BRS SEMINAR SERIES PRESENTS:

Friday 2 September

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Framework for defining environmental water demands: A case study of the Murrumbidgee River

An important environmental policy objective in the Southern Murray-Darling Basin is to re-establish the link between river and floodplain to improve riverine and floodplain habitats. This study aims to establish a framework for defining environmental water demands to meet specific flow based objectives that also allow environmental managers access to water resources at minimal costs to all stakeholders. The approach is applied to billabong and wetland management in the Murrumbidgee River regulated system through the supplementation of natural flows using dam releases. The results indicate considerable benefits to both irrigators and those desiring better environmental management practices.

Defining and Meeting Environmental Demands

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Designing environmental demands

- Moving from quantity to objective based demands
- Environmental objectives
  - **Flood plain connectivity**
  - Minimum flows
  - Flow variation
- Working with uncertainty
  - Volumes
  - Timing

Meeting environmental demands

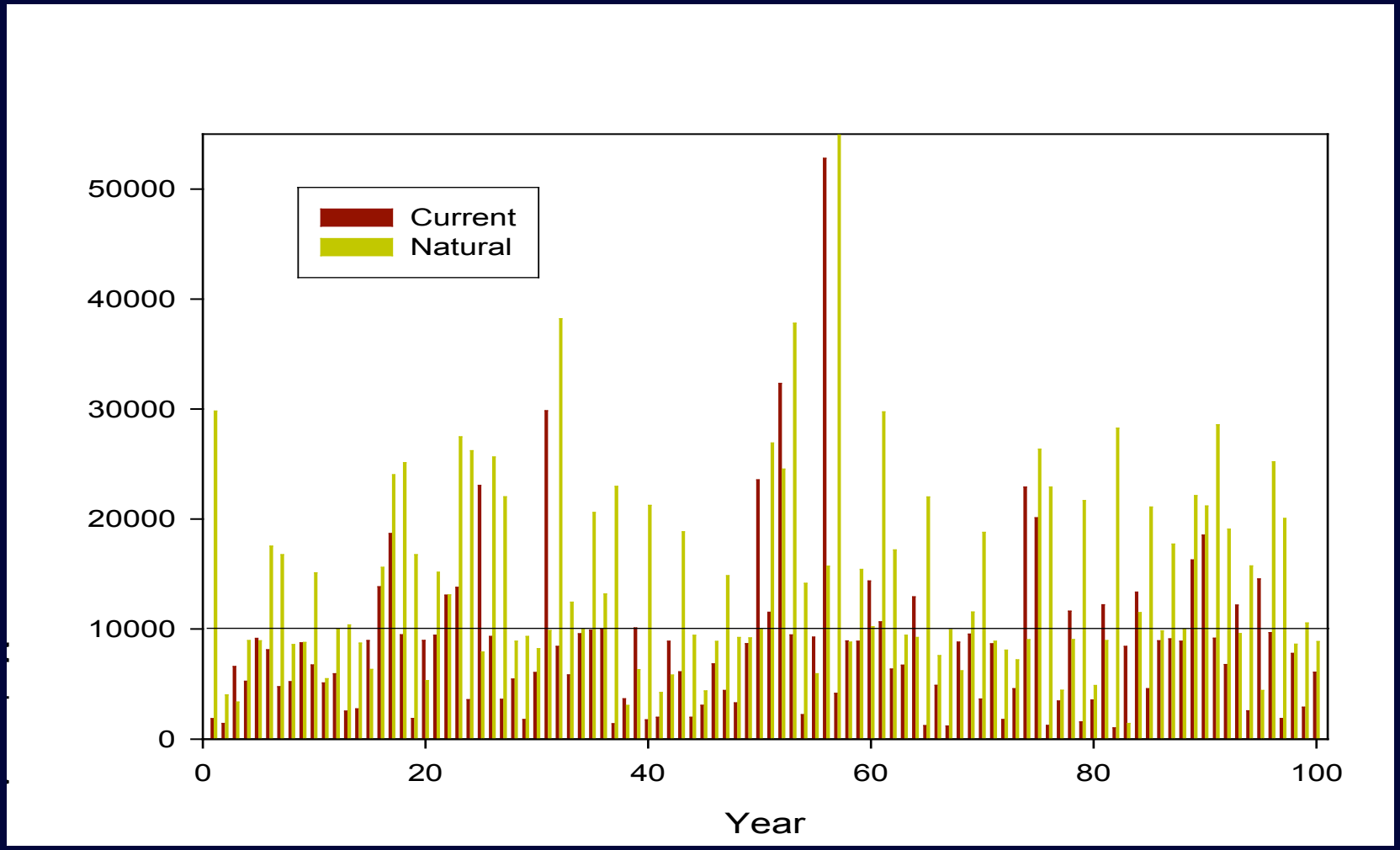
- Recognising the countercyclical nature of irrigator and environmental demands
- Minimising costs through trade and holding the right portfolio of water assets
- Provide planning certainty for both environmental management and irrigators

