Developing Site-Specific Water Quality Objectives for Aquatic Systems

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What are Water Quality Objectives (WQOs)?

- WQOs are trigger values for physicochemical and biological parameters
- WQOs allow rapid assessment of water quality or ecological condition
- WQOs are open to revision
- What is their role?
- Are they supposed to trigger management responses?

WQOs can be developed for a range of tasks including:

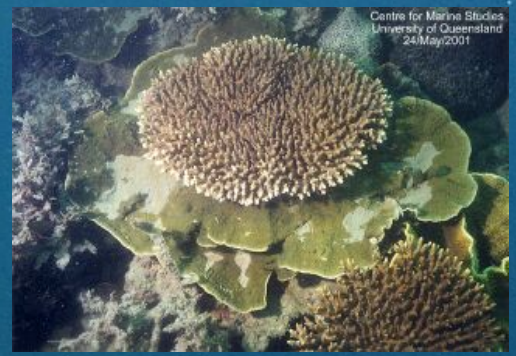
- Condition assessment of natural waters
- Appraisal of discharge compliance
- Control of impacting processes

Disturbance

Pollutants

Interactions

Tolerances



ANZECC/ARMCANZ (2000) Guidelines & Draft Queensland Water Quality Guidelines

- Favour development of site specific water quality objectives based on:
  - Local environmental conditions
  - Environmental and conservation values
  - Most appropriate indicators

Requirements of Water Quality Objectives

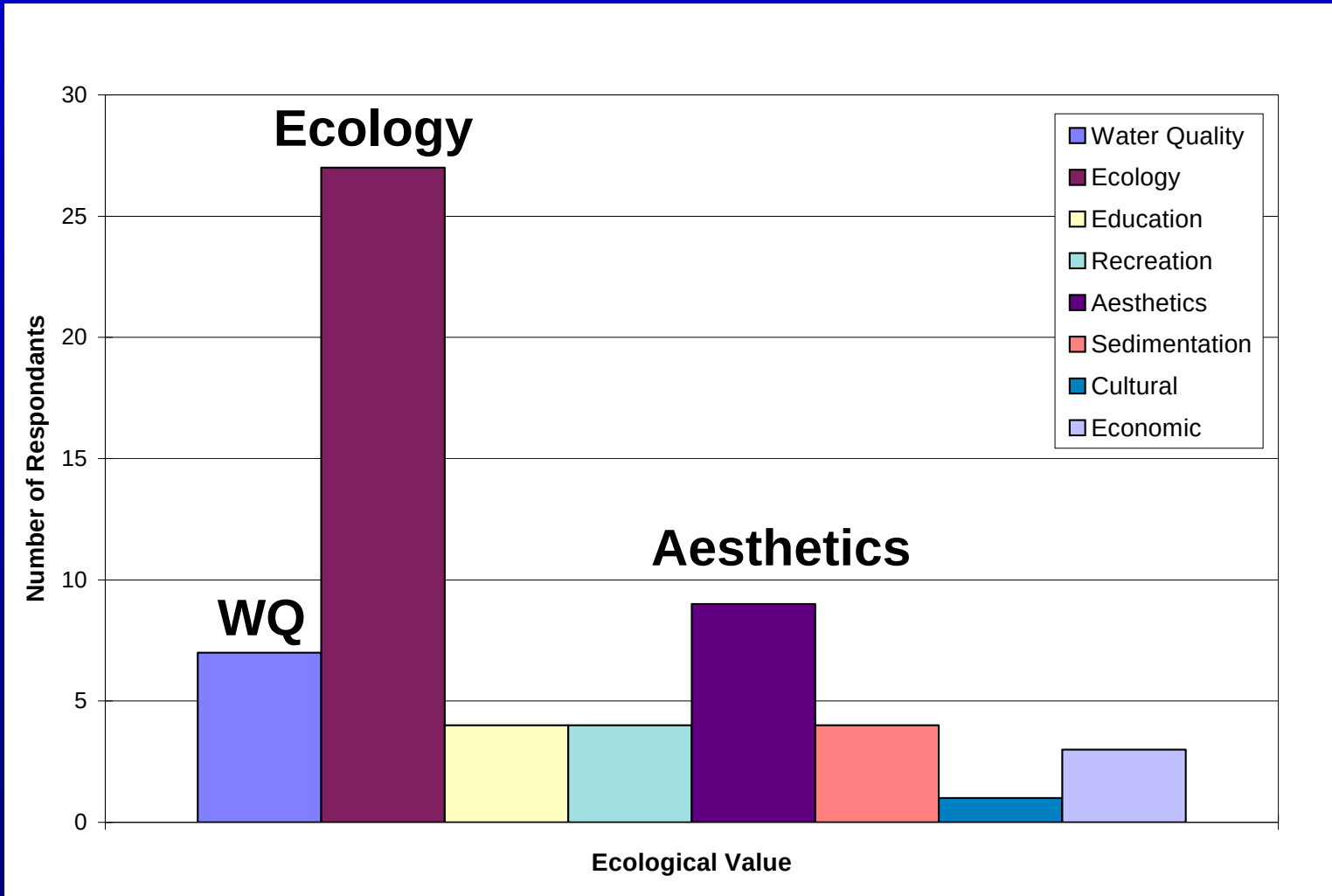
- **Compatible**
  - with environmental values placed on the waterway by stakeholders, community and land use managers
- **Practical**
  - taking current ecological condition, pressures and habitat tolerances into account
- **Achievable**
  - Using predictive modelling to take into account current and future capacity a system to meet specified WQOs

