SA Aquatic Ecosystems (SAAE) Classification

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Ben Fee (Ecologist)

Glen Scholz (Principal Ecologist)

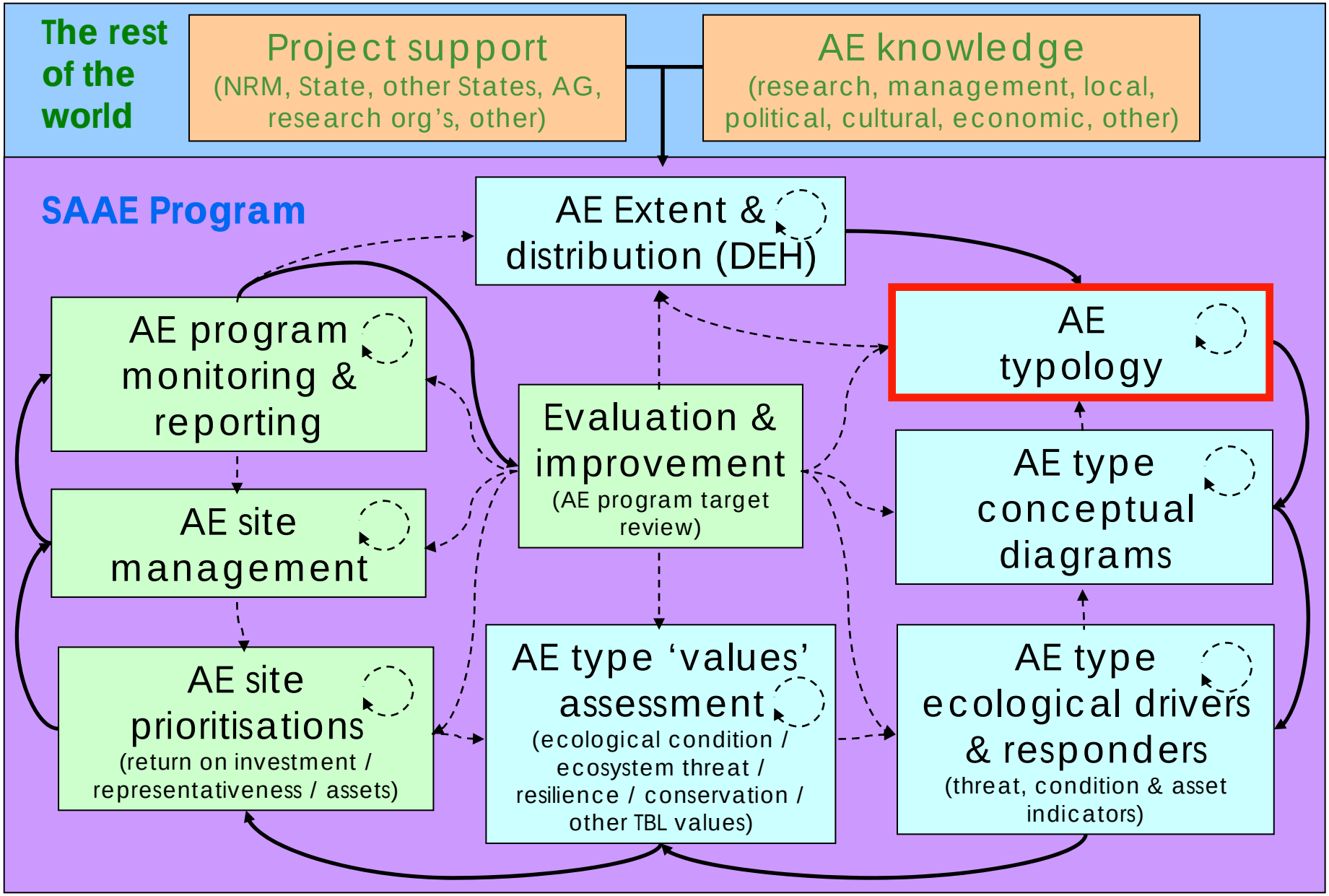
Science, Monitoring and Information Division

Government of South Australia
Department of Water, Land and Biodiversity Conservation

SAAE Program

- Coordinate and integrate management the State's AEs
  - Wetlands, watercourses and estuaries
  - Ecosystem function–based, catchment-to-coast approach
  - Allows informed decisions to be made in data-poor areas / sites
- Based on:
  - Best practice landscape-scale science and management;
  - Broad consultation within Environment and Conservation Portfolio, NRM Boards, interstate and national government
  - Application trials – SAMDB, SAAL, MLR
- SAAE products (so far):
  - Improved State AE mapping – consolidation and gap analysis
  - State-scale AE typology – trial application in SAMDB
  - Conceptual diagrams and models – most completed
  - Condition assessments – Flinders & Gawler Ranges
  - EWR determination – MLR

South Australian Aquatic Ecosystems (SAAE)



SAAE Typology

- Why develop a new classification system?
  - *Site features vs landscape function*
- Hale and Butcher (2008) – *Review of AE classifications*
  - Assessment criteria (x8):
    - Hierarchical, scientifically valid, inclusive, comprehensive, objective, ecologically meaningful, feasible, compatible
- Timms and Boulton (2001) – *Typology of arid–zone floodplain wetlands of the Paroo River (inland Australia)*
  - influence of water regime, turbidity and salinity on aquatic invertebrate assemblages.

SAAE Typology

- Ecosystem function-based typology
  - Uses geomorphological, hydrological and ecological characteristics of aquatic ecosystems to define different aquatic ecosystem types that exist in South Australia

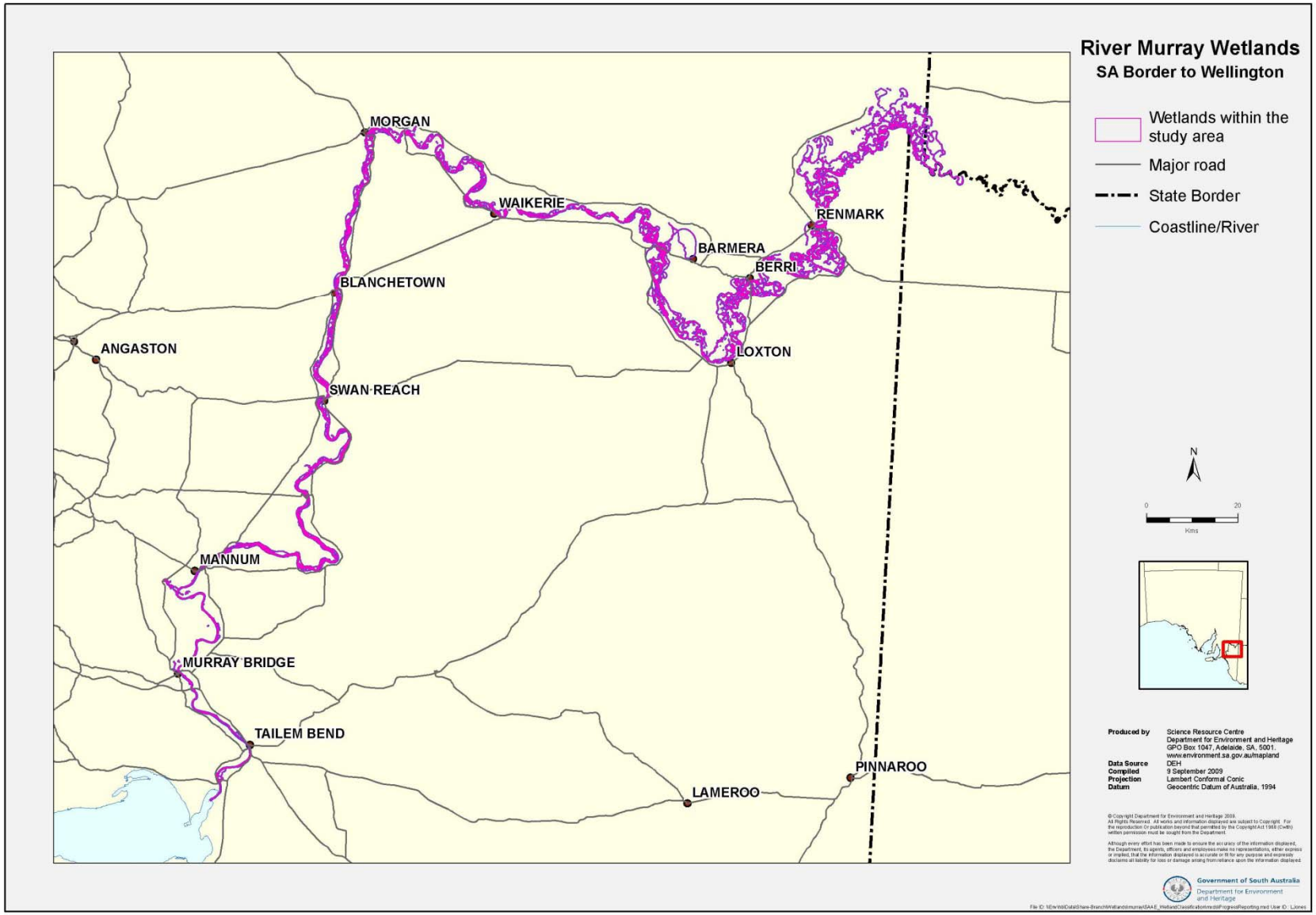
- **Typology attributes:**
  - Climate (Koppen climate regionalisation)
  - Geomorphology
    - Landscape setting – surrounding AE polygon
    - Landform – within AE polygon
    - AE size – area
    - Substrate – rock type, mineral type, organic
  - Hydrology
    - Hydrological connectivity – wrt other AEs
    - Water source – direct runoff, catchment, groundwater
    - Water regime: Inflows – permanent, seasonal, ephemeral
    - Water regime: Persistence – permanent, > 1 yr, < 1 yr
    - Salinity – fresh, brackish, saline

SAAE typology: RRP trial (desk-top)

Riverine Recovery Project			AE CLASSIFICATION ATTRIBUTES										
			Landscape setting					Hydrogeological setting					Other
Wetland type (INLAND & MOT instream)			Climate* (Koppen)	Landscape setting	Landform	Size / scale	Substrate	Hydrology	Water source	Water regime:	Water regime: Persistence	Salinity	Vegetation presence
			D = Desert; G = Grassland; T = Temperate	Fl = Flat; Dun = Dunal; Hill = Hills; Sub = Subterranean; Other	D = Dunes; Fl = Flat; Sub = Subterranean; H = Hmnd; Other	Mega = >10,000 ha; Macro = 100 ha - 10,000 ha; Meso = 25 ha - 100 ha; Micro = 1 ha - 25 ha; Lepto = 0.04 ha - 1 ha; Nano = <0.04 ha	Gr = Granite; Bed = Bedrock (not specifically granite); M-S = Mineral-Sand; M-C = Mineral Clay; Org = Organic; Other	DC = Directly connected to main channel; Thro = Through Flow; Over = Overbank Flow; Ret = Retained; Unconn = Unconnected; Term = Terminal branch; EoS = End of system; Other	LR = Local runoff; SW = Catchment fed; GW = Unconfined groundwater; Art = Artesian GW; Other	P = Permanent; S = Seasonal (> 1:1); E = Ephemeral (<1:1)	P = Permanent; T = Temp (>1 yr / not perm); A = Annual (<1yr)	Fresh = Freshwater (< 1,000 mg/L); Brack = Brackish (1,000 - 10,000 mg/L); Sal = Saline-hypersaline (> 10,000 mg/L)	Veg = Vegetated; Unveg = Unvegetated
1	L	Inland lakes	D	Fl / Dun	B	Macro / Meso	[M-S/M-C]	Thru	[SW/GW]	P / E	P	Brack	Unveg
2	L	Dune lakes	D / G / T	Dun	B	Macro / Meso	M-S	Thru	GW	All	All	Brack	Unveg
3	L	Salt lakes	D / G / T	Fl / Dun	B	Mega / Macro	[M-S/M-C]	EoS	SW	E	Y / A	[Saline/Hyper]	Unveg
4	L	Terminal lakes	D / G / T	Fl / Dun	B	Mega / Macro	[M-S/M-C]	Term	SW	S / E	Y / A	Fresh / Brack	Unveg
5	L	Permanent freshwater lake	T / G	Hill / Fl	B	Macro / Meso / Micro / Lepto	[Bed/M-S/M-C]	Thro / Term	[LR/SW/GW]	P	P	Fresh	Unveg
		Permanent freshwater swamp	T / G	Hill / Fl	B	Macro / Meso / Micro / Lepto	[Bed/M-S/M-C]	Thro / Term	[LR/SW/GW]	P	P	Fresh	Veg
6	P	Artesian springs	D	Fl / Dun	[Fl/Sub] / [M/S	Lepto / Nano	[M-S/M-C/Org]	Thru	Art	P	P / Y	Brack	Veg
7	P	Inland swamps	D	Fl / Dun	Fl	All except Nano	[M-S/M-C/Org]	Thru / [Over/Ret] / [Over/EoS]	SW	E	Y / A	Brack	Veg
8	P	Rockholes	D / G	Fl	B	Nano	Gr	Uncann	LR	E	A	Brack	Unveg
9	P	Claypans	D / G / T	Fl / Dun	B	Macro / Meso / Micro	M-C	Uncann	LR	S / E	A	Brack	Unveg
10	P	Floodplain	D / G / T	Fl	Fl	Macro / Meso / Micro	[M-S/M-C]	Over	SW	S / E	A	All	Unveg
11	P	Inland interdunal wetlands	D / G / T	Dun	Fl	Macro / Meso	[M-S/M-C]	Ret	[LR/SW]	S / E	Y / A	Brack	Veg
12	P	Soaks & springs	D / G / T	Hill / Fl	Fl	Micro / Lepto	[M-S/M-C/Org]	Ret	GW	P / S	All	[Fresh/Brack] / [Brack/Saline]	Veg
13	P	Grass sedge wetland	G / T	Hill / Fl	Fl	Meso / Micro / Lepto	[M-S/M-C/Org]	Ret	[LR/SW/GW]	S	All	[Fresh/Brack]	Veg
14	P	Saline Swamp	G / T	Fl	Fl / B	Macro / Meso / Micro / Lepto	M-S / M-C	Ret / Term / Over / Thro	[LR/GW]	All	All	Saline / Hyper	Unveg
15	P	Temporary wetlands	G / T	Fl	B	Macro / Meso / Micro / Lepto	[M-S/M-C]	Thro / Over / Term	[LR/SW]	S / E	A	Fresh / Brack	Veg / Unveg
16	P	Freshwater meadow	T	Hill / Fl	Fl	Meso / Micro / Lepto	[M-S/M-C]	Ret	LR	S / E	A	Fresh	Veg
17	P	Peat swamp	T	Hill / Fl	Fl	Meso / Micro / Lepto	Org	Ret	[LR/SW/GW]	P	P	Fresh	Veg
18	S	Karst systems	G / T	Sub	Sub	Macro / Meso / Micro / Lepto	Bed / [Bed/M-S/M-C]	Thru	GW	P / S	P	Fresh / Brack / Saline	Unveg

