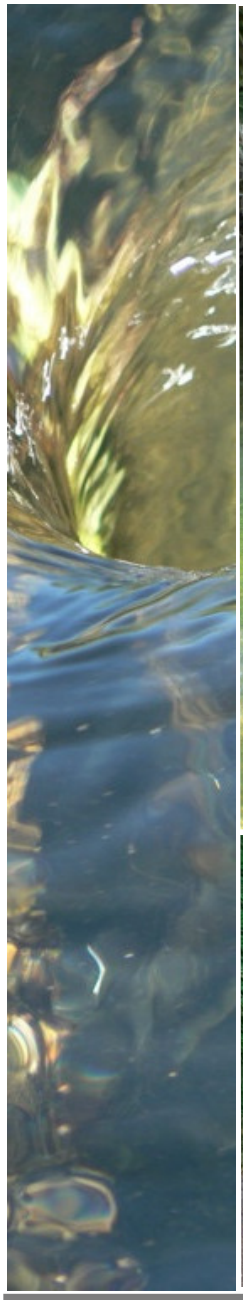

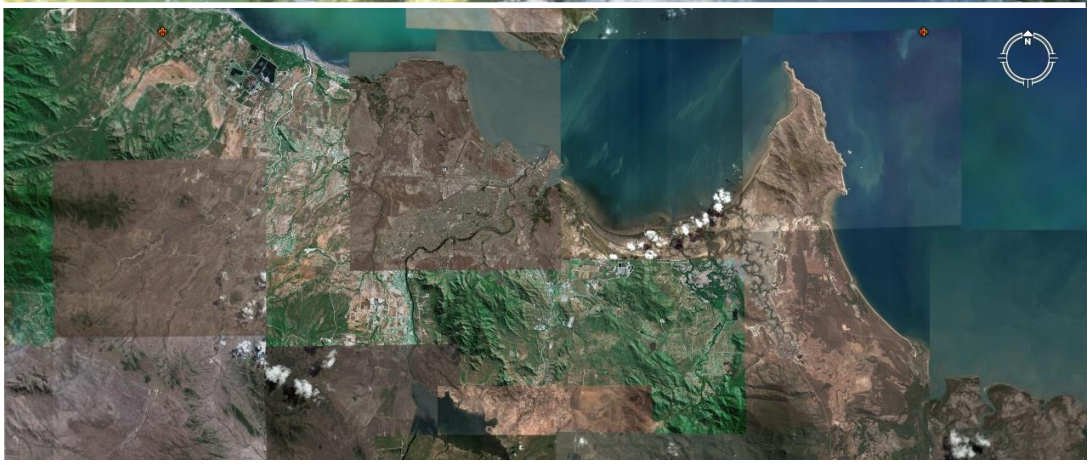

Creek to Coral Coastal Catchment Initiative

Water Quality Condition of the Black and Ross River Basins

Townsville City Council

15 December 2008
Reference 27807-003
Revision 2

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0	24 June 2008	Draft for client comment	SMK/LL	SMK/LL	NAP	PTM
1	7 August 2008	Bore data removed, Sandfly Ck boundary moved	SMK	SMK	NAP	PTM
2	15 December 2008	Additional data from GBRMPA, Citywater & ACTFR	SMK	SMK	JT	MGP

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Executive Summary

Background

The Creek to Coral program was formally launched in October 2003 as a combined Townsville and Thuringowa Local Government infrastructure-based initiative to maintain and enhance the health of waterways in the coastal dry tropics. Creek to Coral is managing a Coastal Catchments Initiative project to develop a Water Quality Improvement Plan for the Black River and Ross River Basins.

The purpose of this document is to summarise the condition of current water quality in the waterways, estuaries and the receiving water bodies of the study area.

Water quality data has been collected from a variety of sources and summarised in an MS Access database. The source data was supplied electronically, mostly as Excel spreadsheets of a variety of formats. The source data was interpreted and manipulated in order to get it into a consistent format for analysis. An assessment of the data quality was also undertaken.

Catchment Description and Water Quality

Black River Basin is approximately 1,060 km^2 and extends from Crystal Creek in the north to Black River in the south (**Figure 3-1**). Water quality values generally fell within the EPA guidelines however the dissolved oxygen was generally low and the total suspended solids was generally high.

The Ross River Basin is approximately 1,700 km^2 and extends from the Bohle River in the north to Alligator Creek in the south (**Figure 4-1**). Water quality results are indicative of disturbed ecosystems. Nutrient levels are high in most of the areas where monitoring has been undertaken, however the levels of phosphorus in the Lower Bohle River sub-basin are significantly above the guideline for lowland streams.

Magnetic Island covers an area of approximately 52 km^2 and is predominately used for conservation. Data is largely limited to those catchments which have been developed and indicates that development has had an impact on water quality. The reliability of data for this catchment is low so it is important that a rigorous monitoring program is established in the urbanised catchments.

The River Influence area is approximately 1,700 km^2 and extends from Cape Cleveland in the south to Crystal Creek in the north. In general there is insufficient data to assess the water quality for the catchments in the River influence area.

In general in the study area dissolved oxygen (% saturated) is low, total suspended solids is high, pH is within the guidelines and turbidity is low.

Conclusions and Recommendations

There is a total of 60 catchments in the study area of which 15 are slightly impacted, 3 are moderately impacted and 11 are heavily impacted. The remaining catchments either have no data (23) or insufficient data (8) to make an assessment. At the waterbody reach level, 18 waterbody reaches are slightly impacted, 15 are moderately impacted and 19 are heavily impacted. Of the remaining waterbody reaches 84 have no data and 12 have insufficient data to make an assessment.

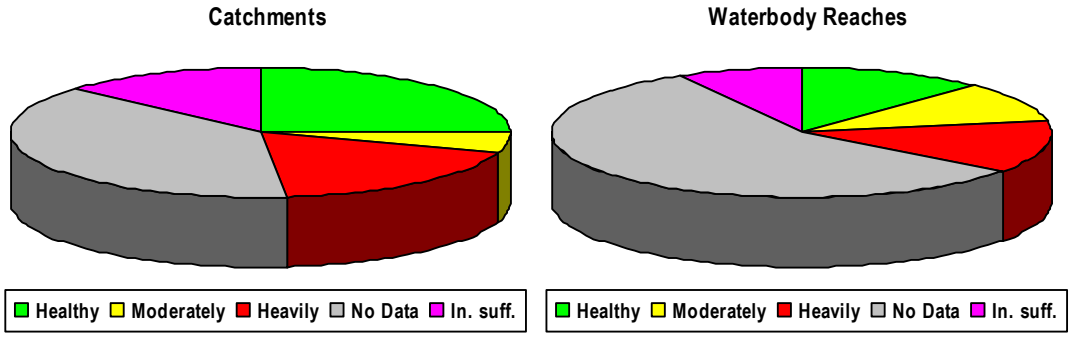

Figure i - Summary of Water Quality Assessment for the study area

In order to improve the water quality data set for the Ross and Black River catchments so that the current water quality conditions can be more accurately assessed, the following improvements to the current water quality monitoring is recommended:

- Monitoring in catchments where there is no data; 1-2, 1-3, 1-4, 2-2, 2-3, 2-4, 2-5, 2-7, 4-2, 5-3, 6-1, 7-2, 7-3, 7-4, 7-6, 9-2, 9-3, 9-4, 10-4, 10-5, 10-7, 10-8, 10-9
- Nearly all areas require additional nutrient monitoring
- Additional surface water monitoring is needed for Magnetic Island for a more accurate assessment
- Additional marine monitoring is necessary to determine the impacts on marine areas
- Representative monitoring locations need to be established along with a standardised sampling methodology
- Flow monitoring needs to be established at representative locations

The guideline limits for turbidity, ammonia, oxidised nitrogen and filterable reactive phosphorus need to be revised.

Further analysis and testing of the relationship between dissolved oxygen, ammonia and total nitrogen should be undertaken to see if low dissolved oxygen is preventing the oxidation of ammonia.

The sources of phosphorus in the Lower Bohle River need to be identified and targeted for action.

The relationship between Chlorophyll-a, nutrient loads and ecosystem health needs to be investigated to determine if the guideline limit for Chlorophyll-a needs to be revised.

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Abbreviations

ACTFR – Australian Centre for Tropical Freshwater Research
CCI – Coastal Catchments Initiative
CVA – Conservation Volunteers Australia
C2C – Creek to Coral
DO – Dissolved oxygen
EPA – Environmental Protection Agency
GBRMPA – Great Barrier Reef Marine Park Authority
LOR – Limit of recognition
NRW – Department of Natural Resources and Water
TCC – Townsville City Council
WQIP – Water Quality Improvement Plan
WW – WaterWatch

1. Introduction

1.1 Background

The Coastal Catchments Initiative (CCI) is an Australian Government funded program aimed at achieving targeted reductions in pollution discharges to coastal water quality 'hot spots'. Hot spots, in this context are coastal waters with high conservation value and are threatened by pollution from various sources. The receiving waters of the Great Barrier Reef lagoon are considered to be one such hot spot.