Case Study 1:
Coombabah Creek Environmental Inventory
Gold Coast

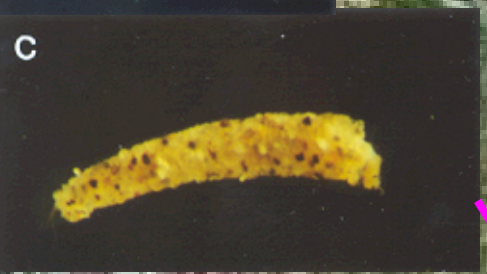
- Ecological inventory of aquatic system
- Stakeholder consultation to select Environmental Values
- Modeling to predict changes in nutrient and sediment inputs
- Development of site specific WQOs
- Development of mitigation strategies

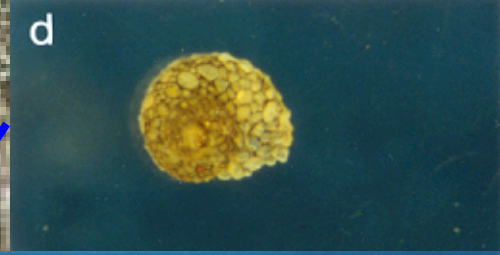

1944
1993

Stakeholder setting of Environmental Values



Substantial biological impacts associated with increased sediment and nutrient loads





Aquatic Fauna from sites 1 & 2 up-stream of quarry – a,b,c typical of healthy creeks – d & e indicators of clean unimpacted waters

Site 2

Inventory findings:

- Currently meeting water quality objectives for the system
- Evidence of nutrient enrichment and sedimentation
- Modelling suggests future nutrient and sediment loads will substantially increase

Key actions:

- Implement:
  - Riparian rehabilitation program
  - Installation of artificial wetlands
  - Stormwater Management Plan
- Revise water quality objectives

Revised Water Quality Objectives

Parameter		Current Objectives	Revised Objectives
Dissolved oxygen	Median	<6 mg/L	<6 mg/L
pH	Range	6.5-9	6.5-9
Total nitrogen	Median	0.75 mg/L	0.5 mg/L
Total phosphorus	Median	0.1 mg/L	0.05 mg/L
Turbidity	Median	10 ntu	10 ntu
	80th percentile	-	30 ntu
E coli	Primary contact	150 cfu/100mL	150 cfu/100mL
	Secondary contact	1000 cfu/100mL	1000 cfu/100mL
Chlorophyll-α	Median	10 μg/L	3 μg/L
	80th percentile	?	6 μg/L
Temperature (freshwater only)	Single measurement	-	< 2^{o}C change between stations

Using multiple condition indicators in ephemeral systems

Case Study 2:
Shoalwater Bay Training Area Water Quality Monitoring Program

Military Training Area – North of Rockhampton

- **>450,000 ha**
- **Army, Navy and Air force; international defence forces**
- **High environmental value: RAMSAR wetlands, rare and threatened plant species**
- **Eastern sectors drain into GBRMP**
- **Ephemeral water courses with some permanent water holes and lagoons**

Water Quality Monitoring Program

- 27 sites sampled once a year for 4 years
- Sites located based on potential land use impacts – diffuse and point sources
- Provide an indication of ecological condition and land use impacts
- Adopted ANZECC (2000) trigger values

Condition Assessment

- Change in water quality is not necessarily linked to land use impacts: eg natural range; feral animals
- Comparison to WQ objectives loses value in isolation
- AUSRIVAS habitat assessment
- Linking of results to rainfall patterns and other environmental factors

How can managers meet modified WQOs for catchment?