A case study on the Murrumbidgee River

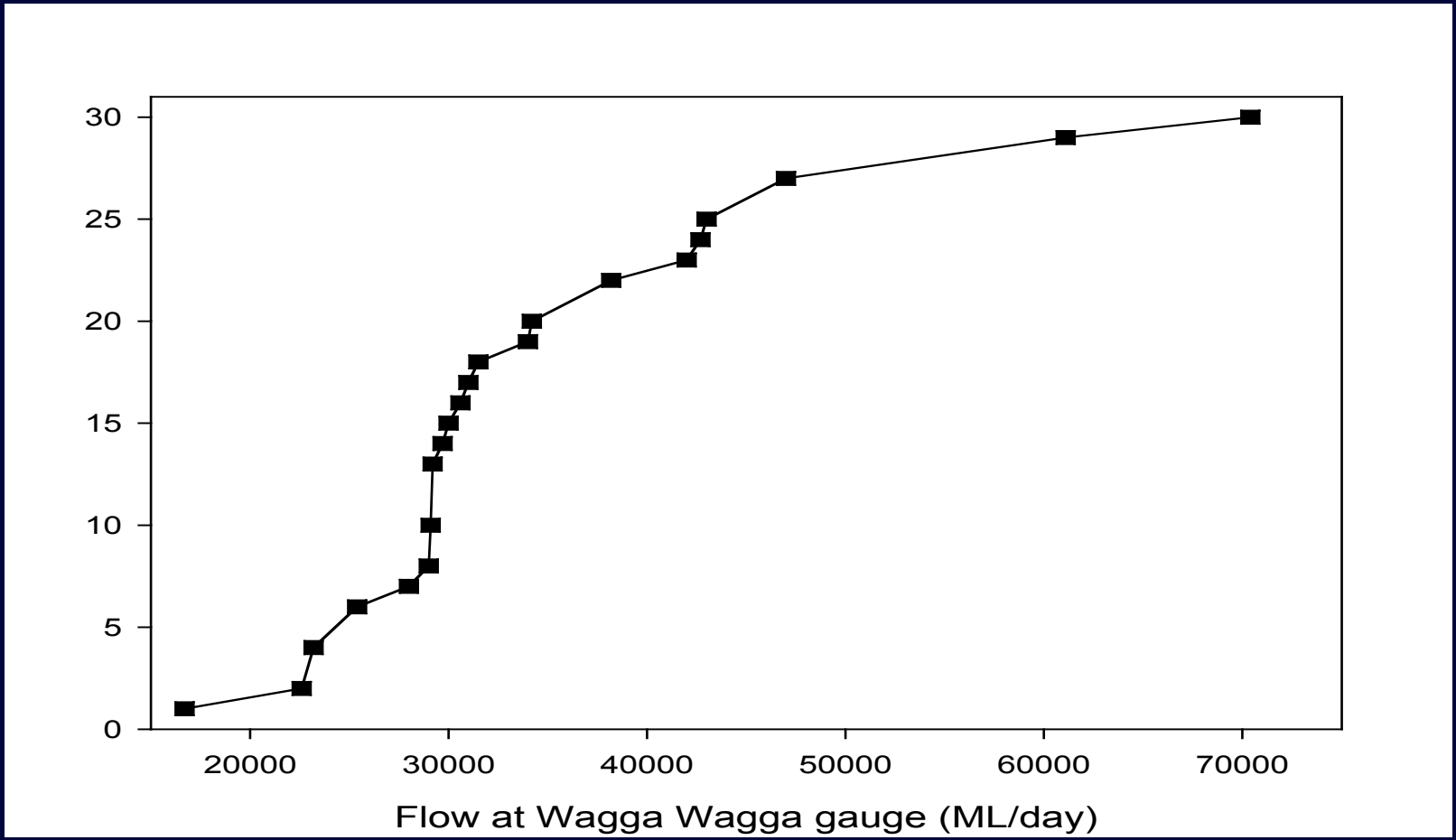
- Reconnecting the lagoons and billabongs along the central river reaches
  - Supplementing high tributary flows with dam releases