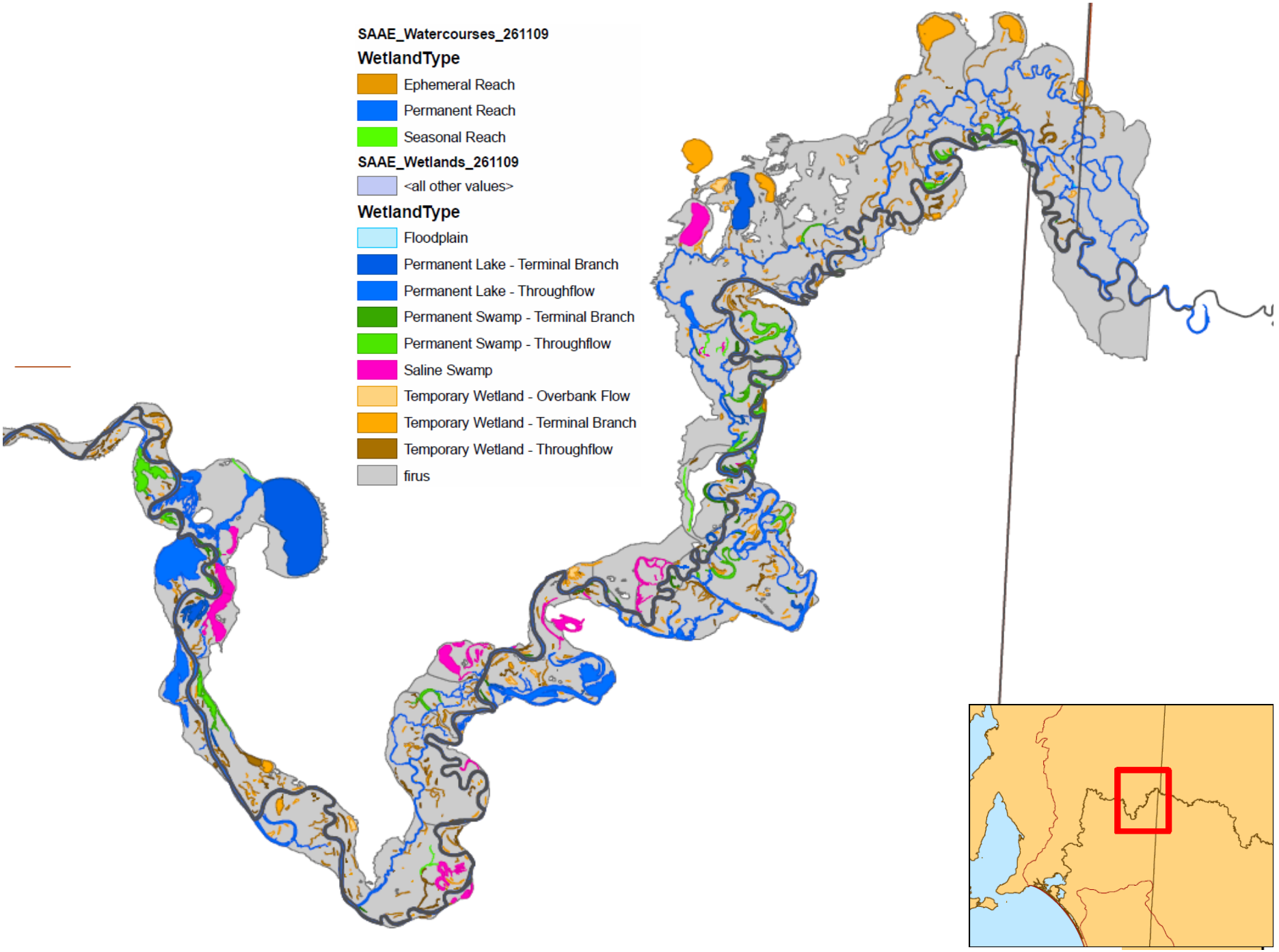
Watercourse type (INSTREAM)			Climate* (Koppen)	Landscape setting	Instream type		Hydrological connectivity	Water source	Water regime:	Water regime: Persistence	Salinity
			D = Desert; G = Grassland; T = Temperate	Hill = Hills; Sl = Slope; Fl = Flat	WC = Watercourse; WH = Waterhole; Sp = Spring; Rock = Rockbank		Conn = Always connected; Semi = Semi-/ephemeral connected	LR = Local runoff; SW = Catchment fed; GW = Groundwater	P = Permanent; I = Intermittent (> 1:1); E = Ephemeral (<1:1)	P = Permanent; M = Mid-term (>1 yr / not perm); A = Annual (<1yr)	Fresh = Freshwater; Saline = Saline; Hyper = hypersaline; Eury = Euryhaline
1	R	Permanent watercourse reach	G / T	Sl / Fl	[WC/Anab/Sp]		Conn	[All]	P	P	Fresh / Eury
2	R	Seasonal watercourse reach	G / T	All	[WC/Anab/Sp]		Semi	[All]	I	A	All
2a	R	Seasonal WC waterhole	G / T	Sl / Fl	[WH/Sp]		Semi	[All]	I	P	Eury
3	R	Ephemeral watercourse reach	D / G	All	[WC/Anab]		Semi	SW	E	A	Eury / Fresh / Saline
3a	R	Ephemeral WC waterhole	D / G	Sl / Fl	[WH/Sp]		Semi	[SW/GW]	E	P / M	Eury / Fresh / Saline

SAAE typology: RRP project area



SAAE typology: RRP regional types

Wetland Type	Border to Overland Corner	Overland Corner to Mannum	Mannum to Wellington	Total
Floodplain	1	1	0	2
Permanent Lake – Terminal Branch	27	43 (2)	6 (3)	76
Permanent Lake - Throughflow	22 (1)	56 (1)	4 (1)	82
Permanent Swamp – Terminal Branch	51	12	3	66
Permanent Swamp - Throughflow	29	19	13	61
Saline Swamp	33 (28)	4 (2)	4 (1)	41
Temporary Wetland – Overbank Flow	210 (7)	122	24 (1)	356
Temporary Wetland – Terminal Branch	118 (8)	78	11(5)	207
Temporary Wetland – Throughflow	111 (2)	127 (1)	5	243
Permanent Reach	92	40	1	133
Seasonal Reach	8	0	0	8
Ephemeral Reach	119	33	1	153
Total	821 (46)	535 (6)	72 (11)	**1,428 (63)**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WetlandType
Ephemeral Reach
Permanent Reach
Seasonal Reach
SAAE_Wetlands_261109
<all other values>
WetlandType
Floodplain
Permanent Lake - Terminal Branch
Permanent Lake - Throughflow
Permanent Swamp - Terminal Branch
Permanent Swamp - Throughflow
Saline Swamp
Temporary Wetland - Overbank Flow
Temporary Wetland - Terminal Branch
Temporary Wetland - Throughflow
firus

Links between typologies

- Can translate between typologies and scales.
  - National = ANAE (hierarchical)
    = DIWA (many-to-many)
  - State = SAAE typology
    = Qld Wetlands Programme (attributes)
    = NSW wetlands classification (attributes)
  - Regional = RRP (polygons … FIRUs?)
    = potential LEB & SE applications

SAAE translation spreadsheet

State-scale translation
Desert wetlands

SA desert wetland typology	NSW desert wetland typology	Qld desert wetland typology
Inland salt lakes (D; L; NP; SW; M; E)	Lacustrine - arid temporary saline floodplain lakes (river & non-river fed)	Semi-arid, lacustrine, all, commonly wet, saline, all
		Semi-arid, lacustrine, all, periodically inundated, all, floodplain
		Semi-arid, lacustrine, all, periodically inundated, all, non-floodplain
		Desert, lacustrine, all, commonly wet, saline, all
		Desert, lacustrine, all, periodically inundated, all, floodplain
		Desert, lacustrine, all, periodically inundated, all, floodplain
Arid zone lakes (D; L; NP; FW; M; E)	Lacustrine - arid temporary fresh floodplain lakes	Semi-arid, lacustrine, all, periodically inundated, all, non-floodplain
	Lacustrine - arid temporary alternating floodplain lakes	Desert, lacustrine, all, periodically inundated, all, non-floodplain
Inland arid zone swamps (D; P; NP; SW; M; S)	Palustrine - arid temporary floodplain wetlands dominated by sedges / grasses	Semi-arid, palustrine, mineral soil, periodically inundated, all, non-floodplain
	Palustrine - arid temporary floodplain wetlands dominated by shrubland	Desert, palustrine, all, periodically inundated, all, non-floodplain
	Palustrine - arid temporary floodplain wetlands dominated by woodland	
GAB springs (D; P; P; FW/SW; M/R; n/a)	Palustrine - arid groundwater dependent wetlands	none
Terminal depression lakes (D/G; L; NP; FW; M/R; S)	none	Semi-arid, lacustrine, all, periodically inundated, all, floodplain
		Desert, lacustrine, all, periodically inundated, all, floodplain
River red gum / Eucalypt woodland (D/G; P; NP; FW; M; E)	Palustrine - arid temporary floodplain wetlands dominated by woodland	Semi-arid, palustrine, mineral soil, periodically inundated, all, floodplain
	Palustrine - semi-arid temporary floodplain wetlands dominated by forest	Desert, palustrine, all, periodically inundated, all, floodplain
	Palustrine - semi-arid temporary floodplain wetlands dominated by woodland	

Use of the SAAE typology

- Multi-use tool:
  - Baseline categorisation to reduce complexity
  - Predictive modelling of ecosystem function through development of complementary conceptual models
  - Provides context to prioritisation (representativeness and rarity of AE types)

- **NOT FOR CULLING** AE numbers at end of process
  - Especially with broad-scale prioritisations
  - Issues of scale

SAAE – Next steps

1. **Communications strategy** for SAAE Program

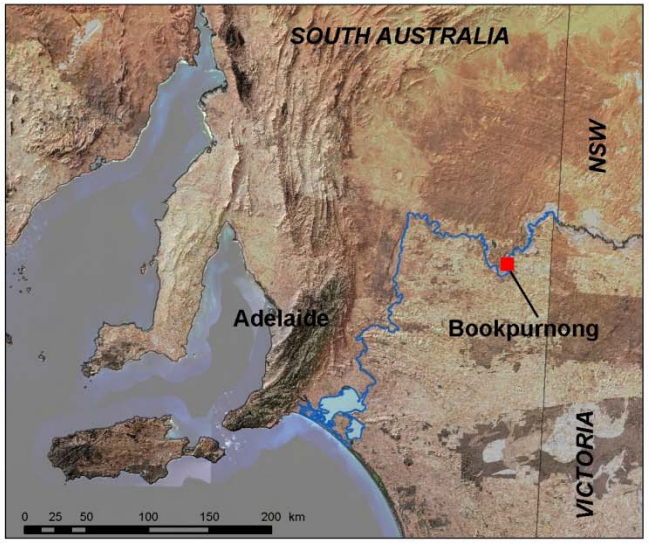
2. **Mapping**: gap analysis and collation of project data

3. **Typology** trials:
   - Incorporate new data / knowledge (e.g. salinity / depth)
   - SAMDB – expert panel validation then bottom-up analysis;
   - LEB and SE– desktop & expert panel;
   - CSIRO FP habitat mapping

4. **Conceptual diagrams / models**: develop for remaining SA AE types

5. **Prioritising** SA AEs: HCVAE LEB trial

LIVING MURRAY TRIAL
BOOKPURNONG S.A.



460000 460500 461000 461500 462000 462500

6199000 6198500 6198000 6197500 6197000 6196500

SITE A
SITE B
SITE D
SITE E
T1
T2
T3
T4
Floodplain break of slope
A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13
B1 B2 B3 B4 B4A B5 B6 B7 B7A B8 B8A B9 B10 B10A B11 B12 B20 B21 B22 B23 B24 B25
LM1 LM2 LM3 LM4 LM5 LM Well
29FO 30FP 31FO 32FP 33FO 34FP 35FO 36FP 37FO 38FP
EI1 EI2 EI3 EI4 EI5

Instream NanoTEM
December 2005

Conductivity (uS/cm)	Resistivity (Ohm.m)
20,000	0.5
5,000	2
2,000	5
1,000	10
500	20
200	50
100	100

Resolve 2005
High
HEM Conductivity
4.20 - 6.62 metres
Low
SA-CNRM (Project CNRM054127)
Application of Airborne Geophysics
Riverland, South Australia.

- Site A Observation Well
- Site B Observation Well
- Site B Production Well
- Site E Injection Well
- Site E Observation Well
- 2002 LM Well
- SIS Production Well
- SIS Observation Well
- Stream Salinity Logger
- Site A Inundation Extent
- River Kilometre Marker

0 50 100 200 300 400 500 m

Projection: Transverse Mercator Zone 54
Datum: Geocentric Datum of Australia 1994
Date: June 2009

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Science Monitoring and Information Division
Department of Water, Land and Biodiversity Conservation

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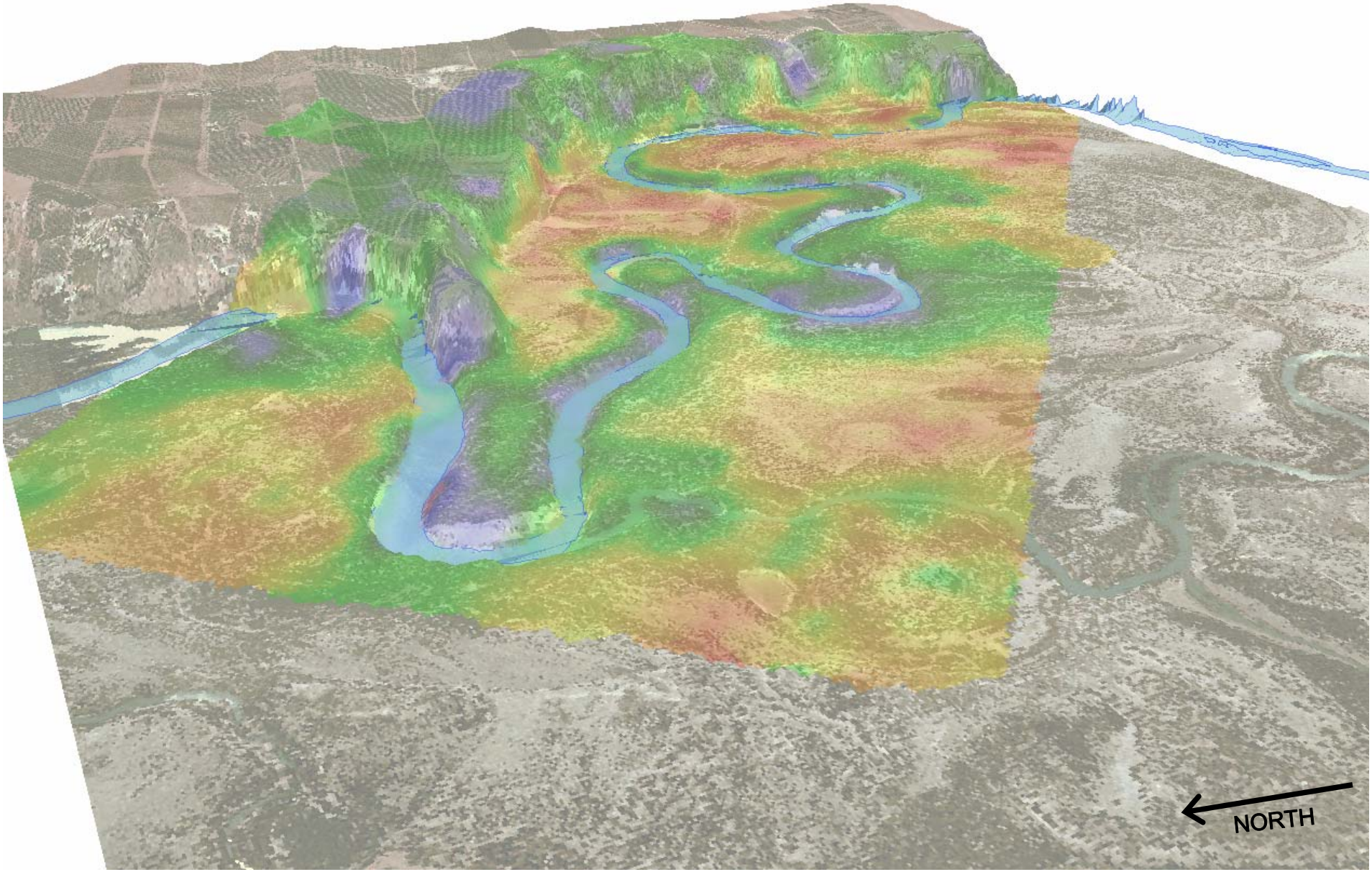
Department of Water, Land and Biodiversity Conservation

The Living Murray
One River. One Life. Our Future.

