ESF to Measure the Benefits of Reducing Diversions in the Murray-Darling Basin

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16 July 2013

Introduction

Healthy (freshwater) ecosystems provide a myriad of benefits to people

- Economic, environmental, social

Documenting the many benefits is difficult but important:

- Not all benefits equal
- Trade-offs may be necessary
- Embryonic understanding
- Multi-disciplinary
- Complex

Introduction

Need to ***integrate*** environmental outcomes and socio-economic value to estimate benefits and trade-offs

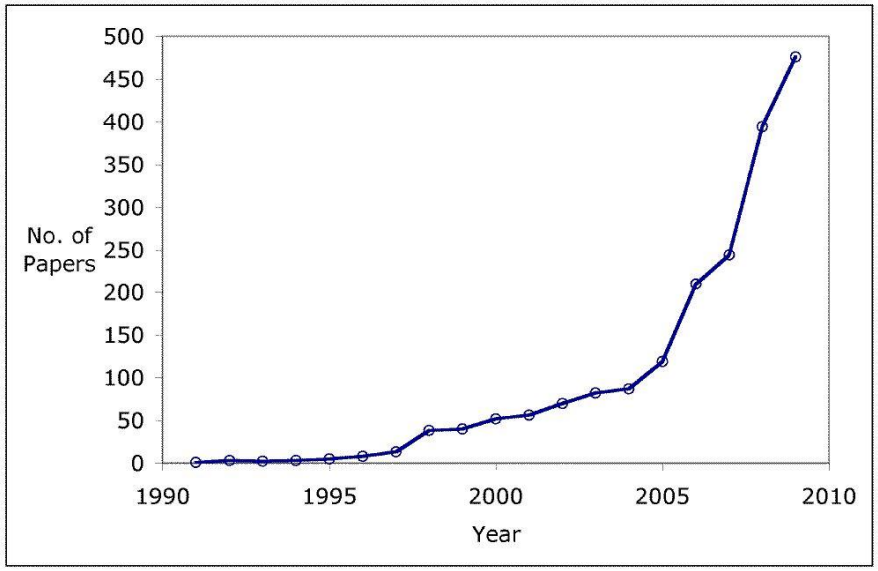
Ecosystem services framework:

- Ecosystem services: the contribution of ecosystems to human well-being
- Concept growing rapidly
- Captures ecological and environmental, social, economic benefits
- Provides an organising framework for communicating benefits and trade-offs
- Integrates across disciplines
- Links ecosystems to human well-being
- Has varying terminology

Growth in interest in ‘ecosystem services’

Table 1
Comparison of basic statistics for several transdisciplinary topic areas.

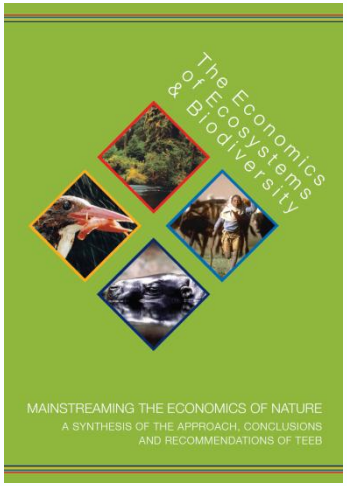
Topic area	# of papers	# of coauthors	# of citations	Average coauthors/ paper	Average citations/ paper	Average citations/ author	h-index	Subject areas	Year of first mention
Ecosystem services	2462	6958	33,429	2.83	13.59	4.80	74	71	1983
Environmental history	1691	3083	13,117	1.82	7.76	4.25	49	81	1972 or earlier
Environmental ethics	837	835	3801	1.00	4.54	4.55	25	60	1972 or earlier
Positive psychology	701	1345	7142	1.92	10.19	5.31	34	55	1994
Ecological economics	623	926	5430	1.49	8.72	5.86	32	50	1974



