Draft Environmental Values, Water Quality Objectives and Targets for the Black and Ross River Basins Water Quality Improvement Plan (WQIP)

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1. Introduction

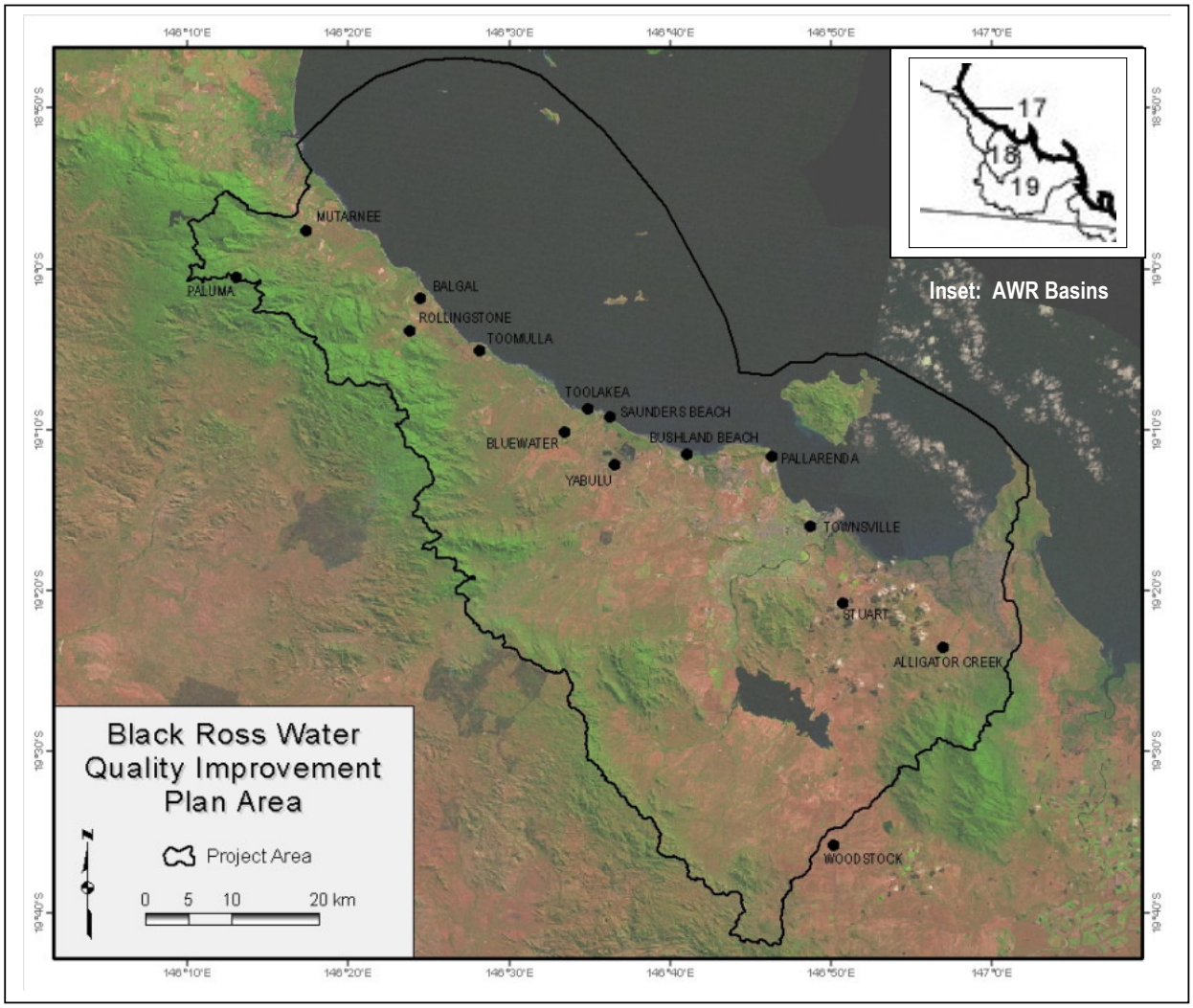
1.1 Background

Creek to Coral is the manager of the Coastal Catchments Initiative (CCI) project for the Black and Ross River Basins and along with its many partners is responsible for the preparation of a Water Quality Improvement Plan (WQIP). The WQIP includes a number of elements including the establishment of environmental values, water quality objectives and water quality targets for the receiving waters draining the Black and Ross River Basins and Magnetic Island. The determination of these elements is based on the process described in the National Water Quality Management Strategy.

1.2 Black and Ross Basins WQIP Area

The Black/Ross WQIP area covers most waterways within the Townsville City local government area with the exception of the Reid River and Major Creek catchments, which are part of the Haughton River Basin. The WQIP area includes the Black River (No. 17) and Ross River (No. 18) Australian Water Resource Council (AWR) Basins and a small part of the Haughton River Basin (No. 19), where the waterways flow to Cleveland Bay. It also includes Magnetic Island, as well as the coastal and marine waters of Cleveland Bay and Halifax Bay (see Figure 1-1).

Figure 1-1 Black/Ross WQIP Area



1.3 National Water Quality Management Strategy

The National Water Quality Management Strategy (NWQMS) has been jointly developed since 1992 by the Australian Government in cooperation with state and territory governments, currently under the Natural Resource Management Ministerial Council. The NWQMS is part of the Council of Australian Governments' (COAG) Water Reform Framework and is acknowledged in the National Water Initiative.

The NWQMS has three major elements: policies, process and guidelines.

"*The main policy objective of the NWQMS is to achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development*".

The NWQMS process involves community and government development and implementation of a management plan for each catchment, aquifer, estuary, coastal water or other waterbody. This includes use of high-status national guidelines with local implementation.

There are currently 21 NWQMS guidelines for managing key elements of the water cycle. The NWQMS guidelines cover:

- Policies and processes to achieve water quality;
- Effluent and sewerage system management;
- Urban stormwater and recycled water;
- Fresh and marine water quality;
- Monitoring and reporting;
- Groundwater protection; and
- Drinking water.

(Source: http://www.environment.gov.au/water/quality/nwqms/)

Components of Queensland's *Environmental Protection (Water) Policy 1997* (EPP Water) are based on the National Water Quality Management Strategy (NWQMS 2000). The EPP Water is subordinate legislation of the *Environmental Protection Act 1994* (EP Act), and is currently under review. The object of the EPP Water, as identified by the EP Act, is to protect Queensland's waters while allowing for development that is ecologically sustainable. This purpose is achieved within a framework that includes:

- Identifying ***Environmental Values*** for Queensland waters; and
- Deciding and stating water quality guidelines and ***Water Quality Objectives*** to enhance or protect the environmental values.

Environmental Values (EVs) and Water Quality Objectives (WQOs) can be included in Schedule 1 of the EPP Water.

Various NWQMS documents and processes are used to assist with the determination of EVs and WQOs with the most relevant being the *Implementation Guidelines* (1998) and the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)*. (Source: http://www.epa.qld.gov.au/environmental_management/water/environmental _values__environmental _protection_water_policy_1997/)

Additionally Queensland now has a set of water quality guidelines, which are used as default guidelines unless local water quality guidelines have been prepared for the subject area.

The NWQMS has a particular terminology and definition set, which places the EVs and WQOs in context.

1.4 Definitions and Terminology

Environmental Values

The particular values or uses of the environment that contribute to public or private benefits (welfare) are called environmental values or beneficial uses. The determination of the regional community's preferred values and uses is an essential step in developing a water quality management program. (ANZECC/ARMCANZ 1994, p.5)

The environmental values originally defined in the "*Australian Water Quality Guidelines for Fresh and Marine Waters*" (ANZECC 1992) were:

- Protection of Aquatic Ecosystems
    - Freshwater and marine ecosystems, production of fish and shellfish, wildlife protection.
- Recreational Water Quality and Aesthetics
    - Primary and secondary contact, visual appreciation.
- Raw Water for Drinking Water Supply
- Agricultural Water Use
    - Irrigation, stock watering, farmstead use
- Industrial Water Quality

(ANZECC/ARMCANZ 1994, p.6)

Environmental values were updated and added too in the 2000 revision of the *Australian and New Zealand Guidelines for fresh and marine water quality (ANZECC 2000).*

Environmental values (EVs) are those qualities of the waterway that make it suitable to support particular aquatic ecosystems and human uses. These qualities require protection from the effects of pollution such as waste discharges, siltation and runoff. All waterways will possess at least one of the EVs listed (i.e. protection of aquatic ecosystems) and, in most cases, other human uses (e.g. irrigation, stock watering, drinking water, recreational uses) will also apply (EPA 2005, p.3).

Currently EVs are divided into two primary categories:

1. Aquatic ecosystem, and
2. Human use.

Human use EVs are further divided into types of human (beneficial) use while aquatic ecosystem EVs are divided into condition classes reflecting the degree of modification from natural conditions (see Table 1-1).

Water quality guidelines

A water quality guideline is a numerical concentration limit or narrative statement recommended to support and maintain a designated use of the water resource (GBRMPA 2008.p.23). Water quality guidelines are identified for different water quality indicators, such as pH, nutrients, heavy metals, pesticides, suspended solids, water clarity/turbidity, salinity, dissolved oxygen, and biological indicators (e.g. macroinvertebrate counts, seagrass distribution)(EPA 2005, p.4). As previously mentioned there are national water quality guidelines and water quality guidelines for Queensland. At present here are no local water guidelines for the Black Ross WQIP area.

Water Quality Objectives

Water Quality Objectives (WQOs) are set to protect the environmental values of waterways in the study area. Where more than one EV is identified for a waterway (e.g. water suitable for both irrigation and aquatic ecosystems), the water quality guidelines to support each value and use should be identified and the most stringent guideline for each water quality indicator is the draft WQO selected (i.e. it will protect all identified EVs).

Draft WQOs are based on the community's initial choices for EVs and the water quality guidelines to protect them. Regional NRM bodies and others are encouraged to use this process to get to the draft WQOs, which they can then adopt as water quality targets in their NRM plans (EPA 2005, p.4).

Table 1-1 Environmental Value Definitiions

EV symbol	Symbol	Interpretation
	**Aquatic Ecosystems**	Supporting pristine or modified Aquatic Ecosystems. There are three Levels of Protection: High conservation/ecological value systems (HCV or HEV). They are often found within national parks, conservation reserves or inaccessible locations. Targets for these systems aim to maintain no discernable change from this natural condition. Slightly to moderately disturbed systems (SMD). These systems have undergone some changes but are not considered so degraded as to be highly disturbed. Highly disturbed systems (HD). These are degraded systems likely to have lower levels of naturalness. These systems may still retain some ecological or conservation values that require protecting. Targets for these systems are likely to be less stringent and may be aimed at remediation and recovery or retaining a functional but highly modified ecosystem that supports other environmental values also assigned to it. See further details in EPA (2005) for each level of protection.
Human Use (Beneficial use)		
	Irrigation	Irrigating crops such as sugar cane, lucerne, etc
	Stock watering	Water for stock e.g. cattle, horses, sheep
	Farm use	Water for farm use such as in fruit packing or milking sheds, etc
	Aquaculture	Water for aquaculture such as barramundi or red claw farming
	Human consumption	Human consumption of wild or stocked fish or crustaceans
	Primary recreation	Primary recreation with direct contact with water such as swimming or snorkelling
	Secondary recreation	Secondary recreation with indirect contact with water such as boating, canoeing or sailing
	Visual appreciation	Visual appreciation with no contact with water such as picnicking, bushwalking, sightseeing
	Drinking	Raw drinking water supplies for human consumption
	Industrial	Water for industrial use such as power generation, manufacturing plants
	Cultural & Spiritual	Cultural and spiritual values including the cultural values of traditional owners

1.5 Catchment Management

The NWQMS (ANZECC/ARMCANZ 1994) identified State agencies as the most likely entity for determining environmental values and the water quality objectives. Following on from the initial success of the Landcare movement the establishment of catchment management structures was seen as the main process for addressing issues associated with diffuse water pollution and erosion. The intent was to encourage more strategic community participation with consultative processes used for determination of such things as environmental values. Catchment management is seen as a voluntary process for building community ownership of water quality and other environmental goals with the potential for using legislative or State government management structures to assist in achieving outcomes when appropriate.

Catchment management groups, and more recently regional natural resource management (NRM) bodies, have been responsible for developing goal-based catchment and NRM regional plans. These participatory structures and processes are also useful for the development of water quality improvement plans (WQIP), which are in essence a more detailed sub component of a catchment management plan. Following the participatory determination of environmental values and water quality objectives the development of strategic plans for water quality management is based both on specific catchments as well as cross-catchment based themes.

In a similar vein to catchment management planning WQIPs are intended to:

- Promote control of diffuse sources not amenable to licensing;
- Encourage sound land use practices, which minimise diffuse pollution;
- Provide an integrated approach to water quality monitoring and reporting;
- Co-ordinate the activities of governmental authorities and private interests within and across catchments to achieve water quality improvements.

In the Black Ross WQIP area Townsville City Council's Creek to Coral program has adopted the role of a catchment management or regional NRM body to manage the preparation of the WQIP and provide an inclusive platform for community and stakeholder organisations input to goal setting and plan development.

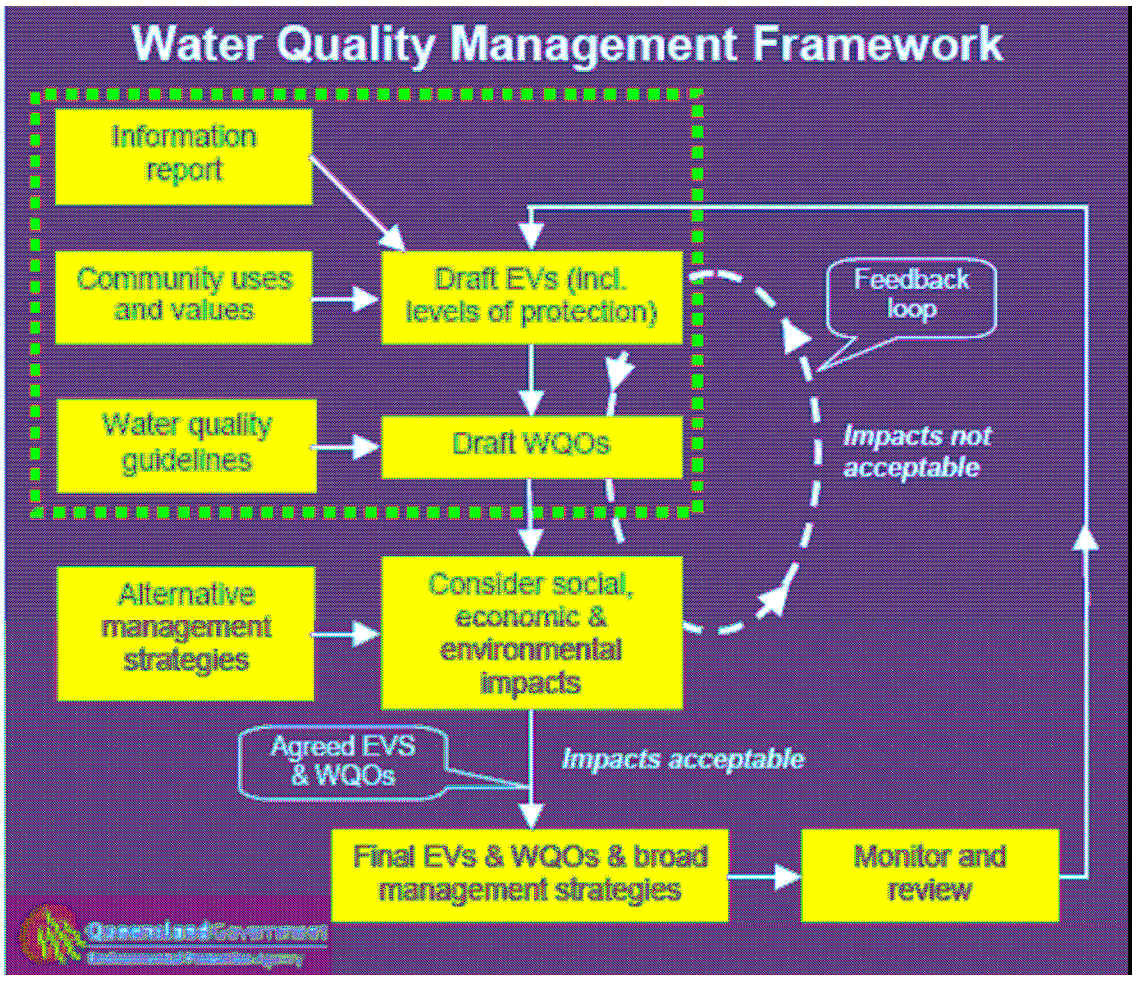
Figure 1-2 Ross River Catchment

Source: J Gunn (CCI\Images\20080712 air cairns tvl\enhanced \ross river enhance cropsmall)

1.6 Process for establishing draft EVs and WQOs

The initial three stages for identifying current condition of waterways and establishing draft EVs and draft WQOs for specific waterways, as per the NWQMS framework, are shown in Figure 1-3, and described briefly below.

Figure 1-3 Water Quality Management Framework



Source: EPA 2005 (p.5)

The main areas of interest from the framework are the initial stages:

- Stage 1 Information report
- Stage 2 Draft environmental values
- Stage 3 Draft water quality objectives

1.6.1 Information report

This stage is about gathering and collating background information including water quality condition and any data that could be used for establishing local water quality guidelines. This is the time to invite stakeholders who are involved in natural resource management to contribute information and expertise to assist with compilation of the background information. The background information can be used to provide a starting point for determining draft high ecological value waterways and waterbodies, and setting the scene for stakeholder and community consultation.

The type of information used to assist in identifying high ecological value waterways and waterbodies, based on aquatic ecosystem values and condition includes:

- Protected estate (e.g. national parks, fish reserves, marine park protection zones, etc.);
- Other designations of high ecological values e.g. in coastal management plans or other planning schemes;
- Areas or species/taxa/communities identified as being under 'threat' from current and/or future land use/water use activities;
- Areas/locations of suspected or known high ecological/conservation values, including good condition, high natural biodiversity, presence of rare/threatened species/taxa/communities, or displaying other special features; and
- Areas of identified ecosystem values to traditional owners; and

Background information on human use environmental values (beneficial uses) also needs to be collated and included in an information report.

1.6.2 Draft environmental values

Draft environmental values are established through a consultation process with stakeholders and the broader community. The background information prepared in the initial stage is used to provide the concepts, context and a starting point for participants involved in determining draft EVs. Stakeholder and community views are collated in relation to the:

- Condition of aquatic ecosystems;
- Current and future (where possible) human uses of waterways;
- Identification of water quality issues; and
- Any additional relevant details e.g. additional scientific studies, information on point and non-point sources of pollution.

(Note: The balancing of these agreed draft EVs with social and economic considerations, leading to final EVs, is part of the broader planning process as shown in Figure 1-3)

1.6.3 Draft water quality objectives

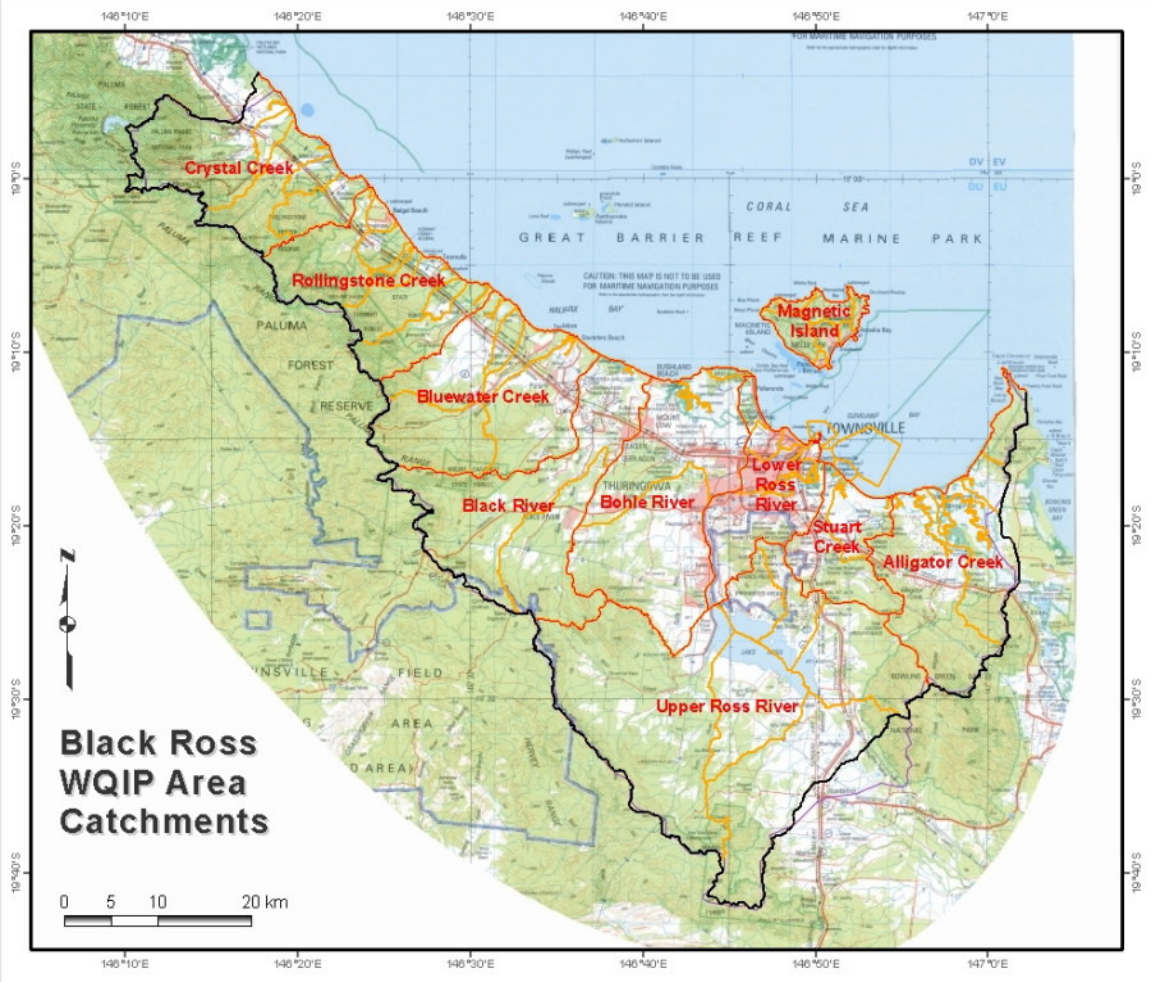
Following stakeholder and community consultation and the establishment of draft EVs, the draft EVs are then related to the relevant water quality guidelines to produce the draft water quality objectives.

2. Black Ross Environmental Values

2.1 Developing EVs for the Black Ross

The Black Ross WQIP area was divided into 10 sub basins and 47 catchments and sub catchments, as well as a number of marine sections (see Figure 2-1). These divisions have been established to assist with condition assessment, monitoring, modelling and reporting. The divisions are also useful in grouping waterways with similar features to assist with determining environmental values and water quality objectives. Profiles of the catchments, sub catchments and associated waterways and wetlands are provided in a separate report.

Figure 2-1 Black Ross Sub Basins and Catchments



2.1.1 Human use

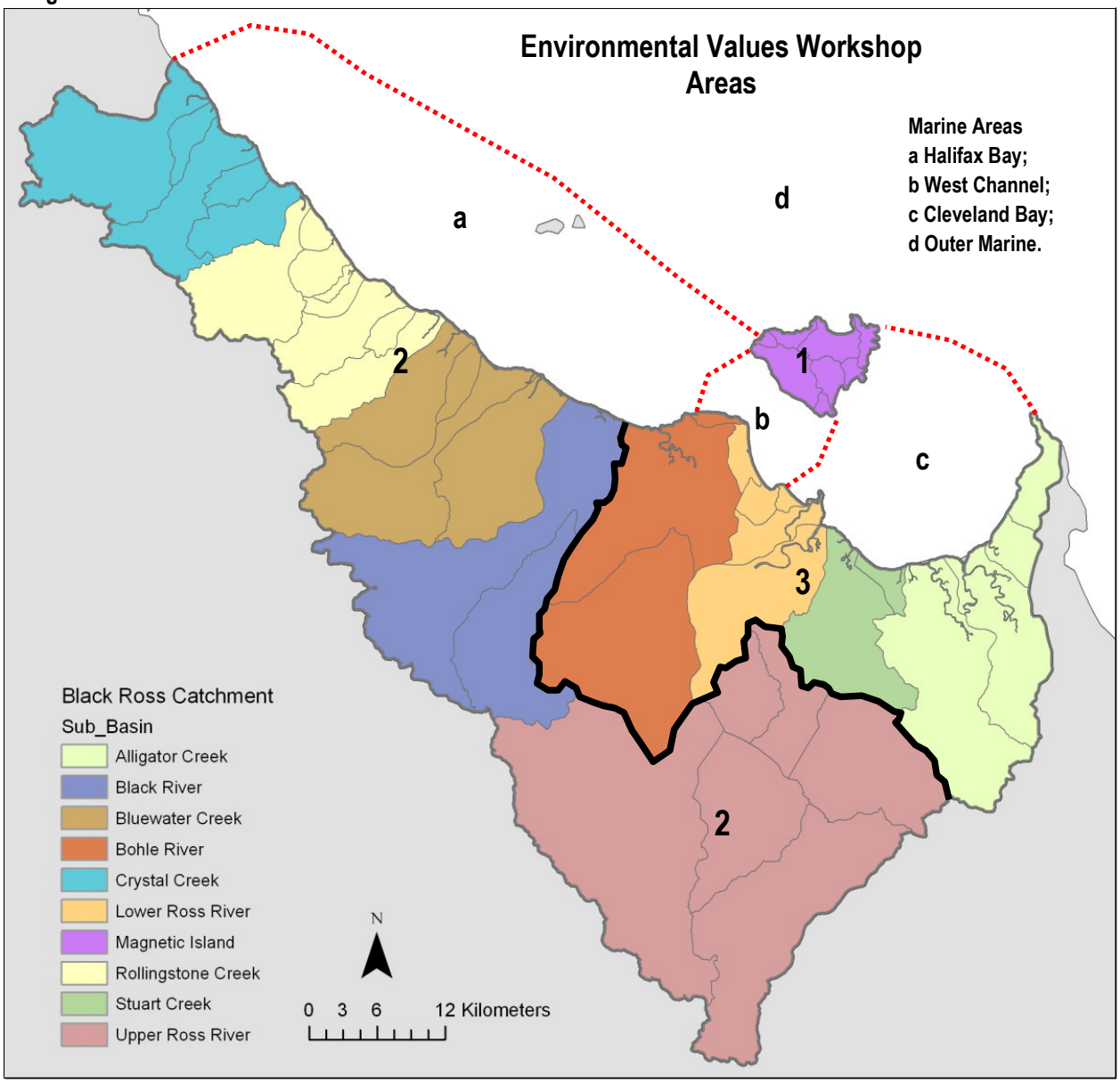
An information report and draft set of human use environmental values was prepared as background for the community consultation workshops through:

- An initial questionnaire sent out to selected stakeholders. The results were collated and used as the starting point for the information report on human uses;
- A desktop study using a variety of public domain information sources. In some cases individuals were also consulted to clarify or source information; and
- Water extraction licence information provided by the Department of Natural Resources and Water. This information was used to collate human uses for the waterways in the vicinity of the licenced property based on the purpose noted for the extraction licence.

2.1.2 Aquatic ecosystems

Creek to Coral partners, Queensland Environmental Protection Agency (EPA) and the Great Barrier Reef Marine Park Authority (GBRMPA), took the lead role in collating the background information to determine a preliminary set of aquatic ecosystem high ecological value areas for discussion, and produced the associated mapping. After the initial compilation of information an expert panel workshop was held (12 October 2007) for the freshwater areas of the Black Ross WQIP area to review the concepts and draft information. A similar workshop was held for the estuarine and marine areas, in conjunction with the Burdekin WQIP team, for the Black Ross WQIP and Burdekin WQIP in March 2008. The results of both workshops were compiled by the EPA and formed the basis for the suggested high ecological value areas to be taken to the community workshops.

Figure 2-2 EV Consultation Areas



2.1.3 Community workshops

Community workshops were held in July 2008 using the combined background information prepared by Creek to Coral, EPA and GBRMPA. For consultation purposes the Black Ross WQIP sub basins were grouped into 3 main areas (see Figure 2-2):

1. Rural (Crystal Creek to Black River and upper Ross River –above the Ross River Dam);
2. Urban and rural residential (lower Ross River, Bohle River, Stuart Creek and Alligator Creek sub basins including waterways to Cape Cleveland); and
3. Magnetic Island.

The community workshops were held at:

- Magnetic Island (Arcadia) on 22 July 2008,
- Bluewater on 23 July 2008 (Rural), and
- Annandale on 24 July 2008 (Urban and rural residential).

Results from the workshops were compiled by Creek to Coral for human use and by EPA for aquatic ecosystems. Human use results were posted on the Creek to Coral website in September 2008 and emailed to workshop participants for review and comment. Comments were incorporated and both the human use and aquatic ecosystem draft results were posted on the Creek to website in January 2009. To view the website go to **www.creektocoral.org** and follow the Coastal Catchments Initiative project links.

Human use environmental values from the workshops are included in Appendix B and aquatic ecosystem results from the workshop, with subsequent amendments and updates, are included as Appendix C. The combined draft environmental values for the Black Ross WQIP area are displayed in Table 2-1, Table 2-2, Table 2-3, Table 2-4, Table 2-5 and Table 2-6.

The community consultation process for determining environmental values and water quality objectives in the context of developing the WQIP for the Black Ross is illustrated in Figure 2-4.

Figure 2-3 Community Workshops

Magnetic Island

Bluewater

Annandale

Figure 2-4 Black Ross WQIP Consultation Process

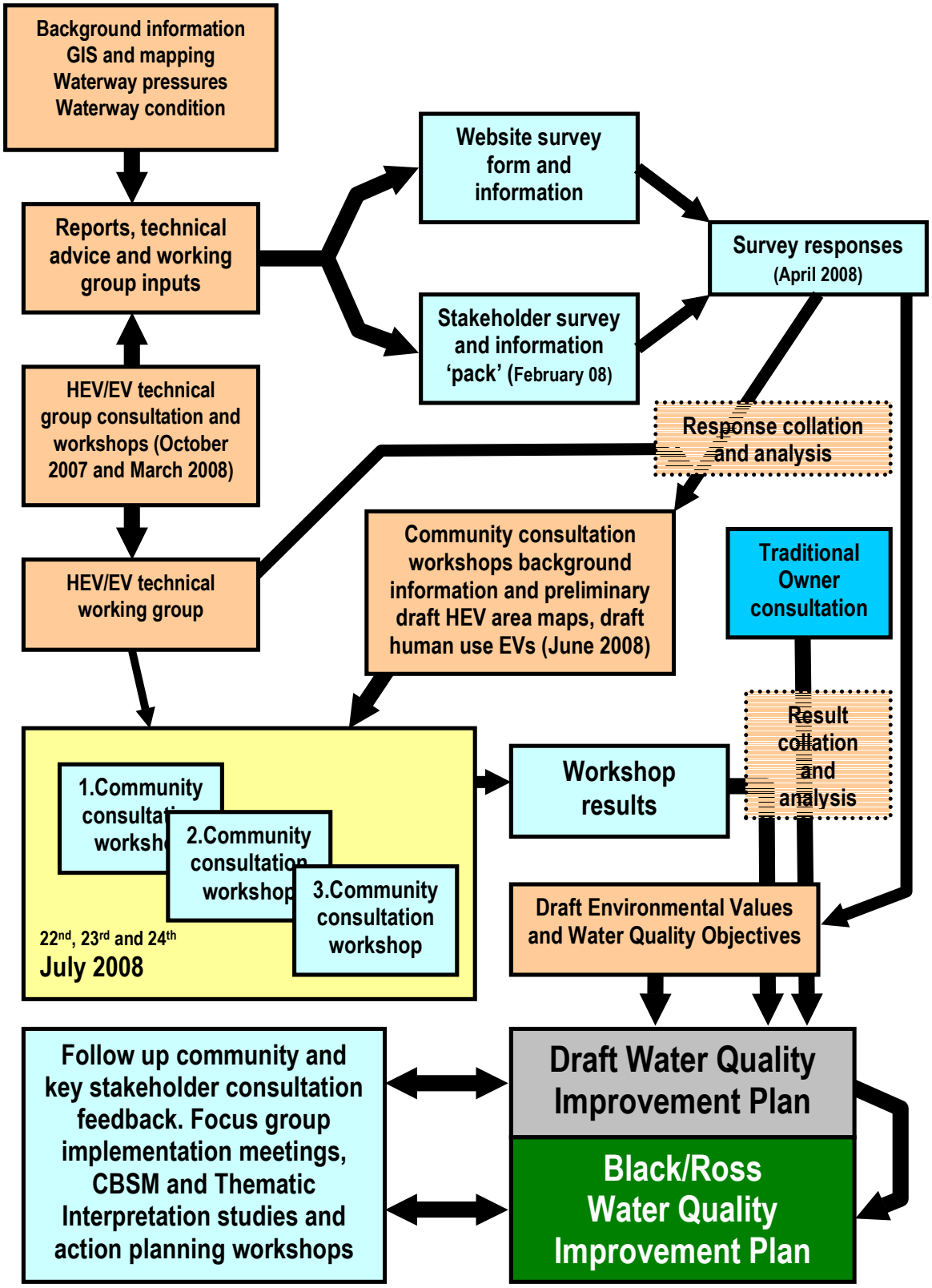


Table 2-1 Draft Environmental Values Black Basin

Waterway	Irrigation	Farm supply	Stock watering	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Industrial use	Cultural and spiritual values	Aquatic ecosystems
Freshwaters (Note: Instream storages (dams, weirs and barrages) have been underlined)												
Black River Basin												
Crystal Creek (Upland)						L	L	M - H	H		H	HEV
Crystal Creek (Lowland)	M	M	H		M	H	L - M	H	H		H	SMD
Lorna Creek (Upland)						L	L	L			H	SMD
Lorna Creek (Lowland)	M	M	H		M	H	L - M	H			H	SMD
Ollera Ck (Upland)						L	L	L			H	HEV
Ollera Creek (Lowland)	M	M	H		M	H	L - M	H			H	SMD
Scrubby Ck (Upland)						L	L	L			H	HEV
Scrubby Creek (Lowland)	M	M	H		M	H	L - M	H			H	SMD
Hencamp Ck (Upland)						L	L	L			H	HEV
Hencamp Ck (Lowland)	M	M	H		M	H	L - M	H			H	SMD
Rollingstone Ck (Upland)						L	L	L			H	HEV
Rollingstone Ck (Lowland)	M	L	H		M	H	L - M	H	L [E]		H	SMD
Surveyors Ck	L [E]					L	L	L			H	HEV
Wild Boar Creek						L	L	L			H	HEV
Station Creek					L [S]	L	L	L			H	HEV
Saltwater Ck (Upland)						L	L	L			H	HEV
Saltwater Creek (Lowland)	M	L	H		M	H	M	M			H	HEV
Cassowary Ck (Upland)						L	L	L			H	HEV
Cassowary Ck (Lowland)	M	L	H		M	H	L - M	H			H	HEV
Leichhardt Ck (Upland)											H	HEV
Leichhardt Ck (Developed)	M	L	H		M	H	M	M	L		H	SMD
Christmas Ck (Upland)											H	HEV
Christmas Ck (Developed)	L	L	H		M	H	L - M	H			H	SMD
Sleeper Log Ck (Upland)											H	HEV

Waterway	Irrigation	Farm supply	Stock watering	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Industrial use	Cultural and spiritual values	Aquatic ecosystems
Sleeper Log Ck (Developed)	L	L	H		M	H	L - M	H			H	SMD
Two Mile Creek					L [S]		L [S]				H	SMD
Bluewater Ck (Upland)						L	L	M - H			H	HEV
Bluewater Ck (Lowland)	M - H	M	H		M	H	H	H			H	SMD
Althaus Creek (Upland)						L	L	M - H			H	HEV
Althaus Creek (Lowland)			H		L	H	H	H			H	SMD
Deep Creek (Upland)						L	L	M - H			H	SMD
Deep Creek (Lowland)	M - H	M	H		L	H	H	H			H	SMD
Healy Creek				?	L [S]		L [S]	L			H	SMD
Black River (Upland)						L	L	L			H	HEV
Black River (Lowland)	L		H		L	L			L [E]	M	H	SMD
Alick Creek (Black R trib.)	[E]		[E]								H	SMD
Log Creek (Black R trib.)	[E]		[E]								H	SMD
Scrubby Ck (Upland)					L [S]	L	L	L			H	SMD
Alice River (Developed)	L		H		L	L					H	SMD
Canal Creek (Alice R trib.)	[E]								[E]		H	SMD

Notes: These notes apply to all draft Environmental Values tables. Most of the human use values have been identified from stakeholder workshops where L = Low, M = Medium and H = High use/value. Additional uses identified through a prior study and not identified at the workshop are indicated by [S] for the preliminary stakeholder survey, [X] from the human use study and [E] from DNRW water licencing extraction data (see Human Use EVs Report for more detail). For Cultural and Spiritual human use a default high value was assigned at workshops. Traditional Owner consultation will be used to define the values.

Aquatic ecosystem environmental values were initially identified through a desktop review and technical panel workshops. The draft aquatic ecosystem environmental values were then reviewed at stakeholder workshops. The WQIP study team is continuing to review/update this information and we welcome further comment on the draft ecological values identified in the tables.