ArcScene



2.0 m - 4.5 m

ArcScene

Ohm.m

1 10 100

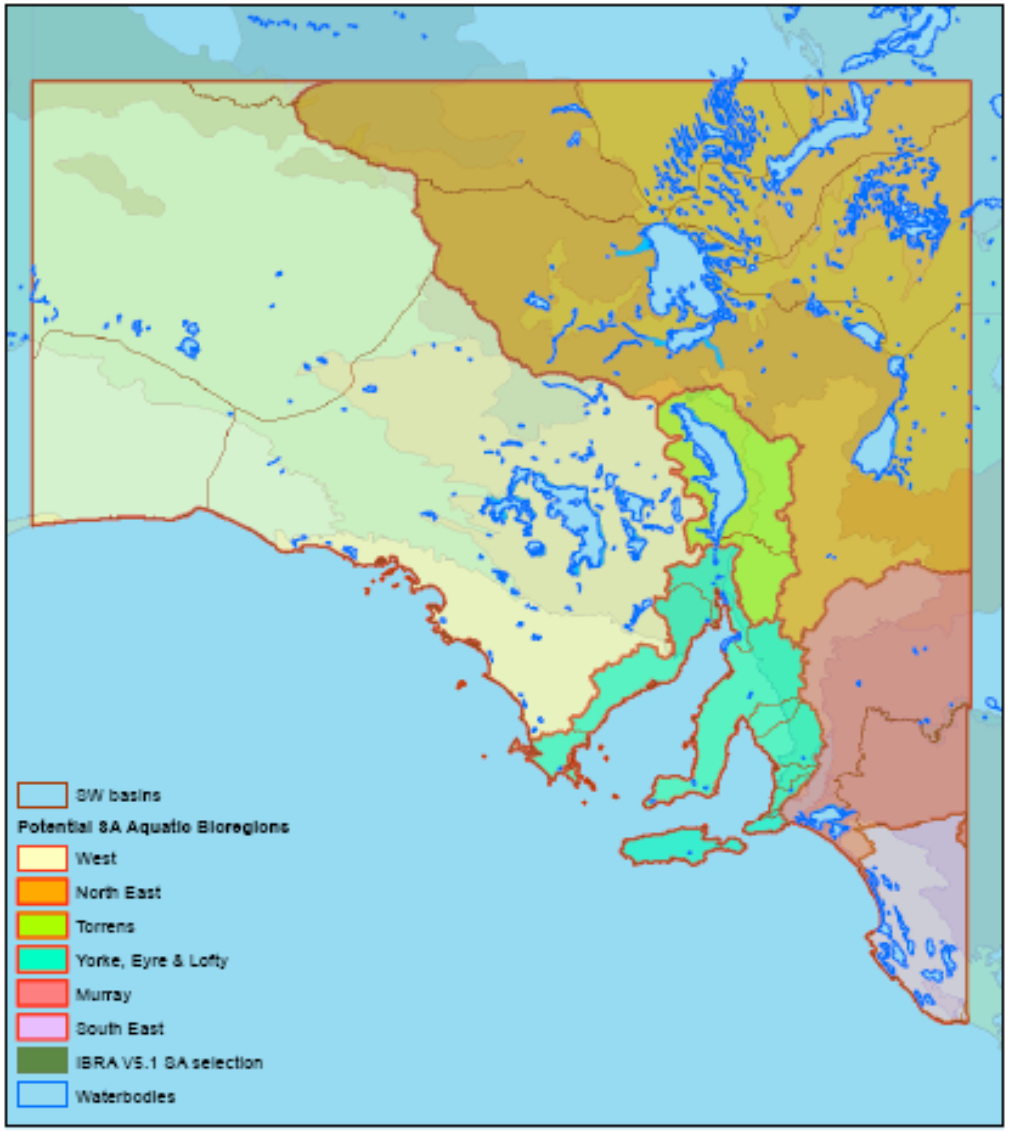
Potential SAMDB Regionalisations

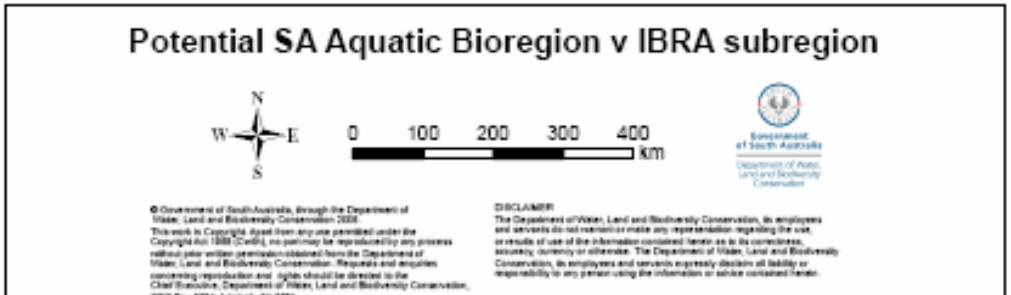
Existing regionalisation data:

- IBRA sub-regions
  - Pro: extensive biotic, etc database
  - Con: limited aquatic dependent species application;
- Surfacewater catchments / sub-catchments
  - Pro: meaningful for lotic systems and aquatic-dependent biota
  - Con: unsophisticated and lentic system limitations
- SRA sub-valley regionalisation
  - Pro: in use and geological / gradient basis
  - Con: spatially inequitable
- Other?

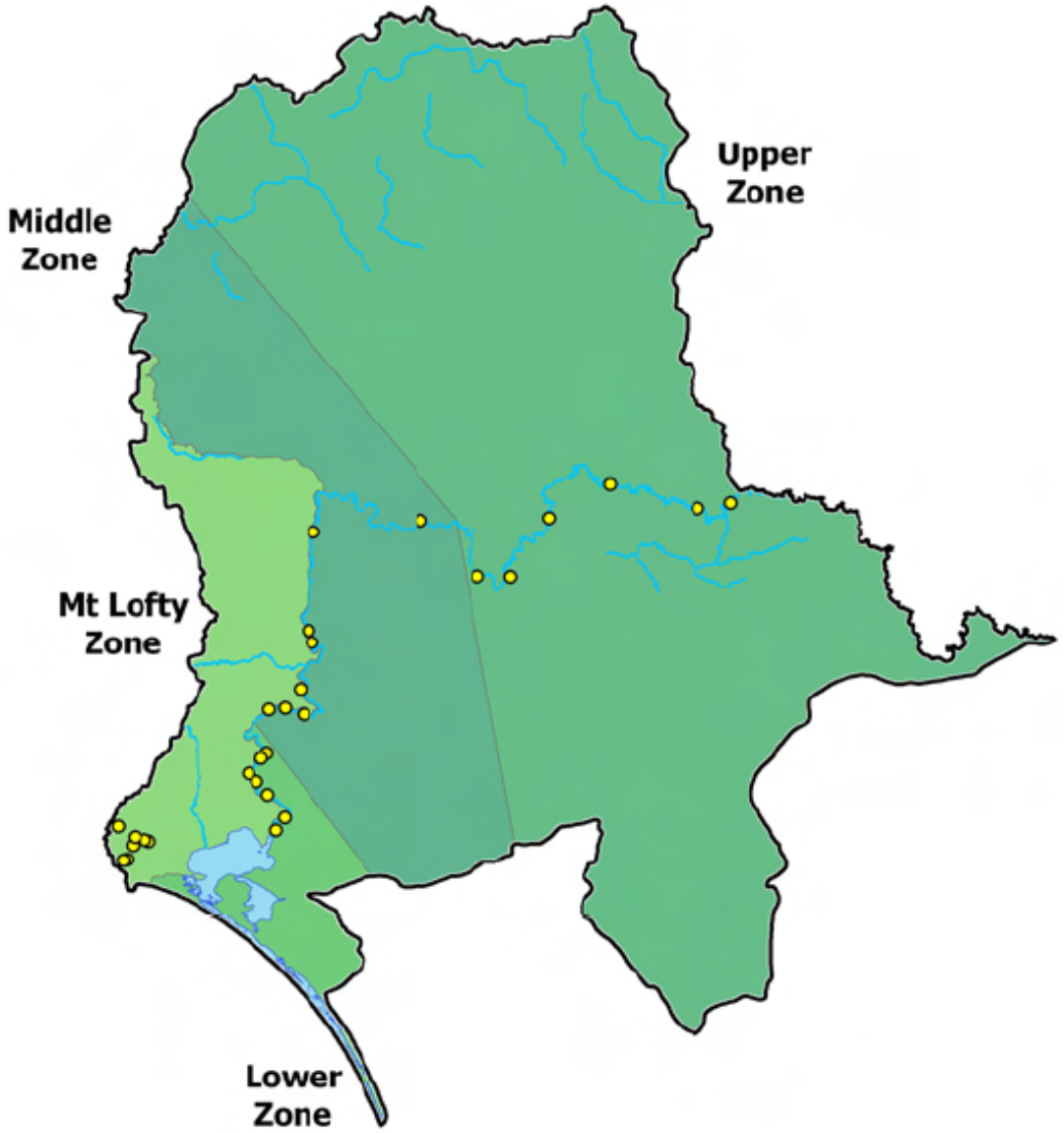
Aquatic Bioregions

(DWLBC, EPA, DEH, Uni of Adelaide, SARDI)

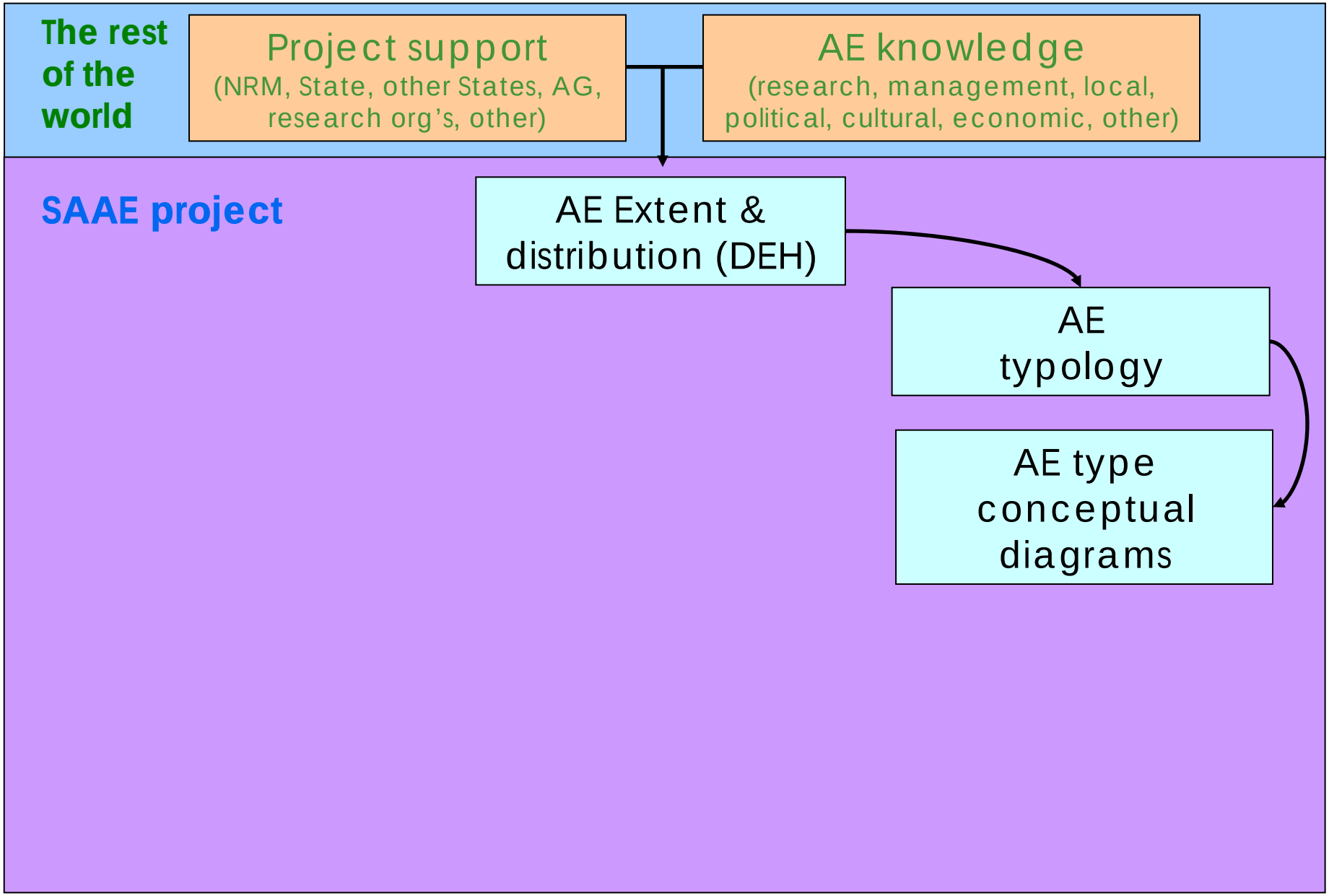




SRA Regionalisation



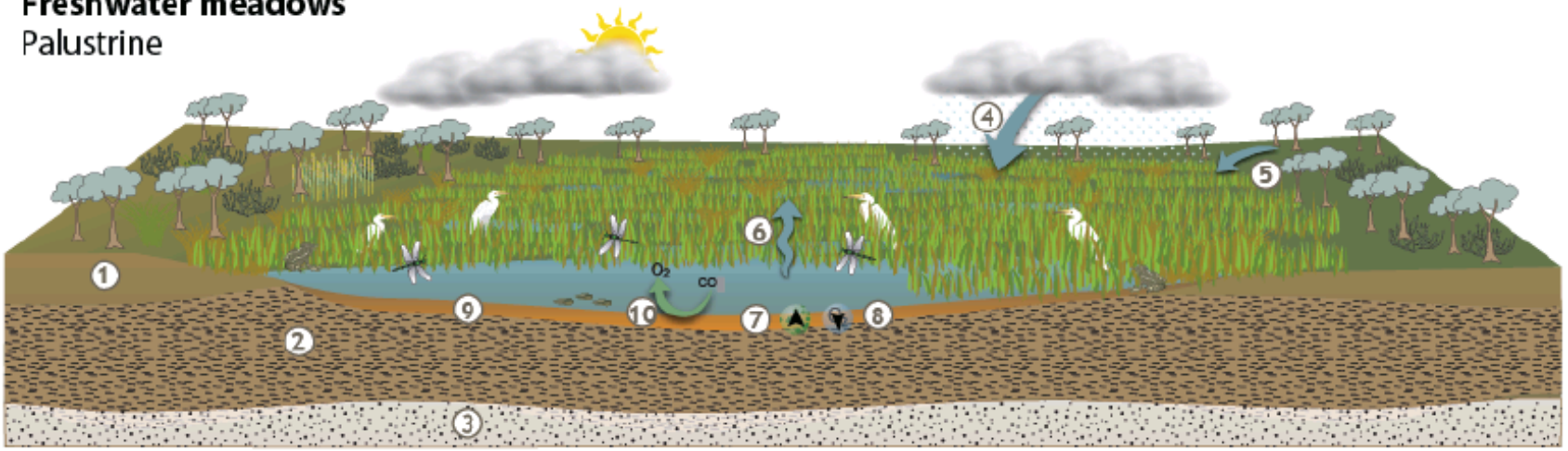
South Australian Aquatic Ecosystems (SAAE)



Wetland types – SW local runoff

Freshwater meadows

Palustrine



Almost all freshwater meadows are cropped or grazed, and are heavily modified
Freshwater meadows are an excellent breeding ground for beetles, bugs and frogs
Aquifer levels increase with higher rainfall; water is present approximately 3/4's of the year
The main threats to the systems are cattle grazing, cropping and ploughing
Location: Mount Lofty region, Hay Plains NSW

Features

1. Light silty clay
2. Silty clay
3. Aquifer: Saturated porous media

Processes

4. Precipitation is the major input of water into the meadow
5. Runoff of freshwater from terrestrial areas
6. Evaporation rates are very high
7. There is high organic matter in the water column and sediments
8. Dissolved oxygen levels in the sediments are low
9. Sediments have high sulfide levels
10. Primary producitivity (O_2 / CO_2) is high

Riparian Growth
Reeds
Lignum
Fringing vegetation
Herb
Frogs
Dragon Fly
Waders

Species Diversity (Qualitative TBD)

LOW | MODERATE | HIGH ?

Species Endemism (Qualitative TBD)

LOW | MODERATE | HIGH ?