The CCI supports the development and implementation of Water Quality Improvement Plans in accordance with the Australian Government *Framework for Marine and Estuarine Water Quality Protection* (EA 2002). The Framework is based on the *National Water Quality Management Strategy* (DEW 2007) and the *National Principles for the Provision of Water for Ecosystems* (ARMCANZ and ANZECC 1996); both approved by Australian Government/State Ministerial Councils.

Townsville and Thuringowa City Councils established the Creek to Coral initiative in 2003 in partnership with the Queensland Environmental Protection Agency (EPA) and supported by the Great Barrier Reef Marine Park Authority (GBRMPA). The Creek to Coral initiative is a locally adapted version of the South East Queensland (SEQ) Healthy Waterways Program and emphasises local concerns and issues in an environmental context relevant to the Townsville Dry Tropics adjacent to the Great Barrier Reef.

Creek to Coral (C2C) is the manager of the CCI project for the Townsville and Thuringowa sub-catchments and, with the assistance of its many partners, is responsible for the preparation of a Water Quality Improvement Plan (WQIP) for the Black and Ross River Basins (to be referred to as the Black/Ross WQIP).

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. The area also includes Magnetic Island, as well as the coastal and marine waters of Cleveland Bay and Halifax Bay. This area is referred to as the study area in the remainder of this report and is shown in Appendix A.

1.2 Purpose of this document

The purpose of this document is to value add to the Stage 1 Water Quality Condition report, which summarised the condition of current water quality in some of the waterways and estuaries of the study area (dependent on available water quality data at the time of writing). In Stage 2 additional water quality data has been collated, and in consultation with Creek to Coral, Connell Wagner has utilised an integrated ecological assessment developed by EPA (2006) for the water quality assessment for the Ross and Black Basins. This water quality assessment will provide a single rating of the current condition of each catchment in the Black and Ross WQIP study area. The relationship between the basins, sub-basins, catchments, and waterbodies is shown in **Table 1-1**.

This report does not discuss the relationship between water quality and potential pollutant sources. This has been discussed in other documents prepared for the Creek to Coral initiative (Gunn and Barker 2008).

Table 1-1 Relationship between basins, sub-basins, catchments and waterbodies

Basin	Sub-basin	Catchment	Waterbody	Water types					
				Upland streams	Lowland streams	Freshwater lakes	Mid-estuarine	Enclosed coastal	Open coastal
Black River	1 Crystal Creek	1-1 Crystal Creek	Crystal Creek	X	X		X		
			Double Barrel Creek	X					
			Little Crystal Creek	X	X				
			Toms Creek	X	X				
		1-2 Lorna Creek	Lorna Creek		X		X		
		1-3 Ollera Creek	Cloudy Creek		X				
			Ollera Creek	X	X		X		
		1-4 Scrubby Creek	Scrubby Creek	X	X		X		
		1-5 Hencamp Creek	Hencamp Creek	X	X		X		
	2 Rollingstone Creek	2-1 Rollingstone Creek	Rollingstone Creek	X	X		X		
			Rollingstone Creek (East Branch)	X	X				
		2-2 Unnamed							
		2-3 Surveyors Creek	Surveyors Creek	X	X		X		
		2-4 Wild Boar Creek	Wild Boar Creek	X	X		X		
		2-5 Station Creek	Station Creek	X	X		X		
		2-6 Saltwater Creek	Saltwater Creek	X	X		X		
		2-7 Cassowary Creek	Camp Oven Creek		X		X		
			Cassowary Creek		X				
		2-8 Leichhardt Creek	Leichhardt Creek	X	X		X		
	3 Bluewater Creek	3-1 Sleeper Log Creek	Christmas Creek		X		X		
			Sleeper Log Creek	X	X		X		
		3-2 Two Mile Creek	Two Mile Creek		X				
		3-3 Bluewater Creek	Bluewater Creek	X	X		X		
			Pine Creek	X	X				
		3-4 Deep Creek	Althaus Creek	X	X				
			Deep Creek		X		X		
			Healy Creek		X		X		
	4 Black River	4-1 Black River	Alick Creek		X		X		
			Black River	X	X		X		
			Log Creek		X				
		4-2 Alice River	Alice River		X				

Basin	Sub-basin	Catchment	Waterbody	Water types					
				Upland streams	Lowland streams	Freshwater lakes	Mid-estuarine	Enclosed coastal	Open coastal
Ross River	5 Bohle River	5-1 Bohle River	Bohle River Lower		X		X		
			Louisa Creek		X				
			Saunders Creek		X				
			Stoney Creek		X				
		5-2 Bohle River 2	Bohle River Upper		X				
			Little Bohle River		X				
			Middle Bohle Creek		X				
	6 Lower Ross River	6-1 Pallarenda							
		6-2 Mundy Creek	Mundy Creek		X				
		6-3 Esplanade	Esplanade		X				
		6-4 Ross Creek	Ross Creek		X				
			The Lakes				X		
		6-5 Ross River (btdam)	Gordon Creek		X				
			Ross River		X		X		
	7 Upper Ross River	7-1 Ross River (atd)	Central Creek		X				
			Ross River Dam			X			
		7-2 Six Mile Creek							
		7-3 Toonpan Lagoon	Lansdowne Creek		X				
		7-4 Antill Plains Creek	Anthill Creek		X				
			Anthill Plains Creek	X	X				
			Five Head Creek		X				
		7-5 Sachs Creek	Sachs Creek		X				
	8 Sandfly Creek	8-1 Stuart Creek	Dick Creek		X				
			Stuart Creek		X		X		
		8-2 Sandfly Creek	Sandfly Creek		X		X		
	9 Alligator Creek	9-1 Alligator Creek	Alligator Creek		X		X		
			Killymoon Creek		X				
			Slippery Rocks Creek		X				
			Whites Creek		X		X		
		9-2 Crocodile Creek	Crocodile Creek				X		
		9-3 Cocoa Creek	Cocoa Creek	X	X		X		
Magnetic Island	10 Magnetic Island	10-1 Cockle Bay	West Coast		X				
		10-2 Picnic Bay	Butler Creek	X	X		X		
			Picnic Bay		X				
		10-3 Nelly Bay	Gustav Creek	X	X		X		
			Nelly Bay		X				
		10-4 Arcadia	Petersen Creek	X	X		X		
		10-5 Radical Bay							
		10-6 Horseshoe Bay	Endeavour Creek	X	X		X		
			Gorge Creek	X	X		X		
			Horseshoe Bay		X				
		10-7	Five Beach Bay						
		10-8	Rollingstone Bay						
		10-9 West Coast	Chinamans Gully	X	X		X		
			Ned Lee Creek	X	X		X		
			Retreat Creek	X	X		X		

Basin	Sub-basin	Catchment	Waterbody	Water types					
				Upland streams	Lowland streams	Freshwater lakes	Mid-estuarine	Enclosed coastal	Open coastal
GBRMP	11 Cleveland Bay	11-01 Harbour	Townsville Harbour					X	
		11-02 Ross River Nearshore	Ross River Nearshore					X	
		11-03 Sandfly Creek Nearshore	Sandfly Creek Nearshore					X	
		11-04 Ross Offshore	Ross Offshore						X
		11-05 Cleveland Bay	Cleveland Bay						X
		11-06 Middle Reef	Middle Reef						X
		11-07 Picnic Bay	Picnic Bay						X
		11-08 Nelly Bay	Nelly Bay						X
		11-09 Arcadia	Arcadia Bay						X
		11-10 Horseshoe Bay	Horseshoe Bay						X
		11-11 Pandora Reef	Pandora Reef						X
		11-12 Other marine	Marine						X

2. Approach

2.1 General

The database from stage 1 was modified to include additional datasets and to perform the water quality assessment. Additional datasets have been sourced from:

- Citiwater;
- Great Barrier Reef Marine Park Authority; and
- Australian Centre for Tropical Freshwater Research.

The source data was supplied electronically, mostly as Excel spreadsheets of a variety of formats. The source data was interpreted and manipulated in order to translate it into a consistent format for analysis. Manipulation consisted of one or more of the following:

- Converting the values to the same unit of measure used in the database, generally this meant multiplying or dividing by 1000
- Removing text characters such as > or <. Where there was a < symbol, it was assumed that this was the limit of detection and the value was also recorded in the testLOR field of TblTest.

Some of the raw data that was supplied (from Stage 1 and Stage 2) has been removed from the database for the following reasons:

- There was insufficient information to locate the site
- There was insufficient information on the unit of measure used
- There was no date for when the tests were performed

The database includes some groundwater monitoring data, mostly associated with various water/sewerage treatment plants in the project area. This data has been excluded from the surface water quality analysis.

The list of fields and tables used in the MS Access database is shown in **Figure 2-1**. This table structure allows for the data to be summarised and analysed at several geographic scales from individual sites, through to watercourses and sub/catchment areas.