HEV = High ecological/environmental value, SMD = Slightly to moderately disturbed, HD = Highly disturbed

Table 2-2 Draft Environmental Values Upper Ross Catchment

Waterway	Irrigation	Farm supply	Stock watering	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Industrial use	Cultural and spiritual values	Aquatic ecosystems
Freshwaters												
Ross River Basin (Ross River Dam and upstream)												
Lake Ross (Ross Dam)	L				L	L	L	M	H	M	H	SMD
Ross River (FrW)	L		M - H			L	L	L			H	SMD
Round Mountain Ck (Upland)											H	HEV
Round Mountain Creek	L		M - H			L	L	L			H	SMD
Lagoon Creek	L		M - H			L	L	L			H	SMD
Plum Tee Creek	L		M - H			L	L	L			H	SMD
Central Ck (aka Ross Ck)	L		M - H			L	L	L			H	SMD
Sandy Creek	L		M - H			L	L	L			H	SMD
Spring Creek	L		M - H			L	L	L			H	SMD
Deep Creek	L		M - H			L	L	L			H	SMD
Leichhardt Creek	L		M - H			L	L	L			H	SMD
Cattle Creek	L		M - H		L [X]	L	L	L			H	SMD
Six Mile Creek	L	L	M					L			H	SMD
Toonpan Lagoon	M [E]	L	M					L			H	SMD
Jimmys Lagoon	L	L	M					L			H	SMD
Four Mile Ck /Flagstone Ck	L	L	M					L			H	SMD
One Mile Creek/Spring Creek	H [E]	L	M					L			H	SMD
Lansdowne Creek	H [E]	L	M					L			H	SMD
Antill Plains Creek	L	L	M					L			H	SMD
Sachs Creek (Upland)											H	HEV
Sachs Creek	M [E]					L	L	M	L [E]		H	SMD
Blacksoil Gully/Mt Stuart (Upland)											H	HEV
Blacksoil Gully/Mt Stuart						L	L	L			H	SMD

Table 2-3 Draft Environmental Values Ross River Basin (excluding Upper Ross River)

Waterway	Irrigation	Farm supply	Stock watering	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Industrial use	Cultural and spiritual values	Aquatic ecosystems
Freshwaters												
Ross River Basin (east)												
Alligator Ck (Upland)	L?					H	H	H	L		H	HEV
Alligator Creek (Lowland)	L - M	M	L		L - M	L	L - M	L - M	L		H	SMD/HD
Whites Creek (Upland)											H	HEV
Whites Creek	L		L		L	L	L - M	L - M			H	SMD
Slippery Rocks Ck (Upland)											H	HEV
Slippery Rocks Creek	L		L		L	L	L - M	L - M			H	SMD
Crocodile Creek	L		L		L	L	L - M	L - M	L		H	SMD
Killymoon Creek (Upland)											H	HEV
Killymoon Creek	M		L		L	L	L - M	L - M	L		H	SMD
Cape Cleveland						L	L	L			H	HEV
Stuart Creek (ephemeral)	L	L	L			L		L			H	SMD
Stuart Creek (includes pools)	L	L	L		M	L	M	L - M			H	SMD/HD
Sandfly Creek			L			L	L	M			H	SMD
Ross River Basin (west)												
	Now / future	**Now / future**	**Now / future**	**Now / future**	**Now / future**	**Now / future**	**Now / future**	**Now / future**	**Now / future**	**Now /future**	**Now / future**	
Stoney Creek	L		L		L	L	L	M			H	SMD
Saunders Creek	L		L		L	L	L	M			H	SMD
Bohle R (above Condon STP)	L	L	L		L	L	L	L			H	SMD
Bohle R (below Condon STP)	L	L	L		M	M/H	M/H	M/H			H	SMD
Little Bohle River	L		L		L	L	L	M			H	SMD
Middle Bohle Creek	L		L		L	L	L	M			H	SMD

Waterway	Irrigation	Farm supply	Stock watering	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Industrial use	Cultural and spiritual values	Aquatic ecosystems
Louisa Creek					L		L	L			H	HD
Town Common							L - M	H			H	SMD
Ross River Basin (below the Ross River Dam)												
Ross River (below Dam)	M	L			H	H	H	H			H	SMD
Ross River Weir Pools (All)	M				H	H	H	H			H	HD
Ross River (Black Weir)	H				H	H	H	H	H		H	HD
Ross R (Gleesons Weir)	L				H	H	H	H			H	HD
Ross River (Aplins Weir)	L				H	H	H	H			H	HD
Tributaries (Defence land)					L	L	L	L			H	HEV to HD
University (Campus) Creek					L	L	L	M			H	HEV to HD
Lavarack ? Ck with weirs					L	L	L	M			H	HD
Ross Creek and tributaries					H	L	L	H			H	HD
Pallarenda					H		H	H			H	HD

Table 2-4 Draft Environmental Values Magnetic Island

Waterway	Irrigation	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Cultural and spiritual values	Aquatic ecosystems
Freshwaters								
Magnetic Island								
Retreat Creek	H	L	M	H	H	L	H	HEV/SMD
Duck Creek	L		M	H	H	L	H	HEV/SMD
Chinamans Gully		L [S]	L	L [S]	L [S]		H	HEV/SMD
Ned Lee Creek			H	H	H	L	H	HEV/SMD
Butler Ck (Picnic Bay)		L	L [S]	L	M		H	SMD/HD
Picnic Bay west creek		L	L [S]	L	M		H	SMD/HD
Gustav Creek (Upland)		L	M	M - H	M - H		H	HEV
Gustav Creek (Lowland)		L	L	H	H		H	SMD/HD
Hoyer Creek (Nelly Bay)			L	L	H		H	SMD/HD
North Nelly Bay creek				L	H		H	HEV/SMD
Petersen Creek (Upland)		L	M - H	H	H		H	HEV
Petersen Creek (Lowland)			M - H	H	H		H	SMD/HD
Gorge Creek (Upland)		L	M - H	H	H		H	HEV
Gorge Creek (Lowland)		L	L	L	H		H	SMD/HD
Endeavour Creek (Upland)		L	M - H	H	H		H	HEV
Endeavour Creek (Lowland)			M - H	H	H		H	SMD
East Horseshoe Bay creek		L	L	L - M	H		H	SMD
Five Beach Bay			M - H	H	H		H	HEV

Notes: Where HEV/SMD is indicated the HEV areas are upstream from the break of slope between the coastal plain and the granite hills

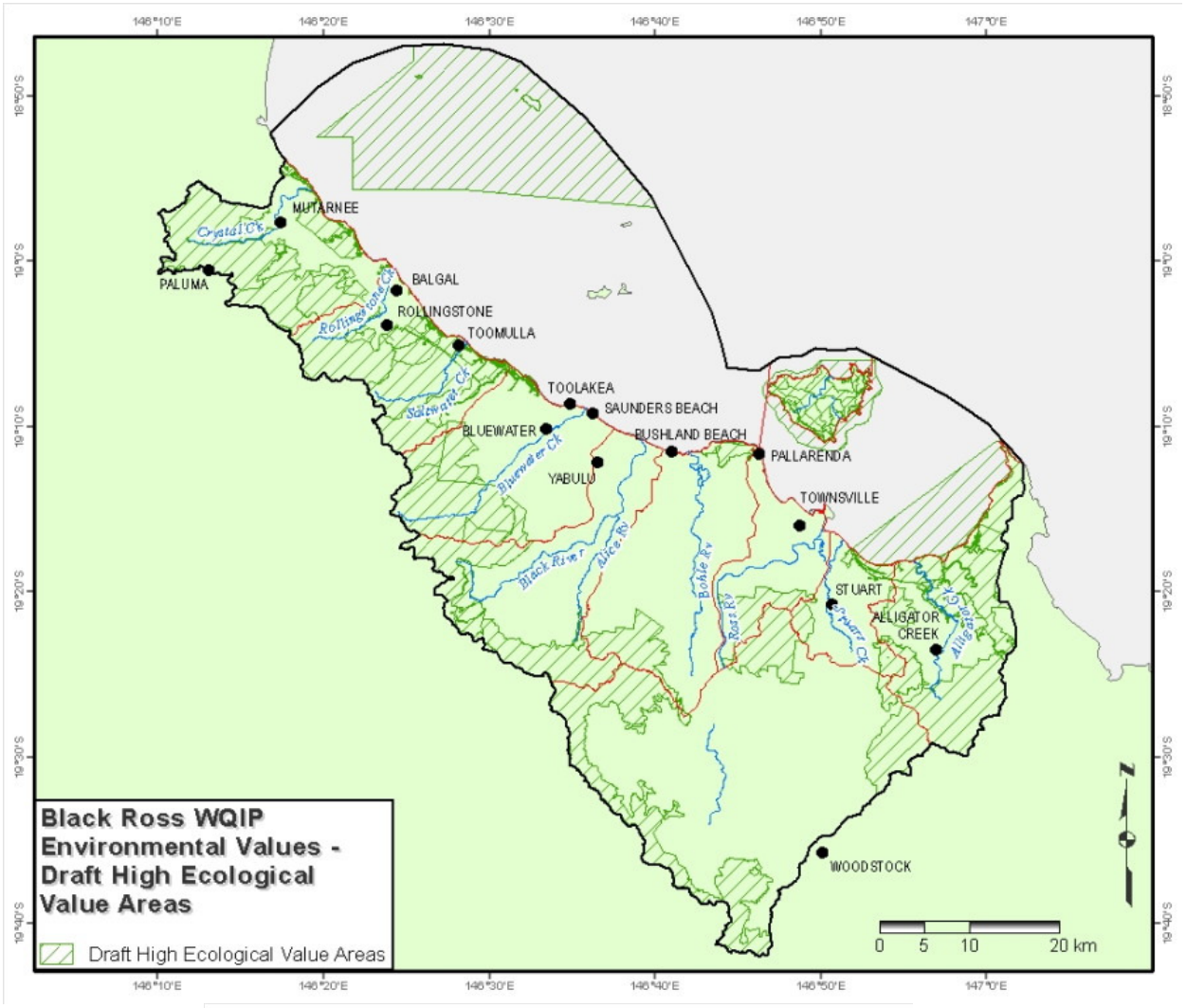
Table 2-5 Draft Environmental Values Mainland Estuaries

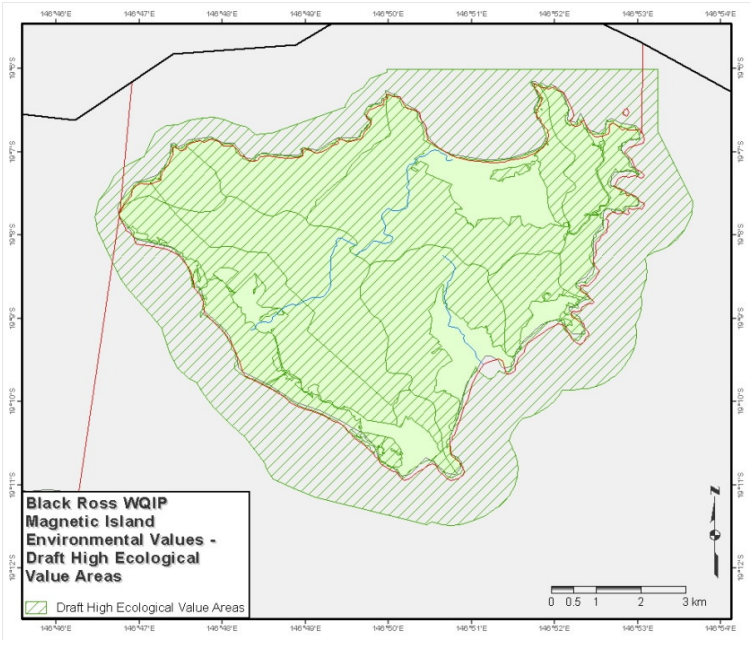
Waterway	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Industrial use	Cultural and spiritual values	Aquatic ecosystems
Estuarine Waters								
Crystal Creek		H	M	M - H	H		H	SMD
Lorna Creek		H	M	M - H	H		H	SMD
Ollera Creek		H	M	M - H	H		H	HEV
Scrubby Creek		H	M	M - H	H		H	HEV
Hencamp Creek		H	M	M - H	H		H	SMD
Rollingstone Creek		H	L	H	H		H	SMD
Surveyors Creek		H	M	M - H	H		H	HEV
Wild Boar Creek		H	M	M - H	H		H	HEV
Station Creek		H	M	M - H	H		H	HEV
Saltwater Creek	H	H	L	H	H		H	HEV
Cassowary Creek		L	L	L	L		H	HEV
Leichhardt Creek		H	L	H	H		H	SMD
Christmas Creek		H	L	H	H		H	SMD
Two Mile Creek		H	L	H	H		H	SMD
Bluewater Creek		H	L	L	H		H	SMD
Deep Creek		H	L	H	H		H	SMD
Healy Creek		H	L	H	H		H	SMD
Black River		H	L	M	L		H	SMD
Bohle River (upper)		M		M	L - M		H	SMD
Bohle River (lower)		H		H	H		H	SMD
Town Common		L [SX]			H		H	SMD
Louisa Creek		M		M	M		H	SMD
Ross River sub basin		H		H	H	M	H	SMD
Stuart Creek sub basin	L	H	L	H	H		H	SMD
Alligator Creek sub basin	L	H	L	H	H		H	HEV

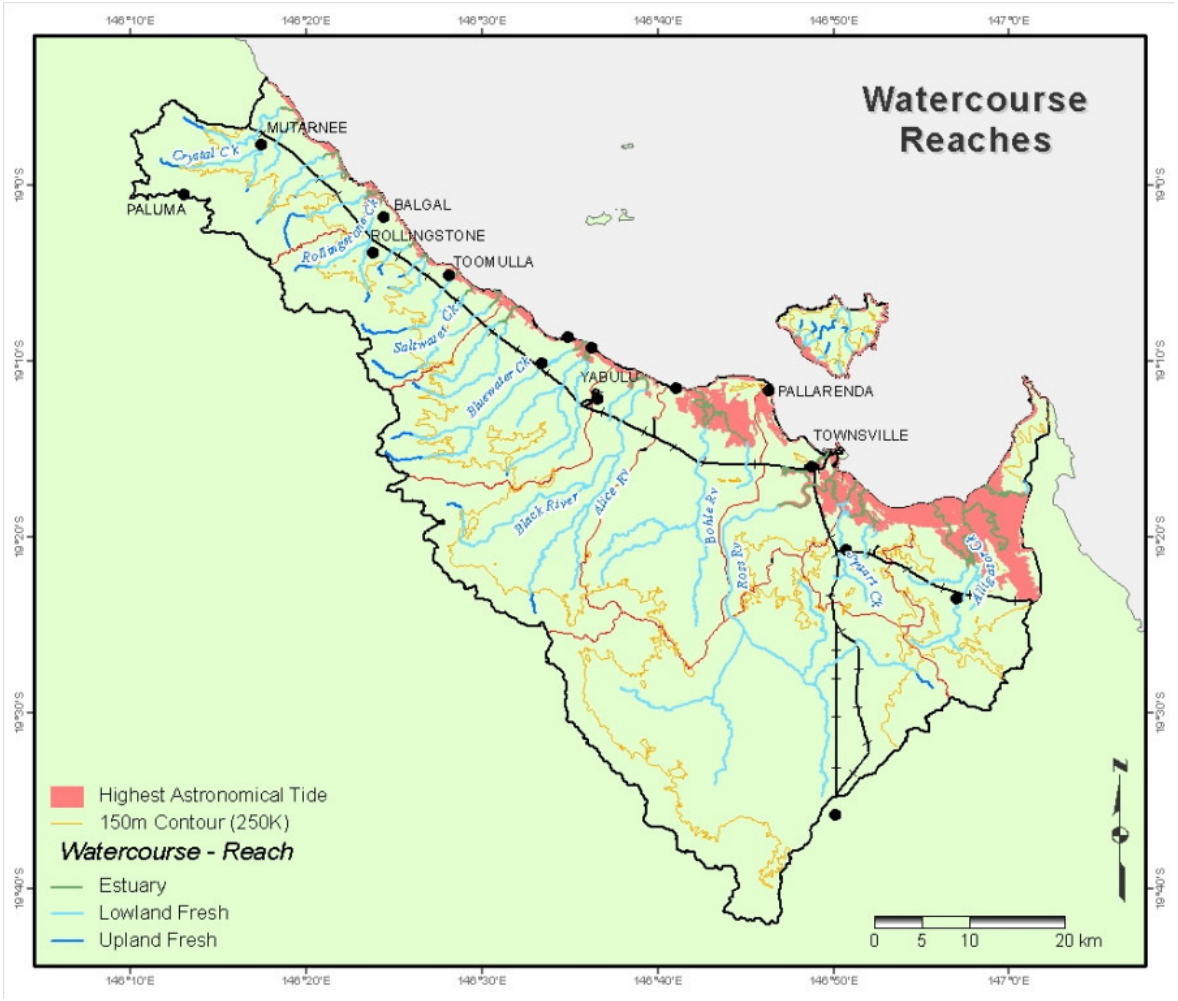
Table 2-6 Draft Environmental Values Magnetic Island Estuaries and Coastal and Marine

Waterway	Aquaculture 	Human consumer 	Primary recreation 	Secondary recreation 	Visual appreciation 	Cultural and spiritual values 	Aquatic ecosystems 
Estuaries							
Magnetic Island (in general)		H	L	L	H	H	HEV
Butler Creek		L	M	M	H	H	SMD
Gustav Creek		L - M	H	H	H	H	HD
East Horseshoe Bay creek		L	L	L	H	H	SMD
Near Coastal and Marine Waters							
Magnetic Island (near coastal)							
West Coast		H	M - H	H	H	H	HEV
Picnic Bay		H	M - H	H	H	H	HEV
Nelly Bay		H	M - H	H	H	H	HEV
Arcadia		H	M - H	H	H	H	HEV
Radical Bay		H	M - H	H	H	H	HEV
Horseshoe Bay	M	H	H	H	H	H	HEV
Five Beach Bay		H	M - H	H	H	H	HEV
Rollingstone Bay		H	M - H	H	H	H	HEV
Remainder (near coastal and marine)							
West Channel		H	H	H	H	H	SMD
Cleveland Bay		H	H	H	H	H	HEV/SMD
Halifax Bay		H	H	H	H	H	SMD
Outer Marine		H	H	H	H	H	HEV/SMD

Figure 2-5 Draft High Ecological Value Areas






Watercourse Reaches
MUTARNEE
PALUMA
BALGAL
ROLLINGSTONE
TOOMULLA
YABULU
PALLARENDA
TOWNSVILLE
Crystal Ck
Saltwater Ck
Blackwater Ck
Black River
Alice R
Bohle R
Ross R
Stuart Ck
Highest Astronomical Tide
150m Contour (250K)
Watercourse - Reach
Estuary
Lowland Fresh
Upland Fresh
0 5 10 20 km
N

3. Water Quality Guidelines

3.1 Australian Water Quality Guidelines

Australian water quality guidelines (AWQG) were published in 2000. These set benchmark values against which the quality of waters can be assessed. They also provide the technical base for draft water quality objectives.

The Australian water quality guidelines were developed under the National Water Quality Management Strategy (NWQMS). It is difficult for a national document to cover the vast range of water types found in Australia and the AWQG themselves recommend developing more regionally specific guidelines. The Queensland Water Quality Guidelines were developed to deliver this regional focus.

3.2 Water Quality Targets OnLine

Water quality targets online was developed to assist regional groups to set water quality targets. Essentially it is a tool that extracts guideline values from *The Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ 2000) to use as a starting point for developing water quality targets.
(Previously available online at http://www.environment.gov.au/water/publications/quality/targets-online/index.php)

Default water quality guidelines for human use and trigger values for aquatic ecosystems from Water quality targets online, are provided in the tables in Appendix A for the Tropical Queensland zone, which encompasses the Black and Ross Basins area. It should be noted that the trigger values are lower than the Queensland Water Quality Guidelines (QWQG) in some cases and are included for reference only (see Appendix A). The QWQG is the main reference for informing our draft set of water quality guidelines and objectives. A summary of human use water quality guidelines derived from Water Quality Targets Online is provided in Table 3-4.

3.3 Queensland Water Quality Guidelines

The *Queensland Water Quality Guidelines 2006* (EPA 2006) (QWQG) were approved for commencement with the Environmental Protection (Water) Amendment Policy (No. 1) 2006 - Subordinate Legislation 2006 No. 30, on the 1st of May 2006.

The QWQG, developed by the Environmental Protection Agency (EPA), are technical guidelines for the protection of aquatic ecosystems. They complement the NWQMS, including the AWQG, by delivering guidelines that include locally and regionally relevant water quality data for fresh, estuarine and marine waters. The QWQG focus largely on aquatic ecosystem protection, initially across three geographic regions for which regional data is available:

- South-east;
- Central Coast; and
- Wet Tropics.

The geographic area extends from Cape York to the Queensland/New South Wales border and west to the Great Dividing Range coastal watershed. The Black Ross WQIP area is within the Central Coast region.

3.3.1 Further details on the guidelines

The EPA has been collecting water quality data from reference (unimpacted) waterways since 1992, and has used this data, together with data collected throughout Queensland by a range of government agencies, tertiary institutions and other organisations, to derive the QWQG. The purpose of the QWQG is to provide guideline values that are tailored to Queensland regions and water types. When guideline information is required for Queensland waters, the Queensland guidelines should be consulted first. However, there are a number of indicators for human use environmental values including, human health, toxicants and primary industry for which the ANZECC 2000, AWQG will remain a primary source of information.

To set about improving or maintaining water quality, clear targets are needed. To protect aquatic ecosystems, knowledge of the requirements for physical and chemical qualities for habitat and flows and what constitutes a healthy ecosystem, is necessary. For agricultural use, crop and livestock requirements need to be known, and for human recreational use, the risks to human health need to be known about. Such information is presented in the form of guidelines – compilations of information about water quality and its impacts on ecosystems and the various human uses of waters.
(Source: http://www.epa.qld.gov.au/environmental_management/water/water_quality_guidelines/#gen0)

3.3.2 Aquatic ecosystems

The physico-chemical water quality guidelines for the Central Coast region from the QWQG (EPA 2006) are presented in Table 3-1.

Table 3-1 Aquatic Ecosystem Physico-chemical Water Quality Guidelines

Water type	Physio-chemical indicator and guideline value													
	Amm N	Oxid N	Org N	Total N	FiltR P	Total P	Chl-a	DO (% sat)		Turb	Secchi	SS	pH	
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	Lower	Upper	NTU	m	mg/L	Lower	Upper
Open coastal	6	3	130	140	6	20	1.0	95	105	1	5	10	8.0	8.4
Enclosed coastal	8	3	180	200	6	20	2.0	90	100	6	1.5	15	8.0	8.4
Mid-estuarine	10	10	260	300	8	25	4.0	85	100	8	1.0	20	7.0	8.4
Upper Estuarine	30	15	400	450	10	40	10.0	70	100	25	0.4	25	7.0	8.4
Lowland streams	20	60	420	500	20	50	5.0	85	110	50	n/a	10	6.5	8.0
Upland streams	10	15	225	250	15	30	n/a	90	110	25	n/a		6.5	7.5
Freshwater lakes/reservoirs	10	10	330	350	5	10	5.0	90	110	1-20	nd	nd	6.5	8.0
Wetlands	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Source: EPA 2006. These are the Water Quality Guidelines for the Central Coast Queensland region (Burnett River Basin to Black River Basin) for slightly-moderately disturbed aquatic ecosystems.
Notes: n/a is not applicable and nd is no data. Mid-estuarine water type includes tidal canals, constructed estuaries, marinas and boat harbours.
Amm N = ammonia nitrogen, Oxid N = oxidised nitrogen, Org N = organic nitrogen, Total N = total nitrogen, FiltR P = filterable reactive phosphorus, Total P = total phosphorus, Chl a = chlorophyll a, DO = dissolved oxygen (percent saturation), Turb = turbidity, Secchi = Secchi depth.

Additional notes from the table
1 DO guidelines (% saturation) for freshwaters should only be applied to flowing waters, including those with significant sub surface flows. Stagnant pools in intermittent streams naturally experience values of DO below 50% saturation.
2 DO guideline values apply to daytime conditions. Lower values may occur at night but should not be more than 10%-15% less than daytime values.
3 DO values as low as 40% may occur in estuaries for short periods following material inflow events after rainfall. DO values consistently <50% are likely to significantly impact on the ongoing ability of fish to persist in a waterbody. DO values <30% saturation are toxic to some species. These values should be applied as absolute lower limit guidelines for DO. Very high DO (supersaturation) values can be toxic to some fish as they cause gas bubble disease.
4 During flood events or nil flow periods, pH values should not fall below 5.5 (except in wallum areas) or exceed 9.
5 In wallum areas, waters contain naturally high levels of humic acids and have a characteristic ti-tree stain. In these types of waters, natural pH values may range form 3.6-6.0.
6 During periods of low flow and particularly in smaller creeks, build up of organic matter derived from natural sources e.g. leaf-litter, can result in increased organic N levels (generally in the range of 400 to 800 µg/L). This may lead to total N values exceeding the QWQG values. Provided that inorganic N (i.e. NH3 and oxidized N) remain low, then the elevated levels of organic N should not be seen as a breach of the guidelines, provided this is due to natural causes.

7 For wetlands see AWQG 2000.
8 For estuaries the turbidity, secchi, and SS guideline numbers apply to estuaries less than 40km in length. Longer estuaries have naturally higher turbidity levels (and corresponding higher suspended solids levels and lower Secchi depth values) due to the longer retention times for suspended particulates and also to the continual resuspension of fine particles by high tidal velocities. Values are variable and site specific. However, most values are <100 NTU and very few values are >200 NTU.
9 For information on general application of the guidelines values, on their application under different flow conditions and on approaches to assessing pulse inputs of pollutants see Section 4 and Appendix D of the QWQG.
10 In the absence of better data, the guidelines adopted for freshwater are for the most part the default AWQG 2000 guidelines. It is acknowledged that these need to be updated with local data as soon as this is available.
11 Temperature varies both daily and seasonally, it is depth dependent and is highly site specific. It is therefore not possible to provide simple generic water quality guidelines for this indicator. The recommended approach is that local guidelines be developed. Thus, guidelines for potentially impacted streams should be absed on measurements from nearby streams with a similar morphology and which are thought not to be impacted by anthropogenic thermal influences.
From an ecological effects perspective, the most important aspects of temperature are the daily maximum temperature and the daily variation in temperature. Therefore measurements of temperature should be designed to collect information on these indicators of temperature, and, similarly, local guidelines should be expressed in terms of these indicators. Clearly there will be an annual cycle in the values of these indicators and therefore a full seasonal cycle of measurements is required to develop guideline values.

Conductivity values (EC) for freshwaters (from the QWQG Appendix G, p.103) for Central Coast North, based on the 75th percentile value, is 375 µS/cm for the Black Basin. The Ross Basin is in the Burdekin-Bowen region and the corresponding value is 271 µS/cm.

Temperature – managers need to define their own upper and lower guideline values using the 80th and 20th percentiles of ecosystem temperature distribution from the AWQG (2000).

3.3.3 Human use guidelines

In the course of their work organisations in Queensland have developed water quality guidelines associated with human use. While generally not required in terms of the Black Ross WQIP for setting water quality improvement targets they will be relevant in some circumstances. Reference to the human use water quality guides for Queensland is provided in Table 3-2.

Table 3-2 Human Use Water Quality Guides

QWQG Ref.	Title	Organisation
Table 5.1.2 p.54	The general recommended levels of water quality parameters for tropical aquaculture	QDPIF
Table 5.1.3 p.55	Recommended levels of water quality parameters for optimal growth of particular species in freshwater	QDPIF
Table 5.1.4 p.56	Recommended levels of water quality parameters for optimal growth of particular marine species	QDPIF
Table 5.2.1 p.57	Guidelines for blue-green algae for primary contact recreation	QDNRW
Table 53.1 p.58	Guidelines for drinking water supply in the vicinity of storage off-takes or in groundwater supplies, before treatment	SEQ Water Corporation

3.3.4 Other applicable guidelines

In the absence of more locally applicable guidelines the guidelines in Table 3-3 are recommended for use in the QWQG.

Table 3-3 Other applicable guidelines for Queensland

Environmental value	Water quality guidelines for particular water types
Aquatic ecosystems	Toxicants in water, sediment and biota as per AWQG 2000 Release of sewage from vessels to be controlled in accordance with requirements of the Transport Operations (Marine Pollution) Act and Regulations, 1995 Comply with Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance, ANZECC
Protection of the human consumer	Guidelines as per ANZECC 2000 and *Food Standards Code*, Australia New Zealand Food Authority, 1996 and updates
Primary contact recreation Secondary contact recreation	Guidelines as per National Health and Medical Research Council (NH&MRC) 2005 – *Guidelines for managing risk in recreational waters*. Endorsed in June 2005. Can be accessed from http://www.nhmrc.gov.au/publications/_files/eh38.pdf.
Visual recreation	Guidelines as per ANZECC 2000
Cultural & spiritual values	Protect or restore Indigenous and non-Indigenous cultural heritage consistent with relevant policies and plans
Industrial use	No guidelines are provided in ANZECC 2000. Some were given in AWQG 1992 but guidelines vary according to the industry and this value is usually protected by other values, such as aquatic ecosystem
Aquaculture	Guidelines as: • Queensland Department of Primary Industries – Water Quality in Aquaculture – DPI Notes April 2004; and • ANZECC 2000 and Food Standards Code, Australia New Zealand Food Authority, 1996, and updates
Irrigation/Stock watering/ Farm use	Guidelines as per ANZECC 2000
Drinking water supply	See Table 5.3.1 for local guidelines. See also Australian Drinking Water Guidelines (2004)
Drinking water	Guidelines as for Australian Drinking Water Guidelines (2004). Can be accessed on http://www.nhmrc.gov.au/publications/synopses/eh19syn.htm

Note: Weblinks have not been checked for currency.

Source: QWQG 2006 (p.59)

A summary of human use physico-chemical water quality guideline values is provided in Table 3-4, a summary of pesticide guideline values in Table 3-5 and a summary of metals guideline values in Table 3-6.

Table 3-4 Human Use Water Quality Guidelines Summary - Physico-chemical

Human Use	Ammonia N	Nitrite NO_2 N	Nitrate NO_3 N	Total N	Phosphates	Total P	Turbidity	Secchi depth	Suspended Solids	Salinity	Chloride	Sodium
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	NTU	m	mg/L	µS/cm	µg/L	µg/L
Recreation Primary	10	1,000	10,000					>1.6			400,000	300,000
Recreation Secondary	10	3,280	44,300					na			400,000	300,000
Recreation Visual	na	na	na				<20% change	<20% change			na	na
Drinking water (Health)	ns	3,000	50,000								nr	nr
Drinking water (Aesthetics)	500	ns	ns				5				250,000	180,000
Drinking water supply*							25		25			
Aquaculture (Freshwater)	<20 <30	<100	<50,000		100		<80		<40	<4,500		
Aquaculture (Saltwater)	<100	<100	<100,000		<50				10-75	49,000 - 55,000		
Livestock drinking water		<30,000	<400,000							<3,000		
Irrigation long term				5,000		50				950		
Irrigation short term				25,000 to 125,000		800 to 12,000					<175,000	<115,000

Notes: na is not applicable, ns is not specified, nr is not required. Drinking water (Aesthetics) is taste and odour. Aquaculture includes human consumption of aquatic food. Aquaculture ammonia values are for cold water (<20) and warm water (<30). Livestock drinking water salinity value is for poultry, the lowest impact on the most sensitive livestock type (values for less sensitive livestock are 2-2.5 times higher). Irrigation Chloride and Sodium vales are for sensitive crops (values for tolerant crops 4-5 times sensitive values). The highest guideline levels of protection for each water quality indicator are highlighted in yellow.

Source: Water Quality Targets Online (Environment Australia (Department of Environment and Heritage) 2002) and * QWQG (EPA 2006, p.58)

Formerly available at http://www.environment.gov.au/water/publications/quality/targets-online/index.php

Table 3-5 Pesticide Guideline Summary by Environmental Value - Freshwater

Pesticide (ug/L)							
Diuron	2.0	30*	1.5 (fish)		40	30	
Atrazine		40*	<3.4 (Rainbow Trout)			40	0.7 H 13 SM
Simazine		20*	10 (fish)			20	0.2 H 3.2 SM
Bromacil		300*				300	
Hexazinone		300*			600	300	
Endosulfan		30*	<0.003		40	30	0.03 H/SM
Malathion			<0.1				0.002 H 0.05 SM

Notes: Most stringent water quality guideline values are shaded yellow.
Irrigation AWQG Table 4.2.12
* Stock drinking water (AWQG - in the absence of guidelines derived specifically for livestock, refer to the Australian Drinking Water Guidelines (NHMRC & ARMCANZ 1996).
Aquaculture and human consumption (d Alistair)?
Aquaculture and human consumption AWQG Table 4.4.3 for Endosulfan and Malathion
Recreation AWQG Table 5.2.4
Drinking water Drinking water from ADWG (2004) Table 10.11 Guideline values for pesticides (Also - Above detection limits specified by Qld Health Scientific Services QWQG Table 5.3.1)
Aquatic ecosystem values are H = High Ecological Value (99% of species protected) and SM = Slightly to Moderately Modified (95% of species protected) Source: AWQG Table 3.4.1 'Trigger values for toxicants at alternative levels of protection' (aquatic ecosystems) Part 8, 9 and 10 (all other values are ID i.e. insufficient data)

Table 3-6 Metals Guideline Summary by Environmental Value - Freshwater

Metal (ug/L)	 a	 a	 q/a	 e	 d	 d	 d	
Cadmium (Cd)	10 LT 50 ST	10	3.0 (0.2-1.8)		5		2	0.06 H 0.2 SM
Chromium (Cr)	100 LT 1000 ST	1000	100 (20)		50		50	0.01 H 1.0 SM
Copper (Cu)	200 LT 5000 ST	400-5000	6 (5)	1000	1000	1000	2000	1.0 H 1.4 SM
Lead (Pb)	2000 LT 5000 ST	100	30 (1-7)		50		10	1.0 H 3.4 SM
Nickel (Ni)	200 LT 2000 ST	1000	10 sw-40 hw (100)		100	50000	20	8 H 11 SM
Zinc (Zn)	2000 LT 5000 ST	20000	30- 60 sw 100-200 hw (5)	5000	5000		ND	2.4 H 8.0 SM

Notes: Most stringent water quality guideline values are shaded yellow.
Irrigation figures are LT long-term values and ST short-term values from AWQG Table 4.2.10.

Livestock drinking water values vary with livestock i.e. 400 (sheep), 1000 (cattle), 5000 (pigs), and 5000 (poultry) from AWQG Table 4.3.2.
Aquaculture sw is soft water and hw is hard water. The upper figures are from QWQG (Table 5.1.2) and figures beneath (in brackets) are from AWGQ Table 4.4.3. 'Toxicant guidelines for the protection of aquaculture species'
Human consumption
Recreation AWQG Tables 5.2.3 Summary of water quality guidelines for recreational purposes: general chemicals
Drinking water from ADWG (2004) Table 10.10 Guideline values for physical and chemical characteristics
Aquatic ecosystem values are H = High Ecological Value (99% of species protected) and SM = Slightly to Moderately Modified (95% of species protected) Source: AWQG Table 3.4.1 'Trigger values for toxicants at alternative levels of protection' (aquatic ecosystems) Part 1.

3.4 Adopted Water Quality Guidelines Freshwater and Estuaries

Insufficient data is available from the Black Ross region to derive locally relevant water quality guidelines for aquatic ecosystems at this time. Consequently, the Queensland Water Quality Guidelines (EPA 2006) (including the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000)) were adopted as defaults as the preliminary step to establishing draft physico-chemical water quality objectives for fresh and estuarine waters for the Black and Ross River Basins. The water quality guideline values relevant to the environmental values are presented in Table 3-1 for aquatic ecosystems and Table 3-4 for human use (see Appendix A for more detail).

The most stringent value for each water quality indicator for freshwater and estuaries are shown in Table 3-7.

Table 3-7 Highest Water Quality Protection Guideline Values

Water type	Physio-chemical indicator and guideline value													
	Ammonia N	Oxides N	Organic N	Total N	FiltR P	Total P	Chl-a	DO (% sat)		Turbidity	Secchi	Susp Solids	pH	
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	Lower	Upper	NTU	m	mg/L	Lower	Upper
Mid-estuarine	10	10	260	300	8	25	4.0	85	100	8	1.0	20	7.0	8.4
Upper Estuarine	30	15	400	450	10	40	10.0	70	100	25	0.4	25	7.0	8.4
Lowland streams	20	60	420	500	20	50	5.0	85	110	50	n/a	10	6.5	8.0
Upland streams	10	15	225	250	15	30	n/a	90	110	25	n/a		6.5	7.5
Freshwater lakes/reservoirs	10	10	330	350	5	10	5.0	90	110	1-20	nd	nd	6.5	8.0

Notes: Guideline values are predominantly from the QWQG (2006 EPA) for aquatic ecosystem protection (slightly to moderately disturbed systems - Central Coast Region). Variations are shaded (blue) and noted below.
Ammonia - Recreation (Primary and Secondary) guidelines for Ammonia are more stringent in upper estuaries and lowland streams i.e. 10 µg/L.
Turbidity - Drinking water (aesthetics) guidelines for turbidity are more stringent for freshwater i.e. 5 NTU. (Nephelometric turbidity unit)
Secchi depth - Primary recreation guidelines for Secchi depth are more stringent for estuaries i.e. >1.6m.

3.4.1 Flow regimes

Water quality guidelines are generally representative of ambient or baseflow conditions and are therefore suitable for application under normal baseflow conditions. Streams of the Dry Tropics are often ephemeral and lack baseflow for part, or most, of the year. Streams are also subject to flood events with short periods of high flow. Determining appropriate water quality guidelines for these conditions is difficult as the water quality monitoring data is generally not available to do so.

Creek to Coral has undertaken two years of event monitoring as part of the development of the Black Ross WQIP and still needs a significant amount of additional information to determine local event water quality guidelines and normal baseflow guidelines. The information that has been gathered to date will be used to make some initial assumptions about event flow guidelines while defaulting to the Queensland guidelines for baseflow (ambient).

The development of the database and collation of a significant amount of water quality data has been undertaken by Creek to Coral as part of the condition assessment process for the Black Ross WQIP. The water quality data gathered locally may be useful in determining water quality guidelines for baseflow and no flow conditions, however additional effort is needed beyond the collation of the data in a database to determine waterway condition. It is planned to undertake the additional work as a component of WQIP implementation and to inform the adaptive management strategy underpinning the WQIP.

The QWQG identifies reference sites in the Black Ross WQIP area (see Table 3-8), which may be useful in the development of local water quality guidelines.

Table 3-8 Black Ross WQIP Area Reference Sites

Location	Water type	Latitude	Longitude
Little Crystal Creek at Paluma Road	Freshwater	-19.01640	146.26580
Little Crystal Creek at Moodys	Freshwater	-18.98190	146.28560
Bluewater Creek at foothills	Freshwater	-19.23972	146.48944
Alligator Creek at Bowling Green Bay NP	Freshwater	-19.43670	146.94580
Cleveland Bay	Open coastal	-19.18389	146.92111

Source: QWQG 2006 Appendix F

3.5 Great Barrier Reef Marine Park Draft Water Quality Guidelines 2008

The *Marine Water Quality Guidelines for the Great Barrier Reef Marine Park* (Great Barrier Reef Marine Park Authority 2008) were developed as a draft for public consultation and is the most recent set of water quality guidelines for the marine environment.

GBRMPA emphasised that the levels of contaminants identified in the guideline are not targets but rather "*they are guideline trigger values that, if exceeded, identify the need for management responses*" (GBRMPA 2008, p.8). Water Quality Improvement Plans being developed for the Great Barrier Reef catchments and regional natural resource management plans are seen as the appropriate avenues to respond to water quality issues in the marine environmental as a result of terrestrial activities in the Great Barrier Reef (GBR) catchments.

Five distinct water bodies were defined for the GBR guideline:

- Enclosed coastal;
- Coastal;
- Inshore;
- Offshore; and
- The Coral Sea.

The enclosed coastal water body was adopted from the *Queensland Water Quality Guidelines 2006* (EPA 2006) to ensure a consistency between State and Australian water quality guidelines in the Great Barrier Reef Marine Park (GBRMP) (GBRMPA 2008, p.17)

"*For coastal, inshore and offshore water bodies the Australian Institute of Marine Science (AIMS) was commissioned to analyse the years of sediment and nutrient data that have been collected from the Great Barrier Reef and derive the trigger values for relevant parameters to the health of the marine ecosystem*" (GBRMPA 2008, p.23). The parameters analysed were: Secchi depth, chlorophyll, suspended solids, particulate, dissolved and total nitrogen, and particulate, dissolved and total phosphorus.

Trigger values for the majority of sediment and nutrient parameters are expressed as annual mean concentrations that should not be exceeded. The exception is Secchi depth. "*The guideline trigger value chosen for Secchi depth is a mean annual water clarity minimum for each water body*". There needs to be some adjustment for this parameter depending on tidal range as "*areas with high tidal ranges experience intense resuspension regimes while chlorophyll and many of the nutrient concentrations in this zone are low*" (GBRMPA 2008, p.25).

The derivation of pesticide guideline trigger values is described in terms of high, moderate and low reliability guideline trigger values with reference to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000* (ANZECC and ARMCANZ 2000) (GBRMPA 2008, pp.26-27).

"*Continued research on relationships between land use actions and intensity in individual catchments to river pollutant loads and to water quality conditions and ecosystem health in the estuaries, coastal seagrasses and the coral reefs of the Great Barrier Reef is essential to improved understanding and management*" (GBRMPA 2008, p. 71).

3.5.1 Sediments and nutrients

"*For the enclosed coastal water body guideline trigger values are adopted from the Queensland Water Quality Guidelines 2006 (EPA 2006). This adoption facilitates a complementarity between Queensland and Australian Government water quality guidelines in the Great Barrier Reef Marine Park*" (GBRMPA 2008, p.29).

The trigger values derived in the guideline are presented in the following tables. Parameters that are not listed here default to the Queensland Water Quality Guidelines 2006, which in turn default to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000.

3.5.2 Water clarity and chlorophyll a

"*For coastal, inshore and offshore water bodies a large number of studies and reviews exist that have demonstrated that high levels of nutrient and sediment lead to deteriorating ecosystem health in coral reefs (reviewed in Fabricius 2005) and many other benthic systems*" (GBRMPA 2008, p.29).

"*Lack of water clarity is a key indicator of poor water quality and is an essential environmental factor for phototrophic organisms that dominate coral reefs, seagrass meadows and the seafloor microphytobenthos (De'ath and Fabricius 2008). Since inorganic nutrients are quickly taken up by phytoplankton, the effects of increased nutrient loads may be expressed as increased phytoplankton biomass, which is readily measured as chlorophyll a concentration, a biological trophic status indicator of the water body*" (GBRMPA 2008, p.30).

GBRMPA guideline trigger values for the related parameters of water clarity (secchi depth) and chlorophyll a are displayed in Table 3-9.

Table 3-9 GBRMP Water Clarity and Chlorophyll a Trigger Values

Water Body Parameter	Enclosed coastal Wet Tropics/ Central Coast	Coastal	Inshore	Offshore
Secchi (metres) (minimum mean annual water clarity)[1]	1.0/1.5	10	10	17
Chl a (µg/L)[2]	2.0	0.45	0.45	0.4

Notes: [1] At shallower depths Secchi will be visible on the seafloor. Guideline trigger values for water clarity need to be decreased by 20% for areas with greater than 5 m tidal ranges. Seasonal adjustments for Secchi depths are presently not possible due to the lack of seasonal data.

[2] Chlorophyll values are ~40% higher in summer and ~30% lower in winter than mean annual values.

Regional guideline values are derived from the 80th percentiles of three or more reference sites.

Sub-regional guidelines are available for Daintree waters and can be referenced in the Queensland Water Quality Guidelines 2006 (EPA 2006).

Source: Table 2: Guideline trigger values for water clarity and chlorophyll a (GBRMPA 2008, p.31)

3.5.3 SS, PN and PP

"*Due to the high correlation between particulate nitrogen, particulate phosphorus, suspended solids and secchi, it is not possible to resolve their individual effects on ecosystem health*" so "*to obtain approximate guideline trigger values, to provide some measure of quantum of improvement required in the current status of the water quality of these parameters, the responses of biota to each of the water quality variables SS, PN and PP were analysed separately*" (GBRMPA 2008, p.33). Guideline trigger values for suspended solids (SS), particulate nitrogen (PN) and particulate phosphorus (PP) developed by GBRMPA are provided in Table 3-10.

Table 3-10 GBRMP Guideline Trigger Values for SS, PN and PP

Water Body Parameter[1]	Enclosed coastal Wet Tropics/ Central Coast	Coastal	Inshore	Offshore
SS (mg/L)	5.0[2]/15	2.0	2.0	0.7
PN (µg/L)		20	20	17
PP (µg/L)		2.8	2.8	1.9

Notes: [1] Seasonal adjustments for SS, PN and PP are approximately ± 20% of mean annual values.

[2] No regional data was available for suspended solids for the Wet Tropics. The current condition mean annual concentration for the coastal water body is adopted here as a guide.

Source: Table 3: Guideline trigger values for SS, PN, and PP (GBRMPA 2008, p.33)

3.5.4 Sedimentation

"*In the longer term, the Great Barrier Reef Marine Park Authority will consider the development of sediment quality guidelines. Such guidelines would aim to include trigger values for sediment nutrient concentrations, which at elevated levels may cause toxicity through the development of excess porewater ammonia and hydrogen sulphide*".
In the interim a guideline trigger value is established at a maximum mean annual sedimentation rate of 3 mg/cm²/day, and a daily maximum of 15 mg/cm² (GBRMPA 2008, p.35).

3.5.5 Temperature

"*Temperature is included in these guidelines because it is clear that corals suffer physiological stress when water temperatures increase above normal maxima*" (GBRMPA 2008, p.36).

A guideline trigger level for sea temperature is set at increases of no more than 1ºC above the long-term average maximum.

3.5.6 Pesticides

"*Seven main herbicides are in widespread use throughout the Great Barrier Reef catchment and are being widely detected in fresh and marine waters of the Great Barrier Reef region. The herbicides are diuron, atrazine, ametryn, simazine, hexazinone, 2,4 -D, and tebuthiuron*" (GBRMPA 2008, p.36).

Aquatic ecosystem protection is the environmental value currently applied to the entire World Heritage Area and for high ecological value water bodies; a guideline concentration that is protective of 99% of species is ideal. High and moderate reliability pesticide trigger values are included in Table 3-11 with low reliability values included in Table 3-12.