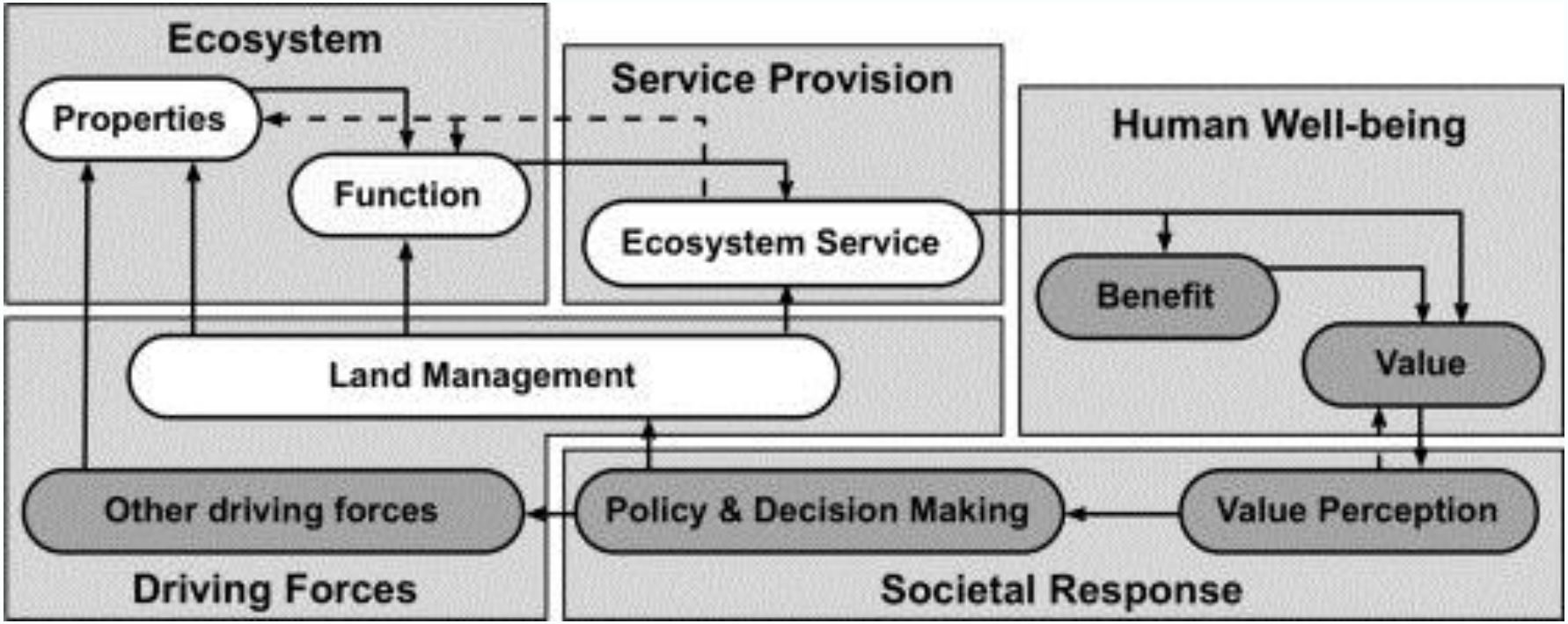
Growth in number of papers on ecosystem services since 1990

Some international developments

- Millennium Ecosystem Assessment
- The Economics of Ecosystems and Biodiversity (TEEB)
- UK National Ecosystem Assessment
- Convention on Biological Diversity and Ramsar Convention ‘Ecosystem Approach’
- EU Biodiversity policy target to map ecosystem services by 2020
- USA investing in quantifying and valuing eco-services through EPA
- Common International Classification of Ecosystem Services (CICES)



From ecological processes to benefits, value & management



Source: A. P.E. van Oudenhoven, K. Petz, R. Alkemade, R. S. de Groot, L. Hein (2012) Framework for systematic indicator selection to assess effects of land management on ecosystem services, Ecological Indicators, doi:10.1016/j.ecolind.2012.01.012

Ecosystem Service Benefits of Reducing Diversions

The Problem:

- Murray-Darling Basin is Australia's Food Bowl, large proportion from irrigated agriculture
- But too much water is diverted for irrigation, threatening the health of wetlands, river ecology and estuarine systems
- Mechanisms legislated for acquiring water from irrigators for environmental uses
- But the trade-off is reduced water for irrigation
  - Created a complex policy problem
  - Must clearly quantify benefits of reducing diversion to give more water to the environment
  - CSIRO contracted to calculate the benefits; we used the ecosystem services framework

Ecosystem Service Benefits of Reducing Diversions

Project Aim:

To calculate the (monetary and non-monetary) benefits of the proposed reduction in water used for irrigated agriculture

Methods:

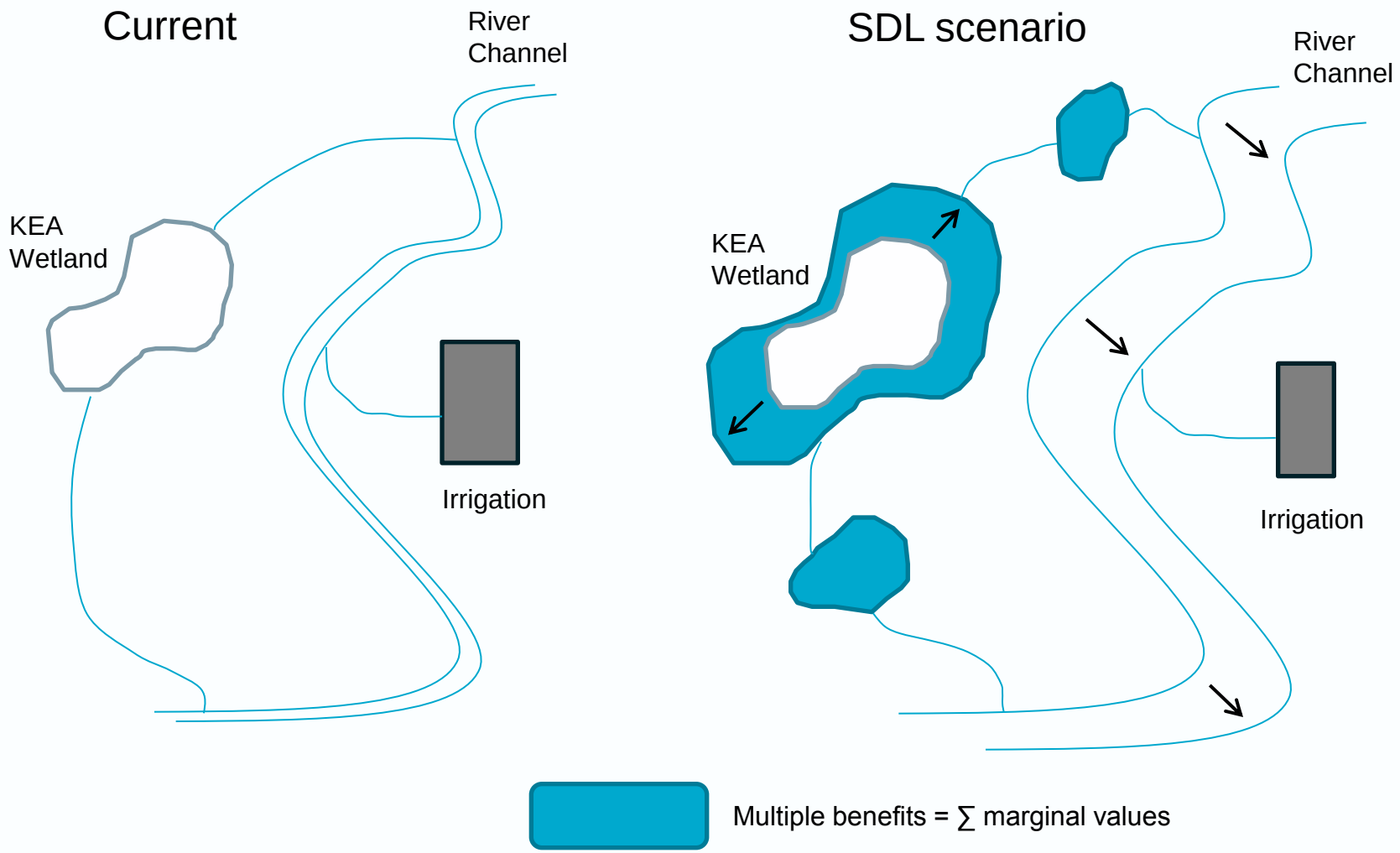
1. Estimate marginal changes in hydrology, ecology and ecosystem services following additional 2800 GL water to the environment proposed in the BP