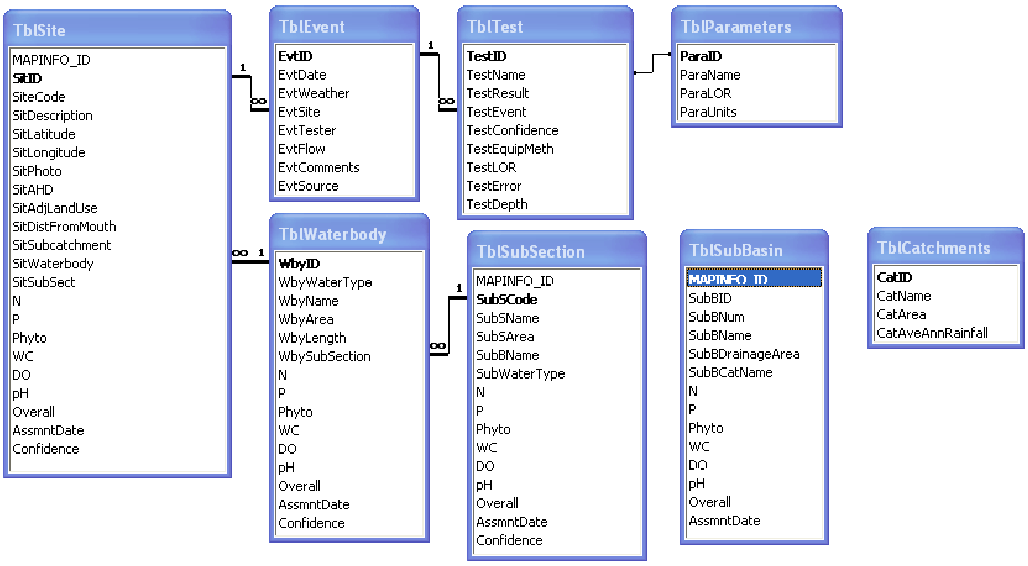


Figure 2-1 Tables and fields in Water Quality database showing relationships

2.2 Determination of Guideline Values

As locally relevant guideline values for the Ross and Black Basins are yet to be defined, the Queensland water quality guidelines QEPA (2006) and ANZECC (2000) default guideline values were adopted for this study. According to QEPA (2006) the Ross and Black Basin are located in the East Coast division and Central sub-region based on climatic zones in Queensland. The guideline is based on water types and is shown in **Table 2-1**.

The ANZECC 2000 Guidelines and the QEPA (2006) are primarily focussed upon deriving guideline values for slightly moderately disturbed (level 2) aquatic ecosystems, as these are considered to represent a significant proportion of Australian waters.

Table 2-1 Guideline values

Central region water type	Physio-chemical indicator and guideline value (slightly-moderately disturbed systems)													
	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	8.4
Enclosed coastal	8	3	180	200	6	20	2.0	90	105	6	1.5	15	8.0	8.4
Mid-estuarine and tidal canals, constructed estuaries, marinas and boat harbours	10	10	260	300	8	25	4.0	85	105	8	1.0	20	7.0	8.4
Upper Estuarine	30	15	400	450	10	40	10.0	70	105	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		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

2.3 Procedure for deriving Integrated Water Quality Assessments

The scoring system used in this study has been derived from QEPA (2006). Data is summarised then analysed in order to determine a rating for the given summary level. The ratings used correspond to the ecological status as shown in **Table 2-2**.

Table 2-2 Colour rating and corresponding ecological status

Colour	Ecological Status
Green	Ecologically healthy / slightly impacted site
Yellow	Slightly / moderately impacted site
Red	Moderately / heavily impacted site

For this study, the data has been summarised at two geographic scales; catchment and watercourse reach. It is possible to apply this assessment process at many different geographic scales however consideration needs to be given to the water type when summarising data. In this study, the data was summarised then compared to the guideline values. Therefore it is assumed that all of the data is of a single water type. At larger geographic scales, such as at the sub-basin and catchment level this is unlikely to be true, and therefore the water type (and the relevant guideline values) need to be chosen based on the majority of the sites represented at that summary level.

It has been assumed that most of the catchments are generally of the 'lowland streams' water type. However it is noted in each section what water type the data was assessed against. The marine areas are generally of the open coastal water type.

Each watercourse has been split into reaches based on water type. The mid-estuarine reaches are based on Regional Ecosystem mapping. The divide between the lowland and upland reaches is based on the 150m contour defined in 250K scale topographic maps. The reaches have been corrected using spot imagery where it was available.

The overall assessment is made using a hierarchical approach, whereby each indicator is assessed against appropriate guidelines, then the assessments for each indicator are used to derive a combined assessment for groups or categories of indicators, and finally these category assessments are used to derive a single assessment (red, yellow or green) for the summary level as a whole. The steps in this process are detailed below:

Step 1: Determine median, 20th and 80th percentiles

Median, 20th and 80th percentile values for each group in a summary level are compared with QEPA (2006) guidelines. These values were derived using the following formulae:

> The median is middle value when all values are ranked in ascending order. If there is an even number of records then the median is the average of the two middle values.
>
> The 20th percentile is the value that corresponds to the nth record where the nth = 0.2 x total record count.
>
> The 80th percentile is the value that corresponds to the nth record where the nth = 0.8 x total record count.
>
> If there were less than 5 records for a given summary then the 20th and 80th percentiles were not calculated.

Step 2: Rate the results for the indicator

The rate for all indicators was determined using the following rules:

Guideline lower limit is <= median and median is <= guideline upper limit	GREEN
Guideline lower limit is <= 80th percentile or 20th percentile is <= guideline upper limit	YELLOW
20th and 80th percentile < guideline lower limit, or	RED
Guideline upper limit < 20th and 80th percentile, or	RED
Guideline lower limit > 20th percentile and 80th percentile >guideline upper limit	RED
Insufficient data (no percentiles)	Insuff.data
No data	No data

These rules are demonstrated in **Figure 2-2** where the guideline range is between 0 and 1.

For indicators where a lower guideline limit is not stated it has been assumed to be zero. The exception to this is the secchi depth where the guideline given is the lower limit and the upper limit has been assumed to be 50m for open coastal and 20m for all other water types.

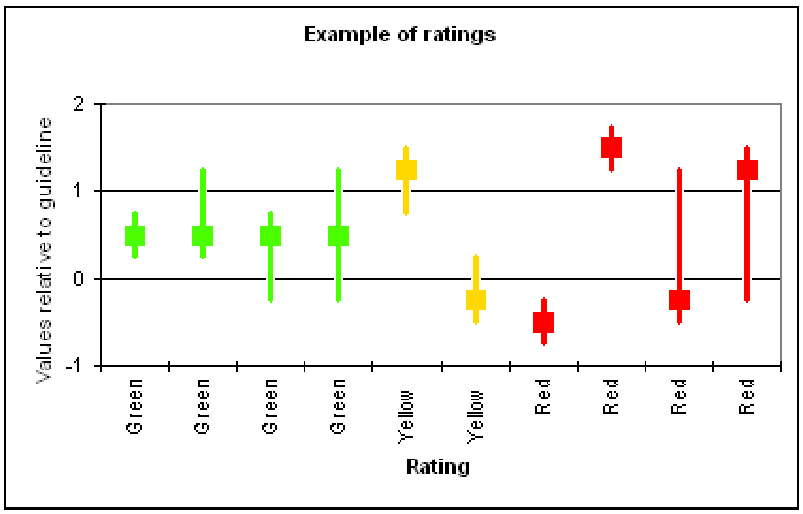


Figure 2-2 Example of how ratings are calculated

Step 3: Combined assessments for indicator categories

The indicators are grouped in the following categories:

- **Nitrogen** (organic nitrogen, ammonia, nitrate plus nitrite and total nitrogen).
- **Phosphorus** (filterable reactive phosphorus and total phosphorus)
- **Phytoplankton biomass** (chlorophyll-a)
- **Water clarity** (turbidity, suspended solids and secchi depth)
- **Dissolved oxygen** (dissolved oxygen)

An assessment for each category is then derived by combining the ratings given to each indicator within the category as shown in **Table 2-3**.

Table 2-3 Rules for summarising category rating

Criteria	Yes / No	Result
0 red and more green than yellow	Yes	Green
	No	Yellow
1 red and more yellow than green	No	Yellow
	Yes	Red
2 or more red		Red

Step 4: Final integrated assessment for each site

The final integrated assessment is derived for each site by combining the ratings for each category, using the same procedure as Step 3. A final integrated assessment is only given if there is enough data to derive a rating for at least three categories. If there are ratings for less than three categories then the overall assessment is that there is insufficient data and it is coloured grey.

2.4 Confidence level

The confidence level is a measure of the data reliability in the database. It is a value between 0 (no confidence) and 100 (very reliable). A confidence level has been set for each data source for the database and is show in **Table 2-4**. The confidence levels were based on the following factors:

- The data provided was in a consistent format for all files supplied;
- Units of measure were included with the data;
- There was consistent cross referencing of site location codes and descriptions;
- The assumed skill level of the people taking the samples;
- Standardise sampling techniques were used.