Table 3-11 GBRMP Moderate and High Reliability Pesticide Trigger Values

Pesticide	95% species protection	99% species protection
	High reliability trigger value (µg/L)	
Chlorpyrifos	0.009	0.005
	Moderate reliability trigger value µg/L	
Diuron	1.6	0.9
Atrazine	2.4	0.4
Ametryn	1.0	0.5
2,4-D	30.8	0.8
Endosulfan	0.005[1]	0.005
Tributytlin (TBT) [3]	0.003	0.0002

Notes: [1] 99th percentile value recommended reef-wide because of bioaccumulation
[2] This trigger value may not protect keystone species given effect concentrations for adult coral colonies are observed at significantly lower concentrations.
Source: Table 20: Summary of high and moderate reliability guideline trigger values for selected pesticides (GBRMPA 2008, p. 55) [3] added from GBRMPA 2008(pp. 57- 58)

Table 3-12 GBRMP Low Reliability Pesticide Trigger Values

Pesticide	Low reliability trigger value (µg/L)	
	95% coastal and inshore value	99% offshore value
Simazine	3.2	0.2
Hexazinone [1]	75	75
Tebuthiuron	2	0.02
MEMC	0.002	0.002
Diazinon	0.01[1]	0.00003

Notes: [1] This trigger value may not protect keystone species given effect concentrations for adult coral colonies are observed at significantly lower concentrations.
Source: Table 21: Summary of low reliability guideline trigger values for selected pesticides (GBRMPA 2008, p. 55)

3.6 GBRMP Water Quality Guidelines Summary

The following tables provide a summary of the GBRMP water quality guidelines. Unlisted parameters default to the Queensland Water Quality Guidelines 2006, which in turn default to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000*.

Table 3-13 GBRMP Guideline Trigger Values Summary

Water Body Parameter	Enclosed coastal Wet Tropics/ Central Coast	Coastal	Inshore	Offshore
Secchi (metres) (minimum mean annual water clarity)[1]	1.0/1.5	10	10	17
Chl a (µg/L)	2.0	0.45	0.45	0.4
SS (mg/L)	5.0/15	2.0	2.0	0.7
PN (µg/L)	na	20	20	17
PP (µg/L)	na	2.8	2.8	1.9
Sedimentation rate	Maximum mean annual sedimentation rate of 3 mg/cm²/day, and a daily maximum of 15 mg/cm²			
Sea temperature	Increases of no more than 1ºC above the long-term average maximum			

Notes: [1] Guideline trigger values for water clarity need to be decreased by 20% for areas with greater than 5 m tidal ranges.
Source: GBRMPA 2008, p.73

Table 3-14 GBRMP Pesticide Guideline Trigger Values Summary

Pesticide	Trigger value µg/L
	High reliability trigger value µg/L
Chlorpyrifos	0.005
	Moderate reliability
Diuron	0.9
Atrazine	0.4
Ametryn	0.5
2,4-D	0.8
Endosulfan	0.005
	Low reliability
Simazine	0.2
Hexazinone [1]	75[1]
Tebuthiuron	0.02
MEMC	0.002
Diazinon	0.00003
Biocide	**Moderate reliability**
Tributytlin (TBT)	0.0002

Notes: High, moderate and low reliability guideline trigger values were derived for listed pesticides, and for tributyltin, where sufficient marine specific data were available. Where there was insufficient data the trigger values from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 are repeated here. All pesticide and biocide trigger values are set protective of 99 per cent of species. [1] This trigger value may not protect keystone species given sub lethal effect concentrations for adult coral colonies are observed at significantly lower concentrations. Research is recommended to better quantify potential impacts.
Source: GBRMPA 2008, pp.73-74

Table 3-15 GBRMP Default Values Nutrients

Region/Water type	Source/comment	Amm N µg/L	Oxid N µg/L	Org N µg/L	Total N µg/L	FiltR P µg/L	Total P µg/L
Wet tropics							
Open coastal	a, b, c	2	f	130	140	3	20
Enclosed coastal	20/80	15	f	130	160	5	20
Central coast							
Open coastal	d	6	3	135	140	6	20
Enclosed coastal	20/80 e	8	3	180	200	6	20

Notes: 20/80 = regional guideline values derived from average 20th and/or 80th percentiles of reference sites; 3 or more sites unless indicated by limited data
a = limited or no regional data. ANZECC 2000 Guidelines default values retained
b = for indicators where AA 2000 provides a range, lower limit of range adopted as recommended for Great Barrier Reef waters; practical laboratory detection limit for ammonia and oxidised N
c = organic nitrogen calculated as total nitrogen minus sum of ammonia and oxidised nitrogen
d = insufficient regional data. Guideline values adopted from open coastal values in southern region
e = insufficient data for nutrients; South-east region guideline values adopted.
f = Additional note from authors of this document: to be derived locally from relationship models where they are available e.g. Wooldridge et al for Burdekin north.
Source: Table 2.5.2.1: *Queensland Water Quality Guidelines 2006* in Honchin et al 2007 (p.iv)

Table 3-16 GBRMP Default Values Sediment

Region/Water type	Source/comment	Turbidity NTU	Secchi metres	SS mg/L
Wet tropics				
Open coastal	a, b, c	1	nd	nd
Enclosed coastal	20/80	10	1.0	nd
Central coast				
Open coastal	d	1	5.0	10
Enclosed coastal	20/80 e	6	1.5	15

Notes: Source/comment column footnotes as for Table 3-15 above. nd = no data or ANZECC 2000 Guidelines default value
Source: Table 2.5.2.1: *Queensland Water Quality Guidelines 2006* in Honchin et al 2007 (p.iv)

3.7 Adopted Water Quality Guidelines Marine

As the most up to date set of water quality guidelines for the marine environment, the *Marine Water Quality Guidelines for the Great Barrier Reef Marine Park* (Great Barrier Reef Marine Park Authority 2008) have been adopted for the Black Ross WQIP. Where a guideline value is not provided by GBRMPA, guideline values from the QWQG are used. The GBR and QWQG marine water quality guideline values are displayed together as draft water quality objectives in Table 4-3.

Table 3-17 Marine WQ Guidelines and Trigger Values

Indicator	Qld WQ Guideline		GBRMP Guideline Trigger Values			
	Enclosed Coastal	Open Coastal	Enclosed Coastal	Coastal	Inshore	Offshore
TSS (mg/L)	15	10	15	2.0	2.0	0.7
$OrgN_Q/PN_G$ – N (µg/L)	180	130		20	20	17
DIN – N (µg/L)	11	9				
PP – P (µg/L)	14	14		2.8	2.8	1.9
FRP – P (µg/L)	6	6				
Turbidity (NTU)	6	1				
Chlorphyll a (µg/L)	2	1	2	0.45	0.45	0.4
Dissolved Oxygen (%)	90-100	95-105				
pH	8.0-8.4	8.0-8.4				
Secchi depth			1.5	10	10	17
Pesticides						
Chlorpyrifos (HR)			0.005			
Diuron (MR)			0.9			
Atrazine (MR)			0.4			
Ametryn (MR)			0.5			
2,4-D (MR)			0.8			
Endosulfan (MR)			0.005			
Simazine (LR)			0.2			
Hexazinone [1] (LR)			75[1]			
Tebuthiuron (LR)			0.02			
MEMC (LR)			0.002			
Diazinon (LR)			0.00003			
Tributytlin [2] (MR)			0.0002			

Note: [1] This trigger value may not protect keystone species given effect concentrations for adult coral colonies are observed at significantly lower concentrations. [2] Tributytlin is a biocide. In the Pesticides column (HR) is high reliability trigger value, (MR) is medium reliability and (LR) is low reliability.

4. Water Quality Objectives

4.1 Water Quality Indicators

The water quality indicators chosen for the Black Ross WQIP are listed in Table 4-1 with a brief description of each and reasons for their use. Not all indicators are used in all situations.

Table 4-1 Water Quality Indicators

WQ Indicator	Description	Reason for Use
TSS	Total suspended sediment/solids	Indicator of erosion and transport of sediment to waterbodies. Can be related to vegetation cover/bare ground and management practices. Can result in smothering of benthic organisms and inhibition of primary production
OrgN/PN	Organic nitrogen / particulate nitrogen	Provides an indication of the amount of plant material entering the system and will become bioavailable in the longer term through decomposition
DIN	Dissolved inorganic nitrogen	Readily bioavailable and supports a range of biological interactions including algal growth
PP	Particulate phosphorus	Can become bioavailability in the longer term and is often related to TSS levels
FRP	Filterable reactive phosphorus	Readily bioavailable and supports a range of biological interactions including algal growth
Turbidity	Visual measure of water clarity	Light penetration and subsequent biological activity is impacted by water clarity
Chlorphyll a	A measure of algal growth	Is an indicator of algal growth and has a close relationship to nutrient concentrations, modified to some extent by water clarity
DO	Dissolved oxygen (percentage saturation)	Oxygen levels are important for fish and other aquatic organisms to survive. Low oxygen levels are one of the main water quality issues in tropical Queensland, often from natural causes
pH	Indicator of acidity and alkalinity	pH is important for chemical and biological processes with highly acid and highly alkaline waters resulting in stressful or toxic conditions for many organisms leading to a change in biodiversity
EC	Electrical conductivity is a simple way to measure salt levels	High levels of salt can impact plant growth and create conditions that are toxic to many organisms leading to a change in biodiversity
Pesticides	Various types	Inhibits plant growth and may bioaccumulate
Urban Specific		
Hydrocarbons	Oil and petroleum based products	Excessive hydrocarbons can result in smothering of aquatic habitats. They can also increase morbidity and mortality in freshwater species, and impact reproductive cycles
Gross Pollutants	Debris items often larger than 5mm. Litter including plastics, garden waste and coarse sediment	Organic material can lead to oxygen depletion during decomposition. Litter, especially plastic bags, can be harmful to marine organisms.
Metals/Heavy metals	Cadmium, Chromium, Copper, Lead, Nickel, Zinc	Excessive levels can be toxic to aquatic organisms and can bioaccumulate and be passed along the food chain (Cobalt, Sellenium, Thallium, Silver, Arsenic, Antimony)

4.2 Draft Water Quality Objectives

A set of draft water quality objectives for ambient conditions have been adopted for the Black Ross WQIP area based on the Queensland Water Quality Guidelines and GBRMPA marine water quality guideline trigger values.

For freshwater and estuaries the draft water quality objectives (Table 4-2) are based principally on the guidelines for slightly to moderately disturbed aquatic ecosystems, which provide a higher level of water quality protection than is required for most human use environmental values. In this way all human use environmental values are protected by default if the aquatic ecosystem water quality objectives are maintained. Where there is an exception to this generalisation (see Table 3-7) the higher level of protection for human use is adopted where a waterway or water body has been identified as having one or more of those human use environmental values.

For marine areas the draft water quality guidelines are based on ecosystem protection. Additional water quality objectives have also been adopted for urban areas (see).

Table 4-2 Draft Ambient Physico-chemical Water Quality Objectives - Freshwater and Estuarine

Indicator	Freshwater			Estuarine	
	Upland	Lowland	Lakes	Mid Estuary	Upper Estuary
TSS (mg/L)	-	10	10	20	25
$Org N_Q/PN_G$ – N (µg/L)	225	420	330	260	400
DIN – N (µg/L)	25	80	20	20	45
Total N (µg/L)	250	500	350	300	450
PP – P (µg/L)	15	30		17	30
FRP – P (µg/L)	15	20	5	8	10
Total P (µg/L)	30	50	10	25	40
Turbidity (NTU)	25	50	1-20	8	25
Chlorphyll a (µg/L)	na	5	5	4	10
Dissolved Oxygen (%)	90-110	85-110	90-110	85-100	70-100
pH	6.5-7.5	6.5-8.0	6.5-8.0	7.0-8.4	7.0-8.4
EC* (µS/cm)	375/271	375/271	375/271		

Notes: PP = Total P – FRP.
Dissolved oxygen is % saturation.
* Conductivity values (EC) for freshwaters (from the QWQG Appendix G, p.103) for Central Coast North, based on the 75th percentile value, is 375 µS/cm for the Black Basin. The Ross Basin is in the Burdekin-Bowen region and the corresponding value is 271 µS/cm.

Table 4-3 Draft Marine Physico-chemical Water Quality Objectives

	Enclosed Coastal	Coastal/ Inshore	Offshore
TSS (mg/L)	15 [1]	2.0 [1]	0.7 [1]
$Org N^{2}/PN^{1}$ – N (µg/L)	180 [2]	20 [1]	17 [1]
DIN – N (µg/L) *	11 [2]	9 [2]	
Total N	200 [2]	29*	
PP – P (µg/L)	14 [2]	2.8 [1]	1.9 [1]
FRP – P (µg/L)	6 [2]	6 [2]	
Total P	20 [2]	8.8*	
Turbidity (NTU)	6 [2]	1 [2]	
Chlorphyll a (µg/L)	2 [1]	0.45 [1]	0.4 [1]
Dissolved Oxygen (%)	90-100 [2]	95-105 [2]	
pH	8.0-8.4 [2]	8.0-8.4 [2]	
Secchi depth	1.5 [1]	10 [1]	17 [1]

Notes: [1] indicates values from the WQ Guideline for the GBRMP (GBRMPA 2008) and [2] indicates values from the Queensland WQ Guidelines (EPA 2006). * Based on the locally derived particulate nitrogen and phosphorous trigger levels an adjustment to the QWQG concentration for the total nitrogen and phosphorus values has been calculated

Table 4-4 Draft Pesticide Water Quality Objectives

Pesticides (µg/L)	Freshwater				Marine	
	Upland	Lowland	HEV	SMD	HEV	SMD
Diuron	<LOD	0.5		2.0	0.9*	1.6*
Atrazine	<LOD	0.3	0.7	13	0.4*	2.4*
Simazine	<LOD	0.01	0.2	3.2	0.2*	3.2*
Bromacil						
Hexazinone	<LOD	0.4			75*	75*
Endosulfan[1]			0.03	0.03	0.005	0.005
Malathion			0.002	0.05		
Chlorpyrifos					0.005*	
Ametryn					0.5*	
2,4-D					0.8*	
Tebuthiuron					0.02*	
MEMC					0.002*	
Diazinon					0.00003*	
Tributytlin[2]					0.0002*	

Pesticides (from Leissmann et al 2007, ACTFR 07/09). Pesticide concentrations for upland and lowland freshwater from MWWQIP p.28 LOD is limit of detection (generally 0.01µg/L)

HEV and SMD values for freshwater from AWQG ANZECC 2000 Table 3.4.1 Trigger values for toxicants at alternative levels of protection (aquatic ecosystems) Part 8, 9 and 10 (all other values ID).

* Marine values from GBR

[1] This trigger value may not protect keystone species given effect concentrations for adult coral colonies are observed at significantly lower concentrations. [2] Tributytlin is a biocide.

Table 4-5 Draft Heavy Metal Water Quality Objectives

Indicator	Freshwater		Marine	
Heavy metal (µg/L)	HEV	SM Dist.	HEV	SM Dist.
Cadmium	0.06	0.2	0.7	5.5
Chromium	0.01	1.0	0.14	4.4
Copper	1.0	1.4	0.3	1.3
Lead	1.0	3.4	2.2	4.4
Nickel	8	11	7	70
Zinc	2.4	8.0	7	15
Hydrocarbons *	300	300		

Source: AWQG Table 3.4.1 Trigger values for toxicants at alternative levels of protection

Note: Trigger values for toxicants (µg/L) at alternative levels of protection (AWQG, pp.3.4-5 to 3.4-10) i.e. 99%, 95%, 90% and 80% for freshwaters and marine waters.

* Hydrocarbon reference (Oils and greases (including petrochemicals) <300 µg/L) appears in Aquaculture Table 4.4.3 Toxicant guidelines for the protection of aquaculture species Part 2.

A range of hydrocarbons are included in AWQG Table 3.4.1

Table 4-6 Draft Metals in Sediment Objectives

Metals in sediment	ISQG low	ISQG high
Cadmium	1.5	10
Chromium	80	370
Copper	65	270
Lead	50	220
Nickel	21	52
Zinc	200	410

Heavy metals from Interim Sediment Quality Guidelines (ANZECC 2000) Measured as mg/kg (dry weight) = ppm Table 3.5.1

Table 4-7 Draft Event Water Quality Objectives

Indicator	Event based WQO
TSS (mg/L)	
OrgNα/PN – N (μg/L)	
DIN – N (μg/L)	
PP – P (μg/L)	
FRP – P (μg/L)	

4.3 Black Ross WQIP Ambient Targets

Draft water quality objectives have been assigned to the waterways and waterbodies of the Black Ross WQIP area based on alignment with the environmental values identified in section 2. A draft set of ambient (concentrations) water quality targets have also been assigned to the waterways and waterbodies of the Black Ross WQIP area based on an assessment of available water quality condition data. The targets are subject to review and are in no way final. The draft water quality objectives, current condition and draft targets are included in Table 4-9, Table 4-10 and Table 4-11.

4.4 Black Ross WQIP Load Targets

A set of draft end of catchment load based targets are being developed for the waters of the Black Ross WQIP area from the results of a modelling study undertaken by BMT WBM. Preliminary baseline modelling results are shown in Table 4-8. For further information load targets refer to the Pollutant Types and Sources report)

Table 4-8 Baseline Modelling Results

Sub Basin		Area	Flow	TSS	TN	TP
	No.	Hectares	ML/Year	kg/Year	kg/Year	kg/Year
Crystal Creek	1	24,074	239,279	5,509,675	90,060	9,376
Rollingstone Creek	2	21,986	144,288	1,601,949	40,420	4,018
Bluewater Creek	3	28,973	145,599	2,805,025	92,637	4,637
Black River (no STP)	4	30,258	114,318	7,190,500	69,131	10,016
Black Basin total		105,291	643,484	17,107,149	292,248	28,047
Bohle River (no STP)	5	33,155	131,618	9,289,250	78,275	14,136
Lower Ross River	6	13,478	53,677	4,202,975	33,097	6,976
Upper Ross River	7		196,735	8,103,000	100,375	12,775
Stuart Creek (no STP)	8	11,158	47,450	1,649,800	18,944	2,957
Alligator Creek	9	27,365	104,762	2,103,495	42,687	4,807
Ross Basin total		85,155	534,242	25,348,520	273,378	41,651
Magnetic Island	10	4,923	27,371	341,983	6,282	943
Black Ross Total		195,369	1,205,098	42,797,652	571,908	70,641

Note: Alligator Creek sub basin has been grouped with the Ross River AWR Basin. It is part of the Haughton River AWR Basin. Figures do not include loads from STPs.

[Targets from the Reef Water Quality Action Plan are included at the end of Appendix A.]

Table 4-9 Draft Water Quality Objectives – Freshwater Systems (µg/L)

Catchment/Management Unit			DIN			PN			Total N			FRP			PP			Total P			TSS		
			WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T
Crystal Creek Sub Basin	Crystal Creek (Upland) 1-1	HEV	PCC	14	14	PCC	95	95	PCC	108	108	PCC	2	2	PCC	2	2	PCC	4	4	PCC	2	2
	Crystal Creek (Lowland FW) 1-1	SMD	10	14	10	200	95	200	240	108	240	4	2	4	6	2	6	10	4	10	ND	4	ND
	Lorna Creek (Upland) 1-2	SMD	36	14	36	125	95	125	150	108	150	5	2	5	5	2	5	10	4	10	ND	4	ND
	Lorna Creek (Lowland FW) 1-2	SMD	10	14	10	200	95	200	240	108	240	4	2	4	6	2	6	10	4	10	ND	4	ND
	Ollera Ck (Upland) 1-3	HEV	PCC	14	14	PCC	95	95	PCC	108	108	PCC	2	2	PCC	2	2	PCC	4	4	PCC	4	4
	Ollera Creek (Lowland FW) 1-3	SMD	10	14	10	200	95	200	240	108	240	4	2	4	6	2	6	10	4	10	ND	4	ND
	Scrubby Ck (Upland) 1-4	HEV	PCC	14	14	PCC	95	95	PCC	108	108	PCC	2	2	PCC	2	2	PCC	4	4	PCC	4	4
	Scrubby Creek (Lowland FW) 1-4	SMD	10	14	10	200	95	200	240	108	240	4	2	4	6	2	6	10	4	10	ND	4	ND
	Hencamp Ck (Upland) 1-5	HEV	PCC	35	35	PCC	300	300	PCC	340	340	PCC	5	5	PCC	5	5	PCC	20	20	PCC	20	20
	Hencamp Ck (Lowland FW) 1-5	SMD	10	35	10	200	300	200	240	340	240	4	5	4	6	5	6	10	20	10	ND	20	ND
Rollingstone Creek Sub Basin	Rollingstone Ck (Upland) 2-1	HEV	PCC	40	40	PCC	300	300	PCC	360	360	PCC	ND	5	PCC	ND	5	PCC	20	20	PCC	20	20
	Rollingstone Ck (Lowland FW) 2-1	SMD	10	40	10	200	300	200	240	360	240	4	ND	4	6	ND	6	10	20	10	ND	20	ND
	Unnamed Creek 2-2	SMD	10	15	10	200	200	200	240	223	240	4	5	4	6	5	6	10	20	10	ND	20	ND
	Surveyors Ck 2-3	HEV	PCC	15	15	PCC	200	200	PCC	223	223	PCC	5	5	PCC	5	5	PCC	20	20	PCC	20	20
	Wild Boar Creek 2-4	HEV	PCC	15	15	PCC	200	200	PCC	223	223	PCC	5	5	PCC	5	5	PCC	20	20	PCC	20	20
	Station Creek 2-5	HEV	PCC	15	15	PCC	200	200	PCC	223	223	PCC	5	5	PCC	5	5	PCC	20	20	PCC	20	20
	Saltwater Ck (Upland) 2-6	HEV	PCC	15	15	PCC	200	200	PCC	223	223	PCC	5	5	PCC	5	5	PCC	20	20	PCC	20	20
	Saltwater Creek (Lowland FW) 2-6	HEV	PCC	15	15	PCC	200	200	PCC	223	223	PCC	5	5	PCC	5	5	PCC	20	20	PCC	20	20
	Cassowary Ck (Upland) 2-7	HEV	PCC	15	15	PCC	200	200	PCC	223	223	PCC	5	5	PCC	5	5	PCC	20	20	PCC	20	20
	Cassowary Ck (Lowland FW) 2-7	HEV	PCC	15	15	PCC	200	200	PCC	223	223	PCC	5	5	PCC	5	5	PCC	20	20	PCC	20	20
	Leichhardt Ck (Upland) 2-8	HEV	PCC	30	30	PCC	300	300	PCC	330	330	PCC	ND	5	PCC	ND	5	PCC	20	20	PCC	20	20
	Leichhardt Ck (Developed) 2-8	SMD	10	30	10	200	300	200	240	330	240	4	ND	4	6	ND	6	10	20	10	ND	20	ND
Bluewater Creek Sub Basin	Christmas Ck (Upland) 3-1	HEV	PCC	17	17	PCC	200	200	PCC	240	240	PCC	5	5	PCC	5	5	PCC	30	30	PCC	30	30
	Christmas Ck (Developed) 3-1	SMD	80	17	80	420	200	420	500	240	500	20	5	20	30	5	30	50	30	50	10	30	10
	Sleeper Log Ck (Upland) 3-1	HEV	PCC	17	17	PCC	200	200	PCC	240	240	PCC	5	5	PCC	5	5	PCC	30	30	PCC	30	30
	Sleeper Log Ck (Developed) 3-1	SMD	80	17	80	420	200	420	500	240	500	20	5	20	30	5	30	50	30	50	10	30	10
	Two Mile Creek 3-2	SMD	80	19	80	420	200	420	500	228	500	20	9	20	30	9	30	50	40	50	10	40	10
	Bluewater Ck (Upland) 3-3	HEV	PCC	61	61	PCC	196	196	PCC	282	282	PCC	6	6	PCC	6	6	PCC	20	20	PCC	20	20
	Bluewater Ck (Lowland FW) 3-3	SMD	80	61	80	420	196	420	500	282	500	20	6	20	30	6	30	50	20	50	10	20	10
	Althaus Creek (Upland) 3-4	HEV	PCC	40	40	PCC	300	300	PCC	370	370	PCC	ND	15	PCC	ND	15	PCC	20	20	PCC	20	20
	Althaus Creek (Lowland FW) 3-4	SMD	80	40	80	420	300	420	500	370	500	20	ND	20	30	ND	30	50	20	50	10	20	10
	Deep Creek (Upland) 3-4	SMD	25	40	25	225	300	225	250	370	250	15	ND	15	15	ND	15	30	20	30	-	20	-
	Deep Creek (Lowland FW) 3-4	SMD	80	40	80	420	300	420	500	370	500	20	ND	20	30	ND	30	50	20	50	10	20	10
	Healy Creek 3-4	SMD	80	40	80	420	300	420	500	370	500	20	ND	20	30	ND	30	50	20	50	10	20	10

	Catchment/Management Unit		DIN			PN			Total N			FRP			PP			Total P			TSS		
			WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T
Black River S.Basin	Black River (Upland) 4-1	HEV	PCC	40	40	PCC	300	300	PCC	335	335	PCC	35	35	PCC	35	35	PCC	32	32	PCC	32	32
	Black River (Lowland FW) 4-1	SMD	80	40	80	420	300	420	500	335	500	20	35	20	30	35	30	50	32	50	10	32	10
	Alick Creek (Black R trib.) 4-1	SMD	80	40	80	420	300	420	500	335	500	20	35	20	30	35	30	50	32	50	10	32	10
	Log Creek (Black R trib.) 4-1	SMD	80	40	80	420	300	420	500	335	500	20	35	20	30	35	30	50	32	50	10	32	10
	Scrubby Ck (Alice R trib.) (Up) 4-2	SMD	80	40	80	420	300	420	500	335	500	20	35	20	30	35	30	50	32	50	10	32	10
	Alice River (Developed) 4-2	SMD	80	40	80	420	300	420	500	335	500	20	35	20	30	35	30	50	32	50	10	32	10
	Canal Creek (Alice R trib.) 4-2	SMD	80	40	80	420	300	420	500	335	500	20	35	20	30	35	30	50	32	50	10	32	10
Bohle River Sub Basin	Stoney Creek 5-1	SMD	80	69	80	420	500	420	500	620	500	20	130	20	30	130	30	50	130	50	10	130	10
	Saunders Creek 5-1	SMD	80	69	80	420	500	420	500	620	500	20	130	20	30	130	30	50	130	50	10	130	10
	Bohle R (below Bruce Hway) 5-1	SMD	80	69	80	420	500	420	500	620	500	20	130	20	30	130	30	50	130	50	10	130	10
	Louisa Creek 5-1	HD	80	69	80	420	500	420	500	620	500	20	130	20	30	130	30	50	130	50	10	130	10
	Town Common 5-1	SMD	80	69	80	420	500	420	500	620	500	20	130	20	30	130	30	50	130	50	10	130	10
	Bohle R (above Condon STP) 5-2	SMD	80	931	80	420	1000	420	500	1822	500	20	4000	20	30	4000	30	50	2500	50	10	2500	10
	Bohle R (below Condon STP) 5-2	SMD	80	931	80	420	1000	420	500	1822	500	20	4000	20	30	4000	30	50	2500	50	10	2500	10
	Little Bohle River 5-2	SMD	80	931	80	420	1000	420	500	1822	500	20	4000	20	30	4000	30	50	2500	50	10	2500	10
	Middle Bohle Creek 5-2	SMD	80	931	80	420	1000	420	500	1822	500	20	4000	20	30	4000	30	50	2500	50	10	2500	10
Lower Ross River Sub Basin	Pallarenda 6-1	HD	80	57	80	420	245	420	500	356	500	20	20	20	30	20	30	50	40	50	10	40	10
	Mundy Creek 6-2	SMD	80	72	80	420	359	420	500	642	500	20	138	20	30	138	30	50	245	50	10	245	10
	Esplanade 6-3	SMD	80	30	80	420	300	420	500	345	500	20	ND	20	30	ND	30	50	40	50	10	40	10
	Ross Creek and tributaries 6-4	HD	80	57	80	420	245	420	500	356	500	20	20	20	30	20	30	50	40	50	10	40	10
	Ross River (below Dam) 6-5	SMD	80	40	80	420	336	420	500	430	500	20	12	20	30	12	30	50	44	50	10	44	10
	Ross River (Black Weir) 6-5	HD	80	40	80	420	336	420	500	430	500	20	12	20	30	12	30	50	44	50	10	44	10
	Ross R (Gleesons Weir) 6-5	HD	80	40	80	420	336	420	500	430	500	20	12	20	30	12	30	50	44	50	10	44	10
	Ross River (Aplins Weir) 6-5	HD	80	40	80	420	336	420	500	430	500	20	12	20	30	12	30	50	44	50	10	44	10
	Tributaries (Defence land) 6-5	SMD	80	40	80	420	336	420	500	430	500	20	12	20	30	12	30	50	44	50	10	44	10
	University (Campus) Creek 6-5	SMD	80	40	80	420	336	420	500	430	500	20	12	20	30	12	30	50	44	50	10	44	10
	Lavarack Ck with weirs (?)6-5	HD	80	40	80	420	336	420	500	430	500	20	12	20	30	12	30	50	44	50	10	44	10
Upper Ross River Sub Basin	Lake Ross (Ross Dam) 7-1	SMD	20	40	20	330	500	330	350	560	350	5	15	5	0	15	0	10	30	10	10	30	10
	Ross River (FrW) 7-1	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Round Mountain Ck (Upland) 7-1	HEV	PCC	40	40	PCC	500	500	PCC	560	560	PCC	15	15	PCC	15	15	PCC	30	30	PCC	30	30
	Round Mountain Creek 7-1	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Lagoon Creek 7-1	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Plum Tee Creek 7-1	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Central Ck (aka Ross Ck) 7-1	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Sandy Creek 7-1	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Deep Creek 7-1	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10

Catchment/Management Unit			DIN			PN			Total N			FRP			PP			Total P			TSS		
			WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T
	Leichhardt Creek 7-1	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Cattle Creek 7-1	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Six Mile Creek 7-2	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Toonpan Lagoon 7-3	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Jimmys Lagoon 7-3	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Four Mile Ck /Flagstone Ck 7-3	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Spring Creek 7-3	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	One Mile Creek/Spring Creek 7-3	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Lansdowne Creek 7-3	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Antill Plains Creek 7-4	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
	Sachs Creek (Upland) 7-5	HEV	PCC	181	181	PCC	248	248	PCC	564	564	PCC	29	29	PCC	29	29	PCC	50	50	PCC	50	50
	Sachs Creek 7-5	SMD	80	181	80	420	248	420	500	564	500	20	29	20	30	29	30	50	50	50	10	50	10
	Blacksoil Gully/Mt Stuart (Up) 7-6	HEV	PCC	40	40	PCC	500	500	PCC	560	560	PCC	15	15	PCC	15	15	PCC	30	30	PCC	30	30
	Blacksoil Gully/Mt Stuart 7-6	SMD	80	40	80	420	500	420	500	560	500	20	15	20	30	15	30	50	30	50	10	30	10
Stuart Ck	Stuart Creek (ephemeral) 8-1	SMD	80	40	80	420	500	420	500	708	500	20	79	20	30	79	30	50	130	50	10	130	10
	Stuart Creek (includes pools) 8-1	HD	80	40	80	420	500	420	500	708	500	20	79	20	30	79	30	50	130	50	10	130	10
	Sandfly Creek 8-2	SMD	80	780	80	420	1400	420	500	2040	500	20	ND	20	30	ND	30	50	460	50	10	460	10
Alligator Creek Sub Basin	Alligator Ck (Upland) 9-1	HEV	PCC	30	30	PCC	300	300	PCC	330	330	PCC	15	15	PCC	15	15	PCC	30	30	PCC	30	30
	Alligator Creek (Lowland FW) 9-1	HD	80	30	80	420	300	420	500	330	500	20	15	20	30	15	30	50	30	50	10	30	10
	Whites Creek (Upland) 9-1	HEV	PCC	30	30	PCC	300	300	PCC	330	330	PCC	15	15	PCC	15	15	PCC	30	30	PCC	30	30
	Whites Creek 9-1	SMD	80	30	80	420	300	420	500	330	500	20	15	20	30	15	30	50	30	50	10	30	10
	Slippery Rocks Ck (Upland) 9-1	HEV	PCC	30	30	PCC	300	300	PCC	330	330	PCC	15	15	PCC	15	15	PCC	30	30	PCC	30	30
	Slippery Rocks Creek 9-1	SMD	80	30	80	420	300	420	500	330	500	20	15	20	30	15	30	50	30	50	10	30	10
	Crocodile Creek 9-2	SMD	80	30	80	420	300	420	500	330	500	20	15	20	30	15	30	50	30	50	10	30	10
	Killymoon Creek (Upland)	HEV	PCC	30	30	PCC	300	300	PCC	330	330	PCC	15	15	PCC	15	15	PCC	30	30	PCC	30	30
	Killymoon Creek	SMD	80	30	80	420	300	420	500	330	500	20	15	20	30	15	30	50	30	50	10	30	10
	Cocoa Creek 9-3	SMD	80	30	80	420	300	420	500	330	500	20	15	20	30	15	30	50	30	50	10	30	10
	Cape Cleveland 9-4	HEV	PCC	30	30	PCC	300	300	PCC	330	330	PCC	15	15	PCC	15	15	PCC	30	30	PCC	30	30
Magnetic Island	Retreat Creek (upland) 10-1	HEV	PCC	20	20	PCC	ND	420	PCC	630	630	PCC	10	10	PCC	10	10	PCC	105	105	PCC	105	105
	Retreat Creek (lowland) 10-1	SMD	80	20	80	420	ND	420	500	630	500	20	10	20	30	10	30	50	105	50	10	105	10
	Duck Creek (upland) 10-1	HEV	PCC	20	20	PCC	ND	420	PCC	630	630	PCC	10	10	PCC	10	10	PCC	105	105	PCC	105	105
	Duck Creek (lowland) 10-1	SMD	80	20	80	420	ND	420	500	630	500	20	10	20	30	10	30	50	105	50	10	105	10
	Chinamans Gully (upland) 10-1	HEV	PCC	20	20	PCC	ND	420	PCC	630	630	PCC	10	10	PCC	10	10	PCC	105	105	PCC	105	105
	Chinamans Gully (lowland) 10-1	SMD	80	20	80	420	ND	420	500	630	500	20	10	20	30	10	30	50	105	50	10	105	10
	Ned Lee Creek (upland) 10-1	HEV	PCC	20	20	PCC	ND	420	PCC	630	630	PCC	10	10	PCC	10	10	PCC	105	105	PCC	105	105
	Ned Lee Creek (lowland)10-1	SMD	80	20	80	420	ND	420	500	630	500	20	10	20	30	10	30	50	105	50	10	105	10

Catchment/Management Unit		DIN			PN			Total N			FRP			PP			Total P			TSS		
		WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T
Butler Ck (Picnic Bay) (upland)10-2	SMD	80	20	80	420	ND	420	500	570	500	20	10	20	30	10	30	50	120	50	10	120	10
Butler Ck (Picnic Bay) (lowland) 10-2	HD	80	20	80	420	ND	420	500	570	500	20	10	20	30	10	30	50	120	50	10	120	10
Picnic Bay west creek (upland)10-2	SMD	80	20	80	420	ND	420	500	570	500	20	10	20	30	10	30	50	120	50	10	120	10
Picnic Bay west creek (lowland) 10-2	HD	80	20	80	420	ND	420	500	570	500	20	10	20	30	10	30	50	120	50	10	120	10
Gustav Creek (Upland) 10-3	HEV	PCC	20	20	PCC	ND	420	PCC	225	225	PCC	10	10	PCC	10	10	PCC	20	20	PCC	20	20
Gustav Creek (Lowland FW) 10-3	SMD	80	20	80	420	ND	420	500	225	500	20	10	20	30	10	30	50	20	50	10	20	10
Hoyer Creek (Nelly Bay) (upland) 10-3	SMD	80	20	80	420	ND	420	500	225	500	20	10	20	30	10	30	50	20	50	10	20	10
Hoyer Creek (Nelly Bay) (lowland) 10-3	HD	80	20	80	420	ND	420	500	225	500	20	10	20	30	10	30	50	20	50	10	20	10
North Nelly Bay creek (upland) 10-3	HEV	PCC	20	20	PCC	ND	420	PCC	225	225	PCC	10	10	PCC	10	10	PCC	20	20	PCC	20	20
North Nelly Bay creek (lowland) 10-3	SMD	80	20	80	420	ND	420	500	225	500	20	10	20	30	10	30	50	20	50	10	20	10
Petersen Creek (Upland) 10-4	HEV	PCC	140	140	PCC	ND	420	PCC	770	770	PCC	10	10	PCC	10	10	PCC	70	70	PCC	70	70
Petersen Creek (Lowland FW) 10-4	SMD	80	140	80	420	ND	420	500	770	500	20	10	20	30	10	30	50	70	50	10	70	10
Gorge Creek (Upland) 10-6	HEV	PCC	140	140	PCC	ND	420	PCC	770	770	PCC	10	10	PCC	10	10	PCC	70	70	PCC	70	70
Gorge Creek (Lowland FW) 10-6	SMD	80	140	80	420	ND	420	500	770	500	20	10	20	30	10	30	50	70	50	10	70	10
Endeavour Creek (Upland) 10-6	HEV	PCC	140	140	PCC	ND	420	PCC	770	770	PCC	10	10	PCC	10	10	PCC	70	70	PCC	70	70
Endeavour Creek (Lowland FW) 10-6	SMD	80	140	80	420	ND	420	500	770	500	20	10	20	30	10	30	50	70	50	10	70	10
East Horseshoe Bay creek 10-6	SMD	80	140	80	420	ND	420	500	770	500	20	10	20	30	10	30	50	70	50	10	70	10
Five Beach Bay 10-7	HEV	PCC	140	140	PCC	ND	420	PCC	770	770	PCC	10	10	PCC	10	10	PCC	70	70	PCC	70	70

Notes: DIN – Dissolved Inorganic Nitrogen, PN – Particulate Nitrogen, Total N – Total Nitrogen, FRP – Filterable Reactive Phosphorus, PP – particulate Phosphorus, Total P – Total Phosphorus, TSS – Total Suspended Sediments
WQO – Water Quality Objective; CC – Current Condition; T – Target, PCC – Protect/Maintain Current Condition; ND – No Data

Table 4-10 Draft Water Quality Objectives – Estuarine Systems (µg/L)

Catchment/Management Unit		DIN			PN			Total N			FRP			PP			Total P			TSS		
		WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T
Crystal Creek	Crystal Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Lorna Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Ollera Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Scrubby Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Hencamp Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
Rollingstone Creek	Rollingstone Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Surveyors Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Wild Boar Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Station Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Saltwater Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Cassowary Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Leichhardt Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20

Catchment/Management Unit		DIN			PN			Total N			FRP			PP			Total P			TSS		
		WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T
Bluewater Ck	Christmas Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Two Mile Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Bluewater Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Deep Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Healy Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
Black River	Black River	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
Bohle River	Bohle River (upper)	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Bohle River (lower)	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Town Common	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Louisa Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
Ross River	Ross River	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Ross Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Pallarenda	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Mundy Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
Stuart Ck	Stuart Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
Alligator Ck	Alligator Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Crocodile Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Cocoa Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
Magnetic Island	Retreat Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Duck Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Ned Lee Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Butler Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Gustav Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20
	Petersen Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Gorge Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Endeavour Creek	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	East Horseshoe Bay Creek	20	ND	20	260	ND	260	300	ND	300	8	ND	8	17	ND	17	25	ND	25	20	ND	20

Table 4-11 Draft Water Quality Objectives - Marine Systems (µg/L)

Catchment/Management Unit			DIN			PN			Total N			FRP			PP			Total P			TSS			Chlorophyll a			Secchi Depth		
			WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T	WQO	CC	T
Near Coastal	West Coast		PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Picnic Bay		PCC	2.1	3	PCC	22.8	23	PCC	91	92	PCC	ND	PCC	PCC	3.81	3	PCC	19.205	15	PCC	2.48	2	PCC	0.96	0.8	PCC	4.25	5
	Nelly Bay		PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Arcadia		PCC	3.1	4	PCC	20.7	20	PCC	89.8	70	PCC	ND	PCC	PCC	4.55	3	PCC	13.01	10	PCC	4.52	4	PCC	0.88	0.7	PCC	4	5
	Radical Bay		PCC	ND	PCC	PCC	13.6	14	PCC	71.4	72	PCC	ND	PCC	PCC	1.7	2	PCC	18.45	15	PCC	2.07	2	PCC	0.26	0.3	PCC	9.5	10
	Horseshoe Bay		PCC	ND	PCC	PCC	17.9	18	PCC	89	90	PCC	ND	PCC	PCC	3.4	3.5	PCC	22.72	18	PCC	4.14	3	PCC	0.45	0.45	PCC	ND	PCC
	Five Beach Bay		PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	Rollingstone Bay		PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC	PCC	ND	PCC
	West Channel		9	ND	9	20	40.44	30	29	138	29	6	ND	6	2.8	6.07	5	8.8	17.93	14	2	6	4	0.45	0.94	0.45	ND	2.13	ND
	Cleveland Bay		9	ND	9	20	ND	20	29	ND	29	6	ND	6	2.8	ND	2.8	8.8	ND	8.8	2	ND	2	0.45	ND	0.45	ND	ND	ND
	Halifax Bay		9	ND	9	20	ND	200	29	ND	29	6	ND	6	2.8	ND	2.8	8.8	ND	8.8	2	ND	2	0.45	ND	0.45	ND	ND	ND
Marine	Outer Marine		ND	ND	ND	17	ND	17	ND	ND	ND	ND	ND	ND	1.9	ND	1.9	ND	ND	ND	0.7	ND	0.7	0.4	ND	0.4	17	ND	17

Note: Revised 9/6/09

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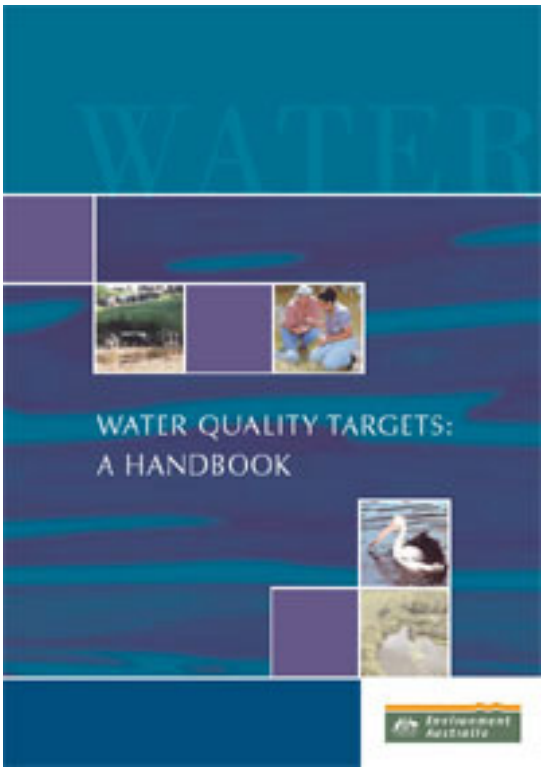
Appendix A

Water Quality Guideline Extracts

Water Quality targets: A Handbook



Water quality targets: a handbook (Version 1.0), Environment Australia, 2002

This handbook aims to assist regional groups to set environmental values and water quality targets for their catchments/region. These targets will be used in developing regional plans to guide investments, management and progress towards attainment of regional goals.