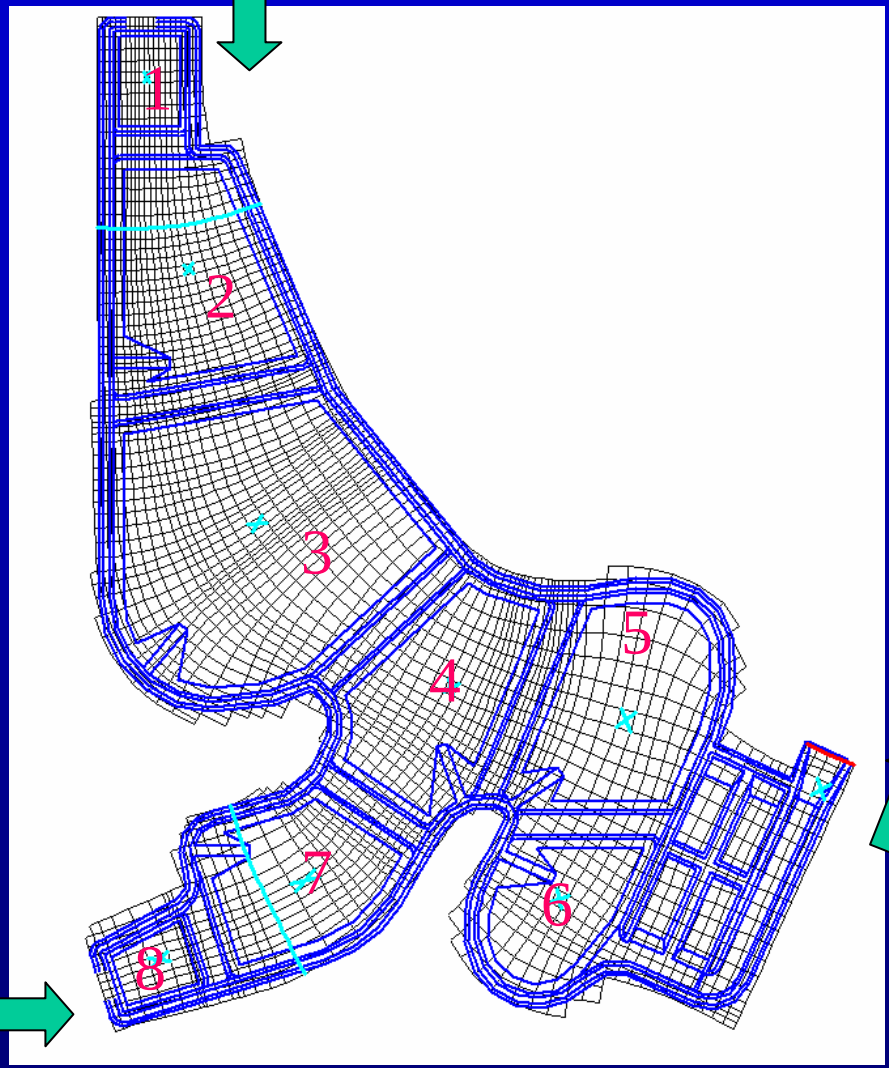
Case Study 3:
Multi-celled Stormwater Treatment Lake – BM Webb Development

Town Common Estuarine Wetland - Townsville

- **High environmental value: CAMBA JAMBA wetland**
- **Receives untreated stormwater from industrialised catchment**
  - **Nutrients, suspended sediment, heavy metals, hydrocarbons, acidic and alkaline wastewater**
- **Adopted ANZECC (2000) trigger values (none were previously set)**

Multi-celled stormwater treatment lake

West Inflow



Outflow

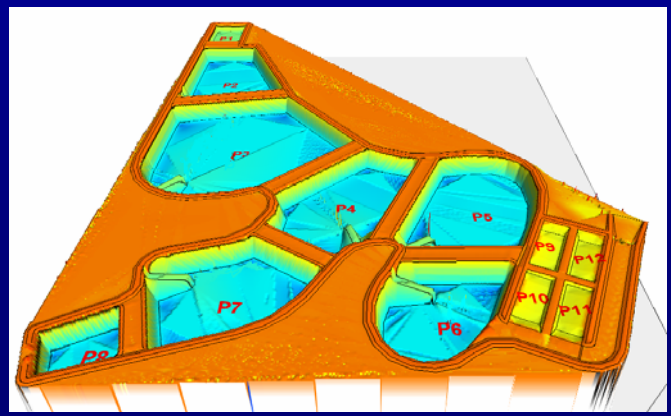
East Inflow

Catchment Runoff and Pollutant Export Concentrations

Statistic	SS (mg/L)		TN (mg/L)		TP (mg/L)	
	No ponds	Ponds	No ponds	Ponds	No ponds	Ponds
Average	15.2	3.1	0.67	0.40	0.062	0.031
Median	2.6	1.6	0.51	0.38	0.027	0.027
Minimum	1.5	0.0	0.34	0.00	0.013	0.000
Maximum	89.5	100.7	1.50	7.77	0.254	0.592
80th percentile	19.6	5.0	1.04	0.50	0.092	0.044
20th percentile	1.8	0.1	0.41	0.25	0.017	0.014

Conclusions

- Setting of practical and achievable WQOs represents a mature response to the management of aquatic systems
- Adoption of such modified WQOs challenges land use managers to implement state-of-the-art water sensitive urban design and land use management practices
- Assessment of ecological condition involves more than comparison to water quality objectives



Modelling stormwater quality and mitigation measures

Effects of Land Use Changes on Stormwater Quality
Average Concentration (mg/L) – Coombabah Lake

Parameter	Average Annual Concentration (mg/L)			Increase in Concentration (%)		Decrease in Concentration (%) from Future to M2
	Existing	Future	M2[1]	Existing to Future	Existing to M2	
Suspended Solids	34.96	43.70	28.07	25.0%	-19.7%	35.8%
Total Nitrogen	1.09	1.22	1.03	11.8%	-5.7%	15.7%
Total Phosphorus	0.13	0.16	0.12	19.8%	-9.2%	24.3%

M2 = mitigation using detention basins and wetlands