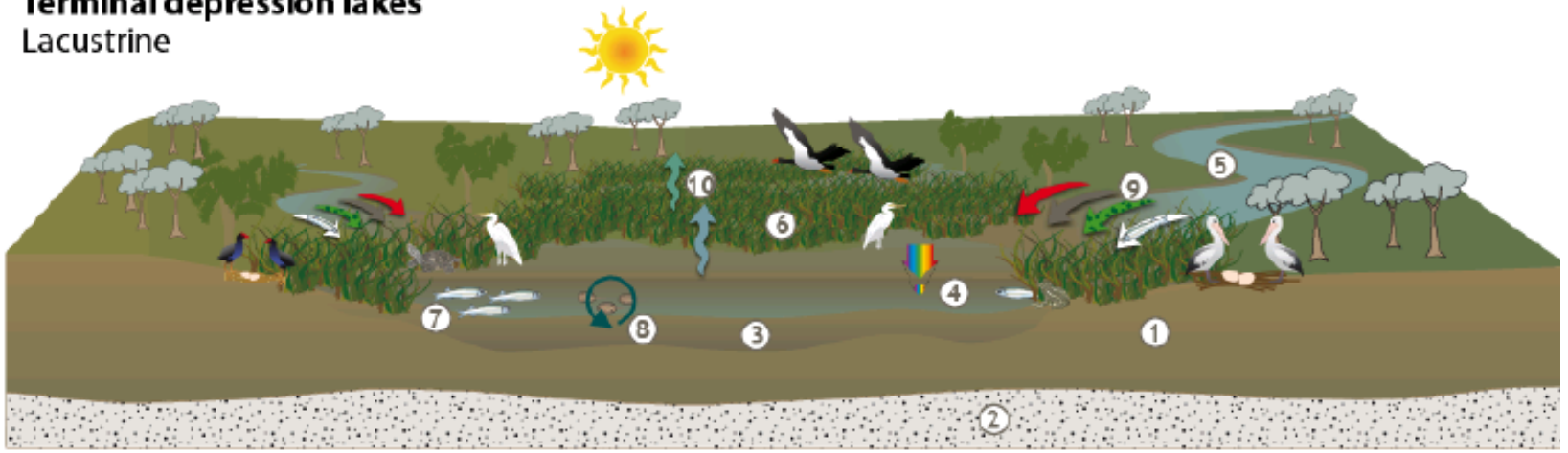
Salinity Threshold

0 150 500 750 1000 1500 2000 2500 3000 3500 4000 4500 5000

TDS mg/L

Wetland types – SW catchment runoff

Terminal depression lakes
Lacustrine



The frequency of inundation varies.
The inflow point is higher than the lowest point of the lake.
The lakes in South Australia are freshwater and are not much deeper than 2m.
Low fish and bird abundance through dry phases.
Grazing is the biggest threat to terminal depression lakes.
Location: Bool Lagoon, SE

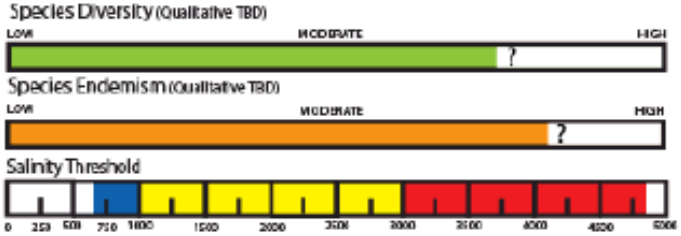
Features

1. Surficial sediments
2. Aquifer: Saturated porous media
3. Sediment layers can be up to 3m deep, laid down over 100,000 years

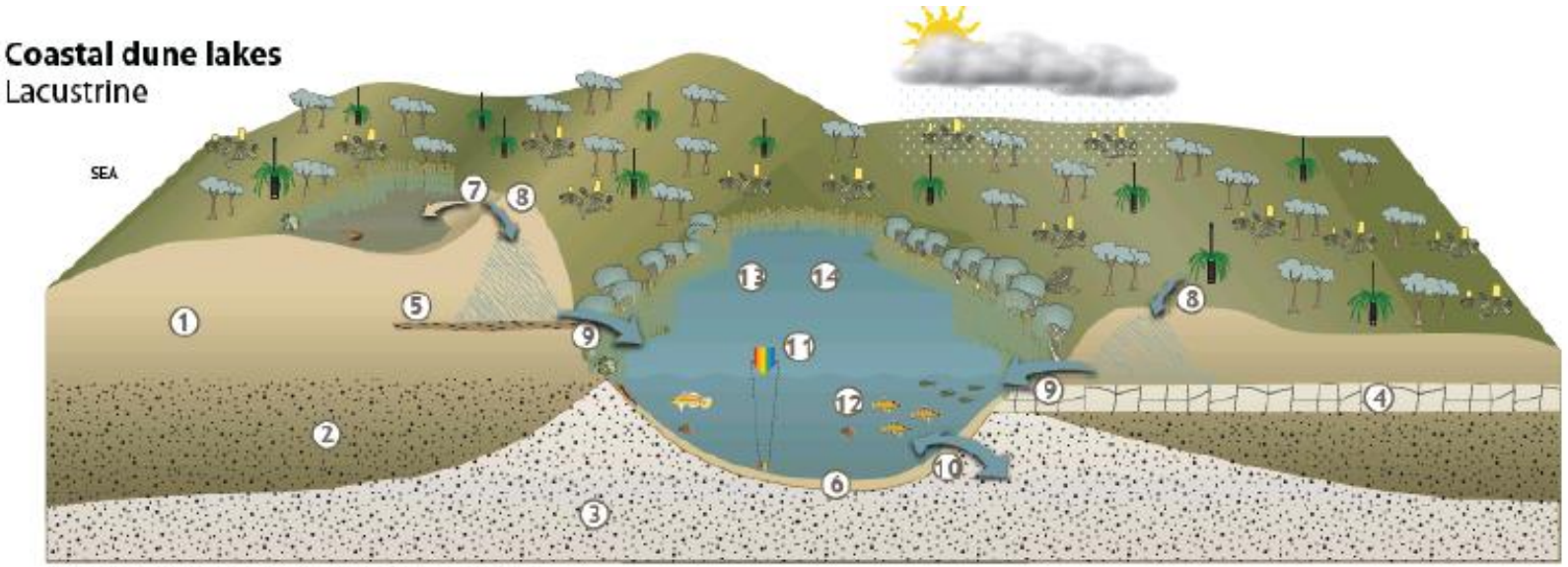
Processes

4. Terminal depression lakes are fed by river, shallow, highly turbid and largely heterotophic in the main water body and autotrophic at the margins
5. Access channel is prone to drying up and therefore the lake can easily be cut-off
6. Vegetation can cover much of the lake, moreso in arid areas
7. Fish and bird abundance is high in freshwater
8. Boom bust populations of invertebrates
9. River inflow brings nutrients , sediments , organic carbon and organisms
10. There are high transpiration and evaporation rates

Riparian Growth
Fish
Frogs
Lignums
Waders



Wetland types – GW driven



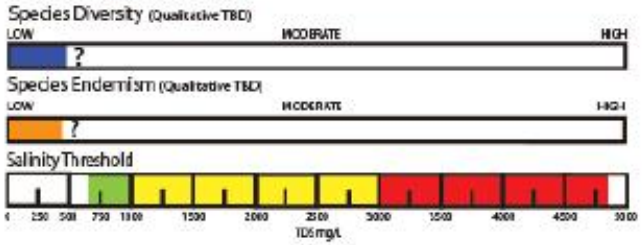
The lake is mostly driven by local groundwater and generally shallow
The larger systems are often saline, while the smaller systems are freshwater
The major threates to the sytems are rising salinity, vegetation clearance, grazing and groudwater extraction
Very little submerged vegetation
The banks are shaded with dense Melaluca
Location: Seagull Lake, Lake Noolan, SE Lake Bonney

Features

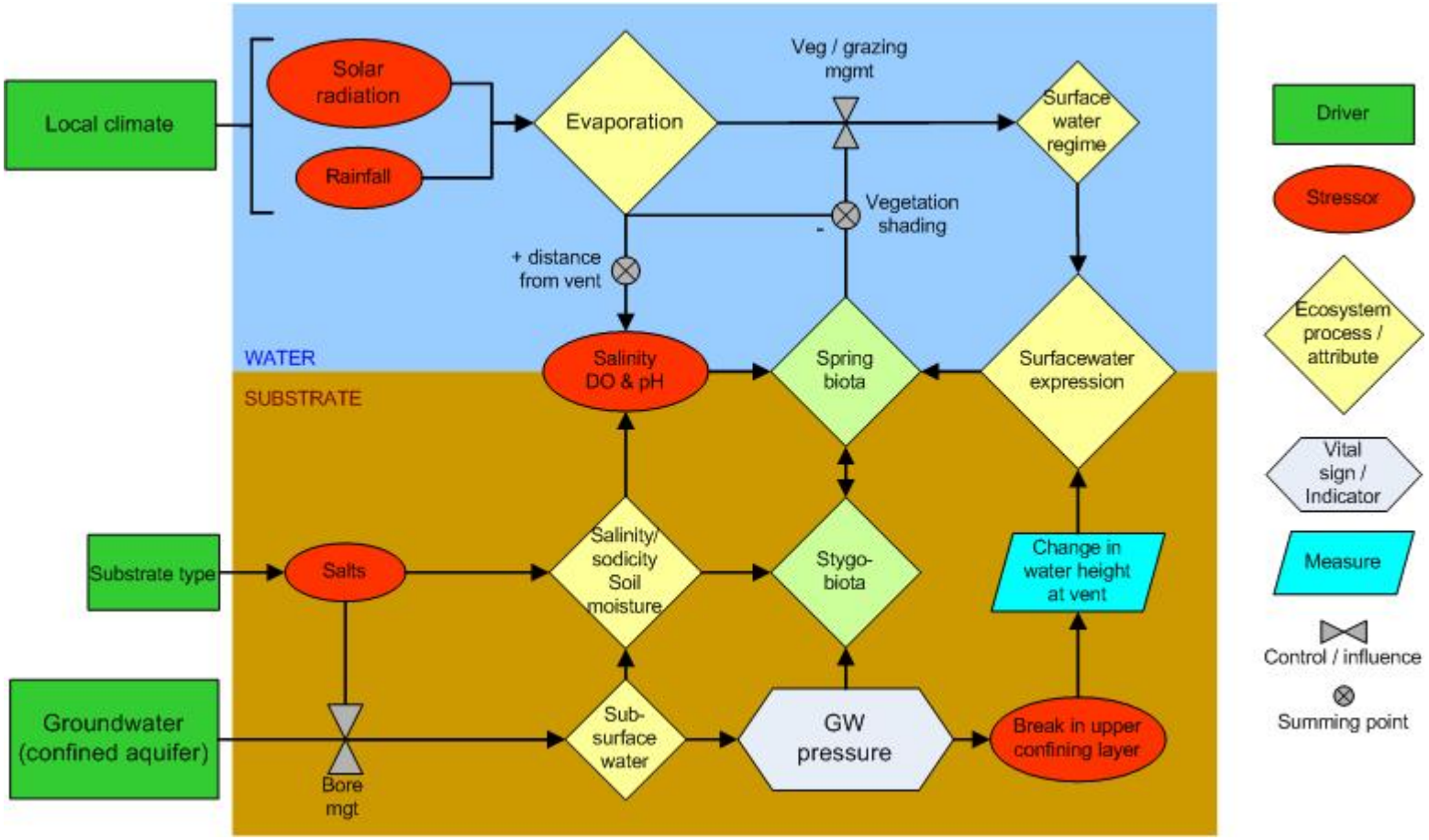
1. Sediments
2. Unsaturated porous media
3. Aquifer: Saturated porous media
4. Limestone
5. Clay lense prevents the water to permeate through to recharge the aquifer, creates a local water table, and discharges into the lake
6. Silica sand substrate

Processes

7. Sand dunes may fall into the lakes, primarily into lakes within actively moving dune systems
8. Rain water seeps down through the sand
9. The clay lense or limestone layer create a local watertable and discharges into the lake
10. Groundwater-surface water interaction
11. Waters are very clear and therefore light transmission is very high
12. Low species richness and abundance but home to rare taxa
13. pH is quite low (5-6) and biota are adapted to the acidic environment
14. Conductivity and nutrient levels are very low



SAAE – conceptual models



For conceptual model template, see: Wilkinson, J, Souter, N, & Fairweather, P 2007, *Best Practice Framework for the Monitoring and Evaluation of Water-Dependent Ecosystems 1: Framework* and *2. Technical Resource,* DWLBC Report 2007/12, Government of South Australia, through DWLBC, Adelaide.

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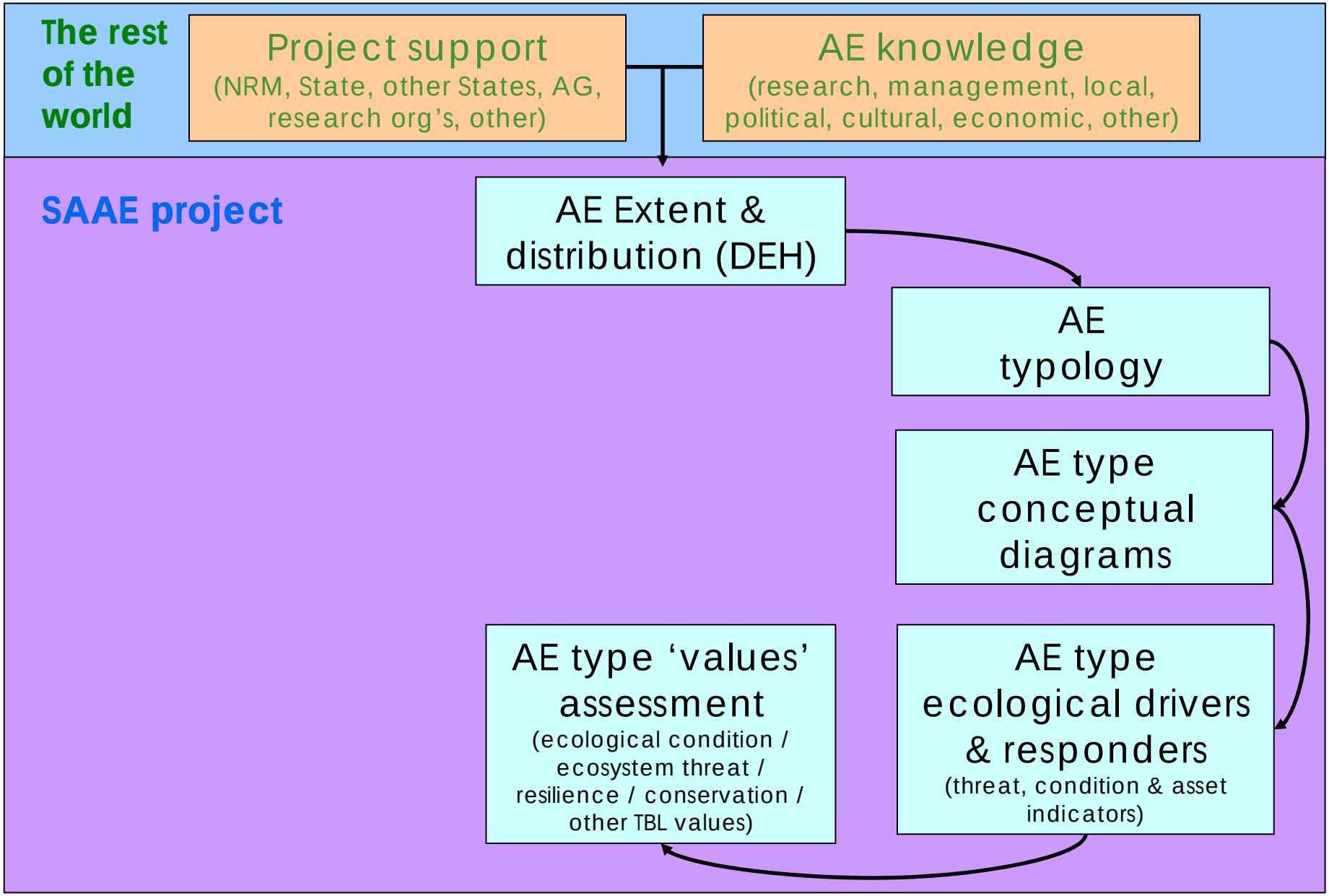


SE WaterRAT – GW use (threat)