Table 2-4 Confidence levels for data sources

Source	Confidence Level (0-100)
ACTFR	100
CityWater	20
CVA - Creekwatch	20
EPA	100
GBRMPA	100
NRW	100
TCC	20
WW	20

Each monitoring event in the database has been given a confidence level based on the organisation that was doing the monitoring as outlined in **Table 2-4**. The confidence level is averaged when summarising data in the database. For example, the confidence level for Total Nitrogen for a waterbody is the average of the confidence level for all events where Total Nitrogen was monitored. Similarly the confidence level for the assessment for a catchment is the average of the confidence level for all the monitoring events that were used to derive the assessment.

3. Black River Basin

3.1 Basin description

Black River Basin is approximately 1,060 km^2 and extends from Crystal Creek in the north to Black River in the south. The predominant land use is grazing (approximately 800km^2, GBRMPA 2001) but there are small areas of sugar cane and other horticulture. Approximately 300km^2 of the catchment is part of a protected area (National Park or State Forest) as shown in **Figure 3-1**.

The Black River Basin encompasses the following waterways and water bodies:

- Crystal Creek
- Double Barrel Creek
- Little Crystal Creek
- Toms Creek
- Lorna Creek
- Cloudy Creek
- Ollera Creek
- Scrubby Creek
- Rollingstone Creek
- Rollingstone Creek (East Branch)
- Camp Oven Creek
- Cassowary Creek
- Leichhardt Creek
- Christmas Creek
- Sleeper Log Creek
- Two Mile Creek
- Bluewater Creek
- Pine Creek
- Althaus Creek
- Hencamp Creek
- Deep Creek
- Healy Creek
- Alick Creek
- Black River
- Log Creek
- Alice River
- Surveyors Creek
- Wild Boar Creek
- Station Creek
- Saltwater Creek

3.2 Basin Issues

As identified by the Great Barrier Reef Marine Park Authority (GBRMPA 2001) there are various issues in the Black River catchment. These include:

- There are problems of groundwater supplies in the Black River
- Significant quantities of sand and gravel are extracted from the Black River for the Townsville market, creating an in-stream environmental impact
- The riverbanks are severely eroded
- Significant areas of the catchment has been cleared for grazing
- Some fauna species have been subjected to pressure in the catchment
- Approximately 28% of the catchment is within protected areas
- Expansion of cultivated agriculture
- Increasing contribution of nutrient and pesticides
- Commercial and recreational fishery
- Recreational marine use

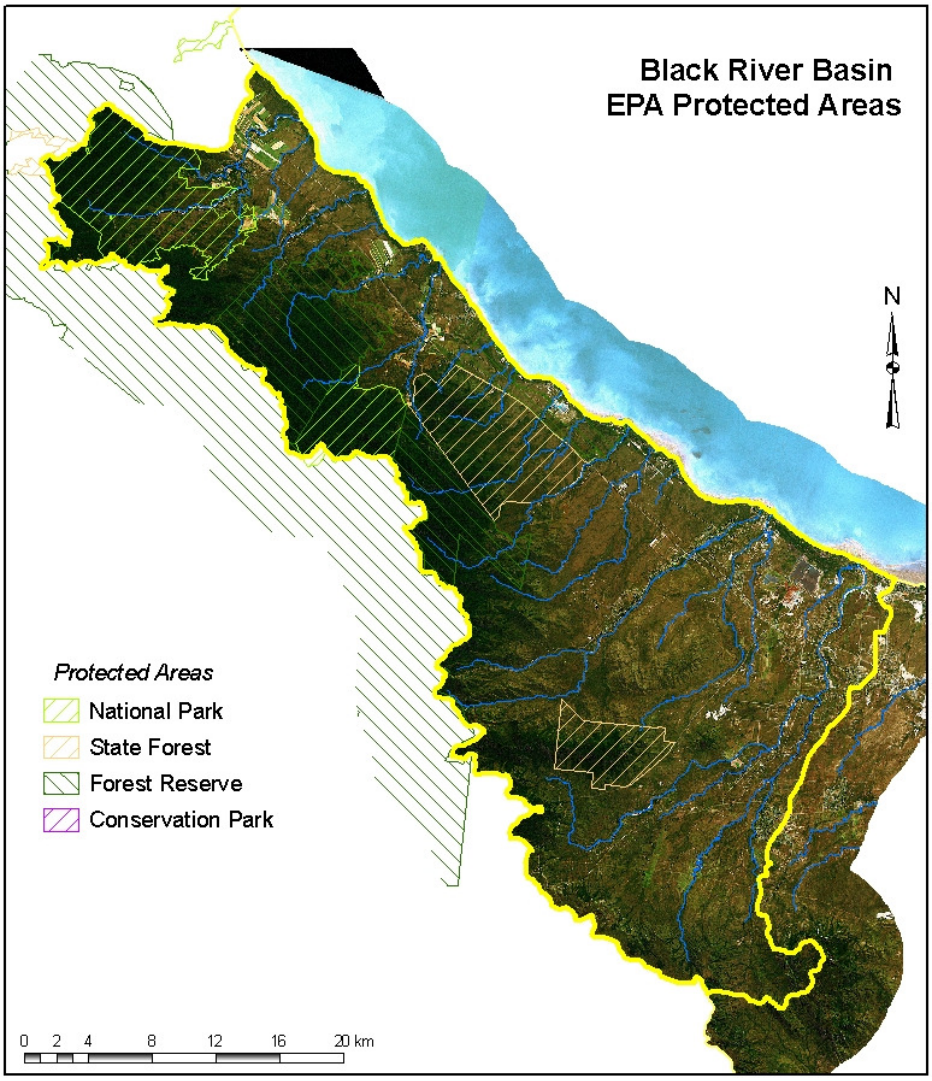


Figure 3-1 Overview of Black River basin

3.3 Current water quality

The assessment has shown that nine of the eighteen catchments are slightly impacted (1-1, 1-5, 2-1, 2-6, 2-8, 3-1, 3-2, 3-3, 3-4), one catchment is moderately impacted (4-1) and there is insufficient data to assess the remaining nine catchments (see **Figure 3-2**, **Figure 3-6**, **Figure 3-10** and **Figure 3-15**).

3.3.1 Crystal Creek

The assessment has been performed against the guidelines for the lowland stream water type. Data sources for this sub-basin include CitiWater, EPA and ACTFR. Data for this sub-basin includes monitoring undertaken from December 1986 until February 2008. A breakdown of the data sources for this sub-basin is shown in **Table 3-2**.

The assessment shows that two of the catchments are rated as healthy but there is insufficient information to assess the remaining areas. While there is insufficient data for an assessment of Ollera Creek, the available data shows the median is within the guideline values (see **Figure 3-4**).

Additional sampling in the lower reaches of Crystal Creek would improve the certainty of the assessment. Most of the sampling data is greater than 5 years old. Recent data shows that the water clarity for catchment 1-1 and 1-5 is still at an ecologically healthy level (see Appendix C).