Setting water quality targets can be a complex process. This handbook outlines the steps to be followed to set default targets derived from the published guidelines in *The Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ 2000), hereafter called the Water Quality Guidelines. The Water Quality Guidelines provides comprehensive information and procedures for setting more specific water quality targets tailored for unique conditions for a range of pollutants or indicators and may be used to further customise water quality targets for local conditions.

When used in conjunction with Water Quality Targets OnLine, this handbook simplifies the task of setting water quality targets when preparing regional plans. It is not prescriptive and is intended as a tool to assist the planning process. It is anticipated that some regions or catchments may already be involved in developing regional plans and have set environmental values and water quality targets.
(Source: http://www.environment.gov.au/water/publications/quality/targets-handbook.html)

Water quality targets online (http://www.environment.gov.au/water/publications/quality/targets-online/map.php) has been developed to assist regional groups to set water quality targets and includes a companion handbook which outlines the steps to be followed. It is specifically aimed at regional groups developing water quality targets for inclusion in regional plans in accordance with the National Action Plan for Salinity and Water Quality (NAP) and the extension of the Natural Heritage Trust (NHT).
(Source: http://www.environment.gov.au/water/publications/quality/targets-online/index.php)

[Extract from the CD Water Quality Targets: A Handbook Version 1.0 June 2002 (Environment Australia)]

Background Information

Environmental Values

The first step in setting targets for water quality indicators is to establish the environmental values for a particular water body. Environmental values describe what we want and need to protect. They outline values and uses of the environment that are important for healthy ecosystems, public benefit, industry and health that require protection from the effects of pollution and waste discharges.

For water, the following environmental values may require protection:

- Aquatic ecosystems;
- Primary industries (irrigation and general water uses, stock drinking water, aquaculture and human consumption of aquatic foods);
- Recreation and aesthetics;
- Drinking Water;
- Industrial water, and
- Cultural and spiritual values.

No specific water quality guidelines are provided for industrial water and cultural and spiritual values. These values will need to be determined on a case-by-case basis depending upon the specific issues and uses of water to be protected and should be considered by the community in the planning and management of their water resources. See the Handbook for a more detailed discussion.

When setting environmental values, the community and other stakeholders should define what they want to protect. For this reason, setting environmental values should be a process undertaken by, or in full consultation with, the community. Once these environmental values have been decided, water quality targets should be set to achieve or maintain these values.

Water quality targets are influenced by environmental, social and economic considerations, which in most cases will be unique to that region. Targets should therefore, where possible, have regard for current condition, and long-term trends in water quality.

Existing water quality data may be used to provide some idea of whether the desired environmental values could be achieved. Water quality targets for a water body are normally set by identifying the agreed environmental value that has the most stringent requirement.

Targets

Targets measure or guide progress towards an overall resource management goal or outcome. They should:

- Define an acceptable, physical condition of catchment health;
- Relate to the current ecological and water quality condition of the water body;
- Be measurable and time-specific;
- Relate to any existing targets established under statutory planning or environmental protection processes and policies;
- Provide a focus for actions and investment; and
- Be based on trend information, scientific studies or best available information, where possible.

Protection of Aquatic Ecosystems

Aquatic ecosystems comprise the animals, plants and micro-organisms that live in water, and the physical and chemical environment and climatic regime with which they interact. The physical components of an ecosystem (e.g. light, temperature, mixing, flow, habitat) and its chemical components (e.g. organic and inorganic carbon, oxygen, nutrients) are important in determining what lives in it, and therefore the structure of the food web. Biological interactions also play a key role in the functions of aquatic ecosystems.

Many benefits of aquatic ecosystems can only be maintained if the ecosystems are protected from degradation.

Aquatic ecosystems may require different levels of protection in recognition of the various degree of 'naturalness' that may need to be protected to sustain particular uses and values.

Three categories of aquatic ecosystem protection:

Ecosystems of high conservation or ecological value. These are ecosystems which have high ecological integrity, or which are valued highly for other reasons. They would normally be expected to be found associated with national parks and remote areas, but may also occur elsewhere. The target for ecosystems of this kind should be that there is no change detected from natural variation.

Slightly to moderately disturbed ecosystems have experienced some degradation due to human impacts. Biological communities and ecological integrity should be largely retained. Examples could include freshwater systems which may have significant disturbance both within the waterway and its catchment (say, 60% clearing within the catchment). Some marine ecosystems adjoining metropolitan areas may also fit into this category.

Highly disturbed ecosystems are clearly degraded. Examples could include shipping ports, urban streams receiving road and stormwater run off, or rural streams receiving runoff from intensive horticulture. Use the same targets as for slightly to moderately disturbed ecosystems, unless dealing with toxicants (see below).

Types of impacts

Physical and Chemical stressors

Physical and chemical stressors include the natural water quality parameters, - including nutrients, salinity, and turbidity (or sediments etc which reduce clarity). Physical and chemical stressors are major contributors to changes in aquatic ecosystems, such as nuisance growth of aquatic plants, smothering of organisms living in aquatic environments, and stress to or death of native freshwater fish. They may also modify the effects of toxicants.

Toxicants

Toxicants are chemical contaminants such as metals, aromatic hydrocarbons, pesticides and herbicides that can potentially have toxic effects at concentrations that might be encountered in the environment. Water Quality Targets OnLine deals with only two toxicants - ammonia and nitrate. If you think you need to set targets for other contaminants (such as herbicides or heavy metals), refer to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000).

Recreation

Three categories of recreational use are recognised:

- Primary Contact - activities in which the user comes into frequent direct contact with water, either as part of the activity or accidentally; for example, swimming or surfing;
- Secondary Contact - activities that generally have less-frequent body contact with the water; for example, boating or fishing;
- Aesthetics (No Contact) this comprises the passive recreational use of water bodies, mainly as pleasant places to be near or to look at (no human contact or immersion).

Drinking Water
Guidance on drinking water quality is provided by the National Health and Medical Research Council's Australian Drinking Water Guidelines, which are under continued revision. The Australian Drinking Water Guidelines are a subset of the National Water Quality Management Strategy.

The Australian Drinking Water Guidelines are intended to meet the needs of consumers and apply at the point of use, for example, at the tap. They are applicable to any water intended for drinking irrespective of its source (municipal supplies, rainwater tanks, bores, point-of-use treatment devices, etc.) or where it is used (the home, restaurants, camping areas, shops, etc.).

Three categories of targets are provided:

Not Detected
This applies to pesticides and some bacteria, where the permissible level is the level at which the contaminant can be detected or measured (the level of detection).

Human Health
A human health-related target is the concentration or measure of a water quality characteristic that (based on present knowledge) does not result in any significant risk to the health of the consumer over a lifetime of consumption.

Aesthetics
An aesthetic target is the concentration or measure of a water quality characteristic that is associated with good quality water, - drinking water is required to look, taste and smell 'good?

Aquaculture and Human Consumption of Aquatic Foods
Aquaculture includes the production of food for human consumption, fry for stocking recreational and natural fisheries, ornamental fish and plants for the aquarium trade, raw materials for energy and biochemicals, and items such as pearls and shell products.

Within the growing aquaculture industry, it is well accepted that satisfactory water quality is needed for maintaining viable aquaculture operations. Poor water quality can result in loss of production of culture species, and can also reduce the quality of the end product.

Quality is reduced when low levels of a contaminant cause no obvious adverse effects but gradually accumulate in the culture species to the point where it may pose a potential health risk to human consumers.

Water quality targets are provided for source water quality, and also address the safety of aquatic foods for human consumers, whether the foods be produced by aquaculture, or commercial, or recreational or indigenous fishing.

Irrigation
Agricultural activities within Australia are often dependent upon irrigation systems because of climatic constraints.

An important goal of Water Quality Targets OnLine is to maintain the productivity of irrigated agricultural land and associated water resources, in accordance with the principles of ecologically sustainable development and integrated catchment management. This should be a key consideration in any irrigation strategy, alongside optimum yield, profitability and economic viability.

Emphasis has been placed on sustainability in agricultural practice which aims to ensure that:
- The supply of necessary inputs is sustainable;
- The quality of natural resources is not degraded;

- The environment is not irreversibly harmed;
- The welfare and options of future generations are not jeopardised by the production and consumption activities of the present generation; and
- Yields and produce quality are maintained and improved.

In terms of water quality, the focus for sustainable farming systems is on adopting management practices that maintain productivity and minimise off-farm losses of potential aquatic contaminants. Key issues include soil erosion, landscape salinity, fertiliser and pesticide management, livestock access to streams, and safe disposal of effluent from intensive animal industries.

Two target values are provided:
Long Term Targets
The long-term target (LTT) is the maximum concentration (micro g/L) of contaminant in the irrigation water which can be tolerated, assuming 100 years of irrigation.

Short Term Targets
The short-term target (STT) is the maximum concentration (micro g/L) of contaminant in the irrigation water, which can be tolerated for a shorter period of time (20 years).

Various sensitivity categories are provided for commonly irrigated crops, ranging from 'sensitive' to 'highly tolerant' values for specific water quality indicators.

Stock Drinking Water
Poor quality water may reduce animal production, impair fertility or cause stock death. Contaminants in stock water can produce residues in and tainting of animal products (e.g. meat, milk and eggs), adversely affecting their appeal to the market and/or creating human health risks. Animal industries themselves may impair water quality downstream (e.g. through faecal contamination), highlighting the need for an integrated approach to land and water management in rural catchments.

Daily water intake varies widely among different forms of livestock and is also influenced by factors such as climate and the type of feed being consumed.

The default targets are set a level such there should be minimal risk to animal health. If the water quality exceeds these values, it is advisable to investigate further to determine the level of risk.

The three categories used for stock drinking water in Water Quality Targets OnLine are:

Not Detected
This applies to pesticides and some bacteria, where the level permissible is the level, which can be detected.

Health
A health-related target is the concentration or measure of a water quality characteristic that (based on present knowledge) does not result in any significant risk to the health of the consumer over a lifetime of consumption.

Aesthetics
An aesthetic target is the concentration or measure of a water quality characteristic that is associated with good quality water - it should taste and smell acceptable.

Previously available online at:
http://www.environment.gov.au/water/publications/quality/targets-online/index.php
http://www.environment.gov.au/water/publications/quality/targets-online/background.php

Australian Water Quality Guidelines (Trigger Values) for Tropical Australia

Water type	Physio-chemical indicator and guideline value													
	Amm N	Oxid N	Org N	Total N	FiltR P	Total P	Chl-a	DO (% sat) f		Turb	Salinity	SS	pH	
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	Lower	Upper	NTU	µS/cm	mg/L	Lower	Upper
Upland streams e	6	30	-	150	5	10	naa	90	120	2-15	2-250		6.0	7.5
Lowland streams e	10	10b	-	200-300 h	4	10	5.0	85	120	2-15	2-250	-	6.0	8.0
Freshwater lakes/reservoirs	10	10b	-	350c	5	10	3.0	90	120	2-200	90-900	-	6.0	8.0
Wetlands g	10	10	-	350-1200	5-25	10-50	10	90	120	2-200	90-900	-	6.0	8.0
Estuaries e	15	30	-	250	5	20	2.0	80	120	1-20	-	-	7.0	8.5
Inshore d	1-10	2-8	-	100	5	15	0.7-1.4	90	nd	1-20	-	-	8.0	8.4
Offshore d	1-6	1-4	-	100	2-5	10	0.5-0.9	90	nd	1-20	-	-	8.2	8.2

Source AWQG Table 3.3.4 and Table 3.3.5 (turbidity and salinity)

Notes: nd is no data and na is not applicable

a = monitoring of periphyton and not phytoplankton biomass is recommended in upland rivers — values for periphyton biomass (mg Chl a m-2) to be developed;

b = Northern Territory values are 5µgL-1 for NOx, and <80 (lower limit) and >110% saturation (upper limit) for DO;

c = this value represents turbid lakes only. Clear lakes have much lower values;

d = the lower values are typical of clear coral dominated waters (e.g. Great Barrier Reef), while higher values typical of turbid macrotidal systems (eg. North-west Shelf of WA);

e = no data available for tropical WA estuaries or rivers. A precautionary approach should be adopted when applying default trigger values to these systems;

f = dissolved oxygen values were derived from daytime measurements. Dissolved oxygen concentrations may vary diurnally and with depth. Monitoring programs should assess this potential variability (see Section 3.3.3.2);

g = higher values are indicative of tropical WA river pools;

h = lower values from rivers draining rainforest catchments.

"3.3.2.3 Defining low-risk guideline trigger values

The guideline trigger values are the concentrations (or loads) of the key performance indicators, below which there is a low risk that adverse biological effects will occur. The physical and chemical trigger values are not designed to be used as 'magic numbers' or threshold values at which an environmental problem is inferred if they are exceeded. Rather they are designed to be used in conjunction with professional judgement, to provide an initial assessment of the state of a water body regarding the issue in question. They are the values that trigger two possible responses. The first response, to continue monitoring, occurs if the test site value is less than the trigger value, showing that there is a 'low risk' that a problem exists.

The alternative response, management/remedial action or further site-specific investigations, occurs if the trigger value is exceeded — i.e. a 'potential risk' exists.a The aim with further site-specific investigations is to determine whether or not there is an actual problem. Where, after continuous monitoring, with or without site-specific investigations, indicator values at sites are assessed as 'low risk' (no potential impact), guideline trigger values may be refined.b The guidelines have attempted as far as possible to make the trigger values specific for each of the different ecosystem types." (AWQG p.3.3-5)

Human Use Nitrogen Water Quality Guidelines

Environmental Value Category	**Ammonia (NH_3)**	**Nitrate (NO_3)**	**Nitrite (NO_2)**	**Total Nitrogen (TN)**
Recreation - Primary Contact	10 micro g N /L	44 300 micro g /L converted to nitrate	3 280 micro g /L converted to nitrite	
Recreation - Secondary Contact	10 micro g N /L	44 300 micro g /L converted to nitrate	3 280 micro g /L converted to nitrite	
Recreation - Visual Appreciation (no contact)	Not Applicable	Not Applicable	Not Applicable	
Drinking Water (DW)/ Health Value	Not specified	50 000 micro g/L as Nitrate	3 000 micro g/L as Nitrite	
DW Aesthetic Value (Taste & Odour)	500 micro g/L	Not Specified	Not Specified	
Aquaculture /Human consumption aquatic food	<20 micro g/L (pH >8.0) coldwater; <30 micro g/L warmwater	<50 000 micro g/L	<100 micro g/L	
Irrigation Long Term Targets				5 000 micro g/L
Irrigation Short Term Targets				25 000 -125 000 micro g/L STT *
Livestock Drinking Water (LDW) Health Value		< 400 000 micro g /L (1 500 000 micro g /L toxic)	<30 000 micro g/L	

Note: Values are for Tropical Queensland Rivers Upland and Lowland as well as Wetlands (Lakes and Reservoirs)

Aquatic Ecosystem Nitrogen Water Quality Guidelines

Aquatic Ecosystem Protection	**Oxides of Nitrogen (NO_x)**	**Total Nitrogen (TN)**
Upland	30 micro g N /L	150 micro g /L
Lowland	10 micro g N /L	Rainforest 200 micro g /L; OTHER-300 micro g /L
Wetlands, Lakes and Reservoirs	10 micro g N /L	350 micro g /L for turbid lakes only; Clear lakes have lower values

Note: *site-specific assessment needed. Nitrate (NO3) and Ammonia (NH3) can be toxicants to the flora and fauna of an ecosystem. Toxicity is determined by tests on specific organisms. The values provided are for specific levels of aquatic ecosystem protection.

The default targets where the Environmental Value selected is Aquatic Ecosystem Protection assume that the ecosystem is slightly to moderately disturbed. Where the system is highly disturbed, the same values can be used as default targets. Where, however, the system is of high conservation value and/or essentially undisturbed, the target set should ensure there will be no detectable change from natural variation.

For Irrigation: Long Term Targets - those that should allow no deterioration in 100 years of use and Short Term Targets - should allow no deterioration within 20 years of use. It is preferable to use the Long Term Targets.

Human Use Phosphorus Water Quality Guidelines

Environmental Value Category	Phosphates	Phosphorus - Total
Aquaculture /Human consumption aquatic food	<100 micro g/L	
Irrigation Long Term Targets		50 micro g/L
Irrigation Short Term Targets		800-12 000 micro g/L STT *

Note: Values are for Tropical Queensland Rivers Upland and Lowland as well as Wetlands (Lakes and Reservoirs)

Aquatic Ecosystems Phosphorus Water Quality Guidelines

Aquatic Ecosystem Protection	Filterable Reactive Phosphate (FRP)	Phosphorus - Total
Upland	5 micro g P /L	10 micro g /L
Lowland	4 micro g P /L	10 micro g /L
Wetlands, Lakes and Reservoirs	5 micro g P /L	10 micro g /L

Note: The default targets where the Environmental Value selected is Aquatic Ecosystem Protection assume that the ecosystem is slightly to moderately disturbed. Where the system is highly disturbed, the same values can be used as default targets. Where, however, the system is of high conservation value and/or essentially undisturbed, the target set should ensure there will be no detectable change from natural variation. * indicates site-specific assessment needed.

Human Use Turbidity Water Quality Guidelines

Environmental Value Category	Colour and appearance of water	Turbidity/Suspended Solids	Natural Reflectance
Recreation - Primary Contact	Not Applicable	For swimming Secchi disk (200mm diameter) sighted horizontally >1.6m	Not Applicable
Recreation - Secondary Contact	Not Applicable	Not Applicable	Not Applicable
Recreation - Visual Appreciation (no contact)	The natural hue of water should not be changed by more than 10 points on Munsell Scale	Natural visual clarity not reduced by more than 20%	Natural reflectance not changed by more than 50%
Drinking Water Aesthetic Value (Taste & Odour)		5 NTU	
Aquaculture/Human consumption aquatic food - Freshwater	30-40 (Pt-Co units)	<40 000 micro g/L	

Note: Values are for Tropical Queensland Rivers Upland and Lowland as well as Wetlands (Lakes and Reservoirs)

Aquatic Ecosystem Turbidity Water Quality Guidelines

Aquatic Ecosystem Protection	Turbidity/Suspended Solids
Rivers	2-15 NTU
Wetlands, Lakes and Reservoirs	2-200 NTU - Low in deep lakes; High in shallow lakes; depends on geology, often wind induced

Note: Low values typical of NT base flow; QLD values variable, depend on catchment changes & seasonal runoff. The default targets where the Environmental Value selected is Aquatic Ecosystem Protection assume that the ecosystem is slightly to moderately disturbed. Where the system is highly disturbed, the same values can be used as default targets. Where, however, the system is of high conservation value and/or essentially undisturbed, the target set should ensure there will be no detectable change from natural variation.

Human Use Salinity Water Quality Guidelines

Environmental Value Category	Salinity	Chloride	Sodium
Recreation - Primary Contact		400 000 micro g/L	300 000 micro g/L
Recreation - Secondary Contact		400 000 micro g/L	300 000 micro g/L
Recreation - Visual Appreciation (no contact)		Not Applicable	Not Applicable
Drinking Water (DW)/ Health Value		Not Required	Not Required
DW Aesthetic Value (Taste & Odour)		250 000 micro g/L	180 000 micro g/L
Aquaculture /Human consumption aquatic food - Freshwater	<4 500 micro S/cm		
Irrigation (see Salinity Surface & Groundwater / Irrigation below)			
Livestock Drinking Water (see Salinity Surface & Groundwater /Livestock Drinking Water below)			

Note: Values are for Tropical Queensland Rivers Upland and Lowland as well as Wetlands (Lakes and Reservoirs)

Aquatic Ecosystems Salinity Water Quality Guidelines

Aquatic Ecosystem Protection	Salinity
Rivers	20-250 micro S/cm
Wetlands, Lakes and Reservoirs	90-900 micro S/cm

Note: Low values typical of NT base flow; QLD values variable, depend on catchment changes & seasonal runoff. The default targets where the Environmental Value selected is Aquatic Ecosystem Protection assume that the ecosystem is slightly to moderately disturbed. Where the system is highly disturbed, the same values can be used as default targets. Where, however, the system is of high conservation value and/or essentially undisturbed, the target set should ensure ther will be no detectable change from natural variation.

Salinity Surface & Groundwater / Irrigation

Tolerance	Chloride - Prevention of foliar Injury	Sodium - Prevention of foliar Injury
Sensitive	<175 mg/L (Almond; Apricot; Citrus; Plum; Grape)	<115 mg/L (Almond; Apricot; Citrus; Plum; Grape)
Mod. Sensitive	175-350 mg/L (Pepper; Potato; Tomato)	115-230 mg/L (Pepper; Potato; Tomato)
Mod. Tolerant	350-700 mg/L (Barley; Maize; Cucumber; Lucerne; Safflower; Sorghum)	230-460 mg/L (Barley; Maize; Cucumber; Lucerne; Safflower; Sorghum)
Tolerant	>700 mg/L (Cauliflower; Cotton; Sugar Beet; Sunflower)	>460 mg/L (Cauliflower; Cotton; Sugar Beet; Sunflower)

Salinity Surface & Groundwater / Livestock Drinking Water:

Impact	Beef Cattle	Dairy Cattle	Sheep
Initial Effect	<6 000 micro S/cm no effect	<3 700 micro S/cm no effect	<7 400 micro S/cm no effect
Moderate Effect	6 000 -7 400 micro S/cm	3 700 - 6 000 micro S/cm	7 400 -15 000 micro S/cm
Major Effect	7 400 - 15 000 micro S/cm	6 000 - 10 400 micro S/cm	15 000 -19 400 micro S/cm
Impact	**Horses**	**Pigs**	**Poultry**
Initial Effect	<6 000 micro S/cm no effect	<6 000 micro S/cm no effect	<3 000 micro S/cm no effect
Moderate Effect	6 000 - 9 000 micro S/cm	6 000 - 9 000 micro S/cm	3 000 - 4 500 micro S/cm
Major Effect	9 000 - 10 400 micro S/cm	9 000 - 12 000 micro S/cm	4 500 - 6 000 micro S/cm

Note: Initial Effect = no effect, Moderate Effect = reluctance to drink + scouring, Major Effect = loss of production & condition

Estuaries and Marine Waters

Marine Human Use Nitrogen Water Quality Guidelines

Human Use Environmental Value	Ammonia (NH_3)	Nitrate (NO_3)	Nitrite (NO_2)
Recreation - Primary Contact	10 micro g N /L	44 300 micro g /L converted to nitrate	3 280 micro g /L converted to nitrite
Recreation - Secondary Contact	10 micro g N /L	44 300 micro g /L converted to nitrate	3 280 micro g /L converted to nitrite
Recreation - Visual Appreciation (no contact)	Not Applicable	Not Applicable	Not Applicable
Aquaculture /Human consumption of aquatic food	<100 micro g/L	<100 000 micro g/L	<100 micro g/L

Note: Values are for Tropical Queensland estuaries and marine waters (inshore and offshore)

Marine Aquatic Ecosystem Nitrogen Water Quality Guidelines

Aquatic Ecosystem Protection	Oxides of Nitrogen (NO_x)	Total Nitrogen (TN)
Estuaries	30 micro g N /L	250 micro g /L
Marine Inshore	Coral Reef- 2 micro g N /L; OTHER- 8 micro g N/L	100 micro g /L
Marine Offshore	Coral Reef- 1 micro g N /L ;OTHER- 4 micro g N /L	100 micro g /L

Note: Nitrate (NO3) and Ammonia (NH3) can be toxicants to the flora and fauna of an ecosystem. Toxicity is determined by tests on specific organisms. The values provided are for specific levels of aquatic ecosystem protection.

The default targets where the Environmental Value selected is Aquatic Ecosystem Protection assume that the ecosystem is slightly to moderately disturbed. Where the system is highly disturbed, the same values can be used as default targets. Where, however, the system is of high conservation value and/or essentially undisturbed, the target set should ensure there will be no detectable change from natural variation.

Marine Human Use Phosphorus Water Quality Guidelines

Human Use Environmental Value	Phosphates
Aquaculture /Human consumption of aquatic food	<50 micro g/L

Note: Values are for Tropical Queensland estuaries and marine (inshore and offshore).

Marine Aquatic Ecosystems Phosphorus Water Quality Guidelines

Aquatic Ecosystem Protection	Filterable Reactive Phosphate (FRP)	Phosphorus - Total
Estuaries	5 micro g P /L	20 micro g /L
Marine Inshore	5 micro g P /L	15 micro g /L
Marine Offshore	Coral Reef- 2 micro g P /L; Other- 5 micro g P /L	10 micro g /L

Note: Values are for Tropical Queensland estuaries and marine waters (inshore and offshore). The default targets where the Environmental Value selected is Aquatic Ecosystem Protection assume that the ecosystem is slightly to moderately disturbed. Where the system is highly disturbed, the same values can be used as default targets. Where, however, the system is of high conservation value and/or essentially undisturbed, the target set should ensure there will be no detectable change from natural variation.

Marine Human Use and Aquatic Ecosystem Turbidity Water Quality Guidelines

Environmental Value Category	Colour and appearance of water	Turbidity/Suspended Solids	Natural Reflectance
Recreation - Primary Contact	Not Applicable	For swimming Secchi disk (200mm diameter) sighted horizontally >1.6m	Not Applicable
Recreation - Secondary Contact	Not Applicable	Not Applicable	Not Applicable
Recreation - Visual Appreciation (no contact)	The natural hue of water should not be changed by more than 10 points on Munsell Scale	Natural visual clarity not reduced by more than 20%	Natural reflectance not changed by more than 50%
Aquaculture /Human consumption aquatic food - Marine	30-40 (Pt-Co units)	<10 000 micro g/L (<75 000 micro g/L Brackish)	
Aquatic Ecosystem Protection		1-20 NTU - Low values: offshore, coral dominated waters; High values: estuaries	

Note: Values are for Tropical Queensland estuaries and marine waters (inshore and offshore). The default targets where the Environmental Value selected is Aquatic Ecosystem Protection assume that the ecosystem is slightly to moderately disturbed. Where the system is highly disturbed, the same values can be used as default targets. Where, however, the system is of high conservation value and/or essentially undisturbed, the target set should ensure there will be no detectable change from natural variation.

Marine Human Use Salinity Water Quality Guidelines

Environmental Value Category	Salinity	Chloride	Sodium
Recreation - Primary Contact		400 000 micro g/L	300 000 micro g/L
Recreation - Secondary Contact		400 000 micro g/L	300 000 micro g/L
Recreation - Visual Appreciation (no contact)		Not Applicable	Not Applicable
Aquaculture /Human consumption aquatic food	49 000 - 55 000 micro S/cm (4 500 - 52 000 micro S/cm Brackish)		

Note: Values are for Tropical Queensland estuaries and marine waters (inshore and offshore).

Human use water quality guidelines summary (freshwater and marine from Water Quality Targets Online (Department of Environment and Heritage 2002)

	Ammonia N	Nitrite NO_2 N	Nitrate NO_3 N	Total N	Phosphates	Total P	Turb	Secchi	SS	Salinity	Chloride	Sodium
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	NTU	m	mg/L	µS/cm	µg/L	µg/L
Recreation Primary	10	3,280	44,3000					>1.6			400,000	300,000
Recreation Secondary	10	3,280	44,3000					na			400,000	300,000
Recreation Visual	na	na	na				<20% change	<20% change			na	na
Drinking water (Health)	ns	3,000	50,000								nr	nr
Drinking water (Aesthetics)	500	ns	ns				5				250,000	180,000
Aquaculture (Freshwater)	<20 <30	<100	<50,000		100				40,000	<4,500		
Aquaculture (Saltwater)	<100	<100	<100,000		<50				<10,000	49,000 - 55,000		
Livestock drinking water		<30,000	<400,000							<3,000		
Irrigation long term				5,000		50						
Irrigation short term				25,000 to 125,000		800 to 12,000					<175,000	<115,000

Notes: na is not applicable, ns is not specified, nr is not required. Aquaculture includes human consumption of aquatic food. Drinking water (Aesthetics) is taste and odour. Aquaculture ammonia values are for cold water (<20) and warm water (<30). Irrigation Chloride and Sodium vales are for sensitive crops (values for tolerant crops 4-5 times sensitive values). Livestock drinking water salinity value is for poultry, the lowest impact on the most sensitive livestock type (values for less sensitive livestock are 2-2.5 times higher)
http://www.environment.gov.au/water/publications/quality/targets-online/index.php

eGuides extracts (Marsh, N., Grice, T. and Thomson, B. 2006, eGuides v.1.0.0, Queensland Government)

eGuides is a fully searchable html Help system that contains five guideline documents. Guideline documents included in e-guides are:

- ANZECC Water Quality Guidelines (2000);
- ANZECC Water Quality Monitoring & Reporting Guidelines;
- Queensland Water Quality Guidelines (EPA 2006);
- NHMRC Recreational Water Quality Guidelines;
- CRC Coastal Indicator Guide.

Important tables from the *Water Quality Guidelines*, including tables of default guideline trigger values that users may need to refer to are listed below.

Environmental value and table description	Reference
Aquatic ecosystems	
Water quality issues and recommended biological indicators for different ecosystem types	Table 3.2.2
Regional values for physical and chemical stressors	Tables 3.3.2 – 3.3.11
Values for toxicants	Table 3.4.1
Values for sediments	Table 3.5.1
Primary industries: irrigation and general water use	
Values for coliforms, salinity and other major ions, nutrients, general toxicants, natural physical and chemical indicators, radiological contaminants	Tables 4.2.2 – 4.2.15
Primary industries: livestock drinking water quality	
Values for salinity, metals and radiological contaminants	Tables 4.3.1, 4.3.2 and 4.3.3 respectively
Primary industries: aquaculture and human consumers of aquatic foods	
Values for physico-chemical stressors and toxicants	Tables 4.4.2 and 4.4.3 respectively
Recreational water quality and aesthetics	
Values for recreational waters	Table 5.2.2
Values for recreational purposes: general chemicals and pesticides	Tables 5.2.3 and 5.2.4 respectively

Source: An Introduction to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality

Aquatic ecosystems

Table 3.2.1 Biological assessment objectives for different management situations and the recommended methods and indicators

Table 3.2.2 Water quality issues and recommended biological indicators for different ecosystem types

Table 3.3.1 Summary of the condition indicators, performance indicators, and location of default trigger value tables, for each issue

Tables 3.3.2–3.3.11 Regional values for physical and chemical stressors

Table 3.3.2 and Table 3.3.3 Default trigger values south-east Australia for slightly disturbed ecosystems

Table 3.3.4 and table 3.3.5 Default trigger values for tropical Australia for slightly disturbed ecosystems

Table 3.3.6 and Table 3.3.7 Default trigger values for south-west Australia for slightly disturbed ecosystems

Table 3.3.8 and Table 3.3.9 Default trigger values for south central Australia — low rainfall areas — for slightly disturbed ecosystems.

Table 3.3.10 and Table 3.3.11 Default trigger values in New Zealand for slightly disturbed ecosystems

Table 3.3.4 Default trigger values for physical and chemical stressors for tropical Australia for slightly disturbed ecosystems

Trigger values are used to assess risk of adverse effects due to nutrients, biodegradable organic matter and pH in various ecosystem types. Data derived from trigger values supplied by Australian states and territories, for the Northern Territory and regions north of Carnarvon in the west and Rockhampton in the east. Chl *a* = chlorophyll a, TP = total phosphorus, FRP = filterable reactive phosphate, TN = total nitrogen, NO_x = oxides of nitrogen, NH_4^+ = ammonium, DO = dissolved oxygen.

Ecosystem type	Chl *a*	TP	FRP	TN	NO_x	NH_4^+	DO (% saturation) [f]		pH	
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Lower limit	Upper limit	Lower limit	Upper limit
Upland river[e]	na[a]	10	5	150	30	6	90	120	6.0	7.5
Lowland river[e]	5	10	4	200–300[h]	10[b]	10	85	120	6.0	8.0
Freshwater lakes and reservoirs	3	10	5	350[c]	10[b]	10	90	120	6.0	8.0
Wetlands	10	10–50[g]	5–25[g]	350–1200[g]	10	10	90[b]	120[b]	6.0	8.0
Estuaries[e]	2	20	5	250	30	15	80	120	7.0	8.5
Marine Inshore	0.7–1.4[d]	15	5	100	2–8[d]	1–10[d]	90	no data	8.0	8.4
Offshore	0.5–0.9[d]	10	2–5[d]	100	1–4[d]	1–6[d]	90	no data	8.2	8.2

na = not applicable

a = monitoring of periphyton and not phytoplankton biomass is recommended in upland rivers — values for periphyton biomass (mg Chl a m-2) to be developed;

b = Northern Territory values are 5mgL-1 for NOx, and <80 (lower limit) and >110% saturation (upper limit) for DO;

c = this value represents turbid lakes only. Clear lakes have much lower values;

d = the lower values are typical of clear coral dominated waters (e.g. Great Barrier Reef), while higher values typical of turbid macrotidal systems (eg. North-west Shelf of WA);

e = no data available for tropical WA estuaries or rivers. A precautionary approach should be adopted when applying default trigger values to these systems;

f = dissolved oxygen values were derived from daytime measurements. Dissolved oxygen concentrations may vary diurnally and with depth. Monitoring programs should assess this potential variability (see Section 3.3.3.2);

g = higher values are indicative of tropical WA river pools;

h = lower values from rivers draining rainforest catchments.

Table 3.3.5 Ranges of default trigger values for conductivity (EC, salinity), turbidity and suspended particulate matter (SPM) indicative of slightly disturbed ecosystems in tropical Australia.
Ranges for turbidity and SPM are similar and only turbidity is reported here. Values reflect high site-specific and regional variability. Explanatory notes provide detail on specific variability issues for groupings of ecosystem type.

Ecosystem type	Salinity ($mScm^{-1}$)	Explanatory notes
Upland & lowland rivers	20–250	Conductivity in upland streams will vary depending upon catchment geology. Values at the lower end of the range are typical of ephemeral flowing NT rivers. Catchment type may influence values for Qld lowland rivers (e.g. 150 $mScm^{-1}$ for rivers draining rainforest catchments, 250 $mScm^{-1}$ for savanna catchments). The first flush of water following early seasonal rains may result in temporarily high values.
Lakes, reservoirs & wetlands	90–900	Values at the lower end of the range are found in permanent billabongs in the NT. Higher conductivity values will occur during summer when water levels are reduced due to evaporation. WA wetlands can have values higher than 900 mScm-1. Turbid freshwater lakes in Qld have reported conductivities of approx. 170 mScm-1.
	Turbidity (NTU)	
Upland & lowland rivers	2–15	Low values for base flow conditions in NT rivers. QLD turbidity and SPM values highly variable and dependent on degree of catchment modification and seasonal rainfall runoff.
Lakes, reservoirs & wetlands	2–200	Most deep lakes and reservoirs have low turbidity. However, shallow lakes and reservoirs may have higher turbidity naturally due to wind-induced resuspension of sediments. Lakes and reservoirs in catchments with highly dispersible soils will have high turbidity. Wetlands vary greatly in turbidity depending upon the general condition of the catchment or river system draining into the wetland, recent flow events and the water level in the wetland.
Estuarine & marine	1–20	Low values indicative of offshore coral dominated waters. Higher values representative of estuarine waters. Turbidity is not a very useful indicator in estuarine and marine waters. A move towards the measurement of light attenuation in preference to turbidity is recommended. Typical light attenuation coefficients (log10) in waters off north-west WA range from 0.17 for inshore waters to 0.07 for offshore waters.

Table 3.4.1 Trigger values for toxicants at alternative levels of protection (aquatic ecosystems)
Part 1

Chemical	Trigger values for freshwater (µgL-1)				Trigger values for marine water (µgL-1)			
	Level of protection (% species)				Level of protection (% species)			
	99%	95%	90%	80%	99%	95%	90%	80%
METALS & METALLOIDS								
Aluminium pH >6.5	27	55	80	150	ID	ID	ID	ID
Aluminium pH <6.5	ID	ID	ID	ID	ID	ID	ID	ID
Antimony	ID	ID	ID	ID	ID	ID	ID	ID
Arsenic (AsIII)	1	24	94	360	ID	ID	ID	ID
Arsenic (AsV)	0.8	13	42	140	ID	ID	ID	ID
Beryllium	ID	ID	ID	ID	ID	ID	ID	ID
Bismuth	ID	ID	ID	ID	ID	ID	ID	ID
Boron	90	370	680	1300	ID	ID	ID	ID
Cadmium	0.06	0.2	0.4	0.8	0.7	5.5	14	36
Chromium (Cr III)	ID	ID	ID	ID	7.7	27.4	48.6	90.6
Chromium (CrVI)	0.01	1.0	6	40	0.14	4.4	20	85
Cobalt	ID	ID	ID	ID	0.005	1	14	150
Copper	1.0	1.4	1.8	2.5	0.3	1.3	3	8
Gallium	ID	ID	ID	ID	ID	ID	ID	ID
Iron	ID	ID	ID	ID	ID	ID	ID	ID
Lanthanum	ID	ID	ID	ID	ID	ID	ID	ID
Lead	1.0	3.4	5.6	9.4	2.2	4.4	6.6	12
Manganese	1200	1900	2500	3600	ID	ID	ID	ID
Mercury (inorganic)	0.06	0.6	1.9	5.4	0.1	0.4	0.7	1.4
Mercury (methyl)	ID	ID	ID	ID	ID	ID	ID	ID
Molybdenum	ID	ID	ID	ID	ID	ID	ID	ID
Nickel	8	11	13	17	7	70	200	560
Selenium (Total)	5	11	18	34	ID	ID	ID	ID
Selenium (SeIV)	ID	ID	ID	ID	ID	ID	ID	ID
Silver	0.02	0.05	0.1	0.2	0.8	1.4	1.8	2.6
Thallium	ID	ID	ID	ID	ID	ID	ID	ID
Tin (inorganic, SnIV)	ID	ID	ID	ID	ID	ID	ID	ID
Tributyltin (as mg/L Sn)	ID	ID	ID	ID	0.0004	0.006	0.02	0.05
Uranium	ID	ID	ID	ID	ID	ID	ID	ID
Vanadium	ID	ID	ID	ID	50	100	160	280
Zinc	2.4	8.0	15	31	7	15	23	43

Notes: Where the final water quality guideline to be applied to a site is below current analytical practical quantitation limits, see Section 3.4.3.3 for guidance.

Values in blue shading are the trigger values applying to typical slightly–moderately disturbed systems; see Table 3.4.2 General framework for applying levels of protection for toxicants to different ecosystem conditions (aquatic ecosystems) and section 3.4.2.4 for guidance on applying these levels to different ecosystem conditions.
Most trigger values listed here for metals and metalloids are High reliability figures, derived from field or chronic NOEC data (see 3.4.2.3 for reference to Volume 2). The exceptions are Moderate reliability for freshwater aluminium (pH >6.5), manganese and marine chromium (III).

Part 2

Chemical	Trigger values for freshwater (µgL-1)				Trigger values for marine water (µgL-1)			
	Level of protection (% species)				Level of protection (% species)			
	99%	95%	90%	80%	99%	95%	90%	80%
Non-metallic Inorganics								
Ammonia	320	900	1430	2300	500	910	1200	1700
Chlorine	0.4	3	6	13	ID	ID	ID	ID
Cyanide	4	7	11	18	2	4	7	14
Nitrate ****	17	700	3400	17000	ID	ID	ID	ID
Hydrogen sulfide	0.5	1.0	1.5	2.6	ID	ID	ID	ID
Organic Alcohols								
Ethanol	400	1400	2400	4000	ID	ID	ID	ID
Ethylene glycol	ID	ID	ID	ID	ID	ID	ID	ID
Isopropyl alcohol	ID	ID	ID	ID	ID	ID	ID	ID
Chlorinated Alkanes								
Chloromethanes								
Dichloromethane	ID	ID	ID	ID	ID	ID	ID	ID
Chloroform	ID	ID	ID	ID	ID	ID	ID	ID
Carbon tetrachloride	ID	ID	ID	ID	ID	ID	ID	ID
Chloroethanes								
1,2-dichloroethane	ID	ID	ID	ID	ID	ID	ID	ID
1,1,1-trichloroethane	ID	ID	ID	ID	ID	ID	ID	ID
1,1,2-trichloroethane	5400	6500	7300	8400	140	1900	5800	18000
1,1,2,2-tetrachloroethane	ID	ID	ID	ID	ID	ID	ID	ID
Pentachloroethane	ID	ID	ID	ID	ID	ID	ID	ID
Hexachloroethane	290	360	420	500	ID	ID	ID	ID
Chloropropanes								
1,1-dichloropropane	ID	ID	ID	ID	ID	ID	ID	ID
1,2-dichloropropane	ID	ID	ID	ID	ID	ID	ID	ID
1,3-dichloropropane	ID	ID	ID	ID	ID	ID	ID	ID
Chlorinated Alkenes								
Chloroethylene	ID	ID	ID	ID	ID	ID	ID	ID
1,1-dichloroethylene	ID	ID	ID	ID	ID	ID	ID	ID
1,1,2-trichloroethylene	ID	ID	ID	ID	ID	ID	ID	ID
1,1,2,2-tetrachloroethylene	ID	ID	ID	ID	ID	ID	ID	ID
3-chloropropene	ID	ID	ID	ID	ID	ID	ID	ID
1,3-dichloropropene	ID	ID	ID	ID	ID	ID	ID	ID

**** Please see Amendment to ANZECC for further development of the Nitrates guideline trigger values

Notes: Where the final water quality guideline to be applied to a site is below current analytical practical quantitation limits, see Section 3.4.3.3 for guidance.