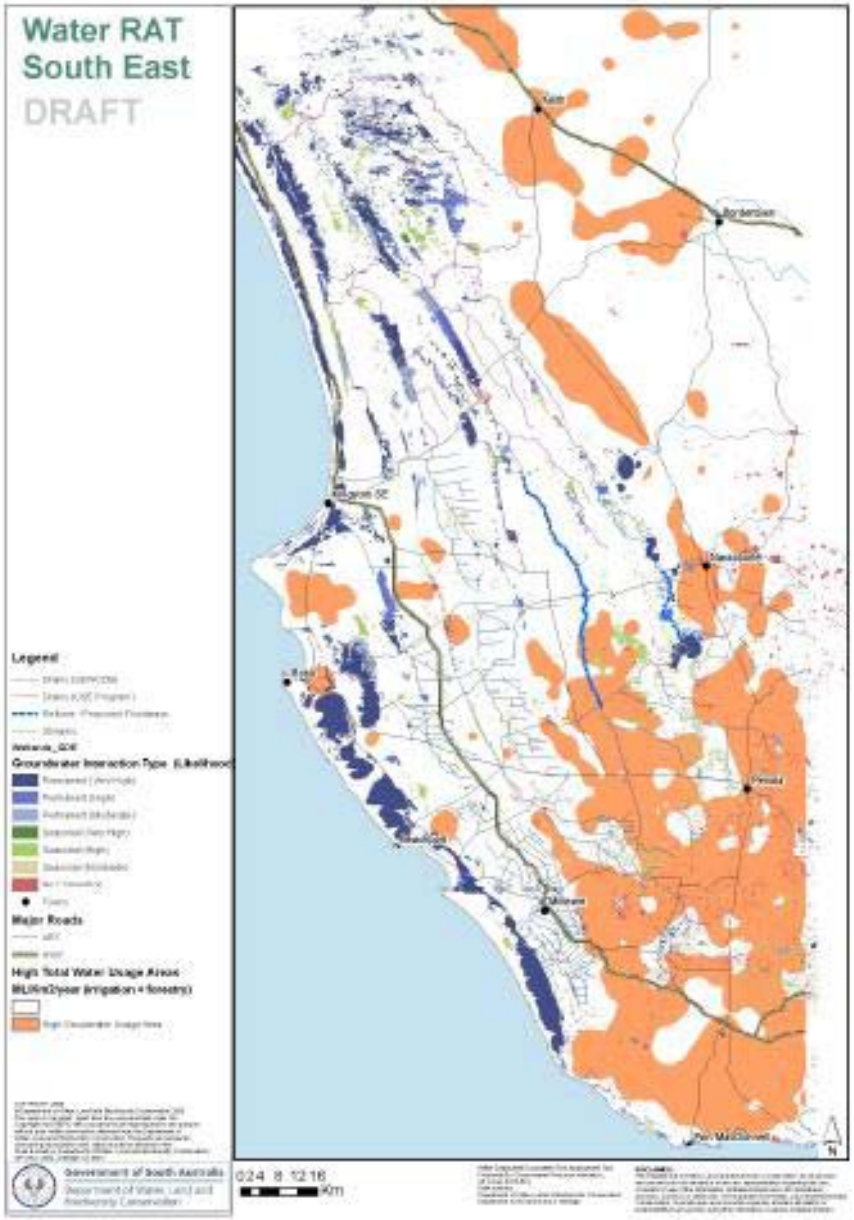
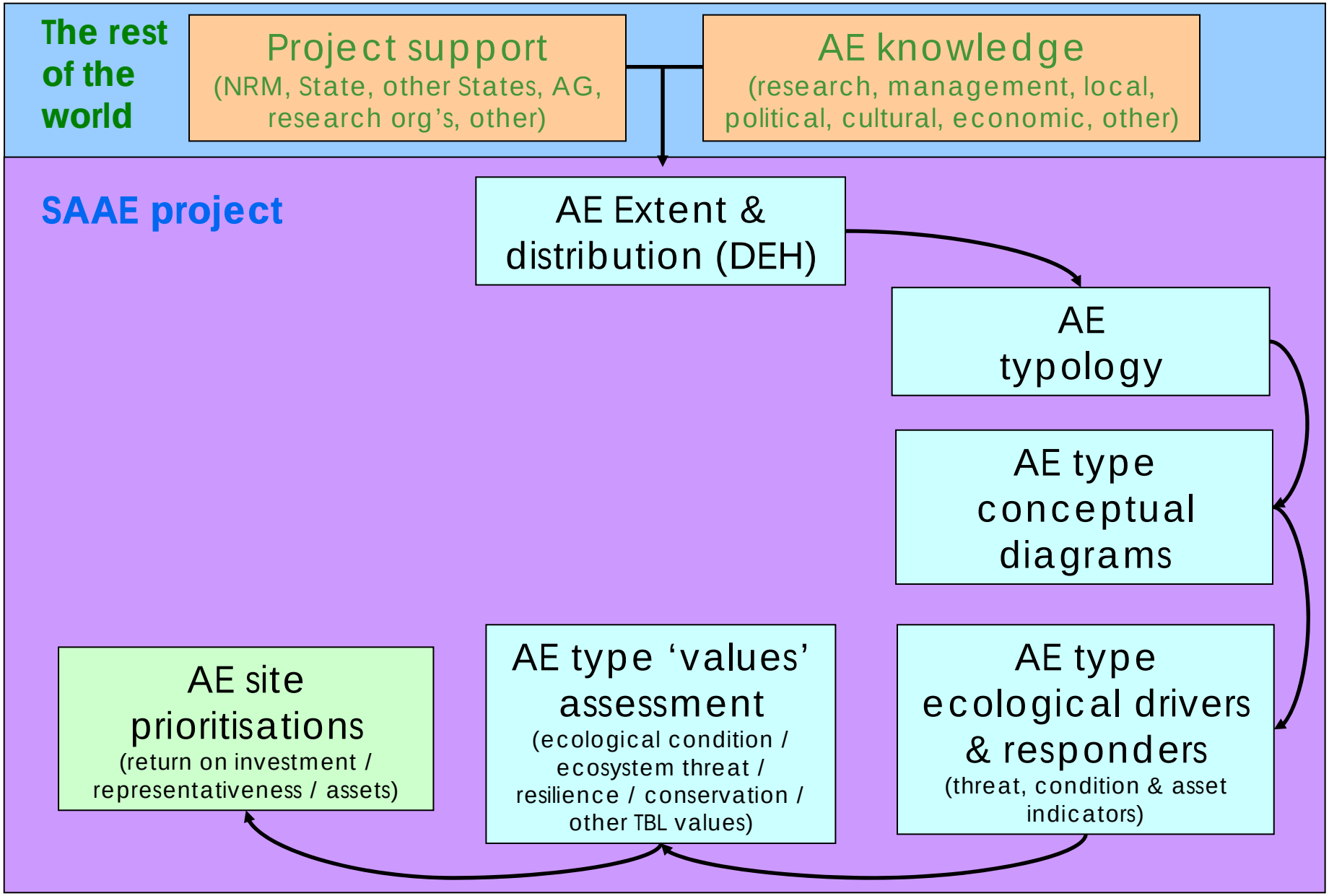
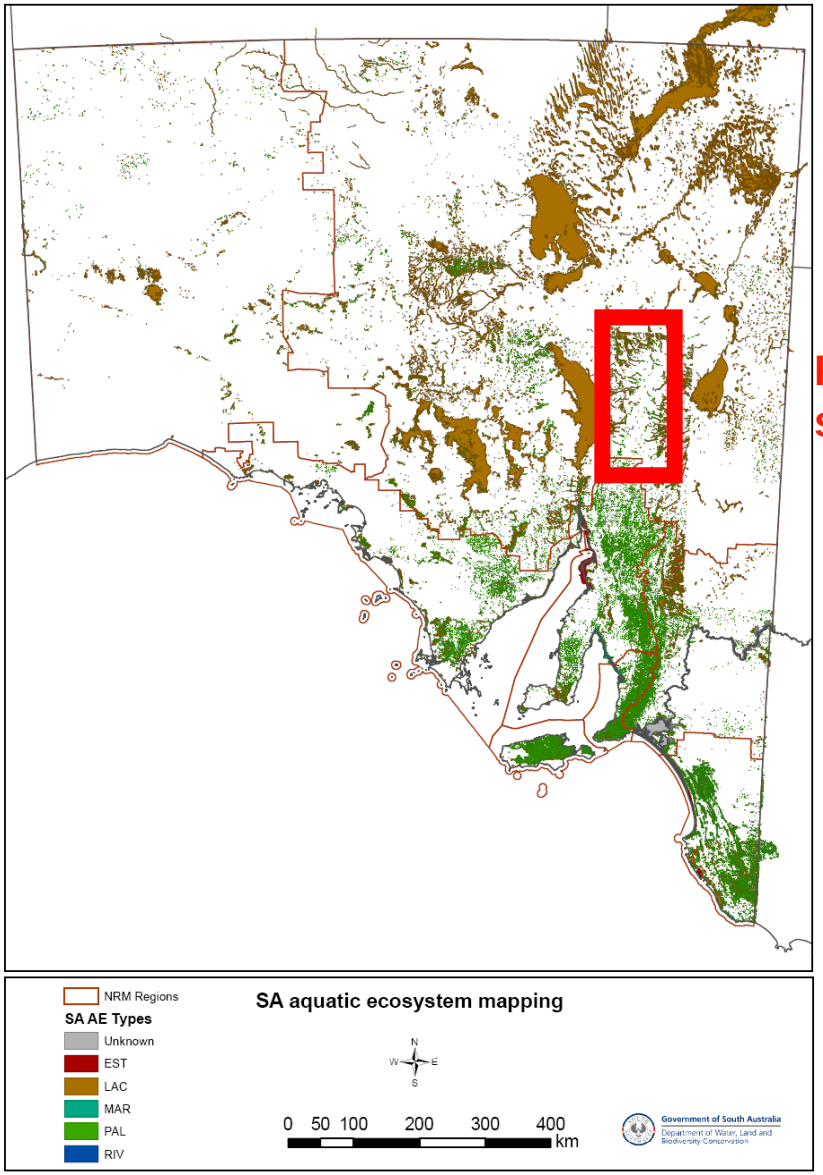


Figure 14. Water-RAT output - Total estimated groundwater usage (both irrigation and forestry)

South Australian Aquatic Ecosystems (SAAE)



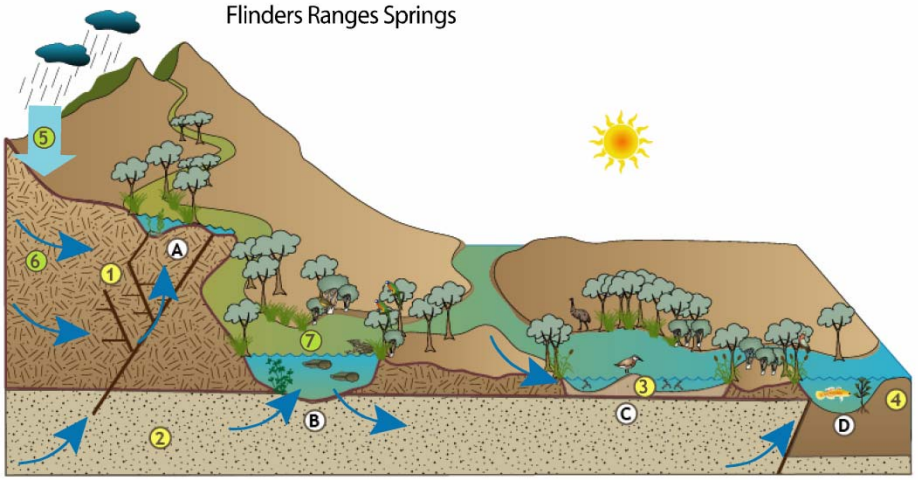
SAAE – condition assessment



Flinders Ranges study area

Matthew Miles (2009). Unpublished DEH Wetlands Mapping

Flinders Ranges Springs Prioritisation



Spring types

Ⓐ Fractured Rock Ⓑ Groundwater Discharge Ⓒ Sub-surface Flow Ⓓ Fault Line

The Flinders Ranges contain a vast array of springs that vary in discharge, permanence, geology, geomorphology and ecology. As more investigations are undertaken it will be necessary to update the conceptual diagram to better understand the hydrological processes and the ecosystem water requirements and determine if any threats exist that may impact these spring aquatic ecosystems.

Typically, springs are located in ephemeral streambeds with spring and stream flow corresponding with rainfall events that recharge the aquifer and cause spring flow in the fractured rock dominated environment. The springs and streams flow either episodically (after heavy rainfall events) or seasonally. Some springs flow permanently and are probably connected to a deeper aquifer source. A summarised description of each spring type follows:

A - Fractured Rock: water follows rock fractures, which may lead to the surface. These fracture features often mimic rainfall events.
B - Groundwater Discharge: where groundwater from a underlying aquifer is expressed at the surface, these are usually permanent features.
C - Sub-surface Flow: whereby a stream disappears underground and is expressed at the surface when the sediment type is very porous.
D - Fault Line: when groundwater travels along a fault line and intersects a streambed and water be expressed at the surface.

Features

1. Fractured Rock
2. Groundwater Aquifer
3. Porous Sediments
4. Sediments

Processes

5. Rainfall is the driving variable as it initiates stream flow and recharges the aquifer.
6. Groundwater directional flow into the springs.
7. Wetland plants and animals occur at springs due to the extended periods of inundation.

Riparian Growth Fringing Vegetation Reeds

Aquatic + amphibious species Terrestrial/migratory birds

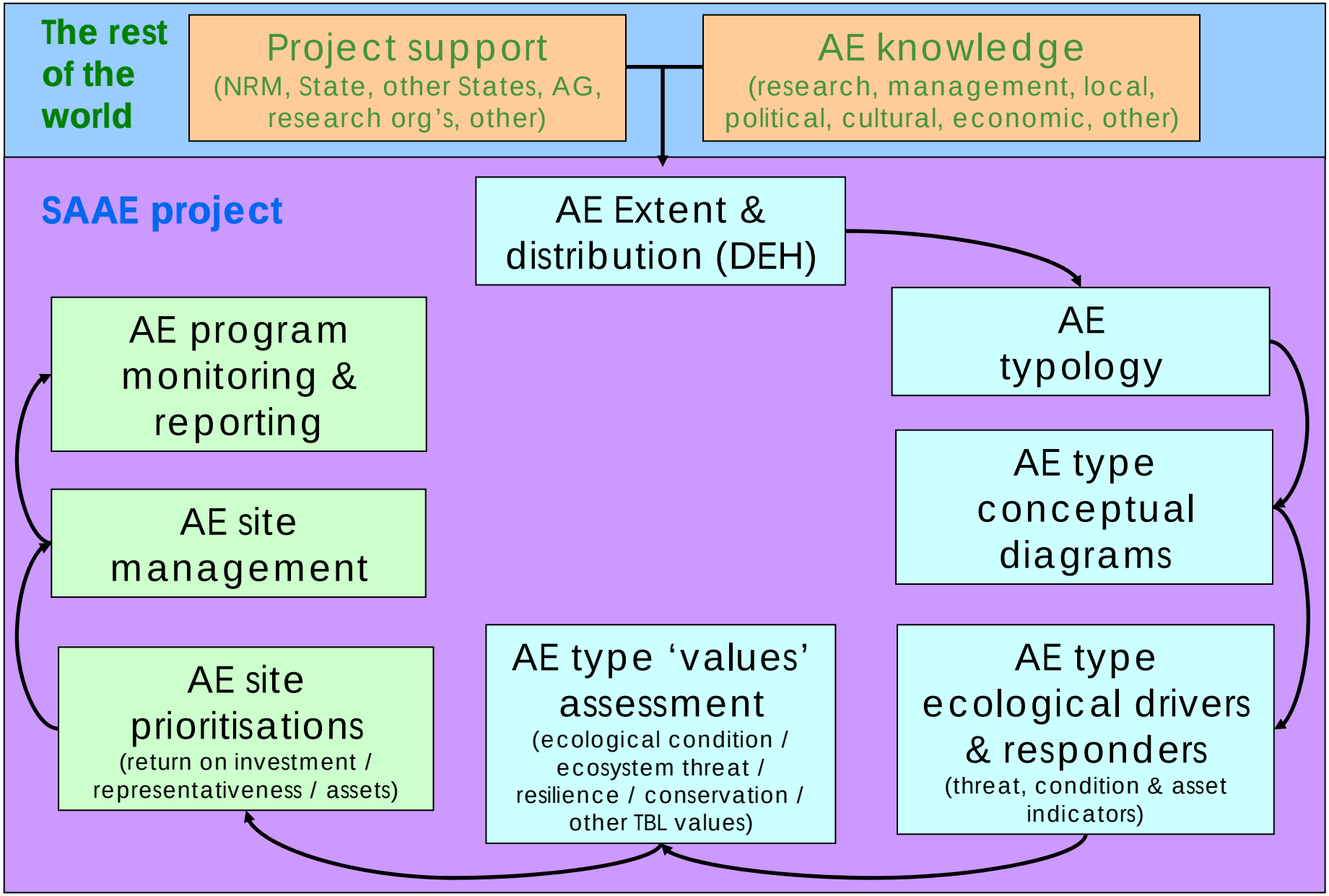
Flinders Ranges Spring Prioritisation

Table 4. Attributes used to assess vegetation condition (*Indicator Protocol: Riverine Vegetation*; developed by the National River Health Contact Group; Roberts & Hale, 2008, In Press).