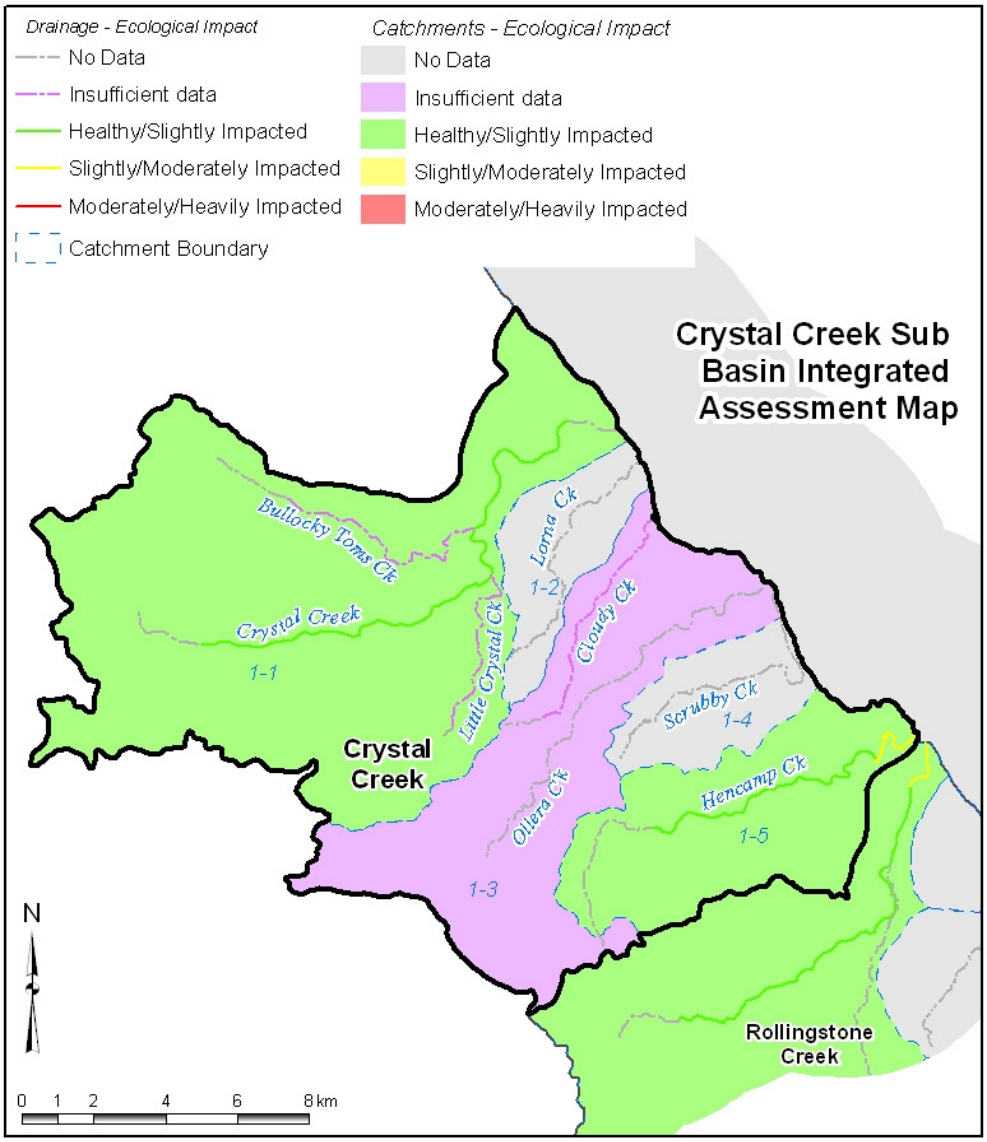


Figure 3-2 Crystal Creek sub-basin and watercourses

Table 3-1 Water quality assessment for Crystal Creek sub-basin

				Min	20th	Med	80th	Max		Confid.
	1-1	Crystal Creek – **45**								
		Nitrogen	Nitrogen (ammonia)	2	2	3	7	70		86
			Nitrogen (organic)	20	40	95	100	200		100
			Nitrogen (oxidised)	2	4	11	40	230		100
			Nitrogen (total)	34	85	107.500	127	275		100
		Phosphorus	Phosphorus (filterable reactive)	2	2	2	10	30		83
			Phosphorus (total)	2	2	4	8	38		100
		Phytoplankton biomass		0.10	0.50	0.50	0.70	5.10		100
		Water Clarity	Secchi depth	0.20	0.20	0.90	2.90	3.80		100
			Total Suspended Solids	2.00		2.00		3.00		100
			Turbidity	0.30	0.60	1.00	3.00	14.00		62
		Dissolved Oxygen		82.7	95.8	102.45	107.1	122		20
		pH		5.4	6.4	6.7	7.0	7.8		68
N/A	1-2	Lorna Creek								
	1-3	Ollera Creek – **20**		**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen								
		Phosphorus								
		Phytoplankton biomass								
		Water Clarity	Turbidity	10.00		10.00		10.00		20
		Dissolved Oxygen		97.1	0	100	0	104.9		20
		pH		6.6		6.7		7.5		20
N/A	1-4	Scrubby Creek								
	1-5	Hencamp Creek – **100**		**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (ammonia)	10	10	15	20	40		100
			Nitrogen (organic)	59	200	300	440.400	1000		100
			Nitrogen (oxidised)	3	20	20	41.400	106.800		100
			Nitrogen (total)	103	250	340	530	1040		100
		Phosphorus	Phosphorus (filterable reactive)	1.500	2.900	5.100	10.600	19.400		100
			Phosphorus (total)	13.400	20	20	40	70		100
		Phytoplankton biomass		2.10		2.35		3.70		100
		Water Clarity	Secchi depth	0.30	0.40	0.40	0.80	1.20		100
			Total Suspended Solids	0.30	5.00	11.00	27.75	80.80		100
			Turbidity	2.40	3.30	4.20	13.00	22.00		100
		Dissolved Oxygen								
		pH		7.8	8.0	8.1	8.4	8.4		100