Values in blue shading are the trigger values applying to typical slightly–moderately disturbed systems; see Table 3.4.2 General framework for applying levels of protection for toxicants to different ecosystem conditions (aquatic ecosystems) and section 3.4.2.4 for guidance on applying these levels to different ecosystem conditions.

Most trigger values listed here for non-metallic inorganics and organic chemicals are Moderate reliability figures, derived from acute LC50 data (see 3.4.2.3 for reference to Volume 2). The exceptions are High reliability for freshwater ammonia, 3,4-DCA, endosulfan, chlorpyrifos, esfenvalerate, tebuthiuron, three surfactants and marine for 1,1,2-TCE and chlorpyrifos.

Part 3

Chemical	Trigger values for freshwater (mgL^{-1})				Trigger values for marine water (mgL^{-1})			
	Level of protection (% species)				Level of protection (% species)			
	99%	95%	90%	80%	99%	95%	90%	80%
ANILINES								
Aniline	8	250	1100	4800	ID	ID	ID	ID
2,4-dichloroaniline	0.6	7	20	60	ID	ID	ID	ID
2,5-dichloroaniline	ID	ID	ID	ID	ID	ID	ID	ID
3,4-dichloroaniline	1.3	3	6	13	85	150	190	260
3,5-dichloroaniline	ID	ID	ID	ID	ID	ID	ID	ID
Benzidine	ID	ID	ID	ID	ID	ID	ID	ID
Dichlorobenzidine	ID	ID	ID	ID	ID	ID	ID	ID
AROMATIC HYDROCARBONS								
Benzene	600	950	1300	2000	500	700	900	1300
Toluene	ID	ID	ID	ID	ID	ID	ID	ID
Ethylbenzene	ID	ID	ID	ID	ID	ID	ID	ID
o-xylene	200	350	470	640	ID	ID	ID	ID
m-xylene	ID	ID	ID	ID	ID	ID	ID	ID
p-xylene	140	200	250	340	ID	ID	ID	ID
m+p-xylene	ID	ID	ID	ID	ID	ID	ID	ID
Cumene	ID	ID	ID	ID	ID	ID	ID	ID
Polycyclic Aromatic Hydrocarbons								
Naphthalene	2.5	16	37	85	50	70	90	120
Anthracene	ID	ID	ID	ID	ID	ID	ID	ID
Phenanthrene	ID	ID	ID	ID	ID	ID	ID	ID
Fluoranthene	ID	ID	ID	ID	ID	ID	ID	ID
Benzo(a)pyrene	ID	ID	ID	ID	ID	ID	ID	ID

Notes: Where the final water quality guideline to be applied to a site is below current analytical practical quantitation limits, see Section 3.4.3.3 for guidance.

Values in blue shading are the trigger values applying to typical slightly–moderately disturbed systems; see Table 3.4.2 General framework for applying levels of protection for toxicants to different ecosystem conditions (aquatic ecosystems) and section 3.4.2.4 for guidance on applying these levels to different ecosystem conditions.

Part 4

Chemical	Trigger values for freshwater (µgL-1)				Trigger values for marine water (µgL-1)			
	Level of protection (% species)				Level of protection (% species)			
	99%	95%	90%	80%	99%	95%	90%	80%
Nitrobenzenes								
Nitrobenzene	230	550	820	1300	ID	ID	ID	ID
1,2-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,3-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,4-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,3,5-trinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID

1-methoxy-2-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-methoxy-4-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-chloro-2-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-chloro-3-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-chloro-4-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-chloro-2,4-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,2-dichloro-3-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,3-dichloro-5-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,4-dichloro-2-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
2,4-dichloro-2-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,2,4,5-tetrachloro-3-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,5-dichloro-2,4-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,3,5-trichloro-2,4-dinitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-fluoro-4-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
Nitrotoluenes								
2-nitrotoluene	ID	ID	ID	ID	ID	ID	ID	ID
3-nitrotoluene	ID	ID	ID	ID	ID	ID	ID	ID
4-nitrotoluene	ID	ID	ID	ID	ID	ID	ID	ID
2,3-dinitrotoluene	ID	ID	ID	ID	ID	ID	ID	ID
2,4-dinitrotoluene	16	65	130	250	ID	ID	ID	ID
2,4,6-trinitrotoluene	100	140	160	210	ID	ID	ID	ID
1,2-dimethyl-3-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,2-dimethyl-4-nitrobenzene	ID	ID	ID	ID	ID	ID	ID	ID
4-chloro-3-nitrotoluene	ID	ID	ID	ID	ID	ID	ID	ID

Notes: Where the final water quality guideline to be applied to a site is below current analytical practical quantitation limits, see Section 3.4.3.3 for guidance.

Values in blue shading are the trigger values applying to typical slightly–moderately disturbed systems; see Table 3.4.2 General framework for applying levels of protection for toxicants to different ecosystem conditions (aquatic ecosystems) and section 3.4.2.4 for guidance on applying these levels to different ecosystem conditions.

Part 5

Chemical	Trigger values for freshwater (µgL-1)				Trigger values for marine water (µgL-1)			
	Level of protection (% species)				Level of protection (% species)			
	99%	95%	90%	80%	99%	95%	90%	80%
Chlorobenzenes and Chloronaphthalenes								
Monochlorobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,2-dichlorobenzene	120	160	200	270	ID	ID	ID	ID
1,3-dichlorobenzene	160	260	350	520	ID	ID	ID	ID
1,4-dichlorobenzene	40	60	75	100	ID	ID	ID	ID
1,2,3-trichlorobenzene	3	10	16	30	ID	ID	ID	ID
1,2,4-trichlorobenzene	85	170	220	300	20	80	140	240
1,3,5-trichlorobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,2,3,4-tetrachlorobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,2,3,5-tetrachlorobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1,2,4,5-tetrachlorobenzene	ID	ID	ID	ID	ID	ID	ID	ID
Pentachlorobenzene	ID	ID	ID	ID	ID	ID	ID	ID
Hexachlorobenzene	ID	ID	ID	ID	ID	ID	ID	ID
1-chloronaphthalene	ID	ID	ID	ID	ID	ID	ID	ID
Polychlorinated Biphenyls (PCBs) & Dioxins								

Capacitor 21	ID	ID	ID	ID	ID	ID	ID	ID
Aroclor 1016	ID	ID	ID	ID	ID	ID	ID	ID
Aroclor 1221	ID	ID	ID	ID	ID	ID	ID	ID
Aroclor 1232	ID	ID	ID	ID	ID	ID	ID	ID
Aroclor 1242	0.3	0.6	1.0	1.7	ID	ID	ID	ID
Aroclor 1248	ID	ID	ID	ID	ID	ID	ID	ID
Aroclor 1254	0.01	0.03	0.07	0.2	ID	ID	ID	ID
Aroclor 1260	ID	ID	ID	ID	ID	ID	ID	ID
Aroclor 1262	ID	ID	ID	ID	ID	ID	ID	ID
Aroclor 1268	ID	ID	ID	ID	ID	ID	ID	ID
2,3,4'-trichlorobiphenyl	ID	ID	ID	ID	ID	ID	ID	ID
4,4'-dichlorobiphenyl	ID	ID	ID	ID	ID	ID	ID	ID
2,2',4,5,5'-pentachloro-1,1'-biphenyl	ID	ID	ID	ID	ID	ID	ID	ID
2,4,6,2',4',6'-hexachlorobiphenyl	ID	ID	ID	ID	ID	ID	ID	ID
Total PCBs	ID	ID	ID	ID	ID	ID	ID	ID
2,3,7,8-TCDD	ID	ID	ID	ID	ID	ID	ID	ID

Notes: Where the final water quality guideline to be applied to a site is below current analyticalpractical quantitation limits, see Section 3.4.3.3 for guidance.

Values in blue shading are the trigger values applying to typical slightly–moderately disturbed systems; see Table 3.4.2 General framework for applying levels of protection for toxicants to different ecosystem conditions (aquatic ecosystems) and section 3.4.2.4 for guidance on applying these levels to different ecosystem conditions.

Part 6

Chemical	Trigger values for freshwater (mgL^{-1})				Trigger values for marine water (mgL^{-1})			
	Level of protection (% species)				Level of protection (% species)			
	99%	95%	90%	80%	99%	95%	90%	80%
PHENOLS and XYLENOLS								
Phenol	85	320	600	1200	270	400	520	720
2,4-dimethylphenol	ID	ID	ID	ID	ID	ID	ID	ID
Nonylphenol	ID	ID	ID	ID	ID	ID	ID	ID
2-chlorophenol	340	490	630	870	ID	ID	ID	ID
3-chlorophenol	ID	ID	ID	ID	ID	ID	ID	ID
4-chlorophenol	160	220	280	360	ID	ID	ID	ID
2,3-dichlorophenol	ID	ID	ID	ID	ID	ID	ID	ID
2,4-dichlorophenol	120	160	200	270	ID	ID	ID	ID
2,5-dichlorophenol	ID	ID	ID	ID	ID	ID	ID	ID
2,6-dichlorophenol	ID	ID	ID	ID	ID	ID	ID	ID
3,4-dichlorophenol	ID	ID	ID	ID	ID	ID	ID	ID
3,5-dichlorophenol	ID	ID	ID	ID	ID	ID	ID	ID
2,3,4-trichlorophenol	ID	ID	ID	ID	ID	ID	ID	ID
2,3,5-trichlorophenol	ID	ID	ID	ID	ID	ID	ID	ID
2,3,6-trichlorophenol	ID	ID	ID	ID	ID	ID	ID	ID
2,4,5-trichlorophenol	ID	ID	ID	ID	ID	ID	ID	ID
2,4,6-trichlorophenol	3	20	40	95	ID	ID	ID	ID
2,3,4,5-tetrachlorophenol	ID	ID	ID	ID	ID	ID	ID	ID
2,3,4,6- tetrachlorophenol	10	20	25	30	ID	ID	ID	ID
2,3,5,6- tetrachlorophenol	ID	ID	ID	ID	ID	ID	ID	ID
Pentachlorophenol	3.6	10	17	27	11	22	33	55

Notes: Where the final water quality guideline to be applied to a site is below current analyticalpractical quantitation limits, see Section 3.4.3.3 for guidance.
Values in blue shading are the trigger values applying to typical slightly–moderately disturbed systems; see Table 3.4.2 General framework for applying levels of protection for toxicants to different ecosystem conditions (aquatic ecosystems) and section 3.4.2.4 for guidance on applying these levels to different ecosystem conditions.

Part 7

Chemical	Trigger values for freshwater (mgL^{-1})				Trigger values for marine water (mgL^{-1})			
	Level of protection (% species)				Level of protection (% species)			
	99%	95%	90%	80%	99%	95%	90%	80%
Nitrophenols								
2-nitrophenol	ID	ID	ID	ID	ID	ID	ID	ID
3-nitrophenol	ID	ID	ID	ID	ID	ID	ID	ID
4-nitrophenol	ID	ID	ID	ID	ID	ID	ID	ID
2,4-dinitrophenol	13	45	80	140	ID	ID	ID	ID
2,4,6-trinitrophenol	ID	ID	ID	ID	ID	ID	ID	ID
ORGANIC SULFUR COMPOUNDS								
Carbon disulfide	ID	ID	ID	ID	ID	ID	ID	ID
Isopropyl disulfide	ID	ID	ID	ID	ID	ID	ID	ID
n-propyl sulfide	ID	ID	ID	ID	ID	ID	ID	ID
Propyl disulfide	ID	ID	ID	ID	ID	ID	ID	ID
Tert-butyl sulfide	ID	ID	ID	ID	ID	ID	ID	ID
Phenyl disulfide	ID	ID	ID	ID	ID	ID	ID	ID
Bis(dimethylthiocarbamyl)sulfide	ID	ID	ID	ID	ID	ID	ID	ID
Bis(diethylthiocarbamyl)disulfide	ID	ID	ID	ID	ID	ID	ID	ID
2-methoxy-4H-1,3,2-benzodioxaphosphorium-2-sulfide	ID	ID	ID	ID	ID	ID	ID	ID
Xanthates								
Potassium amyl xanthate	ID	ID	ID	ID	ID	ID	ID	ID
Potassium ethyl xanthate	ID	ID	ID	ID	ID	ID	ID	ID
Potassium hexyl xanthate	ID	ID	ID	ID	ID	ID	ID	ID
Potassium isopropyl xanthate	ID	ID	ID	ID	ID	ID	ID	ID
Sodium ethyl xanthate	ID	ID	ID	ID	ID	ID	ID	ID
Sodium isobutyl xanthate	ID	ID	ID	ID	ID	ID	ID	ID
Sodium isopropyl xanthate	ID	ID	ID	ID	ID	ID	ID	ID
Sodium sec-butyl xanthate	ID	ID	ID	ID	ID	ID	ID	ID

Notes: Where the final water quality guideline to be applied to a site is below current analyticalpractical quantitation limits, see Section 3.4.3.3 for guidance.
Values in blue shading are the trigger values applying to typical slightly–moderately disturbed systems; see Table 3.4.2 General framework for applying levels of protection for toxicants to different ecosystem conditions (aquatic ecosystems) and section 3.4.2.4 for guidance on applying these levels to different ecosystem conditions.

Part 8

Chemical	Trigger values for freshwater (µgL-1)				Trigger values for marine water (µgL-1)			
	Level of protection (% species)				Level of protection (% species)			
	99%	95%	90%	80%	99%	95%	90%	80%
PHTHALATES								
Dimethylphthalate	3000	3700	4300	5100	ID	ID	ID	ID

Diethylphthalate	900	1000	1100	1300	ID	ID	ID	ID
Dibutylphthalate	9.9	26	40.2	64.6	ID	ID	ID	ID
Di(2-ethylhexyl)phthalate	ID	ID	ID	ID	ID	ID	ID	ID
MISCELLANEOUS INDUSTRIAL CHEMICALS								
Acetonitrile	ID	ID	ID	ID	ID	ID	ID	ID
Acrylonitrile	ID	ID	ID	ID	ID	ID	ID	ID
Poly(acrylonitrile-co-butadiene-co-styrene)	200	530	800	1200	200	250	280	340
Dimethylformamide	ID	ID	ID	ID	ID	ID	ID	ID
1,2-diphenylhydrazine	ID	ID	ID	ID	ID	ID	ID	ID
Diphenylnitrosamine	ID	ID	ID	ID	ID	ID	ID	ID
Hexachlorobutadiene	ID	ID	ID	ID	ID	ID	ID	ID
Hexachlorocyclopentadiene	ID	ID	ID	ID	ID	ID	ID	ID
Isophorone	ID	ID	ID	ID	ID	ID	ID	ID
ORGANOCHLORINE PESTICIDES								
Aldrin	ID	ID	ID	ID	ID	ID	ID	ID
Chlordane	0.03	0.08	0.14	0.27	ID	ID	ID	ID
DDE	ID	ID	ID	ID	ID	ID	ID	ID
DDT	0.006	0.01	0.02	0.04	ID	ID	ID	ID
Dicofol	ID	ID	ID	ID	ID	ID	ID	ID
Dieldrin	ID	ID	ID	ID	ID	ID	ID	ID
Endosulfan	0.03	0.2	0.6	1.8	0.005	0.01	0.02	0.05
Endosulfan alpha	ID	ID	ID	ID	ID	ID	ID	ID
Endosulfan beta	ID	ID	ID	ID	ID	ID	ID	ID
Endrin	0.01	0.02	0.04	0.06	0.004	0.008	0.01	0.02
Heptachlor	0.01	0.09	0.25	0.7	ID	ID	ID	ID
Lindane	0.07	0.2	0.4	1.0	ID	ID	ID	ID
Methoxychlor	ID	ID	ID	ID	ID	ID	ID	ID
Mirex	ID	ID	ID	ID	ID	ID	ID	ID
Toxaphene	0.1	0.2	0.3	0.5	ID	ID	ID	ID

Notes: Where the final water quality guideline to be applied to a site is below current analyticalpractical quantitation limits, see Section 3.4.3.3 for guidance.

Values in blue shading are the trigger values applying to typical slightly–moderately disturbed systems; see Table 3.4.2 General framework for applying levels of protection for toxicants to different ecosystem conditions (aquatic ecosystems) and section 3.4.2.4 for guidance on applying these levels to different ecosystem conditions.

Most trigger values listed here for non-metallic inorganics and organic chemicals are *Moderate reliability* figures, derived from acute LC50 data (see 3.4.2.3 for reference to Volume 2). The exceptions are *High reliability* for freshwater ammonia, 3,4-DCA, endosulfan, chlorpyrifos, esfenvalerate, tebuthiuron, three surfactants and marine for 1,1,2-TCE and chlorpyrifos.

Part 9

Chemical	Trigger values for freshwater (µgL-1)				Trigger values for marine water (µgL-1)			
	Level of protection (% species)				Level of protection (% species)			
	99%	95%	90%	80%	99%	95%	90%	80%
ORGANOPHOSPHORUS PESTICIDES								
Azinphos methyl	0.01	0.02	0.05	0.11	ID	ID	ID	ID

Chlorpyrifos	0.00004	0.01	0.11	1.2	0.0005	0.009		
Demeton	ID	ID	ID	ID	ID	ID	ID	ID
Demeton-S-methyl	ID	ID	ID	ID	ID	ID	ID	ID
Diazinon	0.00003	0.01	0.2	2	ID	ID	ID	ID
Dimethoate	0.1	0.15	0.2	0.3	ID	ID	ID	ID
Fenitrothion	0.1	0.2	0.3	0.4	ID	ID	ID	ID
Malathion	0.002	0.05	0.2	1.1	ID	ID	ID	ID
Parathion	0.0007	0.004	0.01	0.04	ID	ID	ID	ID
Profenofos	ID	ID	ID	ID	ID	ID	ID	ID
Temephos	ID	ID	ID	ID	0.0004	0.05	0.4	
CARBAMATE & OTHER PESTICIDES								
Carbofuran	0.06	1.2	4	15	ID	ID	ID	ID
Methomyl	0.5	3.5	9.5	23	ID	ID	ID	ID
S-methoprene	ID	ID	ID	ID	ID	ID	ID	ID
PYRETHROIDS								
Deltamethrin	ID	ID	ID	ID	ID	ID	ID	ID
Esfenvalerate	ID	0.001	ID	ID	ID	ID	ID	ID
HERBICIDES & FUNGICIDES								
Bypyridilium herbicides								
Diquat	0.01	1.4	10	80	ID	ID	ID	ID
Paraquat	ID	ID	ID	ID	ID	ID	ID	ID
Phenoxyacetic acid herbicides								
MCPA	ID	ID	ID	ID	ID	ID	ID	ID
2,4-D	140	280	450	830	ID	ID	ID	ID
2,4,5-T	3	36	100	290	ID	ID	ID	ID
Sulfonylurea herbicides								
Bensulfuron	ID	ID	ID	ID	ID	ID	ID	ID
Metsulfuron	ID	ID	ID	ID	ID	ID	ID	ID

Notes: Where the final water quality guideline to be applied to a site is below current analyticalpractical quantitation limits, see Section 3.4.3.3 for guidance.

Values in blue shading are the trigger values applying to typical slightly–moderately disturbed systems; see Table 3.4.2 General framework for applying levels of protection for toxicants to different ecosystem conditions (aquatic ecosystems) and section 3.4.2.4 for guidance on applying these levels to different ecosystem conditions.

Most trigger values listed here for non-metallic inorganics and organic chemicals are Moderate reliability figures, derived from acute LC50 data (see 3.4.2.3 for reference to Volume 2). The exceptions are High reliability for freshwater ammonia, 3,4-DCA, endosulfan, chlorpyrifos, esfenvalerate, tebuthiuron, three surfactants and marine for 1,1,2-TCE and chlorpyrifos.

Part 10

Chemical	Trigger values for freshwater (µgL-1)				Trigger values for marine water (µgL-1)			
	Level of protection (% species)				Level of protection (% species)			
	99%	95%	90%	80%	99%	95%	90%	80%
Thiocarbamate herbicides								
Molinate	0.1	3.4	14	57	ID	ID	ID	ID
Thiobencarb	1	2.8	4.6	8	ID	ID	ID	ID
Thiram	0.01	0.2	0.8	3	ID	ID	ID	ID

Triazine herbicides								
Amitrole	ID	ID	ID	ID	ID	ID	ID	ID
Atrazine	0.7	13	45	150	ID	ID	ID	ID
Hexazinone	ID	ID	ID	ID	ID	ID	ID	ID
Simazine	0.2	3.2	11	35	ID	ID	ID	ID
Urea herbicides								
Diuron	ID	ID	ID	ID	ID	ID	ID	ID
Tebuthiuron	0.02	2.2	20	160	ID	ID	ID	ID
Miscellaneous herbicides								
Acrolein	ID	ID	ID	ID	ID	ID	ID	ID
Bromacil	ID	ID	ID	ID	ID	ID	ID	ID
Glyphosate	370	1200	2000	3600	ID	ID	ID	ID
Imazethapyr	ID	ID	ID	ID	ID	ID	ID	ID
Ioxynil	ID	ID	ID	ID	ID	ID	ID	ID
Metolachlor	ID	ID	ID	ID	ID	ID	ID	ID
Sethoxydim	ID	ID	ID	ID	ID	ID	ID	ID
	2.6	4.4	6	9	ID	ID	ID	ID
GENERIC GROUPS OF CHEMICALS								
Surfactants								
Linear alkylbenzene sulfonates (LAS)	65	280	520	1000	ID	ID	ID	ID
Alcohol ethoxyolated sulfate (AES)	340	650	850	1100	ID	ID	ID	ID
Alcohol ethoxylated surfactants (AE)	50	140	220	360	ID	ID	ID	ID
Oils & Petroleum Hydrocarbons	ID	ID	ID	ID	ID	ID	ID	ID
Oil Spill Dispersants								
BP 1100X	ID	ID	ID	ID	ID	ID	ID	ID
Corexit 7664	ID	ID	ID	ID	ID	ID	ID	ID
Corexit 8667	ID	ID	ID	ID	ID	ID	ID	ID
Corexit 9527	ID	ID	ID	ID	230	1100	2200	4400
Corexit 9550	ID	ID	ID	ID	ID	ID	ID	ID

Notes: Where the final water quality guideline to be applied to a site is below current analyticalpractical quantitation limits, see Section 3.4.3.3 for guidance.

Values in blue shading are the trigger values applying to typical slightly–moderately disturbed systems; see Table 3.4.2 General framework for applying levels of protection for toxicants to different ecosystem conditions (aquatic ecosystems) and section 3.4.2.4 for guidance on applying these levels to different ecosystem conditions.

Most trigger values listed here for non-metallic inorganics and organic chemicals are Moderate reliability figures, derived from acute LC50 data (see 3.4.2.3 for reference to Volume 2). The exceptions are High reliability for freshwater ammonia, 3,4-DCA, endosulfan, chlorpyrifos, esfenvalerate, tebuthiuron, three surfactants and marine for 1,1,2-TCE and chlorpyrifos.

Table 3.5.1 Recommended sediment quality guidelines

Contaminant	ISQG-Low (Trigger value)	ISQG-High
METALS (mg/kg dry wt)		
Antimony	2	25
Cadmium	1.5	10
Chromium	80	370
Copper	65	270
Lead	50	220
Mercury	0.15	1
Nickel	21	52
Silver	1	3.7
Zinc	200	410
METALLOIDS (mg/kg dry wt)		
Arsenic	20	70
ORGANOMETALLICS		
Tributyltin (mg Sn/kg dry wt.)	5	70
ORGANICS (mg/kg dry wt) b		
Acenaphthene	16	500
Acenaphthalene	44	640
Anthracene	85	1100
Fluorene	19	540
Naphthalene	160	2100
Phenanthrene	240	1500
Low Molecular Weight PAHs c	552	3160
Benzo(a)anthracene	261	1600
Benzo(a)pyrene	430	1600
Dibenzo(a,h)anthracene	63	260
Chrysene	384	2800
Fluoranthene	600	5100
Pyrene	665	2600
High Molecular Weight PAHs c	1700	9600
Total PAHs	4000	45000
Total DDT	1.6	46
p.p'-DDE	2.2	27
o,p'- + p,p'-DDD	2	20
Chlordane	0.5	6
Dieldrin	0.02	8
Endrin	0.02	8
Lindane	0.32	1
Total PCBs	23	–

a Primarily adapted from Long et al. (1995);

b Normalised to 1% organic carbon;

c Low molecular weight PAHs are the sum of concentrations of acenaphthene, acenaphthalene, anthracene, fluorene, 2-methylnaphthalene, naphthalene and phenanthrene; high molecular weight PAHs are the sum of concentrations of benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, fluoranthene and pyrene.

Primary industries: irrigation and general water use

Tables 4.2.2 – 4.2.15 Values for coliforms, salinity and other major ions, nutrients, general toxicants, natural physical and chemical indicators, radiological contaminants

Table 4.2.2 Trigger values for thermotolerant coliforms in irrigation waters used for food and non-food crops[a]

Intended use	Level of thermotolerant coliforms [b]
Raw human food crops in direct contact with irrigation water (e.g. via sprays, irrigation of salad vegetables)	<10 cfu[c] / 100 mL
Raw human food crops not in direct contact with irrigation water (edible product separated from contact with water, e.g. by peel, use of trickle irrigation); or crops sold to consumers cooked or processed	<1000 cfu / 100 mL
Pasture and fodder for dairy animals (without withholding period)	<100 cfu / 100 mL
Pasture and fodder for dairy animals (with withholding period of 5 days)	<1000 cfu / 100 mL
Pasture and fodder (for grazing animals except pigs and dairy animals, i.e. cattle, sheep and goats)	<1000 cfu / 100 mL
Silviculture, turf, cotton, etc. (restricted public access)	<10 000 cfu / 100 mL

a Adapted from ARMCANZ, ANZECC & NHMRC (1999)
b Median values (refer to text)
c cfu = colony forming units

Table 4.2.3 Soil type and average root zone leaching fraction

Table 4.2.4 Soil and water salinity criteria based on plant salt tolerance groupings

Plant salt tolerance groupings	Water or soil salinity rating	Average root zone salinity, EC_{se} (dS/m)*
Sensitive crops	Very low	<0.95
Moderately sensitive crops	Low	0.95-1.9
Moderately tolerant crops	Medium	1.9-4.5
Tolerant crops	High	4.5-7.7
Very tolerant crops	Very high	7.7-12.2
Generally too saline	Extreme	>12.2

Adapted from DNR (1997b)
* 1 dS/m = 1000 µS/cm

Table 4.2.5 Tolerance of plants to salinity in irrigation water
Table 4.2.6 Chloride concentrations (mg/L) causing foliar injury in crops of varying sensitivity
Table 4.2.7 Risks of increasing cadmium concentrations in crops due to chloride in irrigation waters
Table 4.2.8 Sodium concentration (mg/L) causing foliar injury in crops of varying sensitivity
Table 4.2.9 Effect of sodium expressed as sodium adsorption ratio (SAR) on crop yield and quality under non-saline conditions

Table 4.2.10 Agricultural irrigation water triggers for heavy metals and metalloids

Element	Suggested soil CCL[b]	LTV in irrigation water (long-term use — up to 100 yrs)	STV in irrigation water (short-term use — up to 20 yrs)
	(kg/ha)	(mg/L)	(mg/L)
Aluminium	ND	5	20
Arsenic	20	0.1	2.0
Beryllium	ND	0.1	0.5
Boron	ND	0.5	Refer to table 9.2.18 (Volume 3)
Cadmium	2	0.01	0.05
Chromium	ND	0.1	1

Cobalt	ND	0.05	0.1
Copper	140	0.2	5
Fluoride	ND	1	2
Iron	ND	0.2	10
Lead	260	2	5
Lithium	ND	2.5 (0.075 Citrus crops)	2.5 (0.075 Citrus crops)
Manganese	ND	0.2	10
Mercury	2	0.002	0.002
Molybdenum	ND	0.01	0.05
Nickel	85	0.2	2
Selenium	10	0.02	0.05
Uranium	ND	0.01	0.1
Vanadium	ND	0.1	0.5
Zinc	300	2	5

Table 4.2.11 Agricultural irrigation water long-term trigger value (LTV) and short-term trigger value (STV) guidelines for N & P

Element	LTV in irrigation water (long-term — up to 100 yrs) (mg/L)	STV in irrigation water (short-term — up to 20 yrs) (mg/L)
Nitrogen	5	25–125[a]
Phosphorus	0.05 (To minimise bioclogging of irrigation equipment only)	0.8–12 [a]

Requires site-specific assessment

Table 4.2.12 Interim trigger value concentrations for a range of herbicides registered in Australia for use in or near waters (Part 1 and Part 2)

Herbicide	Residue limits in irrigation water (mg/L)[b]	Hazard to crops from residue in water[c]	Crop injury threshold in irrigation water (mg/L)
Acrolein	0.1	+	Flood or furrow: beans 60, corn 60, cotton 80, soybeans 20, sugar-beets 60. Sprinkler: corn 60, soybeans 15, sugar-beets 15
AF 100		+	Beets (rutabaga) 3.5, corn 3.5
Amitrol	0.002	++	Lucerne 1600, beans 1200, carrots 1600, corn 3000, cotton 1600, grains sorghum 800
Aromatic solvents (Xylene)		+	Oats 2400, potatoes 1300, wheat 1200
Asulam		++	
Atrazine		++	
Bromazil		+++	
Chlorthiamid		++	
Copper sulfate		+	Apparently above concentrations used for weed control
2,4-D		++	Field beans 3.5–10, grapes 0.7–1.5, sugar-beets 1.0–10
Dicamba		++	Cotton 0.18
Dichlobenil		++	Lucerne 10, corn 10, soybeans 1.0,

			sugar-beets 1.0–10, corn 125, beans 5
Diquat		+	
Diuron	0.002	+++	
2,2-DPA (Dalapon)	0.004	++	Beets 7.0, corn 0.35
Fosamine		+++	
Fluometuron		++	Sugar-beets, alfalfa, tomatoes, squash 2.2
Glyphosate		+	
Hexazinone		+++	
Karbutilate		+++	
Molinate		++	
Paraquat		+	Corn 10, field beans 0.1, sugar-beets 1.0
Picloram		+++	
Propanil		++	Alfalfa 0.15, brome grass (eradicated) 0.15
Simazine		++	
2,4,5-T		++	Potatoes, alfalfa, garden peas, corn, sugar-beets, wheat, peaches, grapes, apples, tomatoes 0.5
TCA (Trichloroacetic acid)		+++	
Terbutryne		++	
Triclopyr		++	

a From ANZECC (1992). These should be regarded as interim trigger values only.
b Guidelines have not been set for herbicides where specific residue limits are not provided, except for a general limit of 0.01 mg/L for all herbicides in NSW.
c Hazard from residue at maximum concentration likely to be found in irrigation water: + = low, ++ = moderate, +++ = high

Table 4.2.13 Trigger values for radioactive contaminants for irrigation water
Table 4.2.14 Corrosion potential of waters on metal surfaces as indicated by pH, hardness, Langelier index, Ryznar index and the log of chloride:carbonate ratio
Table 4.2.15 Fouling potential of waters as indicated by pH, hardness, Langelier index, Ryznar index and the log of chloride:carbonate ratio

Primary industries: livestock drinking water quality

Tables 4.3.1 Tolerances of livestock to total dissolved solids (salinity) in drinking water[a]

Livestock	Total dissolved solids (mg/L)		
	No adverse effects on animals expected	Animals may have initial reluctance to drink or there may be some scouring, but stock should adapt without loss of production	Loss of production and a decline in animal condition and health would be expected. Stock may tolerate these levels for short periods if introduced gradually
Beef cattle	0–4000	4000–5000	5000–10 000
Dairy cattle	0–2500	2500–4000	4000–7000
Sheep	0–5000	5000–10 000	10 000–13 000[b]
Horses	0–4000	4000–6000	6000–7000
Pigs	0–4000	4000–6000	6000–8000
Poultry	0–2000	2000–3000	3000–4000

a From ANZECC (1992), adapted to incorporate more recent information

b Sheep on lush green feed may tolerate up to 13 000 mg/L TDS without loss of condition or production

Table 4.3.2 Recommended water quality trigger values (low risk) for heavy metals and metalloids in livestock drinking water (AWQG 2000)

Metal or metalloid	Trigger value (low risk)[a,b] (mg/L)
Aluminium	5
Arsenic	0.5 up to 5[c]
Beryllium	ND
Boron	5
Cadmium	0.01
Chromium	1
Cobalt	1
Copper	0.4 (sheep) 1 (cattle) 5 (pigs) 5 (poultry)
Fluoride	2
Iron	Not sufficiently toxic
Lead	0.1
Manganese	Not sufficiently toxic
Mercury	0.002
Molybdenum	0.15
Nickel	1
Selenium	0.02
Uranium	0.2
Vanadium	ND
Zinc	20

a Higher concentrations may be tolerated in some situations (details provided in Volume 3, Section 9.3.5)

b ND = not determined, insufficient background data to calculate

c May be tolerated if not provided as a food additive and natural levels in the diet are low

Table 4.3.3 Trigger values for radioactive contaminants in livestock drinking water

Radionuclide	Trigger value
Radium 226	5 Bq/L
Radium 228	2 Bq/L
Uranium 238	0.2 Bq/L
Gross alpha	0.5 Bq/L
Gross beta (excluding K-40)	0.5 Bq/L

Primary industries: aquaculture and human consumers of aquatic foods

Table 4.4.1 Representative aquaculture species, occurrence and culture status

Tables 4.4.2 Physico-chemical stressor guidelines for the protection of aquaculture species

Measured parameter	Recommended guideline (mg/L)	
	Freshwater production	Saltwater production
Alkalinity	³20[5]	>20[3]
Biochemical oxygen demand (BOD5)	<15[1]	ND
Chemical oxygen demand (COD)	<40[1]	ND
Carbon dioxide	<10	<15
Colour and appearance of water	30–40[2] (Pt-Co units)	30–40[2] (Pt-Co units)
Dissolved oxygen	>5[3]	>53
Gas supersaturation	<100%[6]	<100%[6]
Hardness (CaCO3)	20–100[5]	NC[6]
pH	5.0–9.0	6.0-9.0
Salinity (total dissolved solids)	<3000[6]	33 000–37 000[6] (3000–35 000 Brackish)[6]
Suspended solids	<40	<10 (<75 Brackish)
Temperature	<2.0°C change over 1 hour4	<2.0°C change over 1 hour[4]

1 Schlotfeldt & Alderman (1995)
2 O'Connor pers. comm.
3 Meade (1989)
4 ANZECC (1992)
5 DWAF (1996)
6 Lawson (1995)
7 Others are based on professional judgements of the project team.

Table 4.4.3 Toxicant guidelines for the protection of aquaculture species

Measured parameter	Guideline (µg/L)	
	Freshwater production	Saltwater production
INORGANIC TOXICANTS (HEAVY METALS AND OTHERS)		
Aluminium	<30 (pH >6.5)[1] <10 (pH <6.5)	<10[1]
Ammonia (un-ionised)	<20 (pH >8.0) coldwater[2] <30 warmwater[2]	<100
Arsenic	<50[1,2]	<30[1,2]
Cadmium (varies with hardness)	<0.2–1.8[2]	<0.5–5[1]
Chlorine	<3[1]	<3[1]
Chromium	<20[2]	<20
Copper (varies with hardness)	<5[2]	<5[3]
Cyanide	<5[1]	<5[1]
Fluorides	<20[4]	ND
Hydrogen sulfide	<1[2]	<2
Iron	<10[1]	<10[1]
Lead (varies with hardness)	<1–7[4]	<1–7[4]
Magnesium	<15 000[1]	ND
Manganese	<10[1,5]	<10[1,5]

Mercury	<1	<1
Nickel	<100[1]	<100[1]
Nitrate (NO_3)	<50 000[6]	<100 000[3,7]
Nitrite (NO_2)	<100[1,7]	<100[1,7]
Phosphates	<100[2]	<50
Selenium	<10[1]	<10[1]
Silver	<3[1]	<3[1]
Tributyltin (TBT)	<0.026[1]	<0.01[1]
Total ammonia nitrogen (TAN)	<1000[1]	<1000[1]
Vanadium	<100[1]	<100[1]
Zinc	<5[1]	<5[1]

ND: Not determined — insufficient information; NC: Not of concern; 1. Meade (1989); 2. DWAF (1996); 3. Pillay (1990); 4. Tebbutt (1972); 5. Zweig et al. (1999); 6. Schlotfeldt & Alderman (1995); 7. Coche (1981); 8. Langdon (1988); 9. McKee & Wolf (1963); 10. Boyd (1990);11. Lannan et al. (1986). Others are based on professional judgements of the project team.

Measured parameter	Guideline (µg/L)	
	Freshwater production	Saltwater production
ORGANIC TOXICANTS (NON-PESTICIDES)		
Detergents and surfactants	<0.1[8]	ND
Methane	<65 000[9,10]	<65 000[9,10]
Oils and greases (including petrochemicals)	<300[6]	ND
Phenols and chlorinated phenols	<0.6–1.7[6]	ND
Polychlorinated biphenyls (PCBs)	<2[1]	<2[1]
PESTICIDES		
2,4-dichlorophenol	<4.0[2]	ND
Aldrin	<0.01[2,3,8]	ND
Azinphos-methyl	<0.01[2]	ND
Chlordane	<0.01[11]	0.004[11]
Chlorpyrifos	<0.001[2]	ND
DDT (including DDD & DDE)	<0.0015[2]	ND
Demton	<0.01[11]	ND
Dieldrin	<0.005[2]	ND
Endosulfan	<0.003[2,11]	0.001[11]
Endrin	<0.002[2]	ND
Gunthion (see also Azinphos-methyl)	<0.01[11]	ND
Hexachlorobenzole	<0.00001[6]	ND
Heptachlor	<0.005[2]	ND
Lindane	<0.01[11]	0.004[11]
Malathion	<0.1[5,11]	ND
Methoxychlor	<0.03[11]	ND
Mirex	<0.001[2,11]	ND
Paraquat	ND	<0.01
Parathion	<0.04[11]	ND
Toxaphene	<0.002[2]	ND

Table 5.1.2 The general recommended levels of water quality parameters for Tropical aquaculture

Water parameter	Recommended range		Water parameter	Recommended range
	Freshwater	Marine		General aquatic
Dissolved oxygen	>4mg/L	>4mg/L	Arsenic	<0.05mg/L
Temperature °C	21-32	24-33	Cadmium	<0.003mg/L
pH	6.8-9.5	7-9.0	Calcium/Magnesium	10-160mg/L
Ammonia (TAN, total ammonia-nitrogen)	<1.0mg/L	<1.0mg/L	Chromium	<0.1mg/L
Ammonia (NH_3, Unionised form)	<0.1mg/L	<0.1mg/L	Copper	<0.006mg/L in soft water
Nitrate (NO_3)	1-100mg/L	1-100mg/L	Cyanide	<0.006mg/L
Nitrite (NO_2)	<0.1mg/L	<1.0mg/L	Iron	<0.5mg/L
Salinity	0-5ppt	15-35ppt	Lead	<0.03mg/L
Hardness	20-450mg/L		Manganese	<0.01mg/L
Alkalinity	20-400mg/L	>100mg/L	Mercury	<0.00005mg/L
Turbidity	<80NTU		Nickel	<0.01mg/L in soft water <0.04mg/L in hard water
Chlorine	<0.003mg/L		Tin	<0.001mg/L
Hydrogen sulphide	<0.002mg/L		Zinc	0.03-0.06mg/L in soft water

Source: Queensland Water Quality Guidelines (EPA 2006)

Recreational water quality and aesthetics

Table 5.2.1 Water quality characteristics relevant to recreational use

Table 5.2.2 Summary of water quality guidelines for recreational waters

Parameter	Guideline
Microbiological	
Primary contact*	The median bacterial content in fresh and marine waters taken over the bathing season should not exceed 150 faecal coliform organisms/100 mL or 35 enterococci organisms/100 mL. Pathogenic free-living protozoans should be absent from bodies of fresh water.**
Secondary contact*	The median value in fresh and marine waters should not exceed 1000 faecal coliform organisms/100 mL or 230 enterococci organisms/100 mL.**
Nuisance organisms	Macrophytes, phytoplankton scums, filamentous algal mats, sewage fungus, leeches, etc., should not be present in excessive amounts.* Direct contact activities should be discouraged if algal levels of 15 000–20 000 cells/mL are present, depending on the algal species. Large numbers of midges and aquatic worms should also be avoided.
Physical and chemical	
Visual clarity & colour	To protect the aesthetic quality of a waterbody: q the natural visual clarity should not be reduced by more than 20% q the natural hue of the water should not be changed by more than 10 points on the Munsell Scale; q the natural reflectance of the water should not be changed by more than 50%. To protect the visual clarity of waters used for swimming, the horizontal sighting of a 200 mm diameter black disc should exceed 1.6 m.
pH	The pH of the water should be within the range 5.0–9.0, assuming that the buffering capacity of the water is low near the extremes of the pH limits.
Temperature	For prolonged exposure, temperatures should be in the range 15–35°C.
Toxic chemicals	Waters containing chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreation. Toxic substances should not exceed values in tables 5.2.3 and 5.2.4.
Surface films	Oil and petrochemicals should not be noticeable as a visible film on the water nor should they be detectable by odour.

* Refer to Section 3.3 of these revised Guidelines relating to nutrient concentrations necessary to limit excessive aquatic plant growth.