- Key Objectives/Parameters
  - Frequency of events
  - Timing
  - Duration of events

Maximum flows in August over the period 1900-1999 using modeled current and natural daily flow data.



Number of local billabongs connected to the river and flow volume at Wagga Wagga gauge



Return frequency per 100 years

Minimum Flow per day	Flow condition	For events lasting at least	
		1 Day	14 Days
30,000 ML	Current	245	24
	Natural	395	39
35,000 ML	Current	190	12
	Natural	353	25

A decision model

- Minimise expected costs

- Subject to
  - A maximum desired duration between events
  - Reliability of success/Penalty for failure
- Given
  - The volume or cost of water on call
  - The opportunity cost of water released
  - Current flow and climatic conditions

Advantages of a decision model

- Environmental demands are well specified:
  - Objectives
  - Expected volume of water required
- Measurable performance
  - Likelihood of success
    - Prior vs Realised
- Transparent to all stakeholders

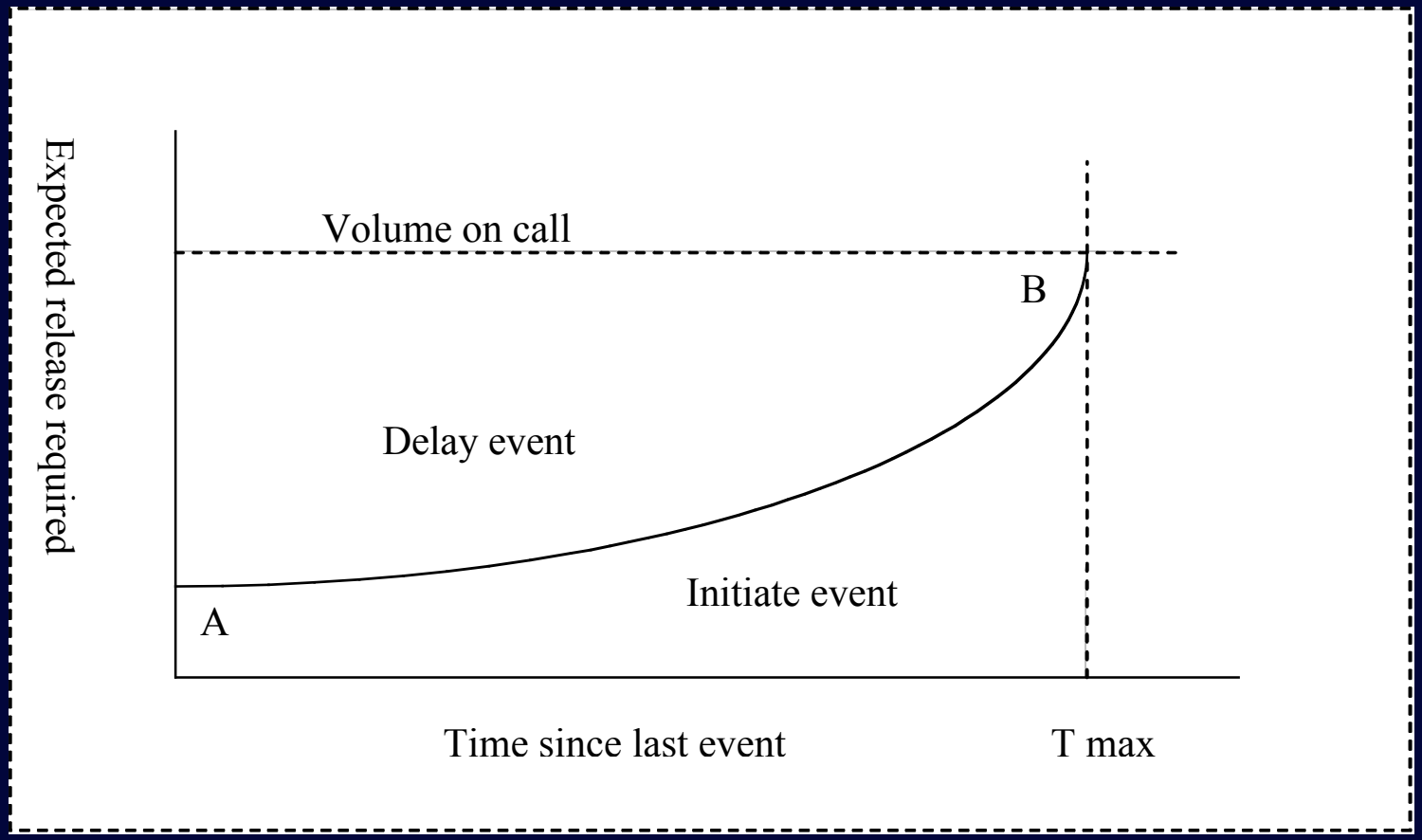
An Example

- Targeted event
  - A minimum flow of 30GL/Day at Wagga
  - Over 14 days
  - Within an August through September window
- Occurring
  - At least every five years
  - With a reliability of 95 per cent
- Given
  - 200 000 ML on call at the dam wall
  - With an opportunity cost of $20/ML

