", *Economic Papers*, 32, pp. 340-352

Diversification was vital for water trade



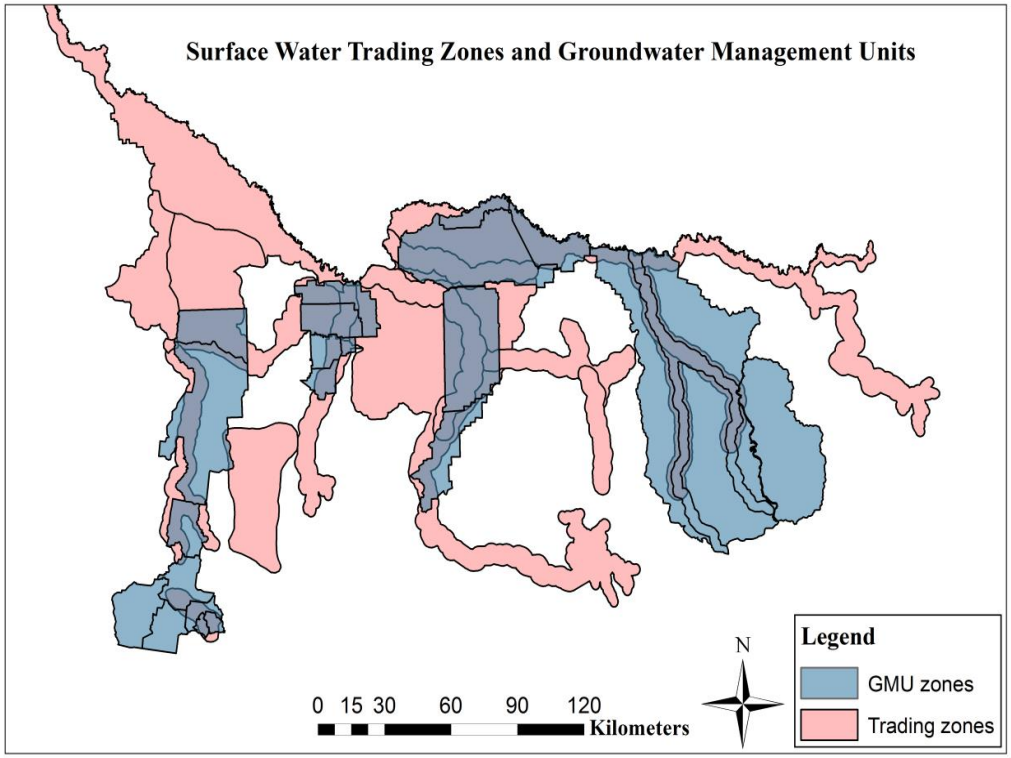
Source: ABS 2013, 46180 Water Use on Australian Farms 2000/01 to 2009/10, Australian Bureau of Statistics, Canberra.

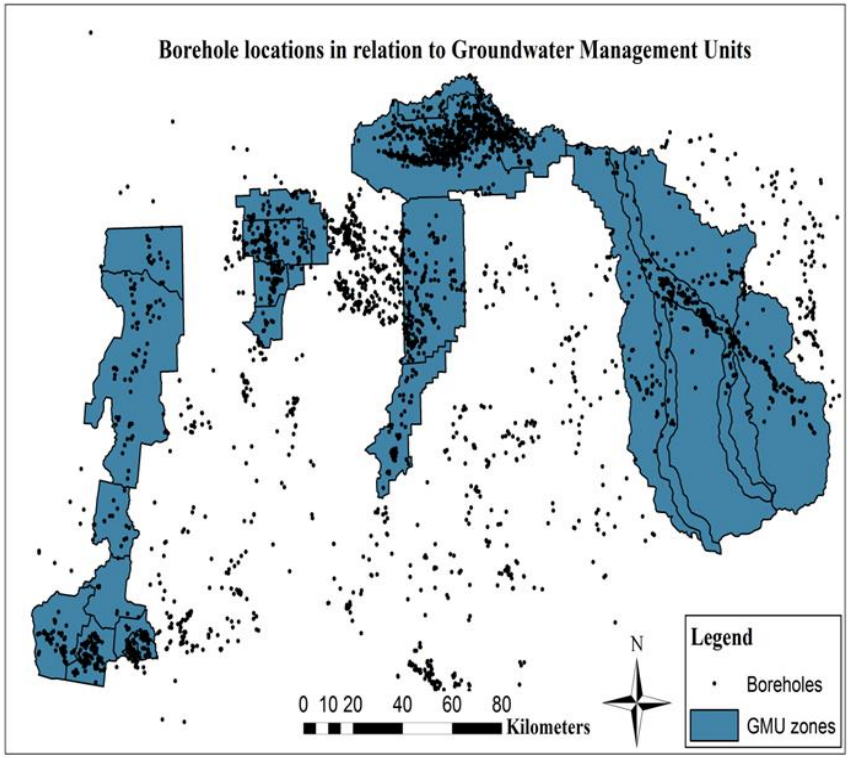
Diversification is vital for water trade….