2. Where possible, estimate the monetary benefits of those changes using established economic valuation techniques

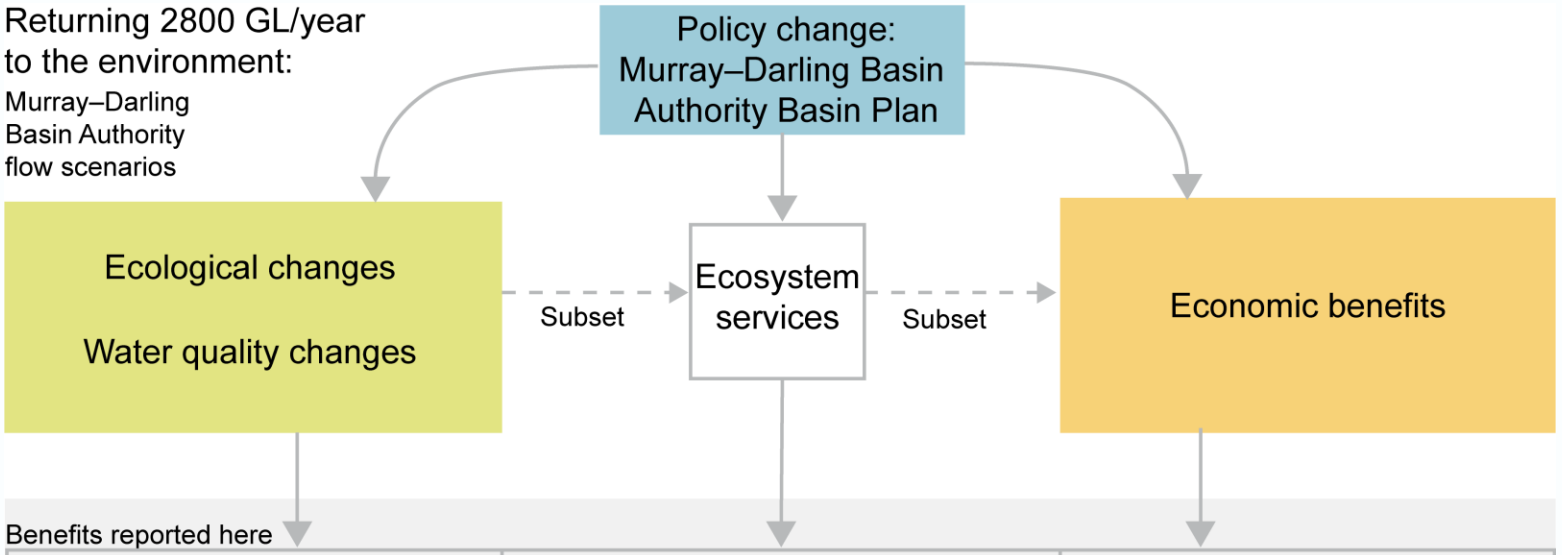
Timing, who involved:

June 2011 – March 2012; ~25 people from CSIRO and Universities

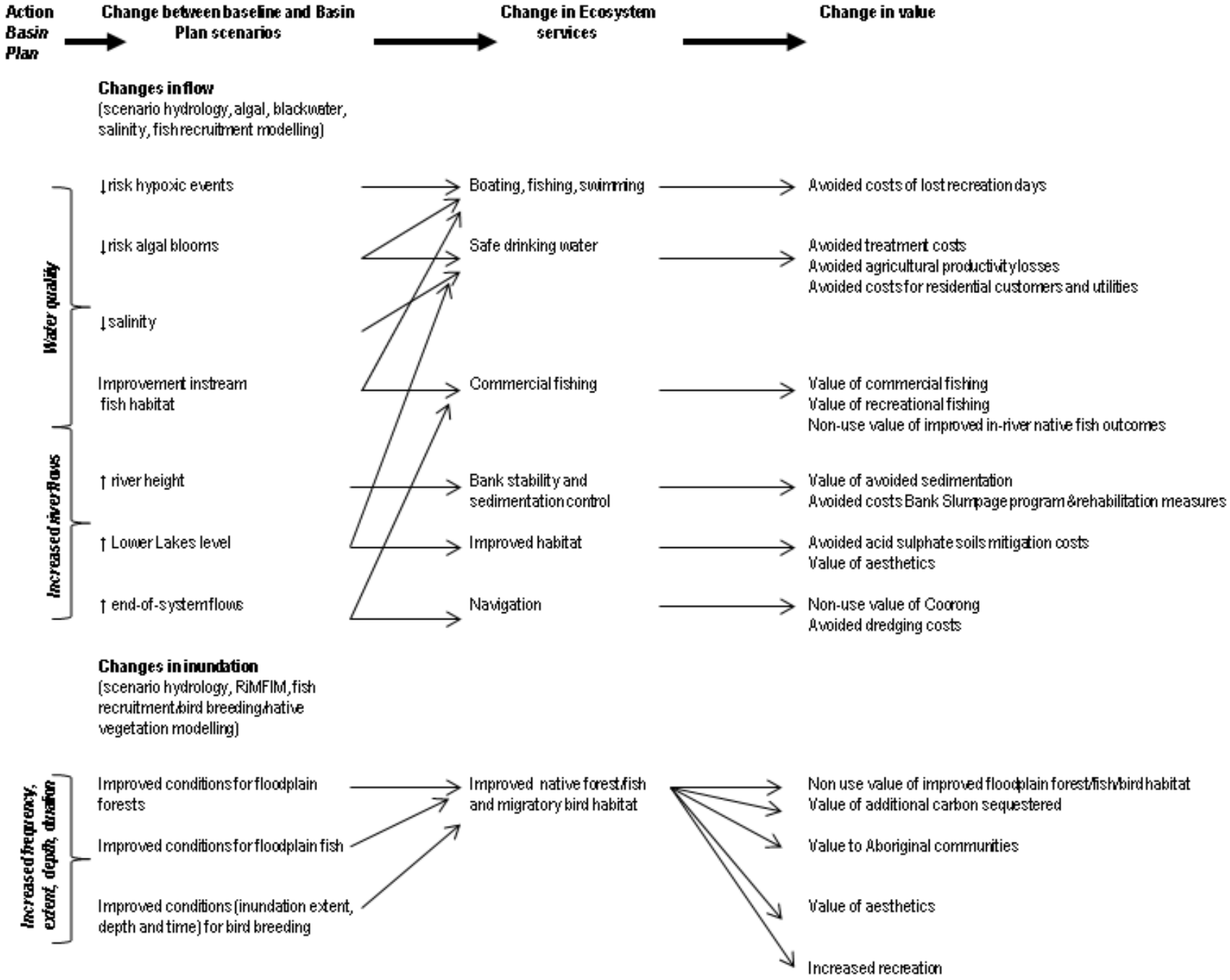
Marginal changes in ecosystem services conceptual diagram



Structure of project



Chapter 3: Ecological benefits Chapter 4: Water quality benefits	Chapter 5: Ecosystem services	Chapter 6: Economic benefits
Question: • What are the potential ecological and water quality benefits of returning 2800 GL/year to the environment?	**Questions:** • What is the magnitude and extent of the supply of a subset of ecosystem services in the Basin? • How well do people understand ecosystem services and which do they think are most important?	**Question:** • What is the monetary value of a subset of ecosystem services?
Answers: Change in supply of habitat and freshwater ecosystem services • non-monetary • quantitative and qualitative	**Answers:** Qualitative estimates of indicators for a subset of ecosystem services • non-monetary • qualitative	**Answers:** Dollar amounts for a subset of ecosystem services • monetary • quantitative