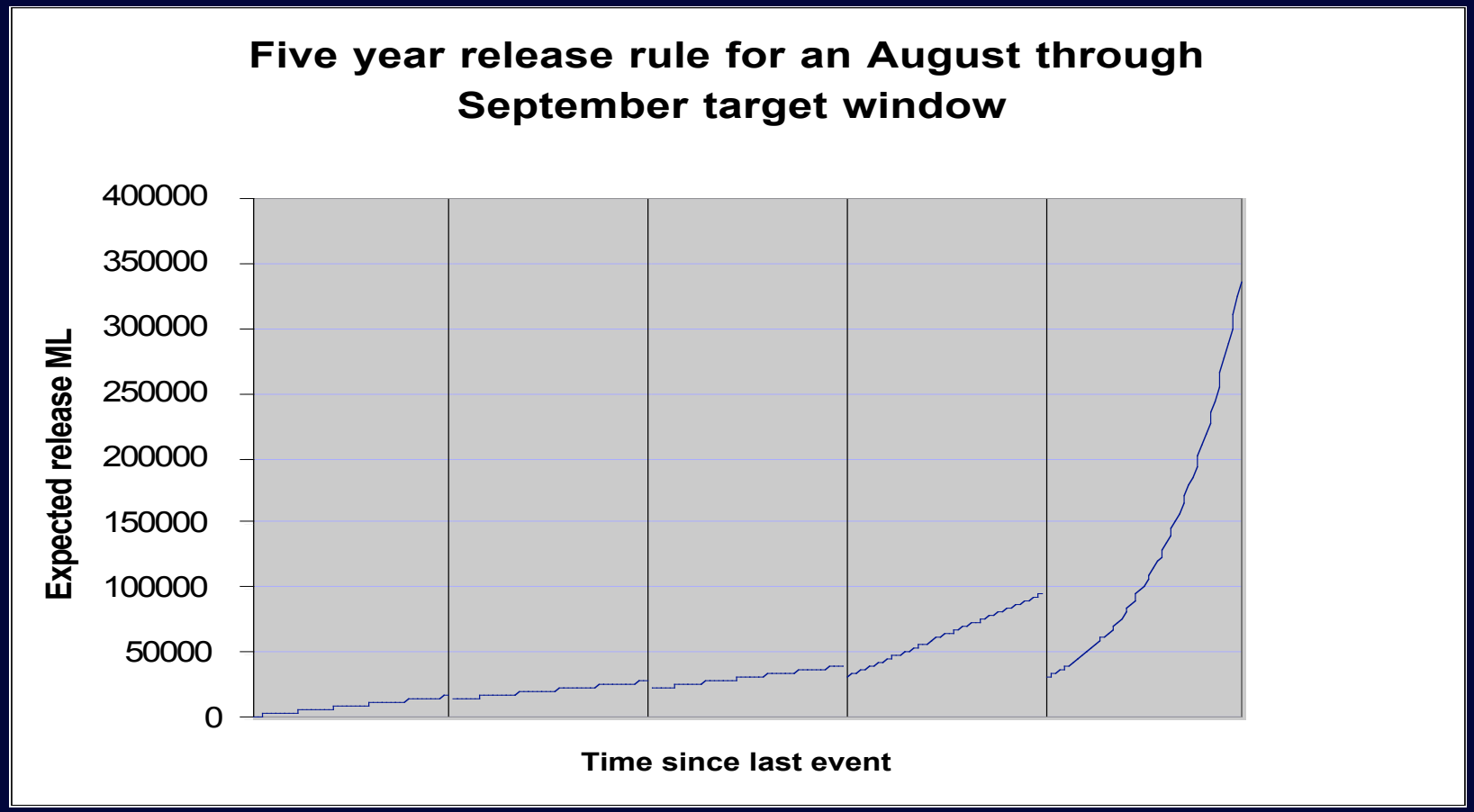
An Alternative Specification

- Targeted event
  - A minimum flow of 30GL/Day at Wagga
  - Over 14 days
  - Within an August through September window
- Occurring
  - At least every five years
  - ***Penalty for failure $30m/year***
- Given
  - ***Cost of an entitlement $1500/ML***
  - With an opportunity cost of $20 ML