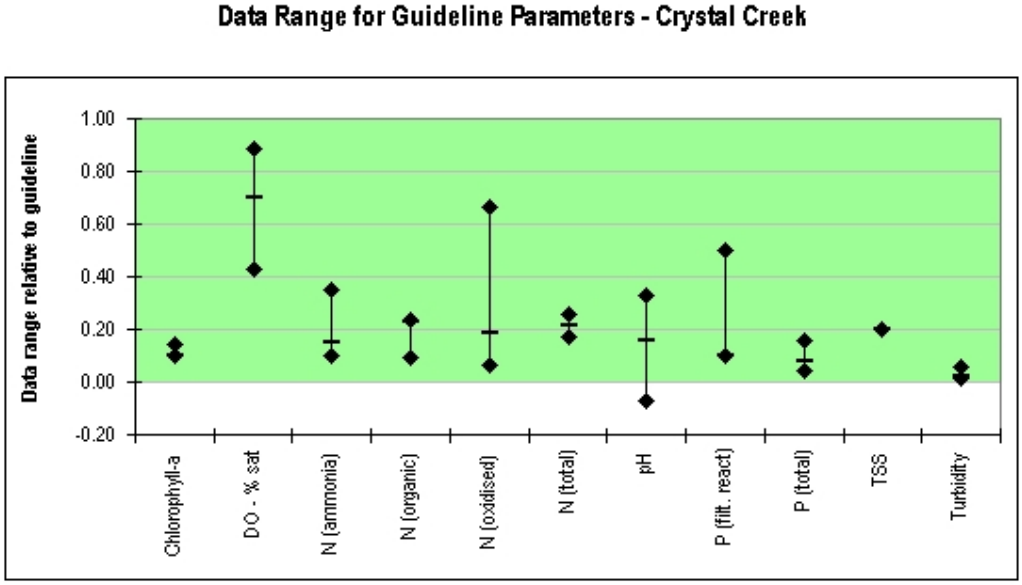


Figure 3-3 Summary of water quality for catchment 1-1 Crystal Creek

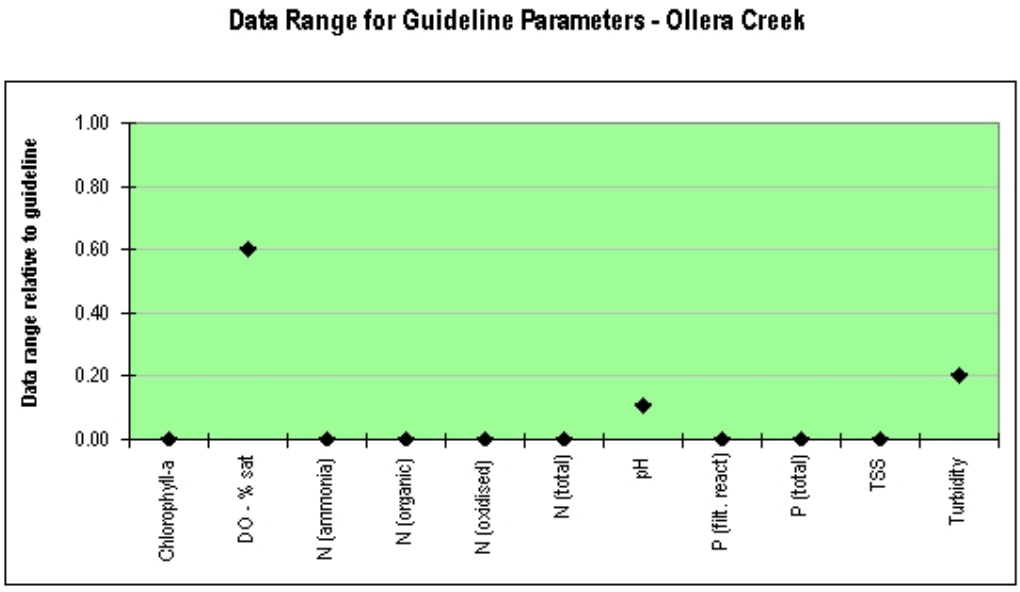


Figure 3-4 Summary of water quality for catchment 1-3 Ollera Creek

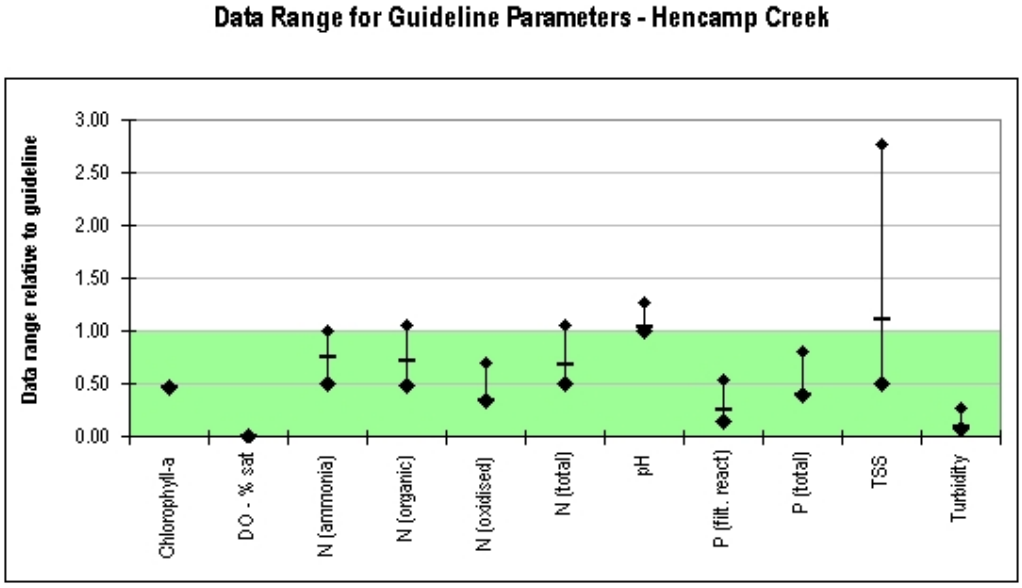


Figure 3-5 Summary of water quality for catchment 1-5 Hencamp Creek

Table 3-2 Data sources for Crystal Creek sub-basin

Catchment	Source	First Event	Last Event	# of Events
1-1	CitiWater	1/07/2006	13/02/2008	20
	EPA	7/12/1994	14/05/1998	82
	WaterWatch	22/11/2001	25/03/2003	18
1-2	No data			
1-3	WaterWatch	25/01/2002	22/10/2002	3
1-4	No Data			
1-5	ACTFR	17/01/2007	1/02/2007	11

Catchment	Source	First Event	Last Event	# of Events
	EPA	16/12/1986	20/07/1988	27

3.3.2 Rollingstone Creek

The assessment has been performed against the guidelines for the lowland stream water type. Data sources for this sub-basin include CitiWater and EPA. Data for this sub-basin includes monitoring undertaken from February 1987 until March 2003. There is no data available for this sub-basin since 2003. A breakdown of the data sources for this sub-basin is shown in **Table 3-4**.

Water quality in this sub-basin is indicative of an ecologically healthy low-land stream system, however, dissolved oxygen is consistently low and TSS is generally high in all of the catchments. As all the data on this section is older than 5 years it is not possible to make knowledgeable comments on current water quality trends.

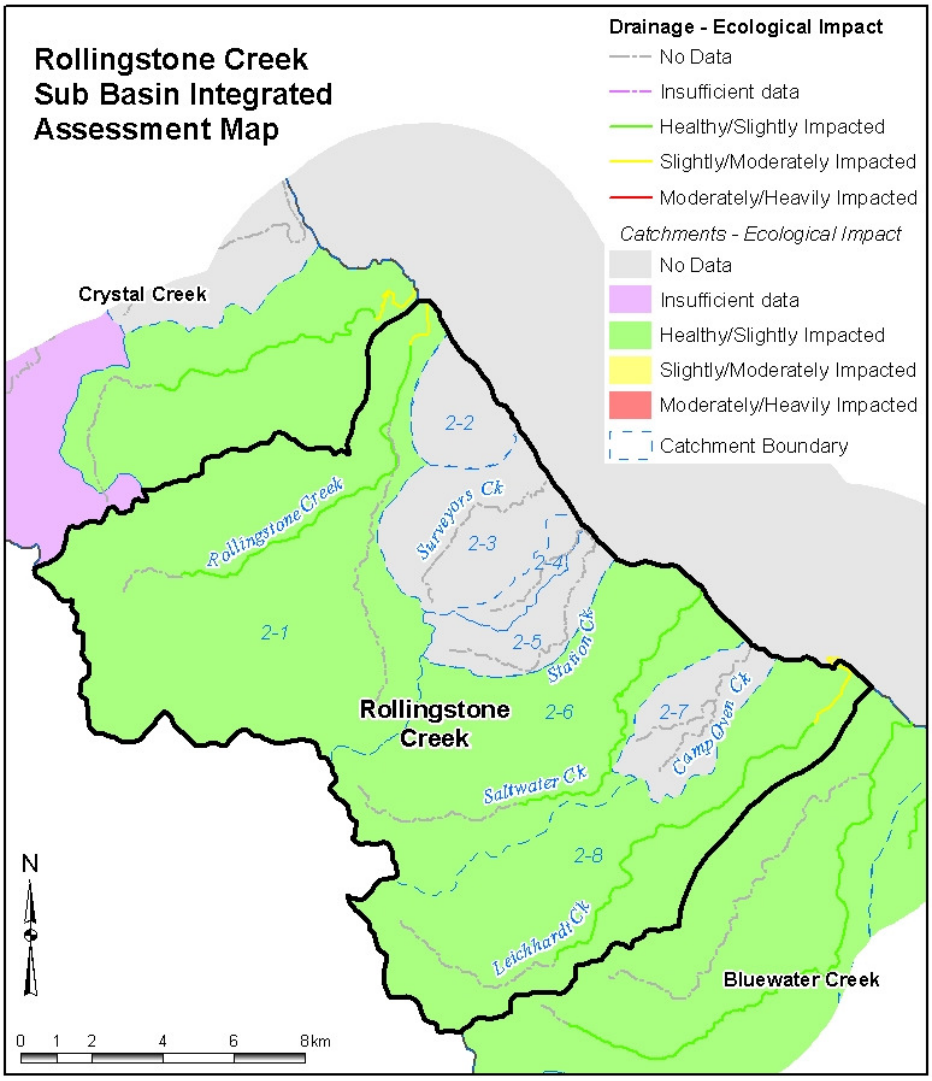


Figure 3-6 Rollingstone Creek sub-basin and watercourses

Table 3-3 Water quality assessment for Rollingstone Creek sub-basin

				Min	20th	Med	80th	Max		Confid.
	2-1	Rollingstone Creek – **70**								
		Nitrogen	Nitrogen (ammonia)	10	10	20	40	70		100
			Nitrogen (organic)	200	300	300	400	500		100
			Nitrogen (oxidised)	20	20	20	40	70		100
			Nitrogen (total)	310	330	360	430	550		100
		Phosphorus	Phosphorus (total)	20	20	20	30	70		100
		Phytoplankton biomass		0.90		1.70		2.50		100
		Water Clarity	Secchi depth	0.40	0.60	0.70	1.20	1.50		100
			Total Suspended Solids	3.00	5.00	7.50	15.00	25.00		100
			Turbidity	2.00	2.50	3.75	7.60	12.00		100
		Dissolved Oxygen		68.9	75	81.25	108.1	113.5		20
		pH		5.5	6.3	6.8	8.1	8.4		48
N/A	2-2	Unnamed								
N/A	2-3	Surveyors Creek								
N/A	2-4	Wild Boar Creek								
N/A	2-5	Station Creek								
	2-6	Saltwater Creek – **76**		**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (ammonia)	2	4	11	24	190		100
			Nitrogen (organic)	100	100	200	500	2000		100
			Nitrogen (oxidised)	1	1	4	20	90		100
			Nitrogen (total)	103	114	223	540	2030		100
		Phosphorus	Phosphorus (filterable reactive)	2	5	5	8	22		100
			Phosphorus (total)	20	20	20	50	260		100
		Phytoplankton biomass		0.10	0.50	1.75	9.30	83.40		100
		Water Clarity	Secchi depth	0.10	0.20	0.20	0.40	1.00		100
			Total Suspended Solids	1.00	8.00	14.00	25.00	154.00		100
			Turbidity	1.00	3.80	6.00	10.00	41.00		93
		Dissolved Oxygen		4.79	73.6	81.3	89.3	154.1		20
		pH		6.5	7.9	8.1	8.3	8.5		61
N/A	2-7	Cassowary Creek								
	2-8	Leichhardt Creek – **74**		**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (ammonia)	10	10	10	20	30		100
			Nitrogen (organic)	100	200	300	400	700		100
			Nitrogen (oxidised)	20	20	20	20	30		100
			Nitrogen (total)	130	230	330	440	730		100
		Phosphorus	Phosphorus (total)	20	20	20	70	130		100
		Phytoplankton biomass		1.10		1.40		4.90		100
		Water Clarity	Secchi depth	0.40	0.50	0.80	1.00	1.40		100
			Total Suspended Solids	4.00	7.00	9.50	13.00	45.00		100
			Turbidity	2.40	2.80	4.25	6.30	7.80		100
		Dissolved Oxygen		48	53.9	66.8	82.8	98.9		20
		pH		6.0	6.6	7.0	8.0	8.5		48