Substitutability between Groundwater Use and Surface Water Entitlement trade

- Higher dryland salinity issues in regions in the MDB drove surface water trade
- Further, lower volumes of surface-water entitlements were sold as groundwater salinity increased (and vice versa). Thus, there appears to be a substitution effect between groundwater and surface-water use.
- As rainfall increased, less surface water entitlements were sold.





Haensch, J., Wheeler, S. A., Zuo, A., & Bjornlund, H. (2015). The Impact of Water and Soil Salinity on Water Market Trading in the Southern Murray–Darling Basin. Water Economics and Policy, 1(4), 26. doi: doi:10.1142/S2382624X16500041

Conclusion

1. Water markets are widely used
2. Water markets are competitive and are responsive to changes in water availability and opportunity costs
3. Water trading during the Millennium Drought saved many farmers
4. The most cost effective means of reducing over-extraction in the MDB is through the voluntary sale of water entitlements from irrigators to governments via reverse tenders.
5. Water trading during the Millennium Drought increased end-of-system flows in key rivers within the Basin
6. Water trading provided a key market-based and risk-based adaptation strategy for farmers in the MDB and a means to respond to likely increases in future water variability.

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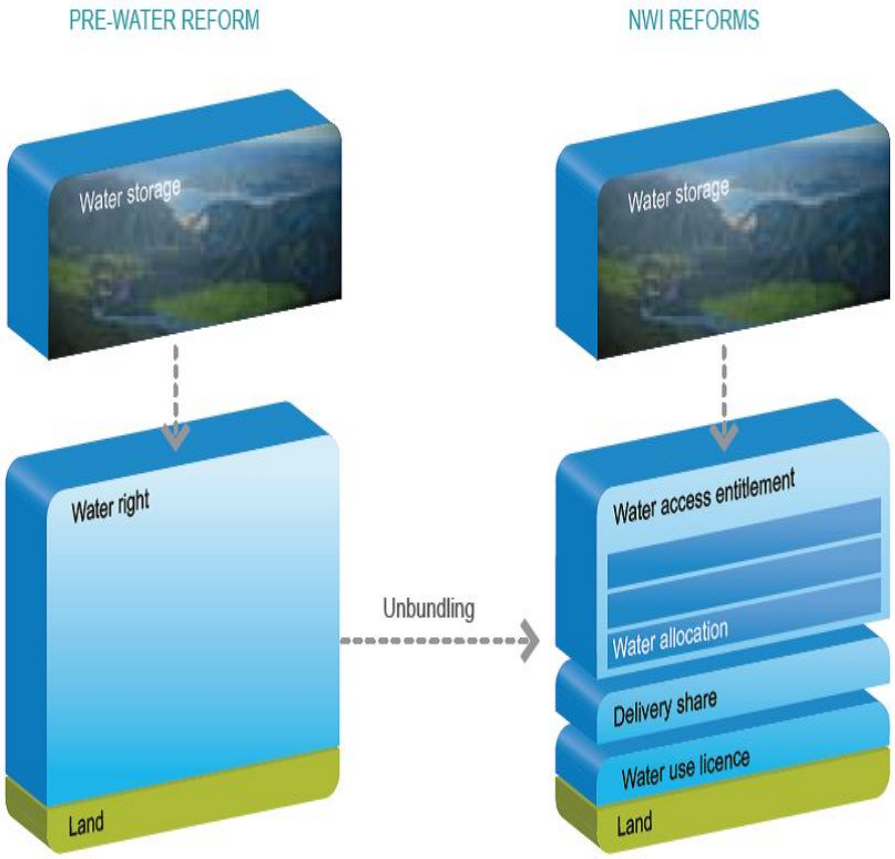
Lessons In Institutional Market Design

1) Separating water access arrangements into their various component parts;
2) Assign policy instruments for specific purposes only, and do not use multi-instruments;
3) Design instruments with hydrological integrity;
4) Keep transaction costs as low as possible;
5) Assign risk to one interest group; and
6) Ensure robustness of the system through proper accounting of water use.



Unbundling of water rights.
Source: NWC (2011)