	LARGELY UNMODIFIED	SLIGHTLY MODIFIED	MODERATELY MODIFIED	SUBSTANTIALLY MODIFIED	SEVERELY MODIFIED
SPATIAL INTEGRITY	No or little evidence of broad scale loss of native vegetation	Width reduced by up to 1/3 and/or some breaks in continuity	About 50% of the native vegetation remains, either in strips or patches	Only small patches of well-separated native vegetation remains	Little or no remaining native vegetation
NATIVENESS (perennials)	Vegetation predominately native, few weeds and no 'high threat' species.	Exotic species present but not dominating any strata, 'high threat' species rare	One or more strata dominated by exotic species, 'high threat' species present	Most strata dominated by exotic species, 'high threat' species abundant	Few native species remaining, cover dominated by exotic species
STRUCTURAL INTEGRITY	Number of strata and cover within each is similar to reference	Cover within one stratum 50% lower or higher than reference	One stratum missing or extra cover within remaining stratum 50% lower or higher than reference	More than one stratum completely altered from reference (lost or <10% remaining)	Structure completely altered from reference (eg. grassland shrubland, forest pasture)
AGE STRUCTURE	Dominant strata with reference level of cover and at least three age classes present (juvenile, sub-adults & adults)	Reduced cover (75-50%) of dominant strata, and/or only two age classes present	Reduced cover (75-50%) of dominant strata, and only one age class present	Reduced cover (<50%) of dominant strata, and only one age class present	Dominant strata mostly absent
DEBRIS	Quantities and cover similar to reference	Some evidence of unnatural loss of debris (eg. firewood collection, trampling of leaf litter by stock)	Quantities and/or cover 50% higher or lower than reference	Very small quantities of debris present	Debris mostly absent or completely dominating the sites, with little or no living vegetation

White, M & Scholz, B. 2008, *Prioritising Springs of Ecological significance in the Flinders Ranges,* DWLBC Report 2008/XX Version 1, Government of South Australia, through Department of Water, Land and Biodiversity Conservation, Adelaide

South Australian Aquatic Ecosystems (SAAE)



Qld EPA estuary monitoring & reporting

Qld EPA estuary targets, prioritisation & mgt

Qld EPA estuary 'condition' assessment

Burnett Mary Regional Group

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BURNETT MARY REGION
State of the Estuarine Environment

BURNETT MARY ESTUARIES IN NATIONAL CONTEXT

Regional summary

Overall the estuaries of the Burnett Mary NRM region are generally under 'low risk' of damage due to human activities, however, some estuaries are currently under 'high' or 'extreme' risk. Despite the overall low risk, the regions estuaries are generally only in 'fair' health. Although no estuaries were found to be in 'poor' or 'very poor' health, 6 of the 18 examined were fair – the remainder being 'good' or 'excellent'.
Download the full ***State of the Estuarine Environment*** report

View Larger Map

Key stressors

The major risk to estuaries in the region results from pressures related to increasing sediment loads and the disturbance or removal of biota. Generally, the overall risk of damage to the estuaries of the region due to stress from bacteria/pathogens, freshwater flow, habitat removal/disturbance, hydrodynamics, litter, nutrients, organic matter, pests, pH and toxicants is 'low' or 'negligible'. This corresponds to 'good' or 'excellent' condition in

Information about the assessment process

As part of the Queensland Government's Stream and Estuarine Assessment Program an estuarine assessment framework has been developed for Queensland. This assessment framework has been used here in the Burnett Mary region to produce this State of the Estuarine Environment report.

THE REGION'S ESTUARIES AT A GLANCE 2007

ESTUARY	HEALTH	RISK	TREND
Baffle	A+	LOW	
Bogimbah	B-	NEGLIGIBLE	
Burnett	C-	EXTREME	
Burrum	C+	LOW	
Coonarr	A+	NEGLIGIBLE	
Coongull	B-	NEGLIGIBLE	
Elliott	A	MODERATE	
Eurimbula	A+	NEGLIGIBLE	
Gregory	C+	LOW	
Isis	C+	LOW	
Kauri	A+	NEGLIGIBLE	
Kolan	A	HIGH	
Littabella	A	NEGLIGIBLE	
Mary	C-	HIGH	
Snapper	A+	MODERATE	
Susan	C+	LOW	
Theodolite	A+	NEGLIGIBLE	
Wathumba	A+	NEGLIGIBLE	

Qld EPA estuary monitoring & reporting

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Qld EPA estuary 'condition' assessment

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Estuary Report: Burnett River

Summary

Overall the Burnett estuary is under an 'extreme' level of risk of damage due to human activities. Despite this extreme level of risk, the estuary is currently in 'fair' health. This suggests that unless management actions are performed to reduce this risk the condition of the estuary will most likely decrease in the future.

View Larger Map

OVERALL ASSESSMENT (ALL STRESSORS) 2007

C-

	Score	Confidence
Overall risk to estuary	EXTREME	VERY HIGH
% of data collected	76	
Overall health of estuary	FAIR	VERY HIGH
% of data collected	77	

Stressor information – bacteria/pathogens

Human activities resulting in increased amounts of bacteria/pathogens entering the Burnett estuary are a major risk to the health of the system. As a result of these pressures the current condition of the estuary in relation to bacteria/pathogens is recorded as good.

A 'high' level of data confidence is reported for the overall risk and condition values recorded, however, with only 50% of the pressure indicators monitored the level of support for the 'risk' is not as strong as those values recorded for condition where all indicators were monitored.

Due to the relatively low flushing rate of the estuary it has a high level of vulnerability to increased bacteria/pathogen levels.

Management of bacteria/pathogens

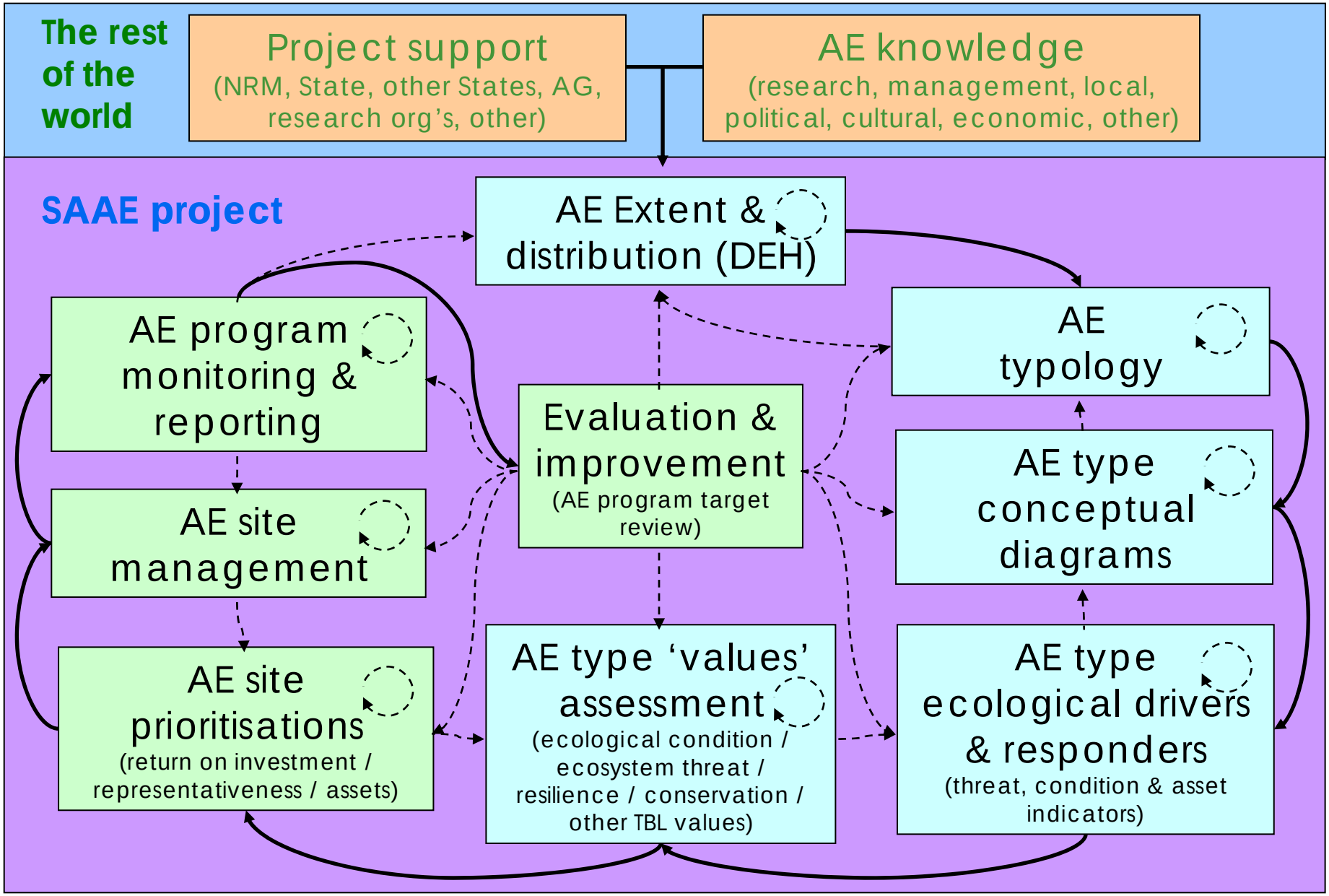
The level of sewage treatment plant wastewater disinfection is the major pressure resulting in the extreme level of risk reported. Sewage overflow events were found to cause a moderate level of risk. These pressures are here identified as key targets

ASSESSMENTS OF INDIVIDUAL STRESSORS

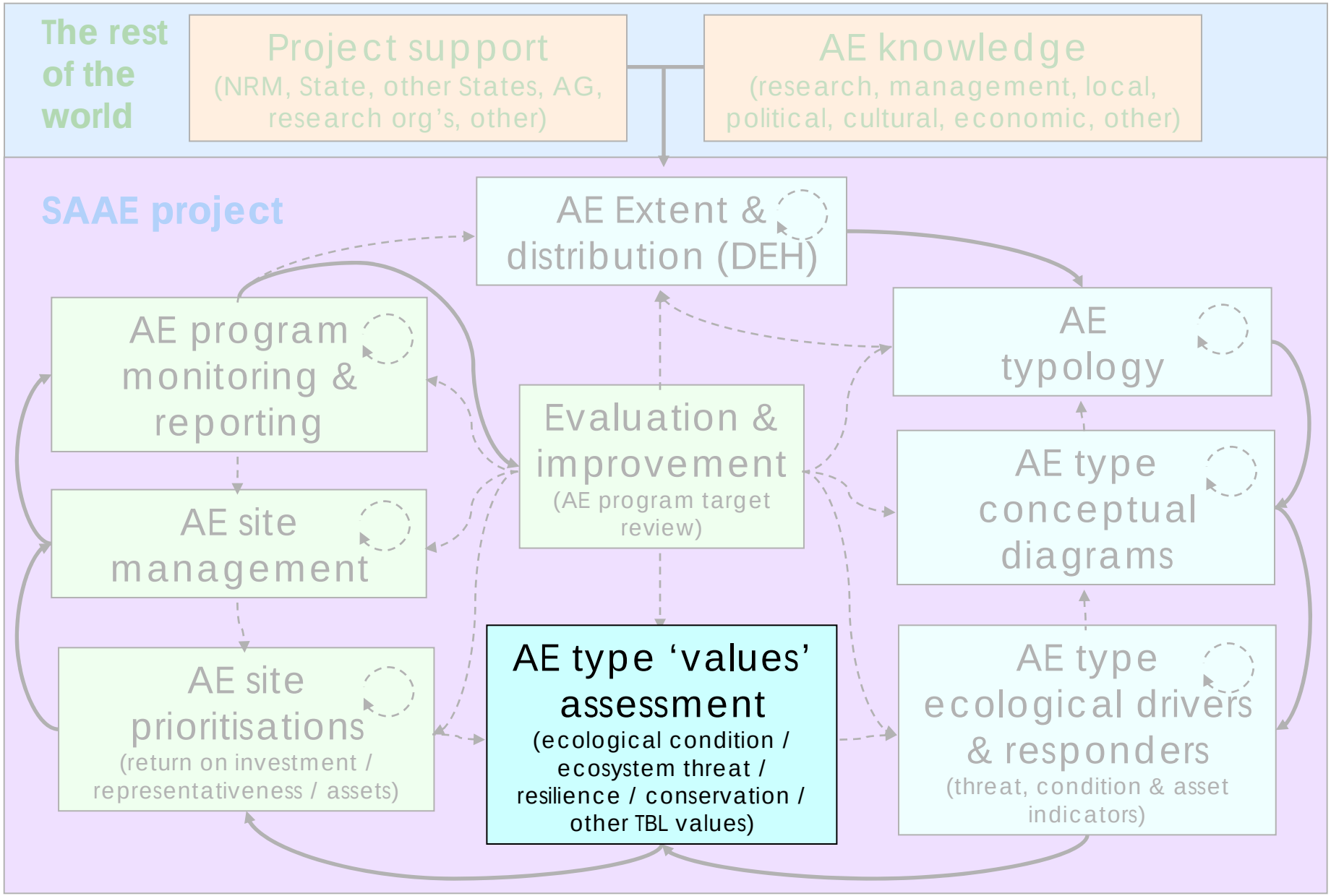
STRESSOR Bacteria/Pathogens 2007

	Score	Confidence
Risk (this stressor)	EXTREME	VERY HIGH
Pressure indicators		
STP outflow disinfection	HIGH	VERY HIGH
sewage overflow events	MODERATE	HIGH
intensive animal production	LOW	HIGH
septics within catchment	No data	
stormwater outflow	No data	
marine aquaculture	No data	
Health (this stressor)	GOOD	HIGH
Condition indicators		
Intestinal enterococci counts	GOOD	HIGH
mass mortality caused by pathogens	EXCELLENT	MODERATE

South Australian Aquatic Ecosystems (SAAE)



SAAE & HCVAEs


The rest of the world
Project support
(NRM, State, other States, AG, research org's, other)
AE knowledge
(research, management, local, political, cultural, economic, other)
SAAE project
AE Extent & distribution (DEH)
AE program monitoring & reporting
AE typology
Evaluation & improvement
(AE program target review)
AE type conceptual diagrams
AE site management
AE type 'values' assessment
(ecological condition / ecosystem threat / resilience / conservation / other TBL values)
AE site prioritisations
(return on investment / representativeness / assets)
AE type ecological drivers & responders
(threat, condition & asset indicators)

HCVAE identification criteria

- **1. Representativeness** – It contains an outstanding example of an aquatic ecosystem class, within a Drainage Division

- **2. Diversity** - It exhibits exceptional diversity of species or habitats, and/or hydrological and/or geomorphological features/processes

- **3. Distinctiveness** - It is a rare/threatened or unusual aquatic ecosystem; and/or it supports rare/threatened species/communities; and/or it exhibits rare or unusual geomorphological features/ processes and/or environmental conditions

- **4. Key habitat** - It provides habitat for unusually large numbers of a particular species of interest; and/or it supports species of interest in critical life cycle stages or at times of stress; and/or it supports specific communities and species assemblages

- **5. Evolutionary history** - It exhibits features or processes and/or supports species or communities which demonstrate the evolution of Australia's landscape or biota

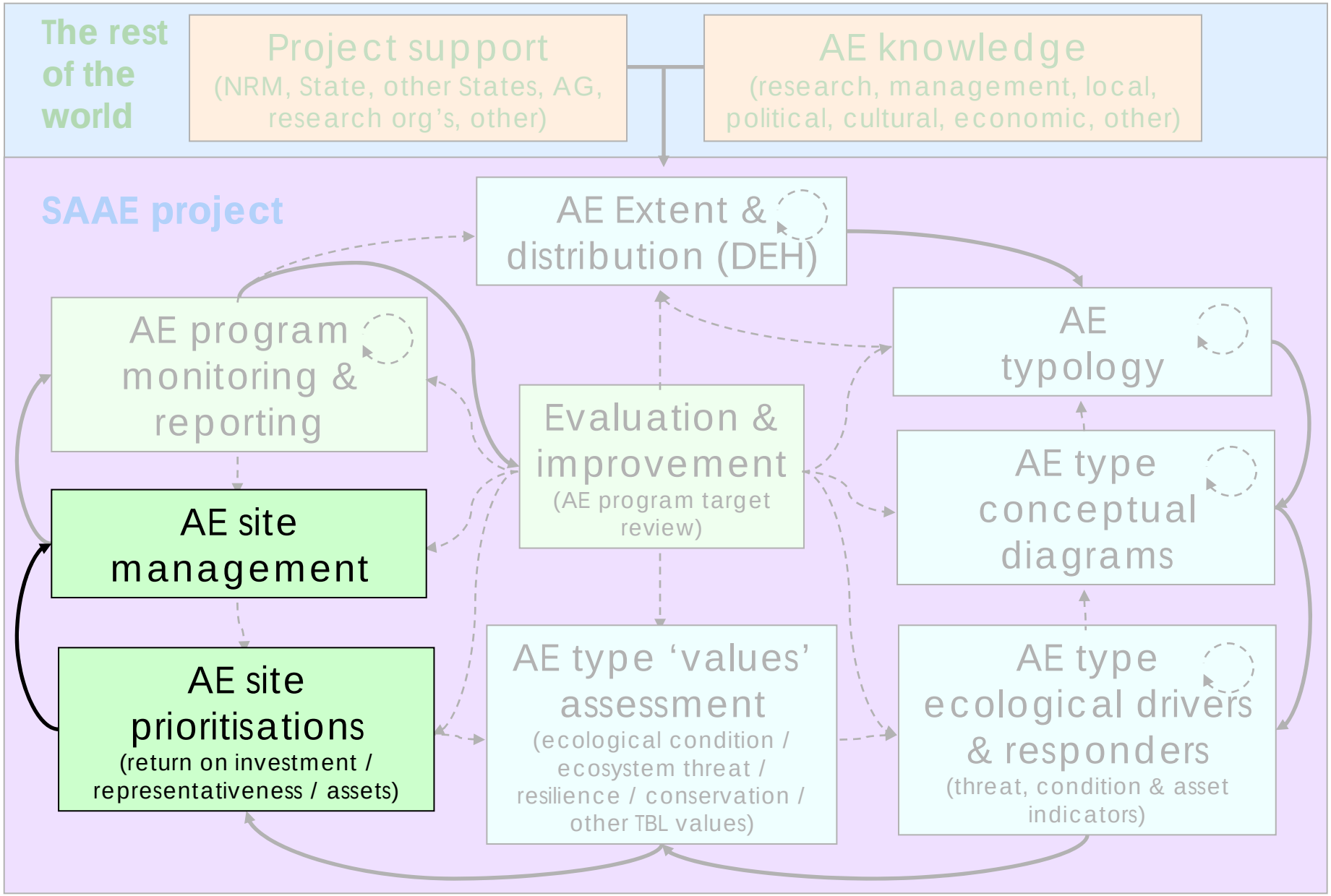
- **6. Naturalness** - The aquatic ecosystem values are not adversely affected by modern human activity to a significant level