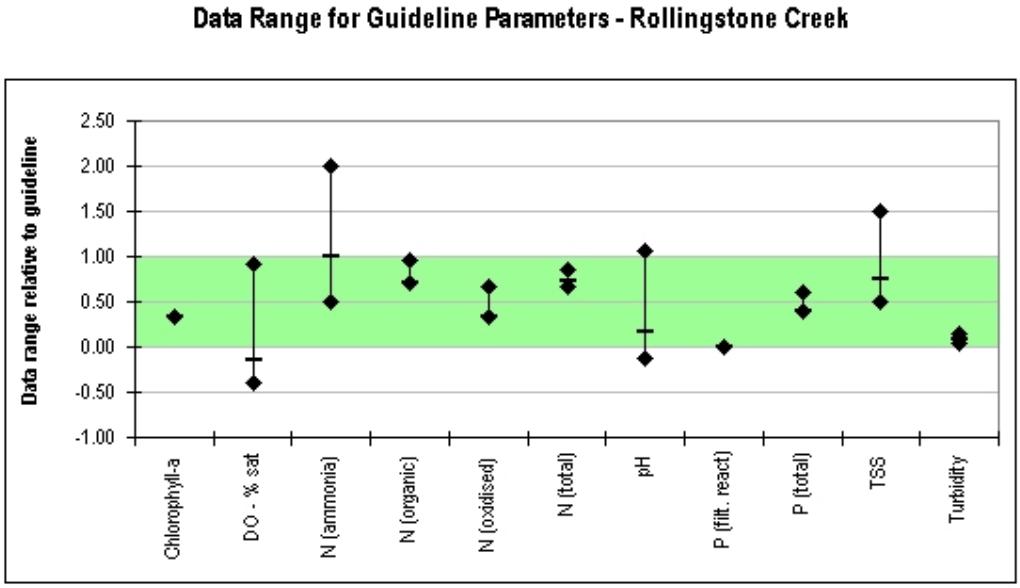


Figure 3-7 Summary of water quality for catchment 2-1 Rollingstone Creek

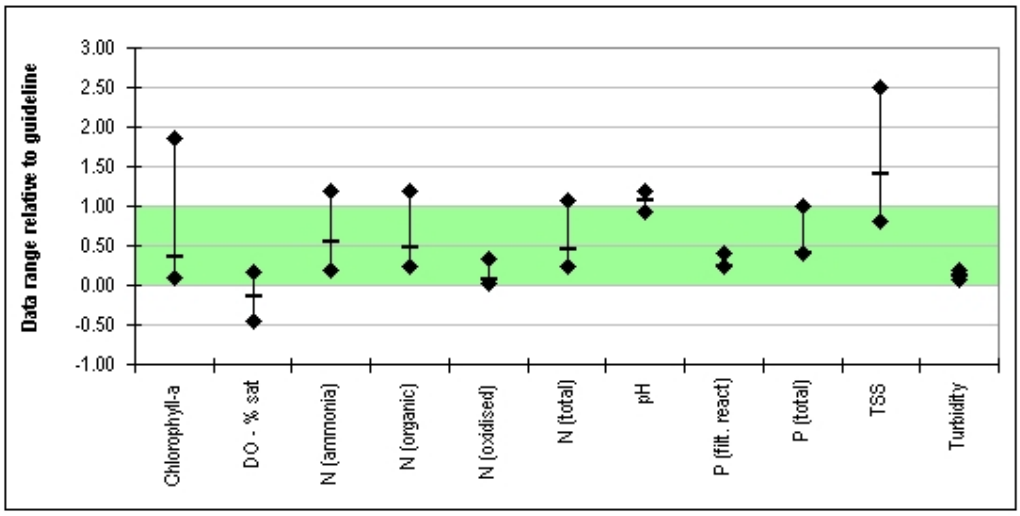


Figure 3-8 Summary of water quality for catchment 2-6 Saltwater Creek

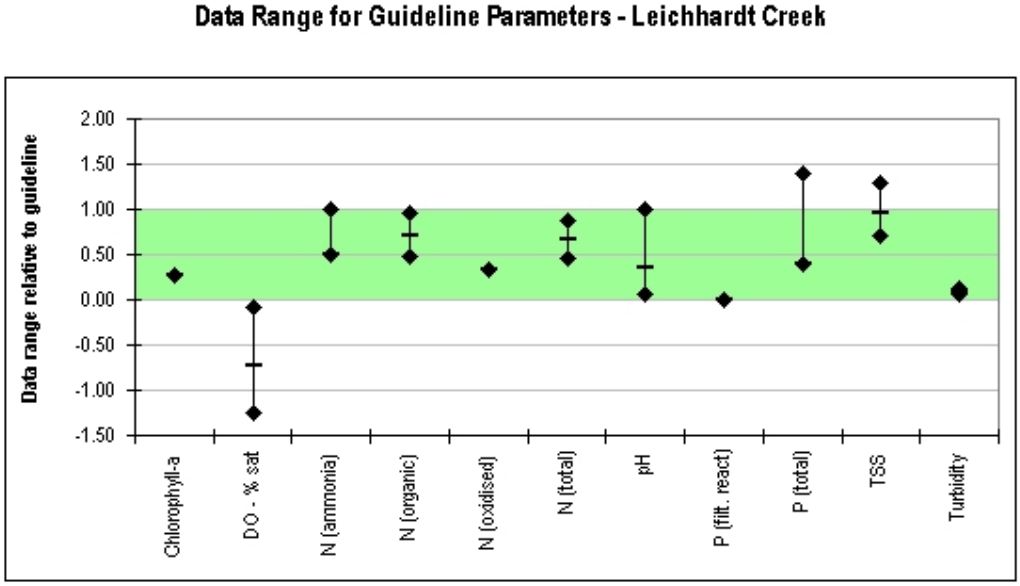


Figure 3-9 Summary of water quality for catchment 2-8 Leichhardt Creek

Table 3-4 Data sources for Rollingstone Creek sub-basin

Catchment	Source	First Event	Last Event	# of Events
2-1	EPA	25/02/1987	20/07/1988	15
	WaterWatch	26/11/2001	25/03/2003	10
2-2	No Data			
2-3	No Data			
2-4	No Data			
2-5	No Data			
2-6	EPA	25/02/1987	9/05/1990	178
	WaterWatch	7/05/2001	25/03/2003	21
2-7	No Data			
2-8	EPA	26/02/1987	21/07/1988	21
	WaterWatch	9/06/2001	14/08/2001	15

3.3.3 Bluewater Creek

The assessment has been performed against the guidelines for the lowland stream water type. Data sources for this sub-basin include CitiWater, EPA, ACTFR, CVA – Creekwatch and NRW. Data for this sub-basin includes monitoring undertaken from January 1982 until February 2007. A breakdown of the data sources for this sub-basin is shown in **Table 3-6**.

Based on the low land stream water type all of the subsections in this sub-basin are ecologically healthy. Similar to Rollingstone Creek the TSS is generally high for this sub-basin and the DO is generally low. Recent data (see Appendix C) for Bluewater Creek shows that the DO is still low however the TSS is within the guideline limit.