** Sampling frequency and maximum values are given in Section 5.2.3.1.

Tables 5.2.3 Summary of water quality guidelines for recreational purposes: general chemicals (Part 1 and 2)

Parameter	Guideline values (µg/L, unless otherwise stated)
Inorganic:	
Arsenic	50
Asbestos	NR
Barium	1000
Boron	1000
Cadmium	5
Chromium	50
Cyanide	100
Lead	50
Mercury	1
Nickel	100

Nitrate-N	10 000
Nitrite-N	1000
Selenium	10
Silver	50
Organic:	
Benzene	10
Benzo(a)pyrene	0.01
Carbon tetrachloride	3
1,1-Dichloroethene	0.3
1,2-Dichloroethane	10
Pentachlorophenol	10
Polychlorinated biphenyls	0.1
Tetrachloroethene	10
2,3,4,6-Tetrachlorophenol	1
Trichloroethene	30
2,4,5-Trichlorophenol	1
2,4,6-Trichlorophenol	10
Radiological:	
Gross alpha activity	0.1 Bq/L
Gross beta activity (excluding activity of ^{40}K)	0.1 Bq/L
Other chemicals:	
Aluminium	200
Ammonia (as N)	10
Chloride	400 000
Copper	1000
Oxygen	>6.5 (>80% saturation)
Hardness (as CaCO3)	500 000
Iron	300
Manganese	100
Organics (CCE & CAE)	200
pH	6.5–8.5
Phenolics	2
Sodium	300 000
Sulfate	400 000
Sulfide	50
Surfactant (MBAS)	200
Total dissolved solids	1 000 000
Zinc	5000

Tables 5.2.4 Summary of water quality guidelines for recreational purposes: pesticides (Part 1 and 2)

Compound	Maximum concentration (µg/L)	Compound	Maximum concentration (µg/L)
Acephate	20	Demeton	30
Alachlor	3	Diazinon	10
Aldrin	1	Dicamba	300
Amitrol	1	Dichlobenil	20
Asulam	100	3,6-Dichloropicolinic acid	1000
Azinphos-methyl	10	Dichlorvos	20
Barban	300	Diclofop-methyl	3

Benomyl	200	Dicofol	100
Bentazone	400	Dieldrin	1
Bioresmethrin	60	Difenzoquat	200
Bromazil	600	Dimethoate	100
Bromophos-ethyl	20	Diquat	10
Bromoxynil	30	Disulfoton	6
Carbaryl	60	Diuron	40
Carbendazim	200	DPA	500
Carbofuran	30	Endosulfan	40
Carbophenothion	1	Endothal	600
Chlordane	6	Endrin	1
Chlordimeform	20	EPTC	60
Chlorfenvinphos	10	Ethion	6
Chloroxuron	30	Ethoprophos	1
Chlorpyrifos	2	Fenchlorphos	60
Clopzralid	1000	Fenitrothion	20
Cyhexatin	200	Fenoprop	20
2,4-D	100	Fensulfothion	20
DDT	3		
Fenvalerate	40	Pendimethalin	600
Flamprop-methyl	6	Perfluidone	20
Fluometuron	100	Permethrin	300
Formothion	100	Picloram	30
Fosamine (ammonium salt)	3000	Piperonyl butoxide	200
Glyphosate	200	Pirimicarb	100
Heptachlor	3	Pirimiphos-ethyl	1
Hexaflurate	60	Pirimiphos-methyl	60
Hexazinone	600	Profenofos	0.6
Lindane	10	Promecarb	60
Maldison	100	Propanil	1000
Methidathion	60	Propargite	1000
Methomyl	60	Propoxur	1000
Metolachlor	800	Pyrazophos	1000
Metribuzin	5	Quintozene	6
Mevinphos	6	Sulprofos	20
Molinate	1	2,4,5-T	2
Monocrotophos	2	Temephos	30
Nabam	30	Thiobencarb	40
Nitralin	1000	Thiometon	20
Omethoate	0.4	Thiophanate	100
Oryzalin	60	Thiram	30
Paraquat	40	Trichlorofon	10
Parathion	30	Triclopyr	20
Parathion-methyl	6	Trifluralin	500

Sources: NHMRC & AWRC (1987), NHMRC (1989)

Table 5.2.1 Guidelines for blue-green algae for primary contact recreation (QWQG EPA 2006)

Hazard status	Guidance level or situation	Health risks	Recommended action
High	Cyanobacterial scum formation in contact recreation areas or >100,000 cells total cyanobacteria mL-1 or >50 µg L-1 chlorophyll-a with dominance of cyanobacteria.	• Short-term adverse health outcomes such as skin irritations or gastrointestinal illness following contact or accidental ingestion • Severe acute poisoning is possible in worst ingestion cases	• Immediate action to prevent contact with scums • Signs to indicate high alert level – warning of danger for swimming and other water contact activities
Moderate	20,000–100,000 cells total cyanobacteria mL-1 or 10–50µg L-1 chlorophyll-a with dominance of cyanobacteria.	• Short-term adverse health outcomes e.g. skin irritations, gastrointestinal illness, probably at low frequency	• Signs to indicate moderate alert level – increased health risk for swimming and other water-contact activities
Low	<20,000 cells total cyanobacteria mL-1 or <10µg L-1 chlorophyll-a with dominance of cyanobacteria.	• Short-term adverse health outcomes unlikely	• Signs to indicate cyanobacteria either absent or present at low levels

Table 9.3 Sources of Chemicals in Recreational Water (NHMRC Recreational Water Quality Guidelines)

Chemical	Drinking water guideline values[a] (mg/L)		Potential sources of contamination			
	Health	Aesthetic	Naturally occurring	Agricultural activities	Human settlements	Industry
Acephate	0.01			✓		
Acrylamide	0.0002					×
Aldicarb	0.001			✓		×
Aldrin/dieldrin	0.0003			✓		×
Ametryn	0.05			✓		
Amitrole	0.01			✓	×	
Ammonia		0.5	✓	✓		✓
Antimony	0.003		×			×
Arsenic	0.007		✓			×
Asbestos	b					✓
Asulam	0.05			✓		
Atrazine	0.04			✓	×	✓
Azinphos-methyl	0.003				×	✓
Barium	0.7		✓			✓
Benomyl	0.1			✓		
Bentazone	0.03			✓		✓
Benzene	0.001				✓	✓
Benzo[a]pyrene	0.00001				×	×
Beryllium	*		✓			×
Bioresmethrin	0.1			✓	×	
Boron	0.03		✓		✓	✓

Bromacil	0.3			✓		
Bromate	0.02					×
Bromochloroacetonitrile	*					×
Bromophos-ethyl	0.01			✓		
Bromoxynil	0.03			✓	×	
Cadmium	0.002		×			✓
Carbaryl	0.03			✓		
Carbendazin	0.1			✓		
Carbofuran	0.01	0.005		✓		×
Carbon tetrachloride	0.003				✓	✓
Carbophenothion	0.0005			✓		
Carboxin	0.3			✓		
Chloral hydrate	0.02			✓		
Chlordane	0.001			✓		×
Chlorfenvinphos	0.005			✓		
Chloride		250	✓		✓	✓
Chlorite	0.3				✓	✓
Chloroacetic acid	0.15					×
Chlorobenzene	0.3					✓
2-Chlorophenol	0.3	0.0001		✓		×
Chlorothalonil	0.03			✓		
Chloroxuron	0.01			✓		
Chlorpyrifos	0.01			✓	✓	
Chlorsulfuron	0.1			✓		

Chromium	0.05		✓			✓
Clopyralid	1			✓		
Copper	2	1	×		×	×
Cyanide	0.08		×			✓
Cyanogen chloride (as CN)	0.08					×
D 2,4-	0.03			✓		×
DDT	0.02			✓		×
Dialkyltins	b					✓
Diazinon	0.003			✓	×	
Dibromoacetonitrile	b					×
Dicamba	0.1				✓	
Dichlobenil	0.01				×	✓
Dichloroacetic acid	0.1					✓
Dichloroacetonitrile	b					✓
1,2-dichlorobenzene	1.5	0.001				✓
1,3-dichlorobenzene	c	0.02				✓
1,4-dichlorobenzene	0.0003	0.02				✓
1,1-dichloroethane	c					✓
1,2-dichloroethane	0.003					✓
1,1-Dichloroethene	0.03					✓
1,2-dichloroethene	0.06					✓
Dichloromethane	0.004				×	✓
2,4-Dichlorophenol	0.2					×

Dichlor vos	0.001				✓	
Dicofol	0.003				✓	
Dicofop-methyl	0.005			✓		
Difenzoquat	0.1			✓		
Dimethoate	0.05			✓		×
Diphemamid	0.3			✓		
Dioxin (2,3,7,8-TCDD)						
Diquat	0.005			✓		×
Disulfoton	0.003			✓		
Diuron	0.03			✓		
2,2-DPA	0.5			✓	×	
EDB	0.001			✓		
Endosulfan	0.03			✓		×
Endothal	0.1			✓		
Epichlorohydrin	0.0005					✓
EPTC	0.03			✓		
Ethion	0.003			✓		
Ethoprophos	0.001			✓		
Ethylbenzene	0.3	0.003			✓	✓
Ethylenediamine tetraacetic acid (EDTA)	0.25				✓	✓
Etridiazole	0.1			✓		
Fenamiphos	0.0003			×	✓	
Fenarimol	0.03			×	✓	
Fenchlorphos	0.03			✓		

Fenitrothion	0.01			✓		×
Fenoprop	0.01			✓		×
Fensulfothion	0.01			✓		
Fenvalerate	0.05			✓		
Flamprop-methyl	0.003			✓		
Fluometuron	0.05			✓		
Fluoride	1.5		✓			×
Formothion	0.05			✓		
Fosamine	0.03			✓		
Glyphosate	1			✓	×	
Heptachlor and Heptachlor epoxide	0.0003			✓		×
Hexachlorobutadiene	0.0007					×
Hexaflurate	0.03			✓		
Hexazinone	0.3			✓		
Hydrogen sulfide		0.05	✓			
Iodide	0.1		✓		×	
Iron		0.3	✓			
Lead	0.01		×		×	×
Lindane	0.02			✓		×
Maldison	0.05			✓	×	
Manganese	0.5	0.1	✓			×
Mercury (total)	0.001		×			✓
Methidathion	0.03			✓		

Methiocarb	0.005			✓		
Methomyl	0.03			✓		
Methoxychlor	0.3			✓		×
Metolachlor	0.3			✓		×
Metribuzin	0.05			✓		
Metsulfuron-methyl	0.03			✓		
Mevinphos	0.005			✓		
Molinate	0.005			✓		×
Molybdenum	0.05		×	×		✓
Monochlorobenzene		0.01				✓
Monocrotophos	0.001			✓	×	
Napropamide	1			✓		
Nickel	0.02		×		×	×
Nitralin	0.5			✓		
Nitrate (as NO3-)	50			✓	✓	
Nitrilotriacetic acid	0.2				×	✓
Nitrite (as NO2-)	3			✓	✓	
Norflurazon	0.05			✓		
Oryzalin	0.3			✓		
Oxamyl	0.1			✓		
Paraquat	0.03			✓		
Parathion	0.01			✓		
Parathion-methyl	0.1			✓		
Pebulate	0.03			✓		

Pendimethalin	0.3			✓		×
Pentachlorophenol	0.01			×		✓
Permethrin	0.1			✓		×
Picloram	0.3			✓		
Piperonyl butoxide	0.1			×	✓	
Pirimicarb	0.005			✓		
Pirimiphos-ethyl	0.0005			✓	×	
Pirimiphos-methyl	0.05			✓		
Profenofos	0.0003			✓		
Promecarb	0.03			✓		
Propachlor	0.05			✓		
Propanil	0.5			✓		
Propargite	0.05			✓		
Propazine	0.05			✓		
Propiconazole	0.1			✓		
Propyzamide	0.3			✓	×	
Pyrazophos	0.03			✓		
Quintozene	0.03			✓		
Selenium	0.01		✓			
Simazine	0.02			✓		×
Sodium	180		✓			×
Styrene	0.03	0.004			×	✓
Sulfate	500	250	✓			✓
Sulprofos	0.01			✓		✓

Synthetic detergents					✓	✓
2,4,5-T	0.1			✓		×
Temephos	0.3			✓		
Terbacil	0.03			✓		
Terbufos	0.0005			✓		
Terbutryn	0.3					
Tetrachloroethene	0.05				×	✓
Tetrachlor vinphos	0.1			✓		
Thiobencarb	0.03			✓		
Thiometon	0.003			✓		
Thiophanate	0.005			✓	×	
Thiram	0.003			✓	×	
Toluene	0.8	0.025			×	✓
Triadimefon	0.002			✓		
Tributyltin oxide	0.001				✓	×
Trichlorfon	0.005			✓		
Trichloroacetaldehyde	0.02					×
Trichloroacetic acid	0.1					×
Trichloroacetonitrile	b					×
Trichlorobenzenes (total)	0.03	0.005				✓
1,1,1-trichloroethane	b					✓
Trichloroethylene	b			✓		
2,4,6-trichlorophenol	0.02	0.002				×
Triclopyr	0.01			✓	×	

Trifluralin	0.05			✓		×
Uranium	0.02		✓			×
Vernolate	0.03			✓		
Vinyl chloride	0.0003					✓
Xylene	0.6	0.02			×	✓
Zinc		3	✓			✓

✓ = Primary source of chemical in recreational water

× = Secondary sources of chemical in recreational water. Secondary sources must be considered as part of the assessment of priority chemicals

a All guideline values listed in Table 9.1 are applicable to drinking water quality and are based on the daily consumption of 2 L.These values should only be used as a guide to deriving chemical values applicable to recreational water bodies. Using a consumption factor of 2 L will result in very conservative health guideline values in recreational water. When applying these values to recreational water exposure, consumption of 100–200 mL per day should be taken into consideration

b Insufficient data to set a guideline value based on health considerations

c The guideline value is below the limit of determination. Improved analytical procedures are required for this compound. Note: Routine monitoring for pesticides is not required unless potential exists for contamination of the recreational water body

Table 5.3.1 – Guidelines for drinking water supply in the vicinity of storage off takes or in groundwater supplies, before treatment

Indicator	Water quality guideline
Suspended solids	Level 1: 25 mg/L Level 2: 100 mg/L
Blue-green algae (cyanobacteria)	2,000 cells/mL
Algal biomass	Level 1: > 30,000 cells/mL Cylindrospermopsin or Microcystin No Level 2
Algal toxin	Level 1: 0.1 µg/L Microcystin or 0.2 µg/L Cylindrospermopsin Level 2: 4 µg/L Microcystin or 1 µg/L Cylindrospermopsin
Taste and odour	Level 1: 5 µg/L Geosmin or 10 µg/L MIB or 10 µg/L combined Geosmin & MIB Level 2: > 30 µg/L of both Geosmin & MIB combined
Cryptosporidium	Level 1: > 0 cyst Level 2: 10 cysts per 10 L
Giardia	Level 1: > 0 cyst Level 2: 10 cysts per 10 L
E coli	Level 1: > 60 cfu/100mL No Level 2
Total coliforms	Level 1: > 800 cfu/100mL No Level 2
Manganese (soluble)	Level 1: 50 µg/L Level 2: 200 µg/L
Iron (soluble)	Level 1: 50 µg/L Level 2: 200 µg/L
Turbidity	Level 1: 25 NTU Level 2: 100 NTU
Colour	Level 1: 50 Hazen Units No Level 2
Conductivity	Level 1: > 50% change from long term median Level 2 same as Level 1 (no treatment options to remove salt)
Dissolved oxygen	Level 1: < 4 mg/L at surface No Level 2
Pesticides	Level 1: Above detection limits specified by Qld Health Scientific Services Level 2: Notification of spills or illegal dumping
Hydrocarbons	No Level 1 Level 2: Notification of spills or illegal dumping

Source: (QWQG EPA 2006, p.58) Environmental Values and Water Quality Objectives for Wivenhoe, Somerset and North Pine Dam, SEQ Water, 2005.

Notes: Level 1 means Level 1 Hazard and Critical Control Point (HACCP) response rating, namely: treatment-plant process-change required to ensure water quality and quantity to customers is not compromised.

Level 2 means Level 2 Hazard and Critical Control Point (HACCP) response rating, namely: treatment-plant process-change required but water quality and quantity to customers may still be compromised.

Australian Drinking Water Quality Guidelines NHMRC 2004

10.8 Summary of guideline values
Table 10.9 Guidelines for microbial quality - monitoring of E. coli (or thermotolerant coliforms)
Guideline No sample of drinking water should contain any E. coli (or thermotolerant coliforms) (minimum sample 100 mL).
Action If E. coli (or thermotolerant coliforms) are detected, then irrespective of the number of organisms, both the following steps should be taken immediately:

1) Another sample (a repeat sample) should be taken from the same site and from the immediate upstream treated sources of supply and tested for the presence of E. coli (or thermotolerant coliforms).

– If the additional samples are negative for E. coli (or thermotolerant coliforms), then routine sampling can resume, but only after step 2 (below) has been completed.

– If any additional sample is positive for E. coli (or thermotolerant coliforms), then increased disinfection and a full sanitary survey should be implemented immediately. The sanitary survey should include a review of the integrity of the system.

AND

2) Disinfection should be increased and/or an investigation undertaken to determine possible sources of contamination. These might include a breakdown in disinfection, a mains break, interruption to the supply, surges in supply, or deliberate or accidental contamination of the system. The investigation may include a visual inspection of the system and associated service reservoirs by trained personnel. When found, the source of contamination should be eliminated.

Table 10.10 Guideline values for physical and chemical characteristics

Characteristic	Guideline value *		Comments
	Health	Aesthetic a	
Acrylamide	0.0002		Minor impurity of polyacrylamide, used sometimes as a flocculant aid
Ammonia (as NH_3)	c	0.5	Presence may indicate sewage contamination and/or microbial activity. High levels may corrode copper pipes and fi ttings.
Antimony	0.003		Exposure may rise with increasing use of antimony-tin solder.
Arsenic	0.007		From natural sources and mining/industrial/agricultural wastes.
Asbestos	c		From dissolution of minerals/industrial waste, deterioration of asbestos-cement pipes in distribution systems. No evidence of cancer when ingested (unlike inhaled asbestos).
Barium	0.7		Primarily from natural sources.
Benzene	0.001		Could occur in drinking water from atmospheric deposition (motor vehicle emissions) and chemical plant effluent. Human carcinogen.
Boron	4		From natural leaching of minerals and contamination. < 1 mg/L in uncontaminated sources; higher levels may be associated with seawater intrusion.
Cadmium	0.002		Indicates industrial or agricultural contamination; from impurities in galvanised (zinc) fi ttings, solders and brasses.

Chloride	e	250	From natural mineral salts, effl uent contamination. High concentrations more common in groundwater and certain catchments.
Chlorine	5	0.6	Widely used to disinfect water, and this can produce (free) chlorinated organic byproducts. Odour threshold generally 0.6 mg/L, but 0.2 mg/L for a few people. In some supplies it may be necessary to exceed the aesthetic guideline in order to maintain an effective disinfectant residual throughout the system.
Chromium (VI)	0.05		From industrial/agricultural contamination of raw water or corrosion of materials in distribution system/plumbing. If guideline value exceeded, analyse for hexavalent chromium.
Copper	2	1	From corrosion of pipes/fittings by salt, low pH water. Taste threshold 3mg/L. High concentrations colour water blue/green. >1mg/L may stain fittings. >2mg/l can cause ill effects in some people.
Cyanide	0.08		From industrial waste and some plants and bacteria.
Dissolved oxygen	Not necessary	>85%	Low concentrations allow growth of nuisance microorganisms (iron/ necessary manganese/sulfate/nitrate-reducing bacteria) causing taste and odour problems, staining, corrosion. Low oxygen concentrations are normal in groundwater supplies and the guideline value may not be achievable.
Fluoride	1.5		Occurs naturally in some water from fluoride-containing rocks. Often added at up to 1 mg/L to protect against dental caries. > 1.5 mg/L can cause dental fluorosis. > 4 mg/L can cause skeletal fluorosis.
Hydrogen sulfide	c	0.05	Formed in water by sulfate-reducing microorganisms or hydrolysis of soluble sulfide under anoxic conditions. Obnoxious 'rotten egg' odour threshold 0.05 mg/L.
Iron	c	0.3	Occurs naturally in water, usually at < 1 mg/L, but up to 100 mg/L in oxygen-depleted groundwater. Taste threshold 0.3 mg/L. High concentrations stain laundry and fi ttings. Iron bacteria cause blockages, taste/odour, corrosion.
Lead	0.01		Occurs in water via dissolution from natural sources or household plumbing containing lead (e.g. pipes, solder).
Manganese	0.5	0.1	Occurs naturally in water; low in surface water, higher in oxygen-depleted water (e.g. groundwater at bottom of deep storages). > 0.1 mg/L causes taste, staining. < 0.05 mg/L desirable.
Mercury	0.001		From industrial emissions/spills. Very low concentrations occur naturally. Organic forms most toxic, but these are associated with biota, not water.
Molybdenum	0.05		Concentrations usually < 0.01 mg/L; higher concentrations from mining, agriculture, or fl y-ash deposits from coal-fuelled power

			stations.
Nickel	0.02		Concentrations usually very low; but up to 0.5 mg/L reported after prolonged contact of water with nickel-plated fittings.
Nitrate (as nitrate)	50		Occurs naturally. Increasing in some waters (particularly groundwater) from intensive farming and sewage effl uent. Guideline value will protect bottle-fed infants under 3 months from methaemoglobinaemia. Adults and children over 3 months can safely drink water with up to 100 mg/L nitrate.
Nitrite (as nitrite)	3		Rapidly oxidised to nitrate (see above).
Organotins - tributyltin oxide	0.001		Tributyltins are biocides used as antifouling agents on boats and in boiler waters.
Polycyclic aromatic hydrocarbons (PAHs) Benzo-(a)-pyrene	0.00001 (10 ng/L)		Widespread. Contamination can occur through atmospheric deposition, or leaching from bituminous linings in distribution systems.
Sodium	e	180	Natural component of water. Guideline value is taste threshold.
Sulphate	500	250	Natural component of water, and may be added via treatment chemicals. Guideline value is taste threshold. > 500 mg/L can have purgative effects.
Tetrachloroethene	0.05		Dry-cleaning solvent and metal degreaser. Could occur in drinking water from contamination or spills.
Toluene	0.8	0.025	Occurs naturally in petrol and natural gas, forest-fi re emissions. Could occur in drinking water from atmospheric deposition, industrial contamination, leaching from protective coatings in storage tanks.
Total dissolved solids	Not necessary	500	< 500 mg/L is regarded as good quality drinking water based on taste. 500-1000 mg/L is acceptable based on taste. > 1000 mg/L may be associated with excessive scaling, corrosion, and unsatisfactory taste.
Turbidity	c	5 NTU	5 NTU just noticeable in a glass. >1 NTU may shield some microorganisms from disinfection. <1 NTU desirable for effective disinfection.
Zinc	c	3	Usually from corrosion of galvanised pipes/fi ttings and brasses. Natural concentrations generally < 0.01 mg/L. Taste problems > 3 mg/L.

Source: 10-22 and 10–26 Australian Drinking Water Guidelines

* All values mg/L unless otherwise stated

HU = Hazen units; NTU = nephelometric turbidity units; THMs = trihalomethanes.

a – Aesthetic values are not listed if the compound does not cause aesthetic problems, or if the value determined from health considerations is the same or lower.

b – If present at all in Australian drinking waters, concentrations of all organic compounds other than disinfection byproducts are likely to be very low relative to the guideline value.

c – Insuffi cient data to set a guideline value based on health considerations.

d – The guideline value is below the limit of determination. Improved analytical procedures are required for this compound.

e – No health-based guideline value is considered necessary.
Note: All values are as 'total' unless otherwise stated.
Note: Routine monitoring for these compounds is not required unless there is potential for contamination of water supplies (e.g. accidental spillage).
Note: The concentration of all chlorination byproducts can be minimised by removing naturally occurring organic matter from the source water, reducing the amount of chlorine added, or using an alternative disinfectant (which may produce other byproducts). Action to reduce trihalomethanes and other byproducts is encouraged, but must not compromise disinfection.

Table 10.11 Guideline values for pesticides

Pesticide	**Value mg/L**	
	Guideline a	**Health** b
Atrazine c	0.0001	0.04
Bromacil	0.01	0.3
Diuron c		0.03
Chlorpyrifos c		0.01
2,4-D c	0.0001	0.03
Diazinon	0.001	0.003
Endosulfan	0.00005	0.03
Glyphosate	0.01	1
Heptachlor c	0.00005	0.0003
Hexazinone c	0.002	0.3
Simazine	0.0005	0.02
Triclopyr c		0.01

Source: 10-27 and 10–28 Australian Drinking Water Guidelines
a – These are generally based on the analytical limit of determination (the level at which the pesticide can be reliably detected using practicable, readily available and validated analytical methods). If a pesticide is detected at or above this value the source should be identifi ed and action taken to prevent further contamination.
b – Based on 10% of acceptable daily intake (ADI).
c – These pesticides have either been detected on occasions in Australian drinking water or their likely use would indicate that they may occasionally be detected.
Note: Routine monitoring for pesticides is not required unless potential exists for contamination of water supplies.
See also Section 6.3.3

National Water Quality Management Strategy 2004, Australian Drinking Water Guidelines 6 2004 (Endorsed by NHMRC 10 – 11 April 2003), National Health and Medical Research Council and the Natural Resource Management Ministerial Council.

GBRMPA Water Quality Trigger Values - Additional Information

Pesticides

Diuron
Moderate reliability guideline trigger values of 0.9, 1.6 and 2.3 µg/L have been derived for diuron for protection of 99, 95 and 90 per cent of species respectively.

Atrazine
Moderate reliability guideline trigger values of 0.4, 2.4 and 5.9µg/L have been derived for atrazine for the protection of 95 and 90 per cent of species respectively.

Ametryn
Moderate reliability guideline trigger values of 0.5, 1.0 and 1.6 µg/L have been derived for ametryn for protection of 99, 95 and 90 per cent of species respectively.

Simazine
A low reliability guideline trigger value of 0.2, 3.2 and 11 µg/L is applied for simazine for protection of 99, 95 and 90 per cent of species respectively.

Hexazinone
In the absence of marine data the low reliability freshwater guideline was adopted for hexazinone. A low reliability guideline trigger value of 75 µg/L is adopted for hexazinone.

2, 4-D
Moderate reliability guideline trigger values of 0.8, 30.8 and 152 µg/L were derived for 2,4- D for protection of 99, 95 and 90 per cent of species respectively.

Tebuthiuron
A low reliability guideline trigger values of 0.02, 2 and 20 µg/L is applied for tebuthiuron for protection of 99,95 and 90 per cent of species respectively.

Chlorpyrifos / Oxon
The high reliability guideline trigger values of 0.005, 0.009 and 0.04 µg/L are applied for chlorpyrifos for protection of 99, 95 and 90 per cent of species respectively.

Endosulfan
Recognising the potential to bioaccumulate, a moderate reliability guideline trigger value of 0.005 µg/L for endosulfan for protection of 99 per cent of species is recommended reef-wide.

2-Methylethyl mercuric chloride (MEMC)
A low reliability guideline trigger value of 0.002 µg/L was derived for MEMC.

Diazinon
A low reliability guideline trigger value of 0.00003, 0.01 and 0.2 µg/L is applied for diazinon for protection of 99, 95 and 90 per cent of marine species, respectively.
(Source: GBRMPA 2008, pp.38-54)

Biocide
Tributyltin (TBT)
Moderate reliability guideline trigger values of 0.0002, 0.003 and 0.01 µg/L were derived for tributytlin for protection of 99, 95 and 90 per cent of species respectively.
(Source: GBRMPA 2008, pp. 57- 58)

New sublethal effects information

Additional reports have become available since the ANZECC and ARMCANZ (2000) values were derived for a number of pesticides. These are listed below.

Diuron
Including the new information results in the derivation of moderate reliability guideline trigger values of 0.01, 0.06 and 0.1 µg/L for diuron for protection of 99, 95 and 90 per cent of species.

Atrazine
Including the new information results in the derivation of moderate reliability guideline trigger values of 0.4, 0.8 and 1.3 µg/L for atrazine for protection of 99, 95 and 90 per cent of species respectively.

Ametryn
Including the new information results in the derivation of moderate reliability guideline trigger values of 0.2, 0.4 and 0.7 µg/L for ametryn for protection of 99, 95 and 90 per cent of species respectively.

Simazine
Including the new information provides a potential low reliability trigger value of 1.1 µg/L for simazine, which is between the 99th and 95th percentile freshwater guideline (0.2µg/L and 3.2µg/L respectively).

Hexazinone
Including the new information provides a potential low reliability trigger value of 0.09µg/L for hexazinone, which is significantly lower than the stated low reliability freshwater guideline that ANZECC and ARMCANZ (2000) adopted in the absence of marine data.

2,4-D
Including the new information results in the derivation of moderate reliability guideline trigger values of 46.5, 112 and 191 µg/L for 2,4-D for protection of 99, 95 and 90 per cent of species respectively.

Tebuthiuron
Including the new information provides a potential low reliability trigger value of 1.8 µg/L for tebuthiuron, which is between the 99th and 95th percentile freshwater guideline (0.2µg/L and 2µg/L respectively).
(Source: GBRMPA 2008, pp. 58- 67)

"*There are some concerns about the adequacy of the guideline trigger values for protection of the tropical marine ecosystem. As discussed in the previous section, photosynthesis, gross primary production and carbon uptake suppression responses are not universally accepted as appropriate endpoints for deriving toxicity guidelines and have not been included in derivations of guideline trigger values. However, this response may be an indicator of sublethal impacts the minimisation of which could prove critical to the protection of the ecosystem. The concern about sublethal effects is heightened particularly if additional environmental stressors are involved, eg high temperatures, storm damage, sedimentation, grazing etc*" (GBRMPA 2008, p. 69).

5.1.1 GBR WQ Action Plan Targets

Soon after the announcement of the National Action Plan for Salinity and Water Quality (NAP) the "Ministerial Council for the Great Barrier Reef noted that activities in the catchments adjacent to the Great Barrier Reef were affecting the quality of water flowing to the Great Barrier Reef World Heritage Area. The Commonwealth Minister for Environment and Heritage directed the Great Barrier Reef Marine Park Authority to develop a Great Barrier Reef Water Quality Action Plan" (Brodie et al 2001). The Action Plan establishes end-of-catchment targets designed to halt the decline in water quality entering the inshore Reef. The targets were seen as the first stage to

reverse water quality decline and eventually allow for the recovery of the inshore reefal ecosystems. More information about the Action Plan can be found at http://www.gbrmpa.gov.au/corp_site/key_issues/water_quality/action_plan).

The Reef Water Quality Protection Plan (2003) (Reef Plan) was subsequently developed in a partnership between the Australian and Queensland Governments (see http://www.reefplan.qld.gov.au/index.shtml). Reef Plan was supported by a body of evidence showing a decline in water quality on the Great Barrier Reef (GBR) including the "*Summary Statement of the Reef Science Panel regarding water quality in and adjacent to the Great Barrier Reef*". This has since been reviewed and updated and is available on the world wide web (http://www.reefplan.qld.gov.au/publications/scientific_consensus_statement.shtm).

The water quality targets for the Black and Ross Basins (catchments) as defined in the Action Plan are listed in **Error! Reference source not found.** and **Error! Reference source not found.** respectively. Conversion of the Action Plan load per km³ of discharge figures to a concentration in mg/L is shown in the tables below.

Table A GBR WQ Action Plan Targets Black Basin/Catchment

Water Quality Parameter	1850 t/yr	2000 t/yr	2000 t/km³	Ratio	2011 targets		
					% red'n	t/yr	t/km³
Sediment export	28,000	82,887	218,421	2	0	82,887	218,421
Total N export	93	411	1082	4.4	33	275	725
Total P export	5	90	237	18	33	60	159

Source: Black River Catchment summary information (Brodie et al 2001, p.85).
Note: Data Confidence Iindex = 1. Also in Table 2. Suspended sediment, total nitrogen and total phosphorus discharge from 26 individual catchments and proposed targets.(Brodie et al 2001, p.8)

Table B GBR WQ Action Plan Targets Ross Basin/Catchment

Water Quality Parameter	1850 t/yr	2000 t/yr	2000 t/km³	Ratio	2011 targets		
					% red'n	t/yr	t/km³
Sediment export	29,000	58,383	118,367	2	0	58,383	118,367
Total N export	119	530	1,082	4.5	33	355	725
Total P export	6	116	237	19.3	33	78	159

Source: Ross River Catchment summary information (Brodie et al 2001, p.87).
Note: Data Confidence Iindex = 2. Also in Table 2. Suspended sediment, total nitrogen and total phosphorus discharge from 26 individual catchments and proposed targets.(Brodie et al 2001, p.8)

Table C Targets Expressed as Event Mean Concentrations

	Black Basin (mg/L/year)		Ross Basin (mg/L/year)	
Water Quality Parameter	2000	2011 target	2000	2011 target
Sediment export	218.42	218.42	118.37	118.37
Total N export	1.08	0.73	1.08	0.73
Total P export	0.24	0.16	0.24	0.16

Note: To convert t/km³ to mg/L for relating to EMC and other concentration based measurements divide the t/km³ figure by 1,000 (1 tonne = 1,000,000g = 1,000,000,000mg (1,000,000,000,000µg) and 1 km³ = 1,000m x 1000m x 1000m = 1,000,000,000m³ = 1,000,000,000,000L as 1000L/ m³). To convert from t/km³ to µg/L is a straight conversion i.e. the t/km³ figure is equivalent to the µg/L figure.

The Action Plan also defines inshore marine water and sediment toxicant target concentrations (Brodie et al 2001, Table 3, p.9) and chlorophyll a targets (Brodie et al 2001, Table 4, p.10). It is assumed that these have been updated through the GBRMP Water Quality Guidelines and are not included here.

Appendix B

Human Use EVs

Human Use Environmental Values Stakeholder Consultation Results

Waterway	Irrigation	Farm supply	Stock watering	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Industrial use	Cultural and spiritual values
	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now /future	Now / future
Freshwaters (Note: Instream storages (dams, weirs and barrages) have been underlined)											
Black River Basin											
Crystal Creek (Upland)						L	L	M - H	H		H
Crystal Creek (Lowland)	M	M	H		M	H	L - M	H	H		H
Lorna Creek (Upland)						L	L	L			H
Lorna Creek (Lowland)	M	M	H		M	H	L - M	H			H
Ollera Ck (Upland)						L	L	L			H
Ollera Creek (Lowland)	M	M	H		M	H	L - M	H			H
Scrubby Ck (Upland)						L	L	L			H
Scrubby Creek (Lowland)	M	M	H		M	H	L - M	H			H
Hencamp Ck (Upland)						L	L	L			H
Hencamp Ck (Lowland)	M	M	H		M	H	L - M	H			H
Rollingstone Ck (Upland)						L	L	L			H
Rollingstone Ck (Lowland)	M	L	H		M	H	L - M	H			H
Surveyors Ck						L	L	L			H
Wild Boar Creek						L	L	L			H
Station Creek						L	L	L			H
Saltwater Ck (Upland)						L	L	L			H
Saltwater Creek (Lowland)	M	L	H		M	H	M	M			H
Cassowary Ck (Upland)						L	L	L			H
Cassowary Ck (Lowland)	M	L	H		M	H	L - M	H			H
Leichhardt Ck (Developed)	M	L	H		M	H	M	M	L		H

Waterway	Irrigation	Farm supply	Stock watering	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Industrial use	Cultural and spiritual values
	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now /future	Now / future
Christmas Ck (Developed)	L	L	H		M	H	L - M	H			H
Sleeper Log Ck (Developed)	L	L	H		M	H	L - M	H			H
Bluewater Ck (Upland)						L	L	M - H			H
Bluewater Ck (Lowland)	M - H	M	H		M	H	H	H			H
Althaus Creek (Upland)						L	L	M - H			H
Althaus Creek (Lowland)			H		L	H	H	H			H
Deep Creek (Upland)						L	L	M - H			H
Deep Creek (Lowland)	M - H	M	H		L	H	H	H			H
Healy Creek				?				L			
Black River (Upland)						L	L	L			H
Black River (Lowland)	L		H		L	L				M	H
Scrubby Ck (Upland)						L	L	L			H
Alice River (Developed)	L		H		L	L					H

L, **M** and **H** indicates results from stakeholder consultation workshops and follow up consultation.

Waterway	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Cultural and spiritual values
Estuaries						
Crystal Creek		H	M	M - H	H	H
Lorna Creek		H	M	M - H	H	H
Ollera Creek		H	M	M - H	H	H
Scrubby Creek		H	M	M - H	H	H
Hencamp Creek		H	M	M - H	H	H
Rollingstone Creek		H	L	H	H	H
Surveyors Creek		H	M	M - H	H	H
Wild Boar Creek		H	M	M - H	H	H
Station Creek		H	M	M - H	H	H
Saltwater Creek	H	H	L	H	H	H
Cassowary Creek		L	L	L	L	H
Leichhardt Creek		H	L	H	H	H
Christmas Creek		H	L	H	H	H
Two Mile Creek		H	L	H	H	H
Bluewater Creek		H	L	L	H	H
Deep Creek		H	L	H	H	
Healy Creek		H	L	H	H	H
Black River		H	L	M	L	H

Waterway	Irrigation	Farm supply	Stock watering	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Industrial use	Cultural and spiritual values
Freshwaters											
Ross River Basin (Ross River Dam and upstream)											
Lake Ross (Ross Dam)	L				L	L	L	M	H	M	M
Ross River (FrW)	L		M - H			L	L	L			H
Round Mountain Creek	L		M - H			L	L	L			H
Lagoon Creek	L		M - H			L	L	L			H
Plum Tee Creek	L		M - H			L	L	L			H
Central Ck (aka Ross Ck)	L		M - H			L	L	L			H
Sandy Creek	L		M - H			L	L	L			H
Spring Creek	L		M - H			L	L	L			H
Deep Creek	L		M - H			L	L	L			H
Leichhardt Creek	L		M - H			L	L	L			H
Cattle Creek	L		M - H			L	L	L			H
Six Mile Creek	L	L	M					L			H
Toonpan Lagoon	L	L	M					L			H
Jimmys Lagoon	L	L	M					L			H
Four Mile Creek /Flagstone Creek	L	L	M					L			H
One Mile Creek/Spring Creek/Lansdowne Creek	L	L	M					L			H
Antill Plains Creek	L	L	M					L			H
Sachs Creek						L	L	M			H
Blacksoil Gully/Mt Stuart						L	L	L			H

Waterway	Irrigation	Farm supply	Stock watering	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Industrial use	Cultural and spiritual values
	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now /future	Now / future
Freshwaters											
Ross River Basin (east)											
Alligator Ck (Upland)	L?					H	H	H	L		H
Alligator Creek (Lowland)	L - M	M	L		L - M	L	L - M	L - M	L		H
Whites Creek	L		L		L	L	L - M	L - M			H
Slippery Rocks Creek	L		L		L	L	L - M	L - M			H
Crocodile Creek	L		L		L	L	L - M	L - M	L		H
Killymoon Creek	M		L		L	L	L - M	L - M	L		H
Cape Cleveland						L	L	L			H
Stuart Creek (Mt Stuart ephemeral)	L	L	L			L		L			H
Stuart Creek (ephemeral to estuary i.e. includes pools)	L	L	L		M	L	M	L - M			H
Sandfly Creek			L			L	L	M			H
Ross River Basin (west)											
Stoney Creek	L		L		L	L	L	M			H
Saunders Creek	L		L		L	L	L	M			H
Bohle River (ab Condon STP)	L	L	L		L	L	L	L			H
Bohle River (below Condon STP to estuary)	L	L	L		M	M/H	M/H	M/H			H
Little Bohle River	L		L		L	L	L	M			H
Middle Bohle Creek	L		L		L	L	L	M			H
Louisa Creek					L		L	L			H

Waterway	Irrigation	Farm supply	Stock watering	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Industrial use	Cultural and spiritual values
	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now / future	Now /future	Now / future
Town Common							L - M	H			H
Pallarenda					H		H	H			H
Ross River Basin (below the Ross River Dam)											
Ross River (below the Dam)	M	L			H	H	H	H			H
Ross River Weir Pools (All)	M				H	H	H	H			H
Ross River (Black Weir)	H				H	H	H	H	H		H
Ross River (Gleesons Weir)	L				H	H	H	H			H
Ross River (Aplins Weir)	L				H	H	H	H			H
Tributaries from Defence land					L	L	L	L			H
University (Campus) Creek					L	L	L	M			H
Lavarack ? Ck with weirs					L	L	L	M			H
Ross Creek and tributaries					H	L	L	H			H

Waterway	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Industrial use	Cultural and spiritual values
Estuarine Waters							
Bohle sub basin (upper)		M		M	L - M		H
Bohle sub basin (lower)		H		H	H		H
Louisa Creek		M		M	M		H
Ross River sub basin		H		H	H	M	H
Stuart Creek sub basin	L	H	L	H	H		H

Waterway	Aquaculture 	Human consumer 	Primary recreation 	Secondary recreation 	Visual appreciation 	Industrial use 	Cultural and spiritual values 
Alligator Creek sub basin	L	H	L	H	H		H

Waterway	Irrigation	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Drinking water	Cultural and spiritual values
Freshwaters							
Magnetic Island							
Retreat Creek	H	L	M	H	H	L	H
Duck Creek	L		M	H	H	L	
Chinamans Gully			L				H
Ned Lee Creek			H	H	H	L	H
Butler Ck (Picnic Bay)		L		L	M		H
Picnic Bay west creek		L		L	M		H
Gustav Creek (Upland)		L	M	M - H	M - H		H
Gustav Creek (Lowland)		L	L	H	H		H
Hoyer Creek (Nelly Bay)			L	L	H		H
North Nelly Bay creek				L	H		H
Petersen Creek (Upland)		L	M - H	H	H		H
Petersen Creek (Lowland)			M - H	H	H		H
Gorge Creek (Upland)		L	M - H	H	H		H
Gorge Creek (Lowland)		L	L	L	H		H
Endeavour Creek (Upland)		L	M - H	H	H		H
Endeavour Creek (Lowland)			M - H	H	H		H
East Horseshoe Bay creek		L	L	L - M	H		H
Five Beach Bay			M - H	H	H		H

Note: Undeveloped areas have been interpreted as being equivalent to the Upland Rivers category and Developed areas as being equivalent to Lowland Rivers (from Queensland Water Quality Guidelines)

Waterway	Aquaculture	Human consumer	Primary recreation	Secondary recreation	Visual appreciation	Cultural and spiritual values
Estuaries						
All Magnetic Island		H	L	L	H	H
Butler Creek (Estuary)		L	M	M	H	H
Gustav Creek		L - M	H	H	H	H
East Horseshoe Bay creek		L	L	L	H	H
Near Coastal and Marine Waters						
All near coastal waters		H	M - H	H	H	H
Horseshoe Bay	M	H	H	H	H	H
West Channel		H	H	H	H	H
Cleveland Bay		H	H	H	H	H
Halifax Bay		H	H	H	H	H
Outer Marine		H	H	H	H	H

Note: Results are the same from all workshops for marine waters and have been combined above

Appendix C

Aquatic Ecosystem Draft EVs

BLACK-ROSS BASINS WATER QUALITY IMPROVEMENT PLAN (WQIP)

DRAFT RESULTS FROM WORKSHOPS - WATERWAY ECOLOGICAL VALUES i.e. 'AQUATIC ECOSYSTEM' ENVIRONMENTAL VALUE (EV)

The following tables contain draft information on the ecological values of the Black and Ross River Basins, Magnetic Island and adjacent coastal waters in the Black-Ross Water Quality Improvement Plan (WQIP) study area. An earlier draft of this information was provided and reviewed at stakeholder workshops held at:

- ***Magnetic Island (Arcadia) on 22 July 2008,***
- ***Bluewater on 23 July 2008, and***
- ***Annandale on 24 July 2008.***

The tables have been updated following the workshops to include stakeholder comments, required further actions and additional information on waterway ecological values. Main required actions/changes to possible HEV waters (and progress on changes made by December 2008) are shown in yellow highlighted text. The WQIP study team is continuing to review/update this information and we welcome further comment on the draft ecological values identified in the tables. A further opportunity for public comment on this material will be provided during the public release of the draft Black-Ross Water Quality Improvement Plan.