SA interim HCVAE list (2010–11)

Drainage Division	Category	Asset	Type of Asset	HCVAE criteria	Priority
Western Plateau	Other HCVAE	Lake Hamilton		2,3,4	5
		Lake Newland	Wetlands (DIWA)	2,4,5	3
		Chain of bays (Streaky, Sceale and Corulsart Bays - including Seagull Lake & Acraman Creek)	Wetlands (DIWA)	3,4,5	1
		Venus Bay	Wetlands	4,5	4
		Ceduna Bays (including Davenport Creek)	Wetlands	3,4,5	2
SE Coast	Ramsar	Bool & Hacks Lagoon	Wetlands (DIWA)	1,3,4,5	9
	Other HCVAE	Piccaninie & Picks Swamp Complex	GDE, Wetlands (DIWA)	1,2,3,4,5,6	1
		SE Coastal Salt Lakes (George, Robe, Eliza & St Clair, Amy Ghost, Little Dip, Big Dip, Fresh Dip & Pick)	GDE, Wetlands (DIWA)	4,5	7
		Lake Frome and Millis Swamp	Wetlands (DIWA)	4,5	3
		Lake Hawdon Complex	Wetlands	3,4	2
		Lower SE Freshwater Marshes (Honan Swamp, Kangaroo Flat, The Marshes, Mt Lyon, Mt Burr, Dismal Swamp, Mt McIntyre, Whennen, Hackett Hill, Woolwash Complexes)	Wetlands (DIWA)	2,3,4,5,6	5
		Rushy Swamp	Wetlands	2,3,4,5	4
		Lower SE Coastal Swamps (Bucks lake to Middlepoint Swamp)	Wetlands	2,3,4,5	6
		SE coastal rising springs (including Stratman Pond, Jerusalem Creek Springs, Cress Creek Springs, The Woolwash and Spencers Pond)	GDE	2,3,4,5,6	8
Lake Eyre	Ramsar	Coongie Lakes	Wetlands	1,2,3,4,5	5
	Other HCVAE	Diamantina River Wetlands	Wetlands (DIWA)	2,3,4,5	3
		Lake Eyre (GAB) Springs (including Dalhousie Springs Complex and Coward Springs Complex)	Wetlands (DIWA)	2,3,4,5,6	4
		Strzelecki Ck	River Reach	1,2,4,5	6
		Cooper Creek In-stream Waterholes (including Cullyamurra Waterhole)	GDE	1,2,3,4,5	2
		Algebuckina Waterhole	Wetland	4,5	1
SA Gulf	Other HCVAE	Coffin Bay, Kellidie Bay and Dutton Bay	Estuary/Wetlands (DIWA)	3,4,5	2
		Onkaparinga Estuary	Estuary	2,5	5
		Tumby & Arno Bays	River Reach (DIWA)	2,4,5	4
		Fleurieu Peninsula Swamps (Glenisiera, Black and Illawong and the Tookayerta & Finnis Catchments)	Wetlands	2,3,4,5	1
		Flinders Ranges Waterholes	Wetlands	2,3,4,5	6
		Big & Little Swamp	Wetlands	2,5	3
Murray – Darling	Ramsar	Banrock Station	Wetlands	1,2,4,5	
		Riverland Ramsar site	Wetlands	1,2,3,4,5	1
		Coorong, Lakes Alexandrina & Albert	Ramsar – Estuary/marine wetlands	1,2,3,4,5	
	Other HCVAE	Katarapko	Wetland		2
		Pike	Wetland		3
		Wetlands between Morgan and Lock 3 (including Markaranka)	Wetlands		
		Brenda Park	Wetland		
		Devon Downs	Wetland		
		Moorundie	Wetland		

35 x HCVAEs

SAAE & C4oC hcvae's



SA interim C4oC hcvae list (2010–11)

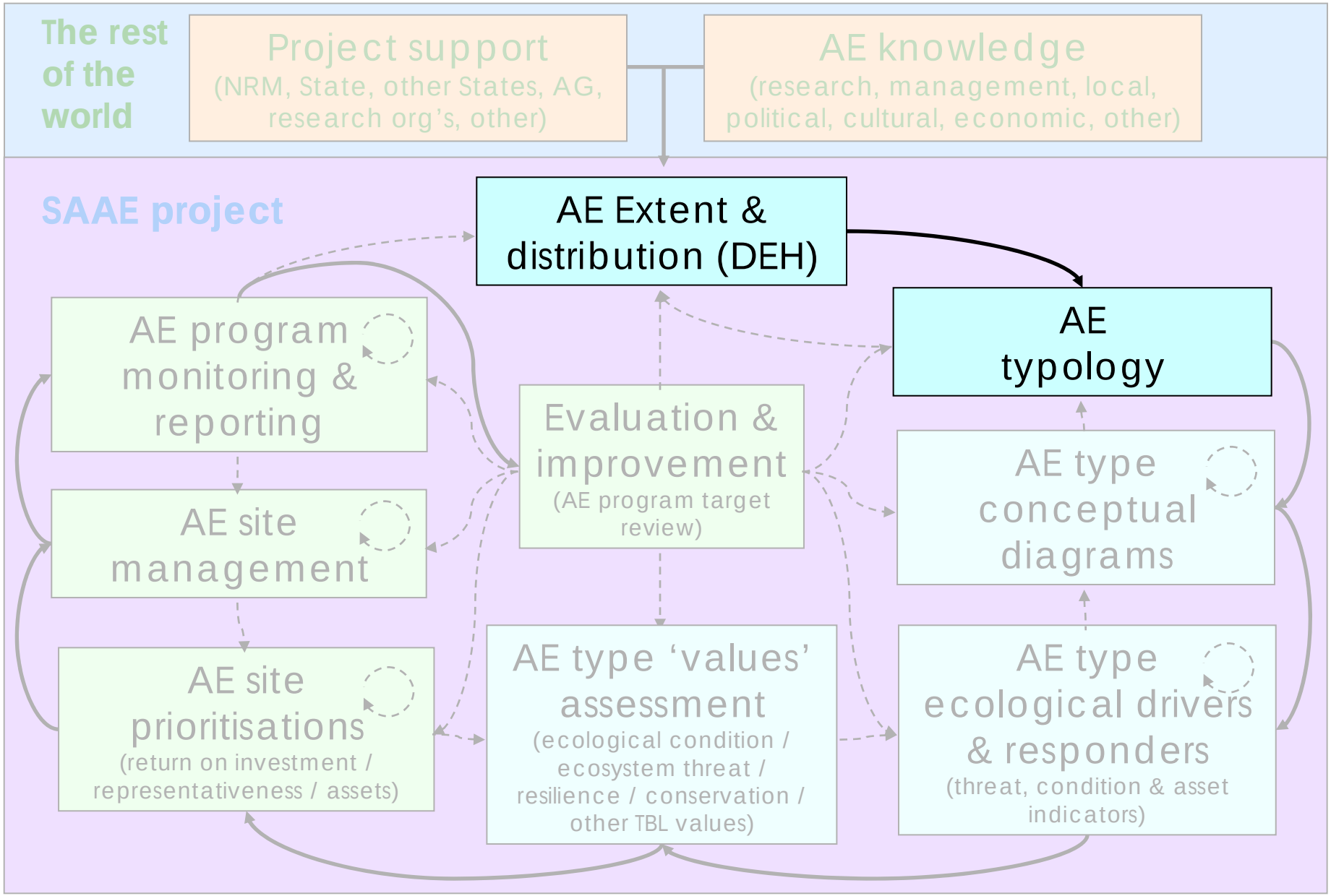
7 x hcvae's

HCVAE	NRM Region	Description
Fleurieu Peninsula Swamps	Adelaide and Mount Lofty Ranges & South Australian Murray Darling Basin	At present, 233 Fleurieu Peninsula Swamps have been identified - 202 within the Adelaide Mount Lofty Ranges and 31 within the South Australian Murray Darling Basin.
Streaky, Sceale and Corvisart Bays	Eyre Peninsula	
Coffin, Kellidie and Dutton Bays	Eyre Peninsula	
Cooper Creek catchment	South Australian Arid Lands	Permanent pool on the Neales River, large freshwater waterhole – the final waterhole in a drying process in the Neales system.
Pike-Mundic Wetland Complex	South Australian Murray Darling Basin	Floodplain anabranch on the SA River Murray that bypasses Lock 5. System includes Pike Lagoon, Upper Pike River, Mundic Creek and Lower Pike River.
Limestone Coast Wetlands Complex	South East	Piccaninnie Ponds is a groundwater fed, freshwater spring with a large swamp area, three sinkholes (the deepest ~ 90m deep) and large underground chasm. Located on SE coast near the SA-Vic border (E 493855; N 5789107). Picks Swamp is adjacent to Piccaninnie Ponds and houses large tracts of Silky Tea tree (*Leptospermum lanigerum*)
Pelican Lagoon and surrounding catchments	KI	

Not a conservation list – an **investment prioritisation** list.

Includes consideration of threats to AE and capacity to manage the identified threats (ecologically and organisationally)

SAAE workshops



SAAE Workshop 1 - 30th January

WHAT WE DID

The workshop worked through five items:

1) **Presentations**
2) **Mapping exercises and discussion on 'applying' the framework**
3) **An audit of what is going on in the regions**
4) **Feedback on the framework and process**

1) **PRESENTATIONS**:

- Chris Auricht (AG consultant) – links between SAAE and the AG (HCVAEs)
- David Scheltinga (Qld) – reporting on AE health (condition) and risk (threats)
- Jim Barratt (DWLBC - SMERF) – connections between SAAE and SMERF
- Ben Fee / Glen Scholz (DWLBC – SAAE) – presented the SAAE Framework

SAAE Workshop 1 - 30th January

2) MAPPING EXERCISE:

- Improve mapping base information
- Improve and test the wetland typology by add typologies to familiar AEs
- Define a process of working with NRM Boards to populate maps and test the typology

What worked?	What didn't work?	What other info is required?	Other notes
- existing info provides a useful starting point - the maps are definite triggers for ideas - catalyst for thinking and refinement of material and typologies - there is a need for this kind of information - the Conceptual Diagram were useful to explain and demonstrate the typologies - visuals are always useful to support the explanation of complex concepts and or processes - maps may be useful to NRM Boards to assist with comments on planning approvals	- typologies didn't always match the real case scenario… therefore hard to classify - the right personnel is required to inform the mapping exercise and associated typologies - Need more detailed wetland and scientific understanding / knowledge from people on ground - unclear how to apply the typologies to artificial systems - What happens when the typologies change over time? Which one do you use? (Need advice on this) - The difference between typologies was hard to follow – need more info - The inconsistencies in mapping for the specific regions (eg Fleurieu Swamps example) wasn't useful - The sale of the maps was difficult to work with	A coordinated approach to collect the map and typology info. This could include: - Linking with NRM Board members - Working with NRM Boards to source local contacts - LAP Groups - Advisory Committees / Board Groups - Regional DEH staff - Need to "vet" typology types with regional experts ie: do they work? - Need some descriptors and development of information that supports the typologies (eg features and how they function) - Photos and written material could support this - Is DWLBC open to new typologies? Eg: Rock holes - Maps need more info labeling and reference points eg: rivers, roads, townships	- Visuals were seen as a powerful tool to support the assessment of typologies - Conceptual Diagrams are supported as a particularly useful tool - Would like to understand the 'science' behind the typologies - Need to add Fresh water lakes

SAAE Workshop 1 - 30th January

3) AUDIT OF AE WORK IN THE REGIONS

	Mapping	Typology	Concept diagrams	Indicators	Condition Assess	Prioritisation	Monitoring	Reporting
Adelaide Mount Lofty Ranges	Y	N	Y?	Y	Y	Y	Y	Y
Eyre Peninsula	Y	Y?		Y?		Y?	Y?	Y?
Kangaroo Island	?	N	N	?	Y	Y?	Y	Y
Northern & Yorke	Y?	N	N	?	Y	Y	?	Y
SA Arid Lands	Y?	Y?	Y?	N	Y?	N	Y?	N
SA Murray Darling Basin	Y	Y	Y	Y?	Y?	Y	Y?	Y?
South East	Y	Y?	N	N	Y	Y?	Y	Y

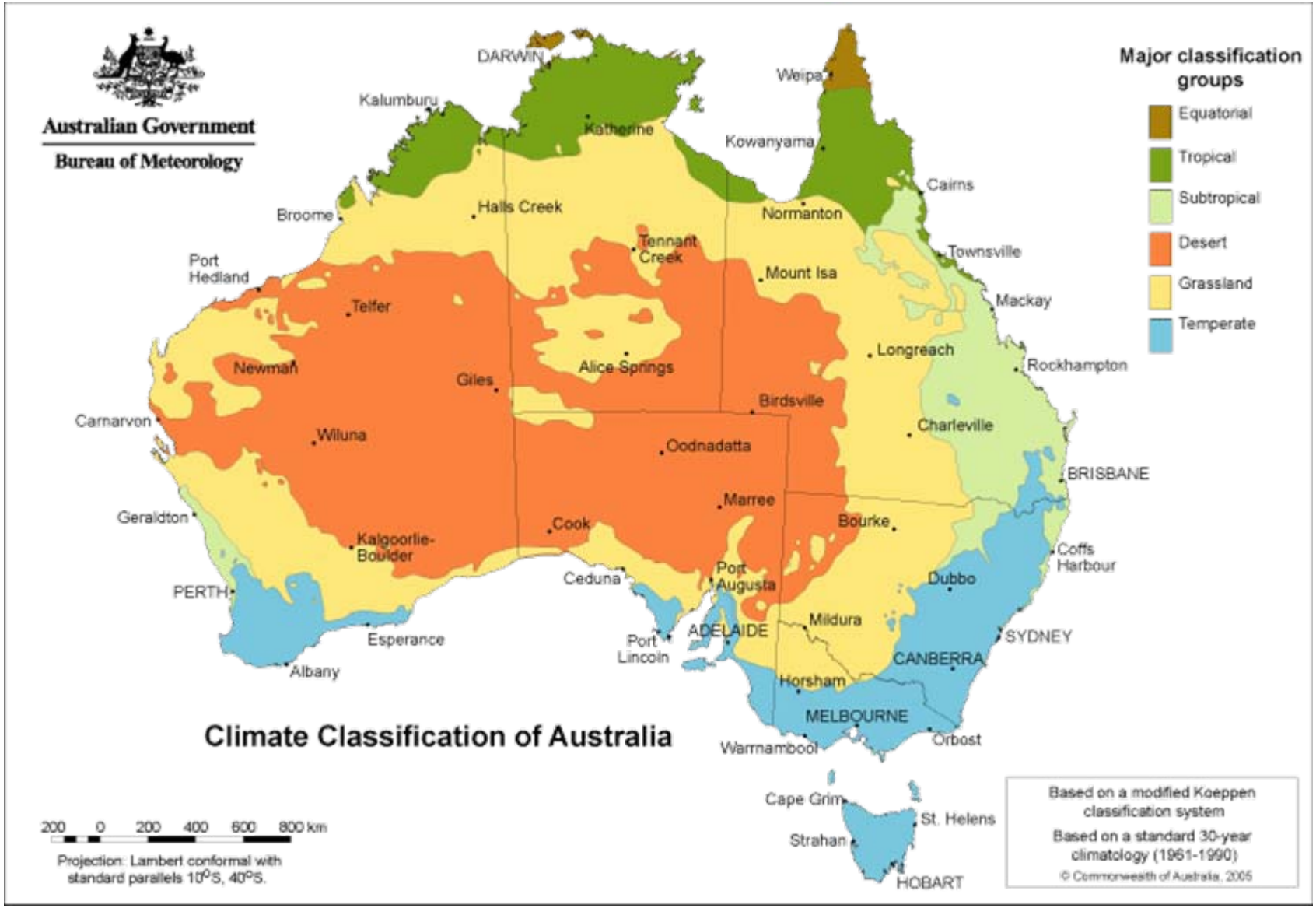
Y= Yes	**Y? =** Yes (somewhat)	**N =** No	**? =** Unsure	“blank” = no entry