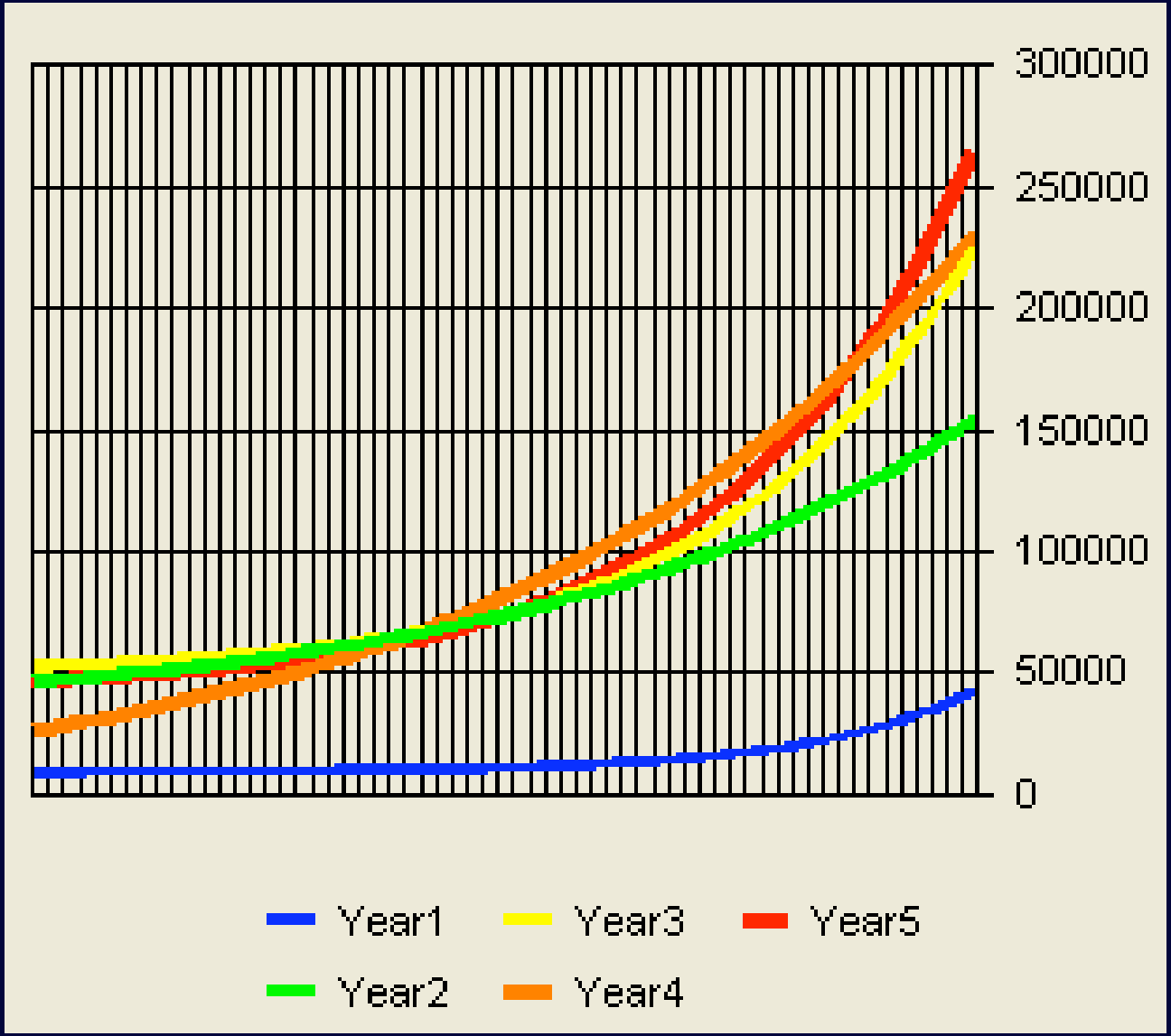
A stylised decision rule



Estimated 5 year release rule with 100 per cent reliability of success



Solution – Trigger Values



Solution – Properties of Strategy

State	Null Proportion	Null Prob Flooding	Proportion	Prob Flooding	Average Release Total	Average Release Failed	Prob Fail
1	0.054	0.054	0.398	0.232	7296	0	0
2	0.051	0.054	0.305	0.482	40520	1786	0.009
3	0.048	0.054	0.158	0.518	60088	14286	0.071
4	0.045	0.054	0.076	0.536	70805	19643	0.098
5	0.043	0.054	0.035	0.562	117936	64286	0.321
6+	0.759	0.054	0.028	0.562	117936	64286	0.321
Avg				0.398	37584	8345	0.042

Solution – Future Values

Total future values. Interest Rate(%)= 5

	Penalties - Null ($Mill)	Penalties -Strategy ($Mill)	Opportunity Cost (Salvage) -Strategy ($Mill)	Entitlement Value - Total ($Mill)	Entitlement Value - Per ML ($/ML)
1	393.571	14.519	15.004	364.047	1820.24
2	414.363	15.465	15.781	383.117	1915.58
3	437.431	17.838	16.385	403.207	2016.03
4	463.023	23.253	16.952	422.818	2114.09
5	491.416	35.834	17.822	437.759	2188.80
Avg		17.339	15.785	385.175	1925.88
AvgNull	478.387			428.703	2143.52

Summary Trial Results

- Likelihood the time since a flood exceeds 5 years
  - Without supplementary releases – 76%
  - With supplementary releases – 3%
- Average water requirement – 37 GL/year
- Average release – 94 GL

Benefits of adoption

- Cost incurred without supplementary releases
  - $418 million
- Cost incurred with supplementary releases
  - $32 million
- Value of the environmental entitlement
  - $1920/ML