The following provides further explanation on the ecological values tables (as provided in the stakeholder meetings).

A Background

1. The accompanying table focuses only on waterway ecological values (i.e. the 'aquatic ecosystem' environmental value). A **separate table** will record information on human uses/values for waterways in the area.
2. Maintenance of aquatic ecosystems is an EV for all waterways, with the minimum requirement being to maintain their current quality (i.e. ecosystem health).
3. This workshop session aims to firstly identify high ecological value (HEV) waterways that the community wants to protect (refer section B). It also aims to identify other natural assets in non-HEV areas that the community considers ecologically important (refer section C).

B High Ecological Value (HEV) waters

4. The accompanying table summarises fresh, estuarine, and coastal/marine waters in the Magnetic Island workshop area that have been identified as containing potentially high ecological value (HEV) waters. More detail on the definitions of high ecological value and the process used to identify these waterways will be provided in the workshop.
5. Waterways marked in ***ITALICS*** (left column of the table) have been assessed as having potentially high ecological value through most/all their area. (Other waterways containing a lesser extent of HEV areas are also identified in the table.)
6. High ecological value waters have been identified using two approaches.

- 'Default' HEV waters: these are based on existing legislation and designations, and include waters within Wet Tropics World Heritage Area (zones A, B), National Parks, high value zones within the Marine Park, and Fish Habitat 'A' Areas. The table shows these 'default' waters (refer top row).
- Local studies with technical panel input: EPA and GBRMPA officers, in consultation with Townsville City Creek to Coral, have collated technical information on ecological values in the Black-Ross WQIP area to identify additional waters which could be considered as high ecological value. As part of this process the team has held two technical panel workshops to assist in identifying HEV waters: a freshwater workshop on 12 October 2007, and an estuarine/coastal/marine waters workshop on 12 March 2008. The approach taken to identify HEV waters and draft results from the assessment will be outlined in the workshop.

7. The table seeks input from workshop participants on these HEV waters, including any suggested changes to boundaries, eg based on impacts from runoff/discharges.
8. The table also provides for stakeholders to nominate other high ecological value waters.

C Ecological values in waterways that are not HEV waters

9. Modified (non-HEV) waters may still have a range of important natural assets. Therefore, the table also allows for stakeholders to identify any such natural assets in non-HEV areas. These assets could include key habitat (eg seagrass, coral, mangroves, riparian vegetation), sites known as key breeding areas (eg for fish, turtles), sites known to support particular species, natural processes (eg flows/links between fresh and estuarine waterways) or other locations the workshop attendees consider ecologically important (even if not within HEV waters).

D Recording information on ecological values

10. Workshop attendees will be invited to discuss the ecological values of the waterways.
11. Organisers will record the information provided by workshop attendees.
12. Following the workshop we will prepare draft tables summarising the information provided by participants and will send draft table outputs to workshop attendees for any feedback/correction.

Explanation of code for coastal/marine waters

Characteristics	Symbol
Turtle (nesting, breeding, feeding)	T
Dugong (feeding)	D
Benthic habitat (Seagrass, reefs and inter-reef areas)	B
Coastal habitat (Mangroves, wetlands, etc.)	CH
Adjacent to mainland or island National Park	NP
Surrounding land use (agriculture, urban, tourism etc)	SLU
Special and unique (rare or unusual sites within the GBRWHA)	SU
Recreational use (including fishing)	R
Heritage values (shipwrecks, lighthouses etc).	H
Shipping and ports	Sh
Public access (anchorage, jetties, boat ramps, marinas etc)	P
Adjacent town	A
Species of concern (*protected species* other than dugongs and turtles, for example whale sharks and Barramundi cod)	S
Tourism sites and transit/access points	TS

Summary of Acronyms used

Acronym (listed alphabetically)	Meaning
CP(Z)	Conservation Park (zone)
DPA	Dugong Protection Area
FHA	Fish Habitat Area
HEV	High Ecological Value
MNP	Marine National Park
NP	National Park
SL	State Land
SR(Z)	Scientific Research (zone)
WHA	World Heritage Area

The following table contains draft information on the ecological values of Magnetic Island and adjacent coastal waters in the Black-Ross Water Quality Improvement Plan (WQIP) study area.

Table A: Ecological values of Magnetic Island waterways – note: table proceeds anti-clockwise around island, dealing with fresh and estuarine waters in each catchment, then coastal/marine

	High ecological value waters						Modified waters	
Catchment/ Waterway	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**EVs Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
ALL WATERS								
DEFAULT HEV WATERS (refer to maps)	National Parks (NP), Wet Tropics World Heritage Area (A, B zones), Fish Habitat 'A' areas, Forest Reserve (where proposed to become NP), 'Highly protected areas' under the Marine Parks Act (eg marine national park, preservation zone, conservation park, buffer), GBR Marine National Park and Preservation zones. (Subject to local technical information, waters in additional areas/designations can also be considered for HEV. These include State Forest, Military Training Areas, Fish Habitat B areas, dugong protection area A/B, other marine park areas, Ramsar areas, Directory of Important Wetlands, etc).	No changes. Default HEVs accepted. Discussed for specific waterways below. General comment (all areas): need to explain how mapping relates to transport/utility easements. (Review undertaken → add statement to mapping that easements not 'extracted' from the HEV mapping because of the scale of the mapping.)	Yes	Discussed for specific waterways below.	Discussed for specific waterways below.	Discussed for specific waterways below.	Discussed for specific waterways below.	Discussed for specific waterways below.
CATCHMENT – FRESHWATERS AND ESTUARIES (anti-clockwise)								
SOUTH WESTERN DRAINING STREAMS (West Point, Young Bay, Bolger Bay etc)								
South western freshwaters (Retreat, Duck, Ned Lee and other freshwater Creeks)	**HEV waters:** Includes upper slopes largely within national Park and State Land (SL) (MI 7). These drain towards the south western side of the island and include sections of Retreat (included within MI 7), Duck (MI10), Chinaman Gully (MI 11) and Ned Lee Creeks (within MI 7). Another unit includes the riverine wetland (MI 9). **Values:** Creeks in upper slopes (MI 7) are in near natural catchment and instream waters. Riverine units (MI 9, 10, 11) are largely intact seasonal streams with connectivity between NP ranges and river flats/estuaries.	Proposed HEVs accepted, with the following items to review: 1) Review HEV boundaries on GIS relative to underlying cadastral/imagery layers, as slight boundary/alignment variation). (Review undertaken→ latest available cadastral layers have been used.) 2) Review local boundaries of MI 7 waters in nature refuges	Yes, with possible changes as noted	No	N/A	N/A	None specified	N/A

	High ecological value waters						Modified waters	
Catchment/ Waterway	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**EVs Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
		relative to cleared areas. (Review undertaken→ localised boundary changes made: reduction in HEV area.)						
South western estuaries	**HEV waters:** One estuarine area, continuous along the coast of the western part of the island, from Young Bay to Cockle Bay (MI 13) is proposed as HEV. **Values:** (MI 13): Most extensive mangrove and estuarine habitat on the island. Unique in being linked to coral reef flat.	Proposed HEVs accepted, with the following possible changes: 1) Check boundaries around barge landing/private property (Bolger Bay) to ensure these are excluded from HEV. (Review undertaken→ property excluded.) 2) Road impacts on waters (West Point Rd) and possible exclusion from HEV boundaries. (Review undertaken→add statement to mapping about easements/corridors.)	Yes, with possible changes as noted.	No	N/A	N/A	None specified	N/A
PICNIC BAY DRAINING STREAMS								
Unnamed freshwaters	**HEV waters:** Waters within NP/SL are proposed as HEV (MI 5). Also includes headlands and Esplanade area on side of headland. Excludes developed areas of Picnic Bay. **Values**; Relatively undisturbed catchment and instream values.	Proposed HEVs accepted. Review how HEV boundaries relate to road easements, in this area road easement across hill crossing from Picnic Bay to Nelly Bay. (Review undertaken→add statement to mapping about easements/corridors.)	Yes, with possible changes as noted.	No	N/A	N/A	None specified	N/A
Estuaries	Because of their small size, no specific HEV estuarine units have been mapped to date. Very small areas of estuarine waters have been captured in coastal HEV mapping (outlined later in table). Small sections of brackish creeks occur in Picnic Bay. These have been modified by surrounding developments and roads etc, and are excluded from the HEV area.	N/A	N/A	N/A	N/A	N/A	Some rare wetlands of conservation value. Effects of STPs (recently built?) on surrounding waters	??
NELLY BAY DRAINING STREAMS (eg Gustav Ck)								
Gustav Ck/other freshwaters	**HEV waters:** Waters within NP/SL (MI 2) are proposed as HEV. Includes headlands. Excludes developed areas of Nelly Bay.	Proposed HEVs accepted, with the following possible items to review:	Yes, with possible changes as noted.	No	N/A	N/A	None specified	N/A

	High ecological value waters						Modified waters	
Catchment/ Waterway	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**EVs Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	Values: Relatively undisturbed catchment and instream values.	1) Rock extraction from quarry on Kellys Street which may extend in to USL. (Review undertaken→ at present, all of USL retained in HEV as no evidence to support excluding area). 2) Areas behind Hideaway Bay resort – exclude freehold from HEV. (Review undertaken→ HEVs exclude freehold.) 3) Effects of pipeline easement in upper catchment near walking track. (Review undertaken: easement was not 'extracted' from the HEV mapping because of the scale of the mapping →add statement to mapping about easements/corridors.)						
Gustav Ck estuaries	Because of their small size, no specific HEV estuarine units have been mapped to date. Very small areas of estuarine waters have been captured in coastal HEV mapping (outlined later in table). Small sections of brackish creeks occur in Nelly Bay. These have been modified by surrounding developments and roads etc, and are excluded from the HEV area.	See above.	See above.	No	N/A	N/A	None specified	N/A
GEOFFREY BAY DRAINING STREAMS (eg Petersen Ck)								
Petersen Ck/other freshwaters	**HEV waters:** Waters within NP/SL (MI 1) are proposed as HEV. Includes headlands. Excludes developed areas of Geoffrey Bay. **Values:** Relatively undisturbed catchment and instream values.	Proposed HEVs accepted, with the following possible changes: 1) Exclude water tower and associated disturbed area from HEV. (Review undertaken→ disturbed area has been removed from HEV.)	Yes, with possible changes as noted.	Yes. Include part of the defence lands on Bremner Point as HEV (excluding housing etc). (Review undertaken→ new area added.)	Potentially natural waterways/catchment.	Yes – subject to further input from Defence.	None specified	N/A
Petersen Ck estuaries	Because of their small size, no specific HEV estuarine units have been mapped to date. Very small areas of estuarine waters have been captured in coastal HEV mapping (outlined later in table). Small sections of brackish creeks occur in Geoffrey Bay. These have been modified by surrounding developments and roads etc, and are excluded from the HEV area.	No changes (proposed HEVs accepted).	Yes.	As above for defence lands.	As above for defence lands.	As above for defence lands.	None specified	N/A
NORTH EASTERN DRAINING STREAMS (Radical Bay, Arthur Bay etc)								
Freshwaters	**HEV waters;** Waters within NP/SL (MI 19) are proposed as HEV.	Proposed HEVs accepted,	Yes, with possible changes	No	N/A	N/A	None specified	N/A

	High ecological value waters						Modified waters	
Catchment/ Waterway	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**EVs Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	The HEV area covers all the catchment but excludes the section of stream, draining to Arthur Bay, downstream of the road causeway and the freehold lots at Radical Bay, which were previously used for the Radical Bay Resort, as well as the Radical Bay Road. **Values:** Relatively undisturbed catchment and instream values.	however need to review boundaries relative to roads/tracks from Arcadia-Horseshoe Bay to The Forts. Investigate the exclusion of a disused eroded track from The Forts to Florence Bay from HEV. (Review undertaken: easement was not 'extracted' from the HEV mapping because of the scale of the mapping →add statement to mapping about easements/corridors.)	as noted.					
Estuaries	Because of their small size, no specific HEV estuarine units have been mapped to date. Very small areas of estuarine waters have been captured in coastal HEV mapping (outlined later in table). The small brackish creek in Arthur Bay has been modified by surrounding development and road causeway, and is not included in the HEV area. Freehold lots at Radical Bay have also been excluded.	See above.	See above.	See above.	See above.	See above.	See above.	See above.
HORSESHOE BAY DRAINING STREAMS (eg Gorge Ck)								

	High ecological value waters						Modified waters	
Catchment/ Waterway	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**EVs Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
Freshwaters, including Gorge Ck, Endeavour Ck	**HEV waters;** Waters within NP/SL (MI 16) are proposed as HEV. This excludes the more downstream developed sections near Horseshoe Bay. Waters in the Horseshoe Bay lagoon proposed HEV area (MI 22) include a large parcel within reserve and Conservation Park (core area), and some optional smaller adjoining parcels. Input is sought on whether all parcels warrant identification as HEV. **Values:** (MI 16) Relatively undisturbed catchment and instream values in upper reaches. The lagoon area (MI 22) is a large wetland that supports significant vegetation communities, birdlife and other flora and fauna. Similar habitat is not available elsewhere on the island in such an extensive wetland.	Waters within upper reaches (including USL) supported, subject to reviewing: 1) Disused pipeline above sports field towards the Forts (has caused erosion.) (Review undertaken: easement was not 'extracted' from the HEV mapping because of the scale of the mapping →add statement to mapping about easements/corridors.) 2) The water tank and easement (above main road). (Review undertaken→water tank excluded from HEV.) 3) A section of state land lots 1USL51543 and 1USL51469 with severe erosion occurring adjacent to roadway and development. (Review undertaken→ this area has been removed from HEV.) 4) Roadway to The Forts through HEV area needs to be reviewed. (Review undertaken: road was not 'extracted' from the HEV mapping because of the scale of the mapping →add statement to mapping about easements/corridors.) 5) Disused pipeline following gully above Swensen Street requires further review. (Review undertaken: disused pipeline was not 'extracted' from the HEV mapping because of the scale of the mapping →add statement to mapping about easements/corridors.)	Yes, subject to further review of boundaries noted.	No	N/A	N/A	A freehold lot and lease hold lot are present near White Lady Bay in Horseshoe Bay, associated with an oyster farm. Nearby two small in-holdings occur with the National Park boundaries of MI16 (153EP626 and 166EP626). None of these lots have been included within the HEV area, although their condition is likely to be good as they do not appear to have been developed.	N/A (identified after workshop)

	High ecological value waters						Modified waters	
Catchment/ Waterway	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**EVs Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
Estuaries	**HEV waters:** Waters in an estuarine area to the west in Horseshoe Bay. **Values:** This water body has undergone some modification due to the installation of a bund wall on the eastern side. Water quality in these waters is still potentially very good. Erosion is occurring in the lower sections of Endeavour and Gorge Creek due to this modification.	Review estuarine components as HEV (disturbance). (Review undertaken→ Initial mapping has been refined to exclude small estuarine reaches, ie no estuarine reaches are in HEV.)	Yes	No	N/A	N/A	None specified	N/A
FIVE BEACH BAY DRAINING STREAMS								
Freshwaters	**HEV waters;** Waters within NP/SL (MI 15) are proposed as HEV. This covers virtually all the catchment. **Values:** Relatively undisturbed catchment and instream values in upper reaches.	No changes (proposed HEVs accepted).	Yes	No	N/A	N/A	N/A	N/A
Estuaries	Because of their small size, no specific HEV estuarine units have been mapped to date. Very small areas of estuarine waters have been captured in coastal HEV mapping (outlined later in table). Small sections of brackish creeks occur in the bays in this section of Magnetic Island and have been included as HEV.	See above.	See above.	See above.	See above.	See above.	See above.	See above.
ROLLINGSTONE BAY DRAINING STREAMS								
Freshwaters	**HEV waters;** Waters within NP/SL are proposed as HEV (MI 14). This covers virtually all the catchment. **Values:** Relatively undisturbed catchment and instream values in upper reaches.	No changes (proposed HEVs accepted).	Yes	N/A	N/A	N/A	N/A	N/A
Estuaries	None identified to date.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
COASTAL/ MARINE WATERS								
Magnetic Isld fringing coastal waters	**HEV waters:** All fringing coastal waters around Magnetic Island (MG 1), aside from Nelly Bay Harbour, are proposed as HEV waters. These waters are part of the GBR WHA and comprise a number of Marine National Parks (MNPs), Conservation Parks (CPs), and some additional waters based on technical panel advice. Key MNPs included as HEV waters are: ○ MNP-19-1089 Magnetic Island - Five Beach Bay ○ MNP-19-1090 Magnetic Island - Balding Bay & Radical Bay ○ MNP-19-1091 Magnetic Island - Gowrie Bay ○ MNP-19-1092 Magnetic Island - Florence Bay	No changes (ie HEVs accepted) for the following proposed HEVs: ○ Marine National Parks (MNPs 1089 – 1094); ○ Mag Is-Arthur Bay CP (CP-19-4057); ○ HEVs on north and east sides based on Dugong	For most areas around the island, HEVs supported. Further review of 2 areas requested, as per comments in previous column.	None specified	N/A	N/A	Waters on SW side of island have been identified as containing assets of conservation value warranting protection, eg seagrass flats and dugong habitat. If not identified as HEV then they warrant identification here.	Yes

	High ecological value waters						Modified waters	
Catchment/ Waterway	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**EVs Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	○ MNP-19-1093 Magnetic Island - Alma Bay ○ MNP-19-1094 Magnetic Island - Geoffrey Bay Key CPs included as HEV waters are: ○ CP-19-4057 Mag Is-Arthur Bay ○ CP-19-4058 Pallarenda – Cleveland Bay (part - adjacent Mag Is = MG 1) Additionally, the HEV waters include waters under Dugong Protection Area (Rollingstone Bay - north west side of Island), and seagrass meadows on the south side of the Island (partly within Conservation Park), and some habitat protection areas (based on technical panel advice). **<u>Values:</u>** 1) **MNPs**: **T D B NP S TS** (refer separate code explanation table after this table) These zones include 2 bioregions (NA3 and RE3) and afford protection to several bays adjacent to Magnetic Island National Park and within the Cleveland Bay – Magnetic Island DPA 'A' Zone important for dugongs and is an important green turtle foraging habitat. The zone in Five Beach Bay (MNP-19-1089) builds on a pre-existing MNPZ simplifying the boundary to assist in compliance and protecting the fringing coral reef within the Bay. White Rock, which was identified as an important line fishing location through submissions on the GBR zoning plan, has not been included in the zone. MNP-19-1090 builds on a pre-existing MNPZ at Balding Bay to include Radical Bay, which was previously a CPZ. Gowrie Bay (MNP-19-1091), Florence Bay (MNP-19-1092) and Alma Bay (MNP-19-1093) have been zoned MNPZ to afford greater protection to the well-developed fringing reefs. MNP-19-1094 reflects the previous MNPZ at Geoffrey Bay. The zone recognises these bays for their non-extractive tourism and recreational values. The boundaries of these zones have been configured to minimise the potential impact on the recreational line fishery by allowing these activities to continue on most of the headlands adjacent to the bays, raised as important through submissions on the GBR zoning plan. **2) CPs** **CP-19-4057:Magnetic Island - Arthur Bay** **T B NP TS**	protection and other designations; Further review of the following two areas was requested before resolution on boundaries in these areas: 1) Proposed HEV waters off Nelly Bay beach – some participants questioned whether there was evidence of impacts from Nelly Bay Harbour on these HEV waters that would require boundary change. Study team to review available information before making decision on need for change. (Review undertaken→ no boundary change proposed.) 2) The HEV area of Cockle Bay (SW side of Island – part of CP-19-4058 Pallarenda – Cleveland Bay). Participants discussed whether the current mangrove/mud dominated condition favouring seagrass and dugong was the original habitat condition compared with a more 'coral-dominated' substrate. Some participants considered that in some locations substrate was changing back to coral (eg Cod Hole re-emergence) (Review undertaken→ no change to HEV area.)					Middle Reef has a mixture of inshore and reef species providing a high diversity (some WQ issues based on WQ data).	

	High ecological value waters						Modified waters	
Catchment/ Waterway	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**EVs Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	The zone recognises the conservation values of Arthur Bay whilst also recognising its importance to local residents and visitors as a location for limited line fishing and spearfishing. The zone complements the adjacent Magnetic Island National Park, the Cleveland Bay – Magnetic Island DPA 'A' Zone, protects the fringing reefs and important green turtle foraging habitat. **CP-19-4058:Pallarenda / Cleveland Bay** **T D B CH R P A S** The zone builds substantially on a pre-existing CPZ at Pallarenda and extends the zone to Magnetic Island, protecting seagrass beds and significant dugong and green turtle foraging habitat. The zone includes fringing reefs on the western shore of Magnetic Island, as well as Middle Reef and Virago Shoal. The zone complements the adjacent Townsville Town Common Conservation Park, the Cape Pallarenda Conservation Park, the Magnetic Island National Park, and the Cleveland Bay – Magnetic Island DPA 'A' Zone. The zone does not extend further east to minimise the potential impact on the trawl fishery. The area is particularly important for recreational use from Townsville and its surrounds. (only the part adjacent to Mag Is is identified as HEV).							
Cleveland Bay	**<u>HEV waters:</u>** CP-19-4058: Pallarenda / Cleveland Bay (in MI 1) CP-19-4059: Cleveland Bay / Cape Cleveland (CL 1) **<u>Values:</u>** **CP-19-4058:Pallarenda / Cleveland Bay** - outlined above **CP-19-4059: Cleveland Bay / Cape Cleveland** **T D B CH NP H P A S** The zone expands on a pre-existing CPZ on the eastern shore of Cape Cleveland to include the entire eastern shore south to the SRZ adjacent to the Australian Institute of Marine Science (SR-19-2008), and much of the western shore and eastern Cleveland Bay. The zone includes parts of both the Cleveland Bay and Bowling Green Bay DPA 'A' and 'B' Zones respectively, and includes some of the most substantial seagrass beds in the region, which are important habitats for dugong, green turtles, juvenile fish and crustaceans. In addition, it is adjacent to Bowling Green Bay National Park and the nationally significant Burdekin-Townsville Coastal Aggregation Wetlands. The zone includes many areas important for the line fishery, including the Cleveland Bay seagrass beds, Cape Cleveland and Salamander Reef. The zone gives protection to this area whilst allowing for limited fishing. The zone does not extend further west to	Possible changes for those sections of CP-19-4058 around Mag Is are outlined above. No comments on HEVs within CP-19-4059. This area was covered in the Townsville workshop, results of which are outlined in a separate table from Townsville workshop).	For HEV waters in CP-19-4058, refer above. No comments on CP-19-4059 (refer Townsville workshop).	None specified	N/A	N/A	None specified	N/A

	High ecological value waters						Modified waters	
Catchment/ Waterway	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**EVs Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	minimise the potential impact on the trawl fishery.							
Halifax Bay coastal waters (including waters around Palm Is)	**HEV waters:** All MNPs, Preservation zones and some additional areas are proposed as HEV. These include: o MNP-18-1082: South east of Great Palm Island o MNP-18-1083: Orpheus (Goolboddi) Island Reef east o MNP-18-1085: Curacoa (Noogoo) Island Reef o MNP-18-1086: Halifax Bay / Pandora Reef o CP-18-4054: Great Palm Island (all captured under unit PI 1) Additional waters adjoining the above have also been identified by the technical panel, including Paluma Shoals and waters immediate west of Palm Islands (between MNP-18-1082 and MNP-18-1086). **MNP-18-1082:South-east of Great Palm Island** **B SU H** The zone includes 3 bioregions (NA3, NB3 and NB5), and includes areas of both Halifax Bay and the Palm Islands special and unique areas, which are of high conservation value owing to their ecological importance and cultural significance. The zone includes shoal areas, important transitory habitat for fishes moving from coastal and inshore nursery grounds to offshore reef and inter-reef habitats. The zone has been placed to exclude Albino, Chilcott, Hayman and Paluma Rocks to the south-east of Great Palm Island as maintenance of access to these rocks for mainly recreational line fishing was raised in submissions on the GBR zoning plan. The potential impact on the recreational line fishery has also been minimised by excluding shoal areas to the south and east of the zone. The zone has also been placed to exclude areas to the east, north-east and west to minimise the potential impact on the trawl fishery. **MNP-18-1083: Orpheus (Goolboddi) Island Reef east** **(18-049d) B NP SU H** The zone includes 2 bioregions (NB3 and RHC), and forms part of the Palm Islands special and unique area. The zone builds on a pre-existing MNPZ to simplify the boundary to assist in compliance. The zone complements the adjacent Orpheus Island National Park, its Indigenous cultural heritage values, and protects fringing reefs on the island's eastern shore. **MNP-18-1085: Curacoa (Noogoo) Island Reef (18-052)**	No changes. HEVs in this area were not reviewed in close detail at the Magnetic Is workshop. They were considered in more detail in the Bluewater rural north workshop. (Refer separate table of results from Bluewater workshop.)	General support for HEVs, although not closely reviewed in this workshop (more detailed review of these areas was undertaken in the Bluewater rural north workshop, results of which are outlined in a separate table from that workshop).	No	N/A	N/A	None specified	N/A

	High ecological value waters						Modified waters	
Catchment/ Waterway	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**EVs Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	B SU H S The zone includes 2 bioregions (NB3 and RHC), and is included in the Palm Islands special and unique area. The zone has been established to protect the fringing reef of Curacoa Island and is limited in placement due to the need to adequately protect the reef bioregion RHC. **MNP-18-1086: Halifax Bay / Pandora Reef (18-051)** **T B CH NP R S** The zone includes 2 bioregions (NA3 and RE3), shallow water seagrass beds that provide important foraging habitat for green turtles, and complements the adjacent nationally-significant Herbert River Floodplain, Bambaroo Aggregation Wetlands and the Halifax Bay Wetlands National Park. The zone provides some connectivity between Pandora Reef and inshore habitats, estuaries and wetlands. The zone has been placed to avoid the small reefs and inshore shoals adjacent to and north and south of Crystal Creek to minimise the potential impact on the line and net fisheries. The northern inshore boundary of the zone was revised to reflect submissions highlighting the importance of area adjacent to Palm Creek for recreational line fishing. The zone is limited in placement due to the need to adequately protect the heavily used non-reef bioregion NA3, however does not extend further east to minimise the potential impact on the trawl fishery and on users of the small islands to the south-west of the Palm Islands Group. **CP-18-4054: Great Palm Island** **B SU R H** The zone includes seagrass beds, and has significant cultural and heritage values to the Palm Island Aboriginal community including the traditional use of marine resources. The zone includes Albino, Chilcott, Hayman and Paluma Rocks to the south-east of Palm Island, as submissions identified these rocks as important line fishing areas from Townsville and surrounding communities. **Paluma Shoals:** This area (HB 1), south west of the Palm Island Group was added by the technical panel based on its values as fish habitat. Mackerel spawning areas. It represents unique benthic shoal reef habitat on sandy alluvial substratum. Occurs on a coastal zone drop off with inter-reef seagrass areas.							
Other marine waters (seaward of the above)	All MNPs and Preservation zones are proposed as HEV. Further details on these values are available based on GBRMPA reporting upon request.	No changes	General support					

The following table contains draft information on the ecological values of waterways in the rural workshop area (Crystal Creek to Black River and upper Ross River and adjacent coastal waters).

Table B: Ecological values of "Rural" Workshop area waterways – note: table proceeds broadly north to south through each catchment, dealing with fresh and estuarine waters, then coastal/marine waters

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
ALL WATERS								
DEFAULT HEV WATERS (refer to maps)	National Parks (NP), Wet Tropics World Heritage Area (A, B zones), Fish Habitat 'A' areas, Forest Reserve (where proposed to become NP), 'Highly protected areas' under the Marine Parks Act (eg marine national park, preservation zone, conservation park, buffer), GBR Marine National Park and Preservation zones. (Subject to local technical information, waters in additional areas/designations can also be considered for HEV. These include State Forest, Military Training Areas, Fish Habitat B areas, dugong protection area A/B, other marine park areas, Ramsar areas, Directory of Important Wetlands, etc).	No changes. Default HEVs accepted. Discussed for specific waterways below. General comment (all areas): need to explain how mapping relates to transport/utility easements. (Review undertaken → add statement to mapping that easements not 'extracted' from the HEV mapping because of the scale of the mapping.)	Discussed for specific waterways below.	Discussed for specific waterways below.	Discussed for specific waterways below.	Discussed for specific waterways below.	Discussed for specific waterways below.	Discussed for specific waterways below.
CATCHMENT - FRESHWATERS AND ESTUARIES								
BLACK RIVER BASIN								
CRYSTAL CREEK								
Crystal Ck freshwaters	**HEV waters:** Three main units, including upper reaches of Crystal Ck and tributaries, eg Little Crystal and Ethel Creeks (all within mapping unit CC 1). These are largely within National Park (NP), and World Heritage Area. Excludes Paluma township and Crystal Ck downstream of pipeline from Paluma Dam (interbasin water transfer). **Values:** High values as recognised by inclusion in Wet Tropics World Heritage Area (WHA). High biodiversity values and largely natural catchment and drainage from within NP areas. (Crystal Creek reach with altered flows from Paluma pipeline excluded).	No changes to the basis/approach of defining HEV boundaries relative to pipeline from Paluma. Three items for review: 1) Review pipeline easement layer relative to HEV boundaries (Review undertaken→add	Yes, with boundary review as noted. Comment made that water quality effects may continue downstream of swimming holes, but at present main exclusion is around swimming hole	No	N/A	N/A	Crystal Ck falls are located in the gorge upstream of the water intake weir and infrastructure but downstream of the water transfer (i.e. within flow-affected non HEV areas) and contains areas with functional and	Yes

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
		statement to mapping about easements/corridors) 2) Crystal Ck swimming hole and Yanks Gully eroded area to be excluded (Review undertaken→ area already excluded) 3) Little Crystal Ck swimming hole to be excluded from HEV area? (Review undertaken→area is too small for mapping scale).					biodiversity value that need protection. Causeway crossing downstream section of Little Crystal Creek (outside HEV area) has been identified as fish barrier.	
Crystal Ck estuary	**HEV waters:** Three main units, including the main channel and some adjacent wetlands. These are: the main channel (CC 12), northern side of Crystal Ck (CC 13), which connects Crystal Ck to the Insulator Ck system and other wetlands to the north (eg Halifax Bay NP); and southern side of Crystal Ck (unit CC 14), connecting to Lorna Ck system. **Values:** Important area of connected estuarine habitat with links to upland HEV waters and downstream coastal HEV areas. Also connects to remnant terrestrial habitat to the west, including mahogany glider habitat.	No changes (HEVs accepted, including main channel) Comment made that the boundary of council areas (Townsville and Hinchinbrook Shire) occurs mid channel - implications for management. (ie has WQIP project team consulted with adjoining Council?)	Yes	No	N/A	N/A	None specified	N/A
LORNA CREEK								
Lorna Ck freshwaters	No HEV waters identified to date.	N/A	N/A	No	N/A	N/A	None specified	N/A
Lorna Ck estuary	**HEV waters:** Units on the north bank (LC 4) and south bank (LC 5) are proposed as HEV. This HEV area includes the estuary main channel, and feedback is invited on the inclusion of the main channel in the HEV area. **Values:** Unit LC 4 connects to Crystal Creek and extensive wetlands further north. It also connects with some riverine tributaries and palustrine wetland (swale swamps). Unit LC 5 provides connectivity to Ollera Creek through large area of remnant habitat	No changes (HEVs accepted, including main channel)	Yes	No	N/A	N/A	None specified	N/A

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	and is adjacent to freshwater palustrine wetlands (swale swamps). The estuary channel provides intact deep water estuarine tidal habitat.							
OLLERA CREEK								
Ollera Ck freshwaters	**HEV waters:** Three units, including waters within the Wet Tropics WHA (unit OL 4), an area on the north side of Ollera Ck, east of Highway (unit OL 1), and an area on the south side of Ollera Ck, east of highway (also in unit OL 1). The latter two were both identified in the technical panel workshop. **Values:** The area within WHA (OL 4) is largely pristine stream with high biodiversity values. A Forestry Reserve (used for orchards/horticulture) occurs on the southern bank of Ollera Creek at the very downstream section of the WHA. This area is included in the WTWHA but has been excluded from the HEV. The areas outside the WHA (OL 1) include large areas of remnant coastal habitat identified under the Veg Management Act and Essential habitat (for Mahogany glider) - Endangered RE 7.3.8b. This area is sometimes referred to as Moongobulla. Rare to find such a large intact coastal tract. Remnant habitat is continuous between Lorna Creek and Ollera Creek. Ollera Creek riparian area provides connectivity between this area and the WHA. OL1 areas contain a number of large palustrine wetlands (Wetland RE 3.3.34 - Of concern). These areas also adjoin remnant habitat that consists of a large area of remnant vegetation classified as essential habitat under the Veg Management Act (largely on State land – but outside HEV areas) that connects to Little Crystal Creek and Crystal Creek, providing additional connectivity corridors from the coastal areas to the WTWHA.	HEVs generally accepted, with one item for review. Comment made that there is a small barrier to fish in Ollera Creek – check location relative to HEV boundaries. (Review undertaken→ HEV waters exclude main Ollera channel.).	Yes, with boundary review as noted.	No	N/A	N/A	None specified	N/A
Ollera Ck estuary	No HEV waters identified to date. (Initial investigations suggest estuary is slightly disturbed).	N/A	N/A	No	N/A	N/A	None specified	N/A
SCRUBBY CREEK								
Scrubby Ck freshwaters	**HEV waters:** Two main units, including headwaters of Scrubby Ck in WHA (SC 1), and a downstream area, east of the highway (OL 1) and linking to the estuary and to Ollera Ck. **Values:** Upper reaches (SC1) within WHA have relatively unmodified catchment and limited evidence of instream disturbance. Downstream area (OL 1) is continuous with Ollera Ck unit OL 1 and contains the same values (described above). Some cleared sections have been excluded from this HEV unit.	No changes (ie HEVs accepted). Workshop attendees indicated that they had limited knowledge of this area, so further stakeholder consultation/input on this area is recommended.	Yes	No	N/A	N/A	None specified	N/A
Scrubby Ck estuary	**HEV waters:** The Scrubby Ck estuary (SC 4, comprising areas on the north and south banks) is proposed as HEV. This HEV area also includes the estuary main channel, and feedback is invited on the inclusion of the main	No changes (ie HEVs accepted). Workshop attendees indicated that	Yes	No	N/A	N/A	None specified	N/A

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	channel in the HEV area. **Values:** Provides links to Ollera Ck and also links to upstream freshwater HEVs through remnant vegetation and riparian areas. Unit SC 4 consists of intact coastal estuary and dune habitats with natural catchment. Extended channel systems occur behind dunes. The estuary channel provides intact deep water estuarine tidal habitat and a small lagoon.	they had limited knowledge of this area, so further stakeholder consultation/input on this area is recommended.						
HENCAMP CREEK								
Hencamp Ck freshwaters	**HEV waters:** Three units, including headwaters of Hencamp Ck in WHA (HC 1), an area extending outside of the WHA approximately down to the highway (HC 2), and a palustrine wetland (HC 7) on south side of Hencamp Ck connecting to both HC 6 and RC 7 (previously omitted from table). **Values:** Upper unit (HC 1) is within minimally disturbed WHA with limited evidence of instream disturbance. The downstream unit (HC 2) is classified as conservation and natural environments on Qld landuse mapping project (QLUMP) and consists of a large area of remnant vegetation classified as essential habitat under the Veg Management Act. HC 7 connects to both HC 6 and RC 7 (see cell below). These areas were determined to be in a natural state during the technical panel workshops.	No changes (ie HEVs accepted).	Yes	No	N/A	N/A	None specified	N/A
Hencamp Ck estuary	**HEV waters:** The Hencamp Ck estuary (comprising two units – HC 5 on north bank, and HC 6 comprising main channel and south bank) is proposed as HEV. **Values:** Largely intact estuarine habitat with links to proposed upstream freshwater HEVs in Hencamp Ck. No evidence of water quality impacts from upstream land use. Development of coastal blocks and caravan park on north coastal area has been excluded from HEV area. Several large artificial ponds (aquaculture) are now part of the caravan park and have replaced natural habitat and reduced connectivity to northern systems. These are excluded from HEV.	No changes (ie HEVs accepted)	Yes	No	N/A	N/A	None specified	N/A
ROLLINGSTONE CREEK								
Rollingstone Ck freshwaters	**HEV waters:** Two units, including headwaters of Rollingstone Ck in WHA and part State Forest (RC 1), and an area extending outside of the WHA approximately down to the highway (RC 2). **Values:** Upper unit (RC 1) captures a large stream at southern extreme of the Wet Tropics. Upper reaches are largely perennial flow (seasonality increases downstream). Area is within minimally disturbed WHA with limited evidence of instream disturbance. Lower unit (RC 2) contains a large tract of intact riparian habitat, made up entirely of endangered RE 7.3.50a. This area consists almost entirely of	No changes (ie HEVs accepted).	Yes	No	N/A	N/A	None specified	N/A

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	remnant vegetation classified as essential habitat under the Veg Management Act. Little or no drainage from intensive agriculture. Status of weeds unclear. Presence and degree of impact from any grazing also unclear, although the area was considered to be in a natural state by the technical panel. (Feedback from the workshop is invited on this.)							
Rollingstone Ck estuary	**HEV waters:** Three units are identified as HEV in Rollingstone estuary (note some of these may be re-defined as freshwater): north bank of estuary channel (RC 7), wetlands near the beach on the south (RC 9) and wetlands near Mystic Sands (RC 10). The main Rollingstone estuary channel and the south bank are not currently proposed as HEV (possible disturbance). **Values:** These areas are less disturbed than the main channel and south bank and include areas of remnant endangered regional ecosystems. .	No changes (ie HEVs accepted, noting that main channel is excluded).	Yes	No	N/A	N/A	None specified	N/A
SURVEYORS CREEK								
Surveyors Ck freshwaters	**HEV waters:** Two areas, primarily within Clemant State Forest (SF) - Paluma Range NP. These are Surveyors Ck and a small creek to its south (both within unit SU 3). **Values:** Largely within NP and SF. Contains large, intact tracts of endangered REs. These largely consist of vegetation classified as essential habitat under the Veg Management Act. This area and adjacent Wild Boar and Saltwater Creek HEV areas provide a large, intact connectivity corridor from coastal habitats to WHA. This is the only area within the Black Ross basin where such an extensive, intact corridor exists.	No changes (ie HEVs accepted)	Yes	No	N/A	N/A	None specified	N/A
Surveyors Ck estuary	**HEV waters:** This comprises one unit (SU 5) and includes the estuary main channel. **Values:** The estuary connects to HEV freshwaters and has an almost completely intact catchment. Connects to Wild Boar Creek estuary (WC 2, discussed below), collectively representing an extensive and diverse coastal estuary and dune system.	No changes (ie HEVs accepted, noting that main channel is included)	Yes	No	N/A	N/A	None specified	N/A
WILD BOAR CREEK (including Station Creek)								
Wild Boar Ck freshwaters	**HEV waters:** Virtually the entire catchment (unit WC 1) is within Clemant SF – Paluma Range NP, and is proposed as HEV. Excludes some small areas of disturbance (eg quarry above highway). **Values:** Possibly the most intact and protected catchment within the region. Contains large, intact tracts of endangered REs. These largely consist of vegetation classified as essential habitat under the Veg Management Act.	No changes (ie HEVs accepted)	Yes	No	N/A	N/A	None specified	N/A