Action
Basin Plan
Change between baseline and Basin Plan scenarios
Change in Ecosystem services
Change in value
Changes in flow
(scenario hydrology, algal, blackwater, salinity, fish recruitment modelling)
Water quality
Increased river flows
↓risk hypoxic events
↓risk algal blooms
↓salinity
Improvement instream fish habitat
↑ river height
↑ Lower Lakes level
↑ end-of-system flows
Boating, fishing, swimming
Safe drinking water
Commercial fishing
Bank stability and sedimentation control
Improved habitat
Navigation
Avoided costs of lost recreation days
Avoided treatment costs
Avoided agricultural productivity losses
Avoided costs for residential customers and utilities
Value of commercial fishing
Value of recreational fishing
Non-use value of improved in-river native fish outcomes
Value of avoided sedimentation
Avoided costs Bank Slumpage program &rehabilitation measures
Avoided acid sulphate soils mitigation costs
Value of aesthetics
Non-use value of Coorong
Avoided dredging costs
Changes in inundation
(scenario hydrology, RiMFIM, fish recruitment,bird breeding,native vegetation modelling)
Increased frequency, extent, depth, duration
Improved conditions for floodplain forests
Improved conditions for floodplain fish
Improved conditions (inundation extent, depth and time) for bird breeding
Improved native forest,fish and migratory bird habitat
Non use value of improved floodplain forest/fish/bird habitat
Value of additional carbon sequestered
Value to Aboriginal communities
Value of aesthetics
Increased recreation

The Multiple Benefits of the Basin Plan

Results:

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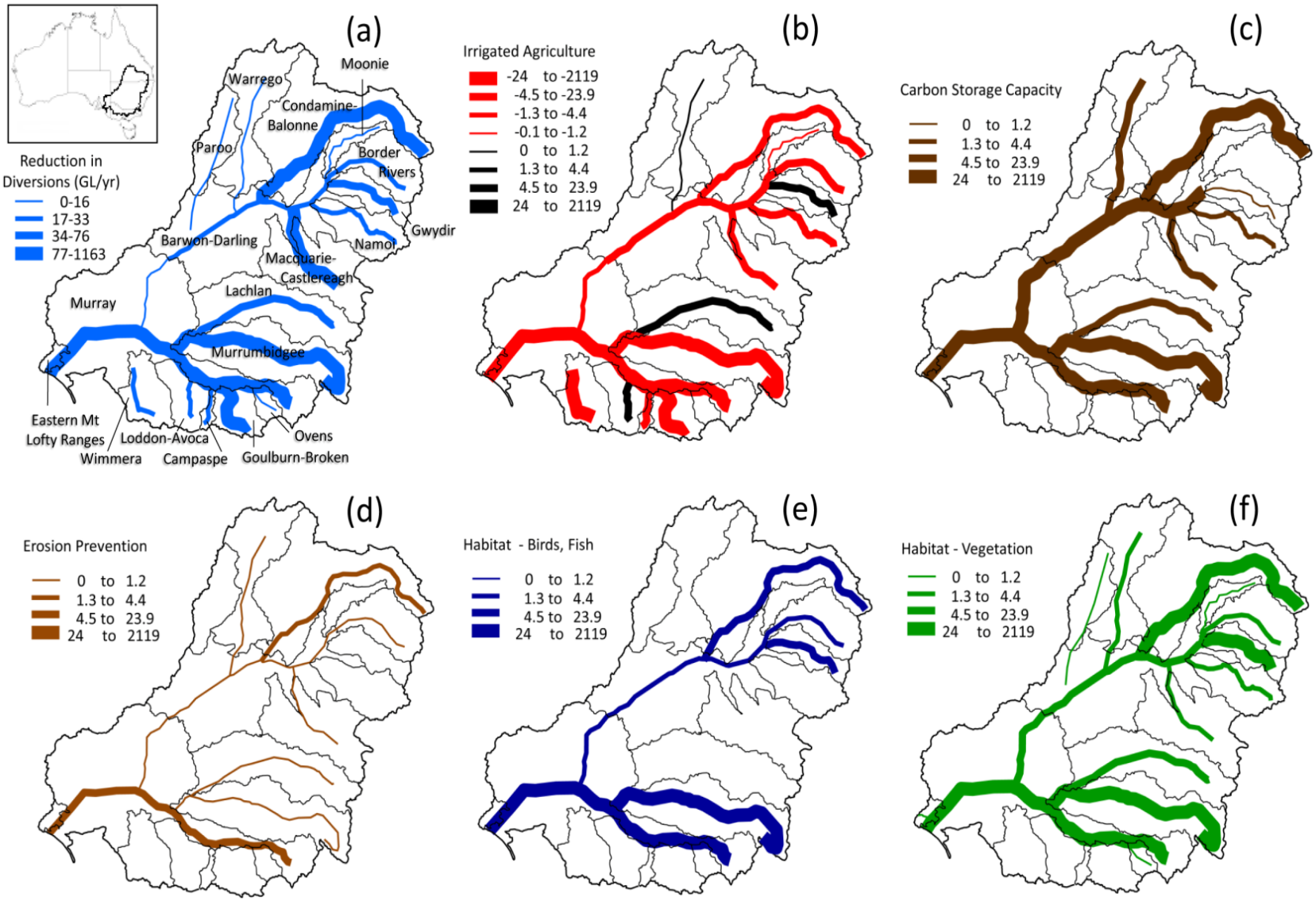
(a)
Reduction in Diversions (GL/yr)
0-16
17-33
34-76
77-1163
Warrego
Moonie
Condamine-Balonne
Paroo
Border Rivers
Gwydir
Namoi
Barwon-Darling
Macquarie-Castlereagh
Lachlan
Murray
Murrumbidgee
Eastern Mt Lofty Ranges
Loddon-Avoca
Wimmera
Campaspe
Ovens
Goulburn-Broken
(b)
Irrigated Agriculture
-24 to -2119
-4.5 to -23.9
-1.3 to -4.4
-0.1 to -1.2
0 to 1.2
1.3 to 4.4
4.5 to 23.9
24 to 2119
(c)
Carbon Storage Capacity
0 to 1.2
1.3 to 4.4
4.5 to 23.9
24 to 2119
(d)
Erosion Prevention
0 to 1.2
1.3 to 4.4
4.5 to 23.9
24 to 2119
(e)
Habitat - Birds, Fish
0 to 1.2
1.3 to 4.4
4.5 to 23.9
24 to 2119
(f)
Habitat - Vegetation
0 to 1.2
1.3 to 4.4
4.5 to 23.9
24 to 2119

Ecosystem Service Benefits of Reducing Diversions

Results:

- Additional flow (2800 GL/yr compared to baseline) potentially worth:
  - $3b - $8b in improved habitat condition
  - $120m - $1b in carbon sequestration
  - $340m in aesthetic appreciation and $160m in tourism benefits
  - Plus many measurable improvements to:
    - water quality (reduced blackwater events, cyanobacterial blooms and Lower Lake acidification)
    - flood-dependant ecosystems (bird-breeding events, floodplain vegetation)
  - Note: Australian Government spending $12.8 billion to acquire water

Ecosystem Service Benefits of Reducing Diversions

Impact:

1. Policy: Results form important part of the Government's decision-making
2. Science: Integration of ecology and economics; advance science of ecosystem services; new way of looking at water management outcomes

Future policy-relevant research needs:

1. Improve understanding of ecological function-ecosystem service-economic value relationships, especially regulating services (erosion prevention, soil fertility, moderation of extreme events, pollination)
2. Develop improved indicators of ecosystem service change from flow changes
3. New tourism and habitat valuation studies
4. Knowledge products and decision-support tools to aid water managers in delivery of environmental water to maximise ecosystem service benefits

Thank you

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