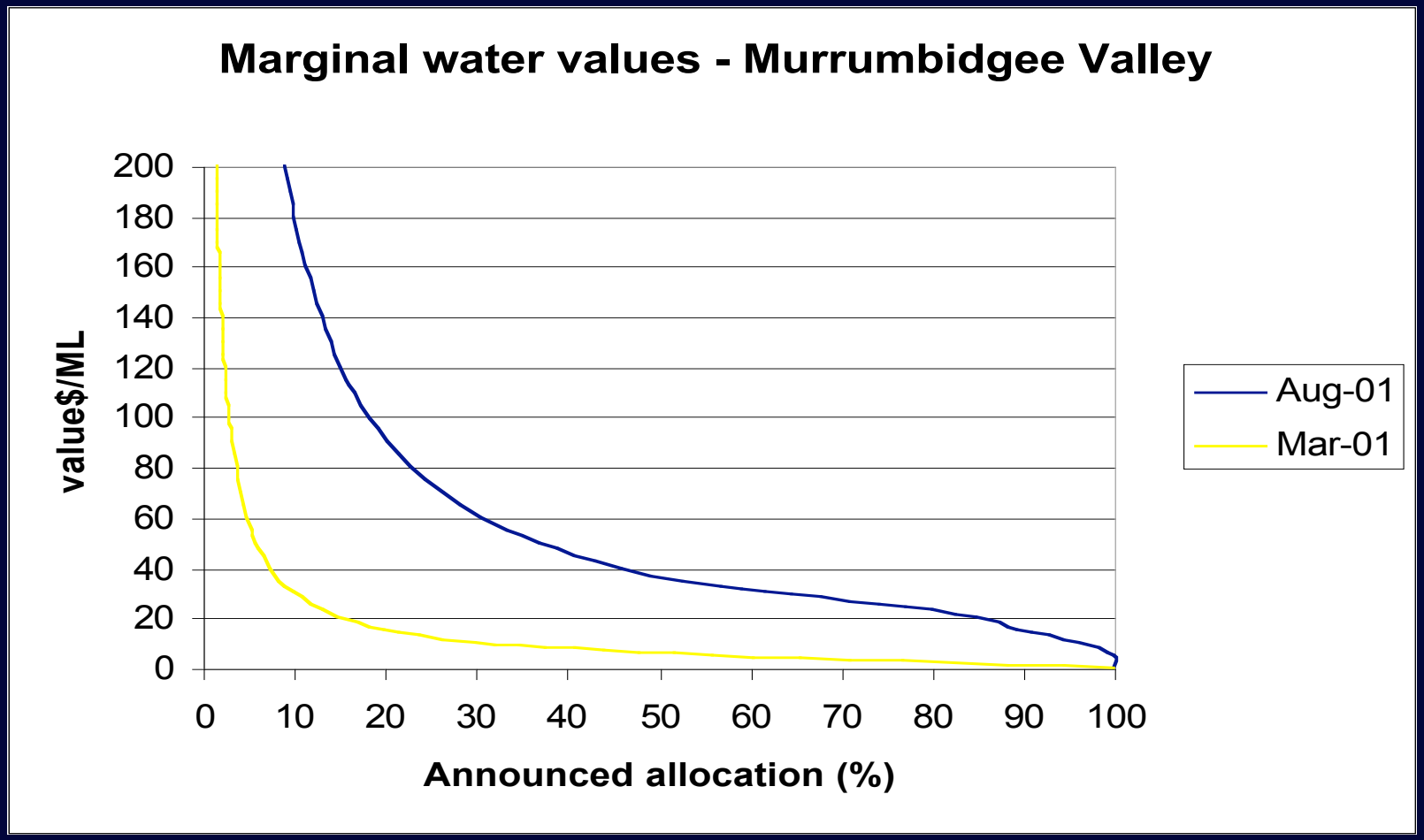
Sourcing environmental demands

- Rules based management
- Environmental entitlements
  - Purchased in the market
  - Deemed from water saving investments
- Options contracts with irrigators