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	This area and adjacent Surveyors Creek and Saltwater Creek HEV areas provide a large, intact connectivity corridor from coastal habitats to WHA. This is the only area within the Black Ross basin where such an extensive, intact corridor exists.							
Wild Boar Ck estuary	**HEV waters:** This comprises one unit (WC 2) which includes the estuary main channel. **Values:** This estuarine unit links to upstream freshwater HEV. Possibly the most intact and protected catchment within the region. Connects to Surveyors Creek estuary (SU 5) to the north, collectively representing an extensive and diverse coastal estuary and dune system.	No changes (ie HEVs accepted, noting that main channel is included)	Yes	No	N/A	N/A	None specified	N/A
STATION CREEK								
Station Ck freshwaters and estuaries	Station Creek falls within the Wild Boar subcatchment for the purposes of this assessment. Refer to description for Wild Boar Creek above.	Refer Wild Boar Creek above	Refer Wild Boar Creek above	Refer Wild Boar Creek above	Refer Wild Boar Creek above	Refer Wild Boar Creek above	Refer Wild Boar Creek above	Refer Wild Boar Creek above
SALTWATER CREEK								
Saltwater Ck freshwaters	**HEV waters:** Three units, namely an upper unit (SW 1) comprising all freshwater drainages down to the highway and within the Clement SF; an area downstream of the highway in the Paluma Range NP (unit SW 2) linking to the estuary, and a small southern tributary of Saltwater Ck (SW 6). **Values:** These units have largely intact catchments. Contains large, intact tracts of endangered REs. These largely consist of vegetation classified as essential habitat under the Veg Management Act. This area and adjacent Surveyors Creek and Wild Boar Creek HEV areas provide a large, intact connectivity corridor from coastal habitats to WHA. This is the only area within the Black Ross basin where such an extensive, intact corridor exists. There may be some water quality issues associated with the highway – otherwise catchment is intact. (workshop feedback invited.)	No changes (ie HEVs accepted)	Yes	No	N/A	N/A	None specified	N/A
Saltwater Ck estuary	**HEV waters:** Two units, namely south bank of the estuary (unit SW 5) downstream of the aquaculture facility (not including the main channel); and the estuary of Camp Oven Creek south of Saltwater Ck (SW 9). **Values:** Links to upstream HEV waters. Unit SW 5 has connectivity to Camp Oven Ck (SW 9), which has a largely intact catchment largely within Paluma Range NP connecting to Clemant SF upstream. These estuarine wetlands create a largely continuous and diverse coastal wetlands system.	No changes (ie HEVs accepted, on basis that developed areas are excluded)	Yes, on basis that developed areas are excluded	No	N/A	N/A	None specified	N/A
LEICHHARDT CREEK								
Leichhardt Ck freshwaters	**HEV waters:** Four units largely within protected estate, including: upper Leichhardt (unit LE 1), largely within the WHA; unit LE 2 extending down to the highway in Clemant SF which includes the riparian area of the stream	Generally, no changes (ie HEVs accepted).	Yes, subject to barrier review.	No	N/A	N/A	None specified	N/A

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	channel; and at the downstream end, riverine wetlands and other freshwaters (unit LE 3, 4) extending from the highway to the estuary, mainly within Paluma Range NP. **Values:** Upper reaches are in minimally disturbed catchments. Mid reaches retain good riparian vegetation. The three HEV areas contain large areas of Endangered and Of Concern REs. Leichhardt Creek largely inaccessible by the public and the stream channel and riparian is largely in a natural state along most its entire length. The technical panel recognised this stream for a diverse freshwater fish fauna and the condition of its estuary area.	Need to review location and effects of low artificial barrier (30cm) approx 300m downstream of highway. (Review undertaken → weir approx 150m downstream of highway is already excluded from HEV waters.)						
Leichhardt Ck estuary	**HEV waters:** A single unit (LE 6) which includes the main channel, estuarine waters to the north and south. Links to upstream HEV freshwaters. **Values:** Links to HEV freshwaters in minimally disturbed catchment. The technical panel determined that the instream habitats, riparian and estuary of Leichhardt Creek are largely intact and in a natural state providing rich fish habitat. Connectivity between upper freshwaters and estuary is evidenced by large numbers of species such as Jungle Perch.	No changes (ie HEVs accepted).	Yes	No	N/A	N/A	None specified	N/A
SLEEPER LOG CREEK								
Sleeper Log Ck freshwaters (includes Two Mile and Christmas Cks)	**HEV waters:** Two main units, including upper catchment headwaters of Christmas Ck and Sleeper Log Ck (SL1), largely within WHA (SL1); and reaches of Christmas Ck and Sleeper Log Ck (SL 12). **Values:** Upper catchment units (SL 1) in protected estate/WHA are in minimally disturbed catchments. Lower unit (SL 12) contains large areas of Endangered and Of Concern REs. These areas were identified as HEV waters by the technical panel.	No changes (ie HEVs accepted).	Yes	No	N/A	N/A	None specified	N/A
Sleeper Log Ck estuary	**HEV waters:** A single unit (SL 7) that excludes the main channel of Sleeper Log Creek **Values:** The technical panel identified this area as a large intact estuarine and dune system in a largely natural state connecting to adjacent northern systems.	No changes (ie HEVs accepted).	Yes	No	N/A	N/A	None specified	N/A
BLUEWATER CREEK								
Bluewater Ck freshwaters	**HEV waters:** One unit (BW 1) comprising upper catchment waters including areas of Mount Cataract SF and State land. **Values:** This unit is in protected estate and SF in minimally disturbed catchment. Includes large areas of endangered and Of Concern REs and vegetation classified under the Veg Management Act as essential habitat.	No changes (ie HEVs accepted).	Yes	No	N/A	N/A	Palustrine wetland behind dunes north of Bluewater Creek (behind houses -Toolakea). In good condition with minimal clearing.	Yes

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
							Contains wetlands with open water, considered of high conservation value. (To be identified as natural asset – not HEV)	
Bluewater Ck estuary	No HEV waters identified to date. Initial investigations suggest estuary is modified.	N/A	N/A	No	N/A	N/A	None specified	N/A
DEEP CREEK								
Deep Ck freshwaters (including Althause and Healy Cks)	**HEV waters:** Area in upper catchment, namely headwaters of Deep and Althause Cks (unit DC 1), including a section of Mount Cataract SF. **Values:** Upper catchment units (DC 1) are largely in protected estate. Large area of remnant vegetation (some Endangered and Of Concern RE) classified as essential habitat under the Veg Management Act.	No changes (ie HEVs accepted).	Yes	No	N/A	N/A	None specified	N/A
Deep Ck estuary	No HEV waters identified to date. Initial investigations suggest estuary is modified.	N/A	N/A	No	N/A	N/A	None specified	N/A
BLACK RIVER								
Black River freshwaters (including Alice River)	**HEV waters:** Two areas comprising two upper catchment units - upper Black and upper Alice (both included in unit BR 1) **Values:** Upper areas (BR 1) include perennial freshwaters with lowland rainforest in relatively undisturbed catchments.	No changes (ie HEVs accepted).	Yes	No	N/A	N/A	Palustrine wetlands – swales/swamps behind Saunders Beach dunes. Located seaward of Queensland Nickel tailings dam. In good condition with minimal clearing. Connects to estuary wetlands and Black River.	N/A
Black River estuary	No HEV waters identified to date. Initial investigations suggest estuary is modified.	N/A	N/A	No	N/A	N/A	None specified	N/A
UPPER ROSS RIVER BASIN (Dam and upstream)								
UPPER ROSS RIVER								

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
Upper Ross River freshwaters	**HEV waters:** Comprises the following units: Upper Ross River, largely within upper catchment (RR1), western slopes of Bowling Green Bay NP (RR 19), the slopes of Mount Stuart (RR 33) taking in areas of the Mount Stuart defence reserve, and the Sisters Mountains (RR 48) north of RR 19. **Values:** These waterways in upper Ross River are in relatively less disturbed catchments, including some in protected estate. RR1 is part of Hervey Range and connects to extensive, continuous HEV areas to the north. RR 19 is part of the Mount Elliot section of the Bowling Green Bay NP, an isolate of the Wet Tropics bioregion to the north with high biodiversity values. RR 33 is an extensive, largely intact mountainous area that has been maintained in a largely natural state by Defence. It supports significant REs including vine thickets in channel gullies extending down slopes. Mount Stuart is drier than Mount Elliot and the mountains of Herveys Range and to the north. The topography and drier climate associated with Mount Stuart make it a unique, isolated landscape and vegetation, compared to other mountainous areas in the Black Ross Basin area. The sisters (RR 48) drain to three major stream systems in the Black Ross basin area. The area contains natural remnant vegetation cover that is continuous with HEV areas in upper Stuart Creek.	No changes (ie HEVs accepted). Boundaries of HEV around Mt Stuart appear to exclude impacted areas.	Yes	No	N/A	N/A	Wetland behind Ross Dam wall. Wetland is partly impounded by dam so changed hydrology, but is in relatively good condition and managed to exclude cattle. Contains water birds, aquatic plants. Need to confirm boundaries relative to wetlands mapping/imagery etc.	Yes

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
Note: other waterways (eg Bohle [BO1], lower Ross, Alligator Ck, Stuart Ck etc) are to be covered in a separate workshop in Townsville		N/A	N/A	N/A	N/A	N/A	N/A	N/A
COASTAL/ MARINE WATERS								
Halifax Bay coastal waters (including waters around Palm Is)	**HEV waters:** All MNPs, Preservation zones and some additional areas are proposed as HEV. These include: ○ MNP-18-1082: South east of Great Palm Island ○ MNP-18-1083: Orpheus (Goolboddi) Island Reef east ○ MNP-18-1085: Curacoa (Noogoo) Island Reef ○ MNP-18-1086: Halifax Bay / Pandora Reef ○ CP-18-4054: Great Palm Island (all within unit PI 1) Additional waters adjoining the above have also been identified by the technical panel, including Paluma Shoals and waters immediate west of Palm Islands (between MNP-18-1082 and MNP-18-1086) **HEV Values:**	Generally no changes (ie HEVs accepted) with the following conditions: 1. Western extent of HEV waters in unit PI 1 to be reviewed relative to degree of impact from pollutants in/from Cattle Creek (immediately to north of study area). (Review undertaken→ no change to existing MNP HEV area.) 2. Paluma Shoals HEV area (HB1) to be reviewed, given possible discharges from Cattle Ck and perception from some	Yes, subject to further review as noted.	No	N/A	N/A	Paluma shoals (coral habitat etc) values.	Yes (if not HEV)

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	MNP-18-1082:South-east of Great Palm Island **B SU H** (refer separate code explanation table after this table) The zone includes 3 bioregions (NA3, NB3 and NB5), and includes areas of both Halifax Bay and the Palm Islands special and unique areas, which are of high conservation value owing to their ecological importance and cultural significance. The zone includes shoal areas, important transitory habitat for fishes moving from coastal and inshore nursery grounds to offshore reef and inter-reef habitats. The zone has been placed to exclude Albino, Chilcott, Hayman and Paluma Rocks to the south-east of Great Palm Island as maintenance of access to these rocks for mainly recreational line fishing was raised in submissions on the GBR zoning plan. The potential impact on the recreational line fishery has also been minimised by excluding shoal areas to the south and east of the zone. The zone has also been placed to exclude areas to the east, north-east and west to minimise the potential impact on the trawl fishery. **MNP-18-1083: Orpheus (Goolboddi) Island Reef east (18-049d)** **B NP SU H** The zone includes 2 bioregions (NB3 and RHC), and forms part of the Palm Islands special and unique area. The zone builds on a pre-existing MNPZ to simplify the boundary to assist in compliance. The zone complements the adjacent Orpheus Island National Park, its Indigenous cultural heritage values, and protects the fringing reefs on the eastern shore of the island. **MNP-18-1085: Curacoa (Noogoo) Island Reef (18-052)** **B SU H S** The zone includes 2 bioregions (NB3 and RHC), and is included in the Palm Islands special and unique area. The zone has been established to protect the fringing reef of Curacoa Island and is limited in placement due to the need to adequately protect the reef bioregion RHC. **MNP-18-1086: Halifax Bay / Pandora Reef (18-051)** **T B CH NP R S** The zone includes 2 bioregions (NA3 and RE3), shallow water seagrass beds that provide important foraging habitat for green turtles, and complements the adjacent nationally-significant Herbert River Floodplain, Bambaroo Aggregation Wetlands and the Halifax Bay Wetlands National Park. The zone provides some connectivity between Pandora Reef and inshore habitats, estuaries and wetlands. The zone has been placed to avoid the small reefs and inshore shoals adjacent to and north and south of Crystal Creek to minimise the potential impact on the line and net fisheries. The northern inshore boundary of the zone was revised to reflect submissions on the GBR zoning plan highlighting the importance of area	stakeholders that its coral habitat had been degraded (increased mud re-suspension and effects on benthic substrate) (Review undertaken – area removed from HEV pending availability of further information to support its inclusion.) Rec from group to speak to Ken Turner (ex comm. fisherman) about his area (not yet done).						

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	adjacent to Palm Creek for recreational line fishing. The zone is limited in placement due to the need to adequately protect the heavily used non-reef bioregion NA3, however does not extend further east to minimise the potential impact on the trawl fishery and on users of the small islands to the south-west of the Palm Islands Group. **CP-18-4054: Great Palm Island** **B SU R H** The zone includes seagrass beds, and has significant cultural and heritage values to the Palm Island Aboriginal community including the traditional use of marine resources. The zone includes Albino, Chilcott, Hayman and Paluma Rocks to the south-east of Palm Island, as submissions identified these rocks as important line fishing areas from Townsville and surrounding communities. **Paluma Shoals**: This area (HB 1), south west of the Palm Island Group was added by the technical panel based on its values as fish habitat, including mackerel spawning areas. It represents unique benthic shoal reef habitat on sandy alluvial substratum, and occurs on a coastal zone drop off with inter-reef seagrass areas.							
Other marine waters (seaward of the above)	All MNPs and Preservation zones are proposed as HEV. Further details on these values are available based on GBRMPA reporting upon request.	No changes (ie HEVs accepted)	Yes	No	N/A	N/A	None specified	N/A

The following table contains draft information on the ecological values of waterways in the Townsville 'urban/rural residential' workshop area. This area include waters draining into Cleveland Bay, (eg Bohle and lower Ross Rivers, Stuart, Alligator and other Creeks) and adjacent coastal/marine waters including Cleveland Bay

Table C: Ecological values of Townsville Workshop area waterways – note: table proceeds broadly north to south through each catchment, dealing with fresh and estuarine waters, then coastal/marine waters

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
ALL WATERS								
DEFAULT HEV WATERS (refer to maps)	National Parks (NP), Wet Tropics World Heritage Area (A, B zones), Fish Habitat 'A' areas, Forest Reserve (where proposed to become NP), 'Highly protected areas' under the Marine Parks Act (eg marine national park, preservation zone, conservation park, buffer), GBR Marine National Park and Preservation zones. (Subject to local technical information, waters in additional areas/designations can also be considered for HEV. These include State Forest, Military Training Areas, Fish Habitat B areas, dugong protection area A/B, other marine park areas, Ramsar areas, Directory of Important Wetlands, etc).	No changes. Default HEVs accepted. Discussed for specific waterways below. General comment (all areas): need to explain how mapping relates to transport/utility easements. (Review undertaken → add statement to mapping that easements not 'extracted' from the HEV mapping because of the scale of the mapping.)						
CATCHMENT - FRESHWATERS AND ESTUARIES								
ROSS RIVER BASIN								
BOHLE RIVER								
Bohle River freshwaters	**HEV waters:** Two areas were identified in this catchment as HEV. These were: Upper Bohle River waters (unit BO1) around Mt Bohle South. This area largely covers the western part of the upper Bohle catchment; & Many Peaks Range north of the Town Common (BO12) **Values:** These waterways are in relatively undisturbed catchments. Upper reaches (BO 1) provide linkages to upper catchment HEV waters in upper Black/Alice catchments (unit BR1). Unit BO 12 consists of a small coastal range that is part of the Town Common Conservation Park. BO 12 is connected to extensive wetland systems and coastal beaches. High biodiversity values. Intact small seasonal streams with areas of vine thicket	Generally, no changes (ie HEVs accepted), conditional on the following further actions: 1) Review extent of BO1 HEV relative to areas of Chinee apple (*Ziziphus mauritiana* – woody weed) infestation and cattle impacts. (Review undertaken→ no changes						

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	in gullies.	made to date.) 2) Review boundaries relative to geomorphological categorisation of Bohle by Alluvium consultants for TCC) (Review undertaken→ no changes made to date.) 3) Check on this area with Merv Hayatt, Burd Council Councillor –local knowledge (to be undertaken)						
Bohle River estuary	No HEV waters identified to date. Small area of HEV previously identified in BO12 freshwaters is estuarine and has been re-coded BOE 1 to reflect estuarine waters (overall HEV boundaries unchanged).	N/A	N/A	Small area of HEV previously identified in BO12 freshwaters is estuarine and has been re-coded BOE 1 to reflect estuarine waters (overall HEV boundaries unchanged).	N/A	N/A	1) Shelly Beach area. Limited apparent impacts of plumes from Bohle and Ross rivers. In good condition. 2) Waters at mouth of Bohle have conservation values warranting protection eg seagrass beds, dugong habitat (DPA), despite WQ changes. [Technical panel also recognised values in this area]	Yes.
PALLARENDA								
Pallarenda freshwaters	**HEV waters:** Many Peaks Range (PA 3). **Values:** Unit PA 3 is part of a small coastal range that is part of the Town Common Conservation Park. PA 3 is connected to extensive wetland systems and coastal beaches. High biodiversity values. Intact small seasonal streams with areas of vine thicket in gullies	No changes (ie HEVs accepted, noting that there are some localised exclusions eg communications infrastructure).	Yes	No	N/A	N/A	Saltpan areas in Town Common – relatively unimpacted habitat although changed water quality	Yes – high conservation value
UPPER ROSS RIVER (DAM and UPSTREAM) ***Note – covered in "rural area" workshop – provided here for context and any comment***								

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
Upper Ross River freshwaters	**HEV waters:** Comprises the following units: Upper Ross River, largely within upper catchment (RR1), western slopes of Bowling Green Bay NP (RR 19) and the slopes of Mount Stuart (RR33) taking in areas of the Mount Stuart defence reserve, and the Sisters Mountains (RR 48) north of RR 19. **Values:** These waterways in upper Ross River are in relatively less disturbed catchments, including some in protected estate. RR1 is part of Hervey Range and connects to extensive, continuous HEV areas to the north (BO1, BR1). RR19 is part of the Mount Elliot section of the Bowling Green Bay NP, a southern isolate of the Wet Tropics bioregion to the north, with high biodiversity values. RR33 is an extensive, largely intact mountainous area that has been maintained in a largely natural state by Defence. It is drier than Mount Elliot but supports significant REs including vine thickets in channel gullies extending down slopes. Mount Stuart is drier than Mount Elliot and the mountains of Herveys Range and to the north. The topography and drier climate associated with Mount Stuart make it a unique, isolated landscape and vegetation, compared to other mountainous areas in the Black Ross Basin area. The sisters (RR 48) drain to three major stream systems in the Black Ross basin area. The area contains natural remnant vegetation cover that is continuous with HEV areas in upper Stuart Creek.	No changes (ie HEVs accepted). Attendees considered that boundaries excluded impacted areas (eg weedy areas of Sachs Ck).	Yes	No	N/A	N/A	None identified	N/A
LOWER ROSS RIVER								
Lower Ross River freshwaters	No HEV waters identified to date.	N/A	N/A	No	N/A	N/A	None identified	N/A
Ross River estuary	No HEV waters identified to date.	N/A	N/A	No	N/A	N/A	None identified	N/A
STUART CREEK								
Stuart Ck freshwaters	**HEV waters:** Upper reach and tributaries of Stuart Creek of the Sisters Mountains down to approximately the 80 m contour (unit ST 1). **Values**: This area retains natural remnant vegetation cover that is continuous with the HEV areas in the Ross (RR 48) and the Alligator Creek (AL22) catchments. This amalgamation therefore drains to three major stream systems in the Black Ross basin area. Populations of the endangered Black Throated finch have been recorded in the Upper Stuart Creek and Upper Ross catchments. This species relies on the surface water of these areas during dry season. Large perennial spring-fed pools occur in the upper reaches of Stuart Creek. These represent very high value aquatic habitat and surface water during the dry season in an otherwise dry landscape.	HEVs accepted, with need to review the following: 1) Permanent springs in the upper reaches of Stuart Creek - for inclusion. 2) Use of contour line to delineate HEV area. 3) HEV boundaries relative to Rocky Springs development. (Review of above related comments undertaken→	Yes, subject to boundary check	No	N/A	N/A	None identified	N/A

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
		HEVs boundary refined to include additional area covering main springs.)						
Stuart Ck estuary	No HEV waters identified to date.	N/A	N/A	No	N/A	N/A	None specified	N/A
ALLIGATOR CREEK								
Alligator Ck freshwaters	**HEV waters:** Upper reaches (within Mt Elliott section of Bowling Green Bay National Park) have been identified as HEV. These comprise waters in upper-most reaches above swimming area/camp ground (unit AL 1), and the swimming area and waters further downstream (unit AL 2) to the NP boundary. Additional areas in Alligator Creek catchment identified as HEV include: AL 18 (within lower section of Cape Bowling Green NP adjacent to estuary between Alligator and Crocodile Creeks), AL 20 (slopes of Mt Cleveland within NP draining into Cocoa Ck), AL 21 (Mt Matthew, north of Bruce Highway), and AL 22 (the Sisters Mountains in the western part of Alligator Ck catchment draining into Slippery Rocks Ck). **Values:** AL 1 and 2 are within NP catchment at the southern extreme of Wet Tropics type conditions with rainforest headwaters. Unit AL 1 is the more upstream area and is within a largely natural catchment. It contains several endemic species of note, including a *Euasticus bindal* crayfish. The perennial nature of the stream systems of Mount Elliot (e.g. Alligator Creek, Killymoon Creek) are very important to aquatic species in the area, including a rich fish fauna. These streams in turn connect to extensive coastal wetlands of the Bowling Green Bay wetland complex. High biodiversity values (both aquatic and terrestrial). Unit AL 2 retains intact riparian habitats and supports high aquatic biodiversity. Its water quality is generally good, receiving flow from relatively undisturbed catchment. Water quality can naturally vary (poorer in dry years) and these conditions can be exacerbated as a result of swimming activities (eg increased faecal coliform concentrations) for a short period. AL 18 is part of Bowling Green Bay NP and is adjacent to other HEV areas (AL 16) AL 20 (slopes of Mt Cleveland) is a small intact catchment adjacent to other HEV areas (MC1, CB 1, AL 16) draining into Cocoa Ck (AL 19). Unit AL 21 (Mt Matthew) contains a large area of intact remnant vegetation that drains to coastal estuaries through seasonal stream systems including	Generally, no changes (ie HEVs accepted) conditional on reviewing the following: 1) Review HEV boundaries (eg Mt Matthew) relative to State Development Area associated with Sun Metals property (check precinct zonings) (Review undertaken: HEVs are in 'buffer' area rather than intensive industry→ no changes made to date.)	Yes, (subject to boundary check).	No	N/A	N/A	Adjacent freshwater lot (42CP905700) in buffer area connects AL21 freshwater HEV to downstream estuarine HEV AL 15 (see below)	N/A (identified after workshop)

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	Whites Ck. Also identified in technical panel workshop as having values. Unit AL 22 (the Sisters) : This area retains natural remnant vegetation cover that is continuous with the HEV areas in the Ross (RR 48) and Stuart Ck (ST 1) catchments. This amalgamation therefore drains to three major stream systems in the Black Ross basin area. Populations of the endangered Black Throated finch have been recorded in the Upper Stuart Creek and Upper Ross catchments. This species relies on the surface water of these areas during dry season.							
Alligator Ck estuary	**HEV waters:** Estuaries on the north (unit AL 15) and south (AL 16) banks of Alligator Ck are proposed as HEV. This does not include the main channel of Alligator Ck. Also includes Crocodile Ck estuary (AL 17) and Coco Ck estuary (AL 19). **Values:** Alligator Ck units (AL 15, AL 16): Extensive estuarine habitats which includes three major estuarine creek systems. This area provides important and productive estuarine fisheries habitat and nursery, as well as habitat for a rich bird fauna and saltwater crocodile. These estuaries are also associated with extensive seagrass beds in Cleveland Bay (CL1) which supports populations of Dugong. Crocodile Ck (AL 17): very limited development in catchment. The majority of the catchment is within Bowling Green Bay NP. Cocoa Ck (AL 19): This is an undeveloped catchment within Bowling Green Bay NP.	Yes, several changes recommended to HEV boundaries, mainly in relation to their western extent: 1) AL 15: reduce extent of HEVs on western side of estuary (ie on Cleveland Palms side) due to disturbance, weeds etc. Option to use the river as the boundary of HEVs. (HEV on east side of river was supported). (Review undertaken→. No changes made to date – current boundaries appear to exclude developed areas) 2) AL 16 – review freehold lots between Alligator and Crocodile Cks for possible HEVs. (Review undertaken→ undisturbed lots included as HEV (LP 5E124282 and 320k124822) = new unit AL23 3) AL 17: Exclusion area around prawn farm (on Croc Ck) needs review and probably extension, particularly on NW side	Conditional on further review of boundaries	No	N/A	N/A	None specified	N/A

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
		(obtain recent aerial photography to assist) (Review undertaken → freehold lots with visible prawn farm activities excluded from HEV.) Also check effects of 4WD tracks. (Review undertaken→ easement was not 'extracted' from the HEV mapping because of the scale of the mapping →add statement to mapping about easements/corridors.) 4) Coco Creek (AL 19) - review boundaries relative to effects of roads/tracks to the (mud) boat ramp. (Review undertaken - →add statement to mapping about easements/corridors.)						
MT CLEVELAND								
Mt Cleveland freshwaters	**HEV waters:** Comprises the Mt Cleveland section of Bowling Green Bay NP extending out to Cape Cleveland (MC 1) (Note: Only the part draining into Cleveland Bay is within Black Ross WQIP area. Other parts are in Burdekin Dry Tropics WQIP area.). **Values:** Area is in undisturbed catchment, entirely within the Bowling Green Bay NP.	No changes (ie HEVs accepted), noting that other adjacent HEV waters (eg draining to Chunda Bay) are within Burdekin WQIP area.	N/A	No	N/A	N/A	None specified	N/A

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
Mt Cleveland estuaries	**HEV waters:** Small estuaries (MC4) within the Mt Cleveland section of Bowling Green Bay NP (Note: Only the part draining into Cleveland Bay is within Black Ross WQIP area. Other parts are in Burdekin Dry Tropics WQIP area.). **Values:** Small estuarine wetlands, largely within NP boundaries, at downstream end of an undisturbed catchment, adjacent to HEV areas including MC 1 and CL 1.	Generally, no changes (ie HEVs accepted) with identification of additional natural asset areas.	Yes.	N/A	N/A	Yes, subject to further review	Area behind and extending north of Sandfly Ck HEV (extending into Stuart estuary) includes remnant habitat of higher conservation value, including areas that may be subject to rehabilitation activity. Area broadly links to Cleveland Bay FHA, other HEV waters. Used as breeding habitat by the Little Tern, *Sterna albifrons*. This species is classified as 'Endangered' in Queensland under the *Nature Conservation Act 1992*. This area is earmarked to become a Conservation Park. Study team to review information including Port Access road study (Maunsells).	Yes
COASTAL/ MARINE WATERS								
Cleveland Bay	**HEV waters:** CP-19-4058: Pallarenda / Cleveland Bay (part adjacent to Mag Is – MG1) CP-19-4059: Cleveland Bay / Cape Cleveland (CL 1)	Generally, no changes (ie HEVs accepted). Possible extension to HEVs or	Yes	1) Area around Shelly Beach considered by workshop to be	1) Workshop thought this areas was less affected by plumes from Bohle	Yes – further review of values recommended	If not identified as HEV these three areas should be recognised as still	Yes.

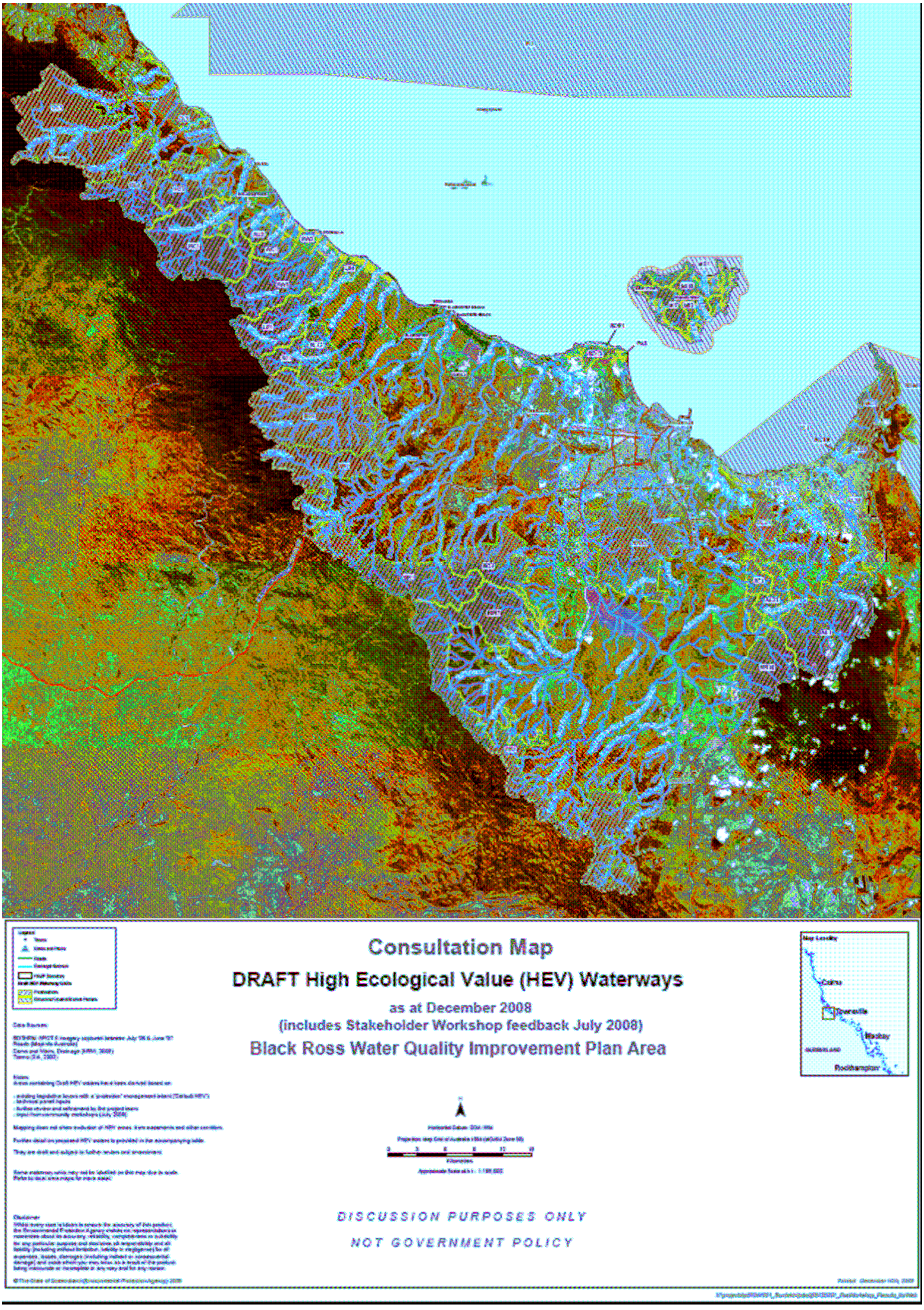
	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	Values: **CP-19-4058: Pallarenda / Cleveland Bay** **T D B CH R P A S** (refer separate code explanation table after this table) (only the part adjacent to Mag Is is identified as HEV). The zone builds substantially on a pre-existing CPZ at Pallarenda and extends the zone to Magnetic Island, protecting seagrass beds and significant dugong and green turtle foraging habitat. The zone includes fringing reefs on the western shore of Magnetic Island, as well as Middle Reef and Virago Shoal. The zone complements the adjacent Townsville Town Common Conservation Park, the Cape Pallarenda Conservation Park, the Magnetic Island National Park, and the Cleveland Bay – Magnetic Island DPA 'A' Zone. The zone does not extend further east to minimise the potential impact on the trawl fishery. The area is particularly important for recreational use from Townsville and its surrounds. **CP-19-4059: Cleveland Bay / Cape Cleveland** **T D B CH NP H P A S** The zone expands on a pre-existing CPZ on the eastern shore of Cape Cleveland to include the entire eastern shore south to the SRZ adjacent to the Australian Institute of Marine Science (SR-19-2008), and much of the western shore and eastern Cleveland Bay. The zone includes parts of both the Cleveland Bay and Bowling Green Bay DPA 'A' and 'B' Zones respectively, and includes some of the most substantial seagrass beds in the region, which are important habitats for dugong, green turtles, juvenile fish and crustaceans. In addition, it is adjacent to Bowling Green Bay National Park and the nationally significant Burdekin-Townsville Coastal Aggregation Wetlands. The zone includes many areas important for the line fishery, including the Cleveland Bay seagrass beds, Cape Cleveland and Salamander Reef. The zone gives protection to this area whilst allowing for limited fishing. The zone does not extend further west to minimise the potential impact on the trawl fishery.	identification of natural asset areas as indicated in following columns.		potentially HEV – for further review by WQIP team. (Review undertaken→ identified as natural asset - refer separate column) 2) Review West Channel (between mainland and Mag Isld) as possible HEV. (with any localised exclusion areas if required). (Review undertaken → natural asset) 3) Review Middle Reef as possible HEV or natural asset (Review undertaken → natural asset, given some WQ issues based on WQ data)	and Ross Rivers and in relatively good condition (comparable to Five Beach Bay on Mag Isld) (Review undertaken → natural asset) 2) WQ comparable to Shelly Beach and resuspension due to shallow nature of channel. 3) Mixture of inshore and reef species providing a high diversity.		having natural assets/conservation values. Additionally, waters at mouth of Bohle have conservation values warranting protection eg seagrass beds, dugong habitat (DPA), despite WQ changes.	
Halifax Bay coastal waters (including waters around Palm Is) – separate workshop	**HEV waters:** All MNPs, Preservation zones and some additional areas are proposed as HEV. These include: ○ MNP-18-1082: South east of Great Palm Island ○ MNP-18-1083: Orpheus (Goolboddi) Island Reef east ○ MNP-18-1085: Curacoa (Noogoo) Island Reef ○ MNP-18-1086: Halifax Bay / Pandora Reef ○ CP-18-4054: Great Palm Island	Generally, no changes (ie HEVs accepted). Possible extension to HEVs as indicated in following columns.	Yes	Workshop recommended review of waters around Acheron Isld and waters around Rattlesnake Isld (subject to use for defence purposes). Probably not appropriate to include Cordelia Rocks SE of Acheron Isld	Good WQ and other conservation values. Study team to obtain and review defence report. (Review undertaken→ not identified as HEV but do have natural asset values)	Subject to review	Yes. Waters around Acheron, Rattlesnake Islds	Yes

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	(all captured under PI 1) Additional waters adjoining the above have also been identified by the technical panel, including Paluma Shoals and waters immediate west of Palm Islands (between MNP-18-1082 and MNP-18-1086) **HEV Values:** **MNP-18-1082:South-east of Great Palm Island** **B SU H** (refer separate code explanation table after this table) The zone includes 3 bioregions (NA3, NB3 and NB5), and includes areas of both Halifax Bay and the Palm Islands special and unique areas, which are of high conservation value owing to their ecological importance and cultural significance. The zone includes shoal areas, important transitory habitat for fishes moving from coastal and inshore nursery grounds to offshore reef and inter-reef habitats. The zone has been placed to exclude Albino, Chilcott, Hayman and Paluma Rocks to the south-east of Great Palm Island as maintenance of access to these rocks for mainly recreational line fishing was raised in submissions on the GBR zoning plan. The potential impact on the recreational line fishery has also been minimised by excluding shoal areas to the south and east of the zone. The zone has also been placed to exclude areas to the east, north-east and west to minimise the potential impact on the trawl fishery. **MNP-18-1083: Orpheus (Goolboddi) Island Reef east (18-049d)** **B NP SU H** The zone includes 2 bioregions (NB3 and RHC), and forms part of the Palm Islands special and unique area. The zone builds on a pre-existing MNPZ to simplify the boundary to assist in compliance. The zone complements the adjacent Orpheus Island National Park, its Indigenous cultural heritage values, and protects the fringing reefs on the eastern shore of the island. **MNP-18-1085: Curacoa (Noogoo) Island Reef (18-052)** **B SU H S** The zone includes 2 bioregions (NB3 and RHC), and is included in the Palm Islands special and unique area. The zone has been established to protect the fringing reef of Curacoa Island and is limited in placement due to the need to adequately protect the reef bioregion RHC. **MNP-18-1086: Halifax Bay / Pandora Reef (18-051)** **T B CH NP R S**			(Review undertaken→ not identified as HEV but do have natural asset values)				

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	The zone includes 2 bioregions (NA3 and RE3), shallow water seagrass beds that provide important foraging habitat for green turtles, and complements the adjacent nationally-significant Herbert River Floodplain, Bambaroo Aggregation Wetlands and the Halifax Bay Wetlands National Park. The zone provides some connectivity between Pandora Reef and inshore habitats, estuaries and wetlands. The zone has been placed to avoid the small reefs and inshore shoals adjacent to and north and south of Crystal Creek to minimise the potential impact on the line and net fisheries. The northern inshore boundary of the zone was revised to reflect submissions on the GBR zoning plan highlighting the importance of area adjacent to Palm Creek for recreational line fishing. The zone is limited in placement due to the need to adequately protect the heavily used non-reef bioregion NA3, however does not extend further east to minimise the potential impact on the trawl fishery and on users of the small islands to the south-west of the Palm Islands Group. **CP-18-4054: Great Palm Island** **B SU R H** The zone includes seagrass beds, and has significant cultural and heritage values to the Palm Island Aboriginal community including the traditional use of marine resources. The zone includes Albino, Chilcott, Hayman and Paluma Rocks to the south-east of Palm Island, as submissions on the GBR zoning plan identified these rocks as important line fishing areas from Townsville and surrounding communities. **Paluma Shoals**: This area (HB 1), south west of the Palm Island Group was added by the technical panel based on its values as fish habitat, including mackerel spawning areas. It represents unique benthic shoal reef habitat on sandy alluvial substratum, and occurs on a coastal zone drop off with inter-reef seagrass areas							
Magnetic Island (separate workshop)	**HEV waters:** All fringing coastal waters around Magnetic Island (MG 1), aside from Nelly Bay Harbour, are proposed as HEV waters. These comprise a number of Marine National Parks (MNPs), Conservation Parks (CPs), and some additional waters based on technical panel advice. Key MNPs included as HEV waters are: ○ MNP-19-1089 Magnetic Island - Five Beach Bay ○ MNP-19-1090 Magnetic Island - Balding Bay & Radical Bay ○ MNP-19-1091 Magnetic Island - Gowrie Bay ○ MNP-19-1092 Magnetic Island - Florence Bay ○ MNP-19-1093 Magnetic Island - Alma Bay ○ MNP-19-1094 Magnetic Island - Geoffrey Bay	Refer to comments on Cleveland Bay above. Otherwise, no additional comments made.	Refer Cleveland Bay comments above	Refer Cleveland Bay comments above	Refer Cleveland Bay comments above	Refer Cleveland Bay comments above	Refer Cleveland Bay comments above	Refer Cleveland Bay comments above

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	Key CPs included as HEV waters are: o CP-19-4057 Mag Is-Arthur Bay o CP-19-4058 Pallarenda – Cleveland Bay (part - adjacent Mag Is) Additionally, the HEV waters include waters under Dugong Protection Area (Rollingstone Bay - north west side of Island), and seagrass meadows on the south side of the Island (partly within Conservation Park), and some habitat protection areas (based on technical panel advice). **Values:** **MNPs**: **T D B NP S TS** (refer separate code explanation table after this table) These zones include 2 bioregions (NA3 and RE3) and afford protection to several bays adjacent to Magnetic Island National Park and within the Cleveland Bay – Magnetic Island DPA 'A' Zone important for dugongs and is an important green turtle foraging habitat. The zone in Five Beach Bay (MNP-19-1089) builds on a pre-existing MNPZ simplifying the boundary to assist in compliance and protecting the fringing coral reef within the Bay. White Rock, which was identified as an important line fishing location through submissions on the GBR zoning plan, has not been included in the zone. MNP-19-1090 builds on a pre-existing MNPZ at Balding Bay to include Radical Bay, which was previously a CPZ. Gowrie Bay (MNP-19-1091), Florence Bay (MNP-19-1092) and Alma Bay (MNP-19-1093) have been zoned MNPZ to afford greater protection to the well-developed fringing reefs. MNP-19-1094 reflects the previous MNPZ at Geoffrey Bay. The zone recognises these bays for their non-extractive tourism and recreational values. The boundaries of these zones have been configured to minimise the potential impact on the recreational line fishery by allowing these activities to continue on most of the headlands adjacent to the bays, raised as important through submissions on the GBR zoning plan. **2) CPs** **CP-19-4057:Magnetic Island - Arthur Bay** **T B NP TS** The zone recognises the conservation values of Arthur Bay whilst also recognising its importance to local residents and visitors as a location for limited line fishing and spearfishing. The zone complements the adjacent Magnetic Island National Park, the Cleveland Bay – Magnetic Island DPA 'A'							

	High ecological value waters						Modified waters	
Catchment/ Waterway (broadly north – south)	**Draft HEV waters (location and values – to be shown in workshop maps/presentation)**	**Workshop input 1: Any changes?**	**Workshop input 2: Support for proposed HEVs? (Y/N)**	**Workshop input 3: Any new HEV waters (including location)**	**Workshop input 4: Basis for listing as potential HEV**	**Workshop input 5: Support for new HEV? (Y/N)**	**Workshop input 6: Natural assets in non HEV waters (including location)**	**Workshop input 7: Support for natural asset (Y/N)**
	Zone, protects the fringing reefs and important green turtle foraging habitat. **CP-19-4058:Pallarenda / Cleveland Bay** **T D B CH R P A S** The zone builds substantially on a pre-existing CPZ at Pallarenda and extends the zone to Magnetic Island, protecting seagrass beds and significant dugong and green turtle foraging habitat. The zone includes fringing reefs on the western shore of Magnetic Island, as well as Middle Reef and Virago Shoal. The zone complements the adjacent Townsville Town Common Conservation Park, the Cape Pallarenda Conservation Park, the Magnetic Island National Park, and the Cleveland Bay – Magnetic Island DPA 'A' Zone. The zone does not extend further east to minimise the potential impact on the trawl fishery. The area is particularly important for recreational use from Townsville and its surrounds. (only the part adjacent to Mag Is is identified as HEV).							
Other marine waters (seaward of the above)	All MNPs and Preservation zones are proposed as HEV. Further details on these values are available based on GBRMPA reporting upon request.	No changes (ie HEVs accepted).	Yes	No	N/A	N/A	None specified	N/A


Consultation Map
DRAFT High Ecological Value (HEV) Waterways
as at December 2008
(includes Stakeholder Workshop feedback July 2008)
Black Ross Water Quality Improvement Plan Area
Map Locality
Cairns
Townsville
Mackay
Rockhampton
DISCUSSION PURPOSES ONLY
NOT GOVERNMENT POLICY