SAAE Workshop 1 - 30th January

4) FEEDBACK ON THE SAAE FRAMEWORK

- The SAAE Framework was agreed on as a practical approach to the assessment, monitoring and management of AEs in SA
- The geomorphology and ecosystem process approach to the typology was questioned by Janet Pedler (NCS / DWLBC) - preferred veg indicators
- More information is required on the scale of mapping and reasoning behind the typology before developing these further with the Boards
- NRM Boards have different needs and AE management capacity so the approach taken to liase within and between NRM Boards was well received
- Some NRM Officers recognised that they were not the correct contact for SAAE – in these cases alternate contacts will be identified

Koppen climate classification



Semeniuk landform diagrams

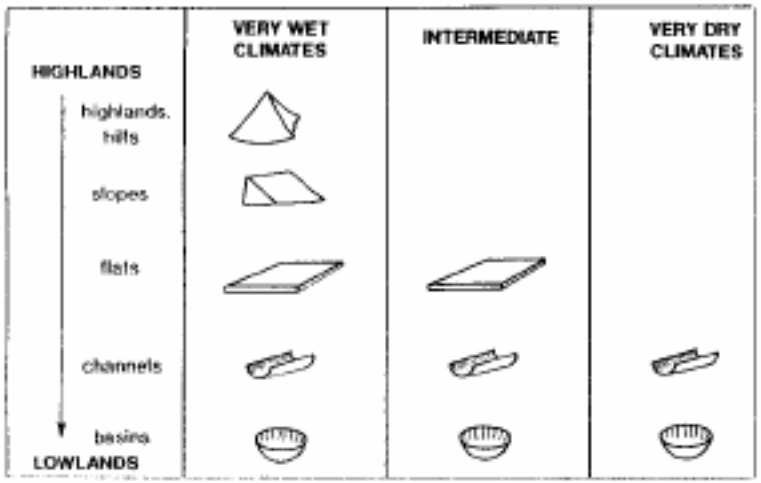


Fig. 14. The various landform types that are captured as wetlands in relationship to climate.

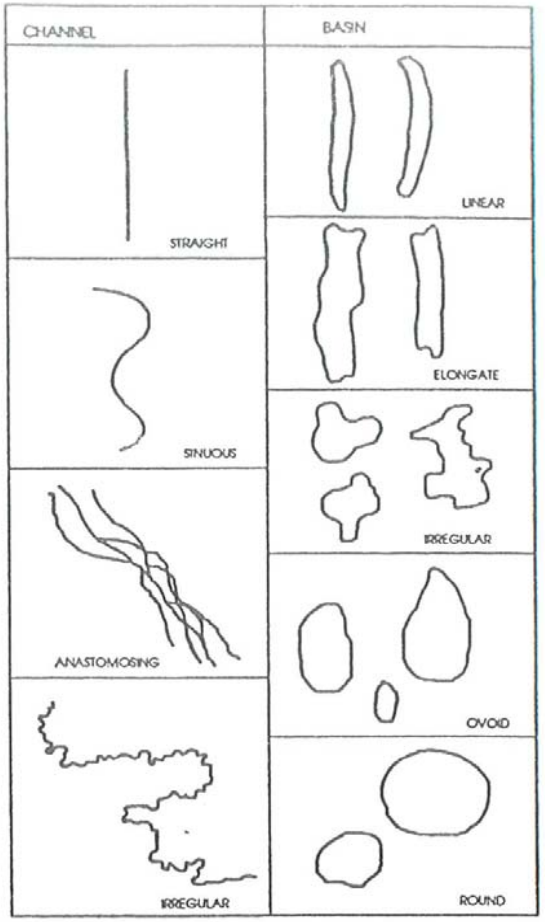
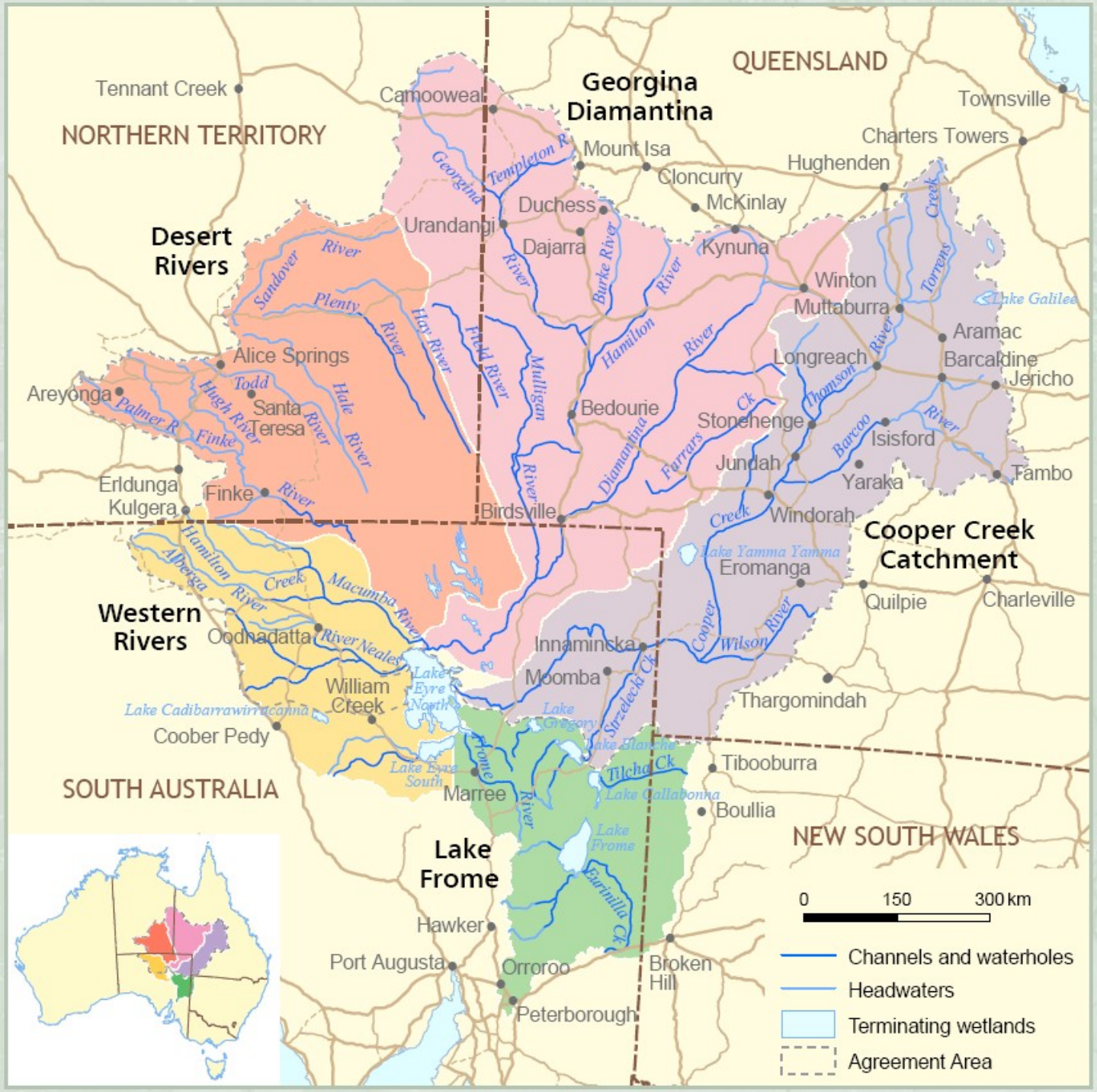


Figure 2.8: Descriptors for plan geometry of wetlands.

Semeniuk, C.A. & Semeniuk, V. 1995. *A geomorphic approach to global classification for inland wetlands.* Vegetatio 118: 103-124.

Lake Eyre Basin
Intergovernmental Agreement

State of the Basin 2008: Rivers Assessment


QUEENSLAND
NORTHERN TERRITORY
SOUTH AUSTRALIA
NEW SOUTH WALES
Georgina Diamantina
Desert Rivers
Western Rivers
Lake Frome
Cooper Creek Catchment
Tennant Creek
Camooweal
Townsville
Charters Towers
Mount Isa
Hughenden
Cloncurry
McKinlay
Duchess
Urandangi
Dajarra
Kynuna
Winton
Muttaburra
Aramac
Longreach
Barcaldine
Jericho
Alice Springs
Areyonga
Santa Teresa
Bedourie
Stonehenge
Isisford
Jundah
Yaraka
Tambo
Erldunga
Kulgera
Finke
Birdsville
Windorah
Eromanga
Quilpie
Charleville
Oodnadatta
Innamincka
Moomba
Thargomindah
William Creek
Coober Pedy
Tibooburra
Marree
Boullia
Hawker
Port Augusta
Orroroo
Broken Hill
Peterborough
Lake Galilee
Lake Yamma Yamma
Lake Cadibarrawirracanna
Lake Eyre North
Lake Eyre South
Lake Gregory
Lake Blanche
Lake Callabonna
Lake Frome
Georgina
Templeton R
Burke River
Hamilton River
Mulligan River
Field River
Hay River
Plenty River
Sandover River
Todd River
Hale River
Palmer R
Hugh River
Finke River
Diamantina River
Farrars Ck
Cooper Creek
Wilson River
Thomson River
Barcoo River
Torrens Creek
Macumba River
Alberga River
Hamilton Creek
Neales River
Strzelecki Ck
Tilcha Ck
Eyrinilla Ck
Frome River
0
150
300 km
Channels and waterholes
Headwaters
Terminating wetlands
Agreement Area

KEY

Indicators of Stress

Hydrological Condition


Low level of flood and flow modification


Moderate level of flood and flow modification


High level of flood and flow modification


Insufficient information available

Landscape Stress:


Least stressed


Moderate stress


Most stressed


Insufficient information available

Landscape stress is a combination of grazing pressure, proportion of native vegetation conserved, density of weeds and feral animals and number of threatened species and is used here as a surrogate for catchment condition.

KEY

Indicators of Condition

Water Quality:


Good


Moderate


Poor


Insufficient information available

Many rivers, wetlands and lakes in the Lake Eyre Basin are naturally turbid. Water quality is assessed relative to natural conditions.

Fish:


All expected fish species present; few introduced species


Majority of expected native fish species with established introduced fish species


Few native fish species with a dominance of introduced fish species


Insufficient information available

Waterbirds:

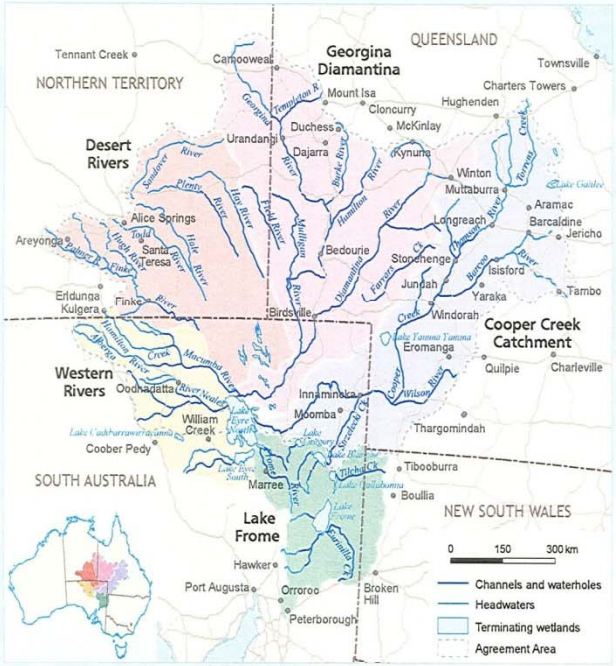

All expected bird species present at natural levels of abundance


All expected bird species present but at lower than expected levels of abundance


Some species missing and those present at a low level of abundance


Insufficient information available

Rivers Assessment Overview



	Hydrological condition
Desert Rivers	• Minor alteration of flow regimes in all catchments.
Western Rivers	• Minor to moderate alteration of flow regimes in central western catchments associated with historically more intensive land use and greater access to shallow Great Artesian Basin water resources. • Little impact elsewhere.
Lake Frome	• Moderate to major alteration of flow regimes in south western catchments (Flinders Ranges) due to historically more intensive land use associated with closer settlement. • Little impact elsewhere.
Cooper Creek	• Headwaters: low flows impacted by farm dams and diversions, especially in the north eastern catchments. • Channel country: low flows slightly impacted by stock and domestic diversions, mainly from permanent waterholes. • Terminal wetlands: minimal impact.
Georgina Diamantina	• Headwaters: low flows impacted by farm dams, diversions and extractions from groundwater pumping in upper Georgina, especially in the area around Mt Isa. • Terminal wetlands: minimal impact. • Little impact elsewhere.

KEY

Landscape Stress:

Least stressed | Moderate stress | Most stressed | Insufficient information available

Landscape stress is a combination of grazing pressure, proportion of native vegetation conserved, density of weeds and feral animals and number of threatened species and is used here as a surrogate for catchment condition.

Water Quality:

Good | Moderate | Poor | Insufficient information available

Fish:

All expected fish species present; few introduced species

Majority of expected native fish species with established introduced fish species

Few native fish species with a dominance of introduced fish species

Insufficient information available

Waterbirds:

All expected bird species present at natural levels of abundance

All expected bird species present but at lower than expected levels of abundance

Some species missing and those present at a low level of abundance

Insufficient information available

Hydrological Condition

Low level of flood and flow modification | Moderate level of flood and flow modification | High level of flood and flow modification | Insufficient information available

	Headwaters	Channels and Waterholes	Terminating Wetlands
Desert Rivers	• Some waterholes naturally saline during dry periods. • Landscape minimally stressed though some sub regions in the north west are moderately stressed.	• Some waterholes naturally saline during dry periods. • No introduced fish species currently known, with isolated introduction of Plague Minnow successfully eradicated. Non-endemic native fish present. • Athel Pine infestations along the riparian zone of the Finke River. • Landscape minimally stressed.	• Landscape minimally stressed.
Western Rivers	• Landscape moderately stressed due to fragile soils of the stony downs.	• Some waterholes naturally saline especially during dry periods. • Isolated nutrient pollution where stock have waterhole access. • One exotic fish species and non-endemic native fish reported. • Fish diversity vulnerable to extended droughts. • Landscape most stressed in the central south due to fragile soils of the stony downs.	• Landscape minimally stressed.
Lake Frome	• Landscape most stressed in the south western Flinders Ranges.	• Landscape most stressed in the central south western catchments (Flinders Ranges) due to historically more intensive land use associated with closer settlement.	• Significantly large wetland systems, Lake Callabonna, Lake Gregory and Lake Blanche, are important for waterbird nesting and feeding areas. Lake Frome is not greatly used by waterbirds. • Landscape minimally stressed.
Cooper Creek	• Red Claw Crayfish, introduced to the Thomson River, presents a threat to native species. • Murray Cod, translocated to the Thomson River, presents a threat to locally endemic species. • Cane Toads are present and pose a threat to entire Basin. • Landscape minimally stressed.	• All expected fish species present, however, increasing fishing pressure on permanent waterholes. • Small numbers of exotic fish are present, but there is risk of further introductions of exotic species from the headwater zones. • Recreational pressure on waterholes. • Grazing pressure around waterholes and on floodplains. • Landscape moderately stressed in the central zone.	• Significantly large wetland systems supporting Lignum shrub structure are important for waterbird nesting. • Landscape minimally stressed.
Georgina Diamantina	• Increasing fishing pressure on permanent waterholes. • Cane Toads may be present and pose threat to entire Basin. • Landscape most stressed in the northern and central region. • Grazing pressure around waterholes and on floodplains.	• All expected fish species present, however, increasing fishing pressure on permanent waterholes. • Small numbers of exotic fish present. • Landscape moderately stressed in the central zone. • Grazing pressure around waterholes and on floodplains.	• Significantly large wetland systems supporting Lignum shrub structure are important for waterbird nesting. • Landscape moderately stressed.