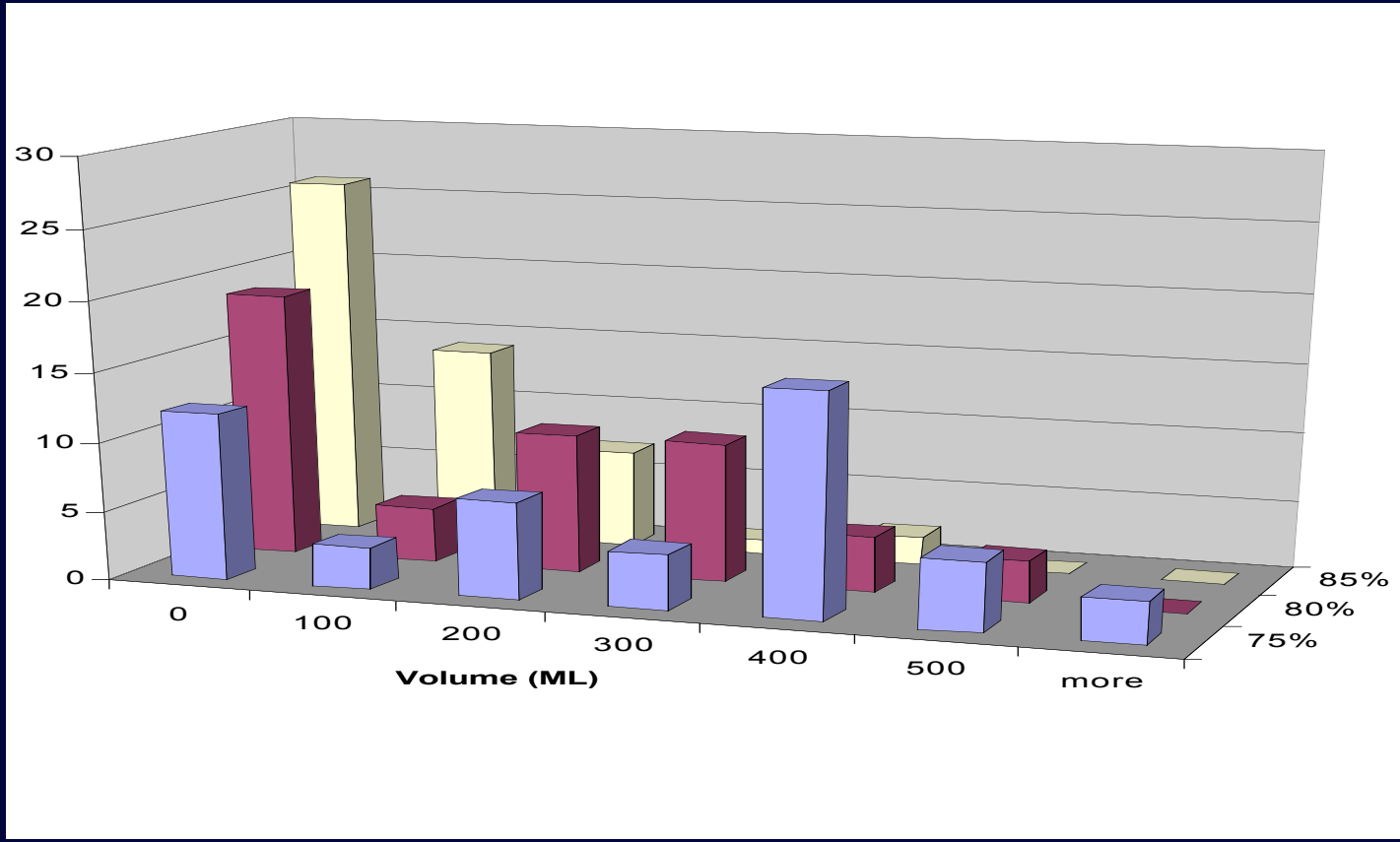
Allocation based options

- Allocation threshold
  - August 1
  - Supplementation of natural spills and tributary inflows
- Sale of allocation above threshold
- Maximum quantity – full uptake

Opportunity costs for an August versus March option



Expected distribution of exercisable option volumes at alternative thresholds



Gross value of a 10 year option contract with an exercise rate of 20 per cent

Permanent entitlement Price $/ML	Option exercise Price $/ML			
	20	**30**	**40**	**50**
500	137	121	104	88
1000	306	290	274	257

Net value of a 10 year option contract with an exercise rate of 20 per cent

Permanent entitlement Price $/ML	Option exercise Price $/ML			
	20	**30**	**40**	**50**
500	37	21	4	-12
1000	106	90	74	57

Advantages

- Low capital outlay for government
- No need to stand in the allocation market
- Reduced transactions costs and greater planning certainty
- Natural hedge retained by irrigators
- No allocation sales through a state monopoly

Ongoing Research and Development

- Improving the decision model
  - The value of improved flow forecasting
  - The opportunity cost of environmental releases versus consumptive releases
  - Full versus partial failures

Ongoing Research and Development

- The broader implications of high flow releases for environmental management
  - Downstream recapture or environmental benefits
  - Connectivity with the Murray River
  - IQQM
- Matching the environmental demands to the optimal portfolio of assets held by an environmental manager