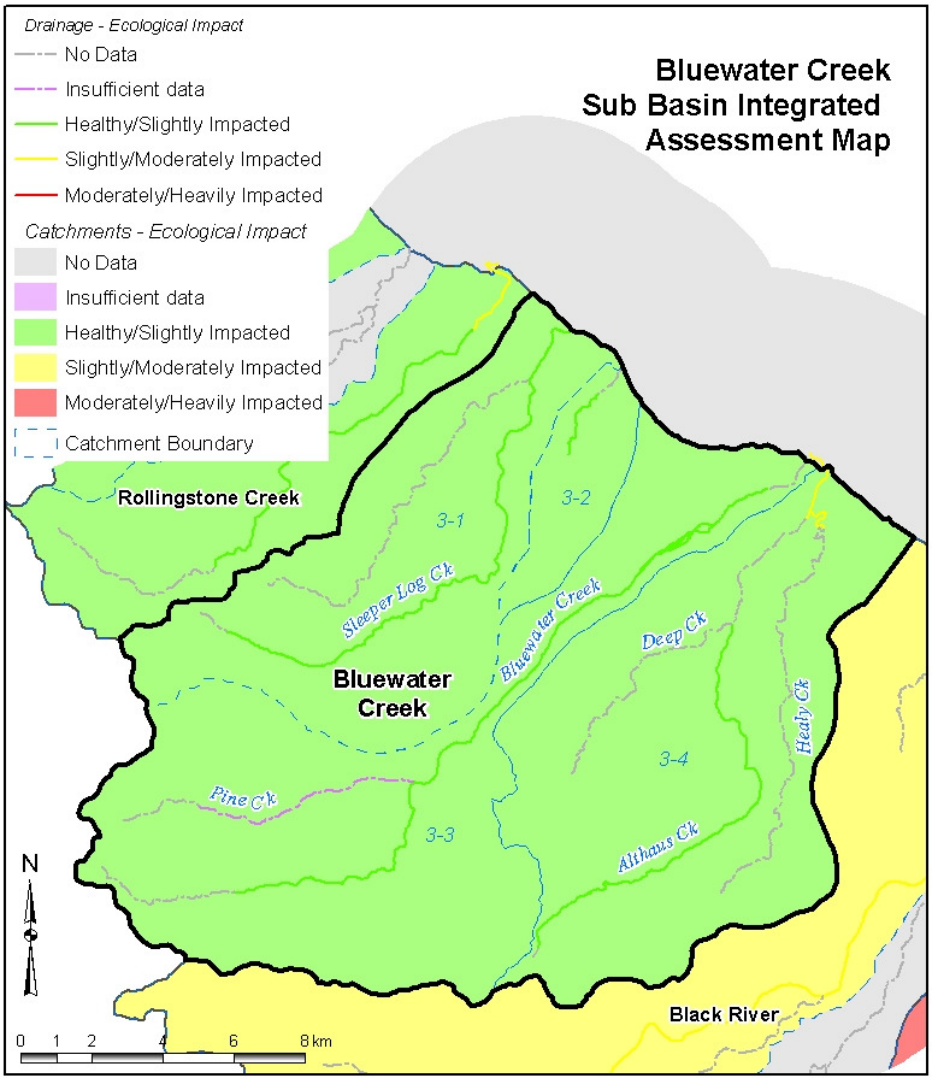


Figure 3-10 Bluewater Creek sub-basin and watercourses

Table 3-5 Water quality assessment for Bluewater Creek sub-basin

				Min	20th	Med	80th	Max		Confid.
	3-1	Sleeper Log Creek – **79**								
		Nitrogen	Nitrogen (ammonia)	2	2	9	20	60		100
			Nitrogen (organic)	10	100	200	400	700		100
			Nitrogen (oxidised)	1	1	8	20	50		100
			Nitrogen (total)	13	120	240	430	780		100
		Phosphorus	Phosphorus (filterable reactive)	5	5	5	9	22		100
			Phosphorus (total)	20	20	30	60	160		100
		Phytoplankton biomass		0.50	0.60	1.30	2.70	8.30		100
		Water Clarity	Secchi depth	0.10	0.20	0.40	0.80	1.50		100
			Total Suspended Solids	2.00	11.00	17.00	25.00	130.00		100
			Turbidity	1.50	3.80	6.00	10.00	70.00		96
		Dissolved Oxygen		10.1	40.9	65.05	92.8	106.9		20
		pH		5.7	6.6	7.8	8.3	8.4		71
	3-2	Two Mile Creek – **100**		**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (ammonia)	2	3	9	14	31		100
			Nitrogen (organic)	100	100	200	300	300		100
			Nitrogen (oxidised)	1	1	10	20	30		100
			Nitrogen (total)	112	160	228	344	350		100
		Phosphorus	Phosphorus (filterable reactive)	5	5	9	18	22		100
			Phosphorus (total)	20	20	40	40	60		100
		Phytoplankton biomass		0.50	0.70	1.30	2.70	4.50		100
		Water Clarity	Secchi depth	0.20		0.25		0.40		100
			Total Suspended Solids	8.00	16.00	24.50	39.00	165.00		100
			Turbidity	2.00	5.50	7.50	15.00	50.00		100
		Dissolved Oxygen								
		pH		7.3	7.4	7.5	8.2	8.3		100
	3-3	Bluewater Creek – **88**		**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (ammonia)	9.700		38.200		66.700		100
			Nitrogen (organic)	71.800	127	162.400	281.600	1239.900		100
			Nitrogen (oxidised)	4.200	21	128.800	160.600	427.800		100
			Nitrogen (total)	53.900	105.600	280	576.100	5812		100
		Phosphorus	Phosphorus (filterable reactive)	2.300	4.500	5.500	8.600	15.900		100
			Phosphorus (total)	2	9.200	16.800	40.700	4008.500		100
		Phytoplankton biomass								
		Water Clarity	Total Suspended Solids	0.50	4.00	5.00	15.00	620.00		100
			Turbidity	2.00	4.00	9.00	14.00	35.00		94
		Dissolved Oxygen		7.57	71.1	76.2	83.8	128		20
		pH		5.7	6.3	6.4	6.5	8.4		24
	3-4	Deep Creek – **100**		**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (ammonia)	10	10	20	40	18000		100
			Nitrogen (organic)	30	200	300	500	1600		100
			Nitrogen (oxidised)	10	20	20	40	1500		100
			Nitrogen (total)	70	230	370	550	20500		100
		Phosphorus	Phosphorus (total)	10	20	20	50	740		100
		Phytoplankton biomass								
		Water Clarity	Secchi depth	0.10	0.30	0.60	1.00	2.40		100
			Total Suspended Solids	1.00	8.00	14.00	20.00	150.00		100
			Turbidity	1.00	3.70	5.65	9.40	65.00		100
		Dissolved Oxygen								
		pH		6.3	7.8	8.0	8.2	8.6		100

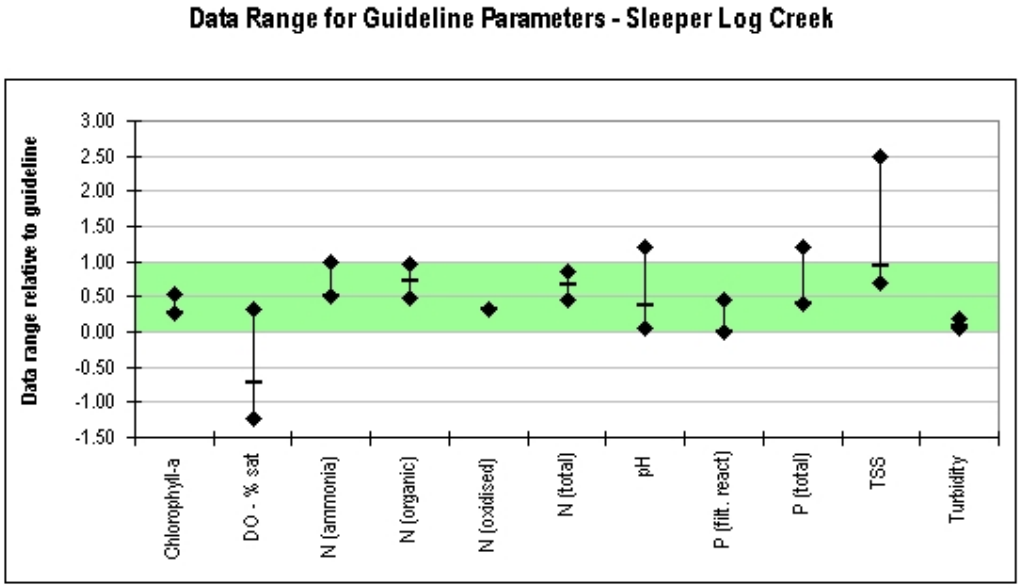


Figure 3-11 Summary of water quality for catchment 3-1 Sleeper Log Creek

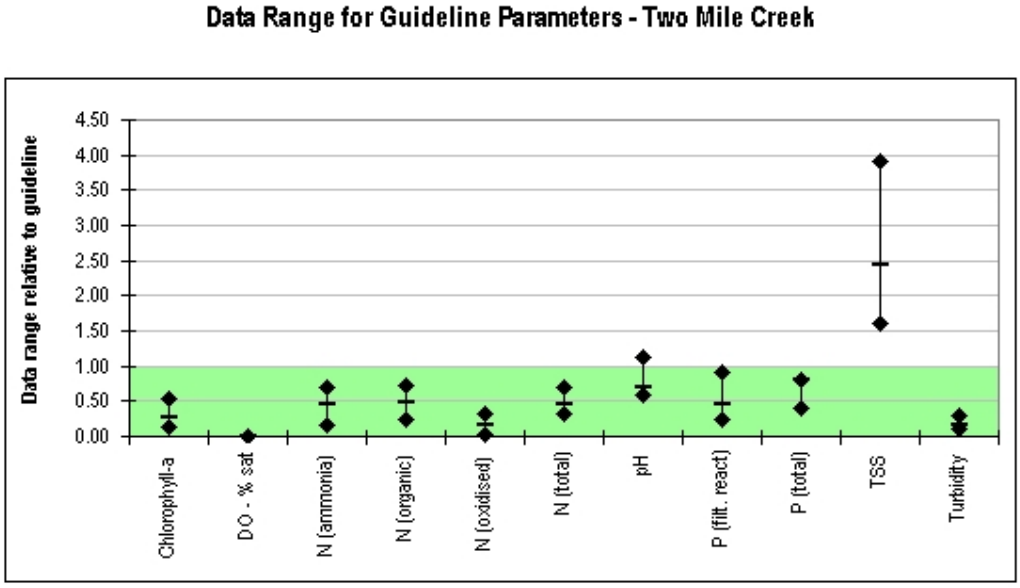


Figure 3-12 Summary of water quality for catchment 3-2 Two Mile Creek

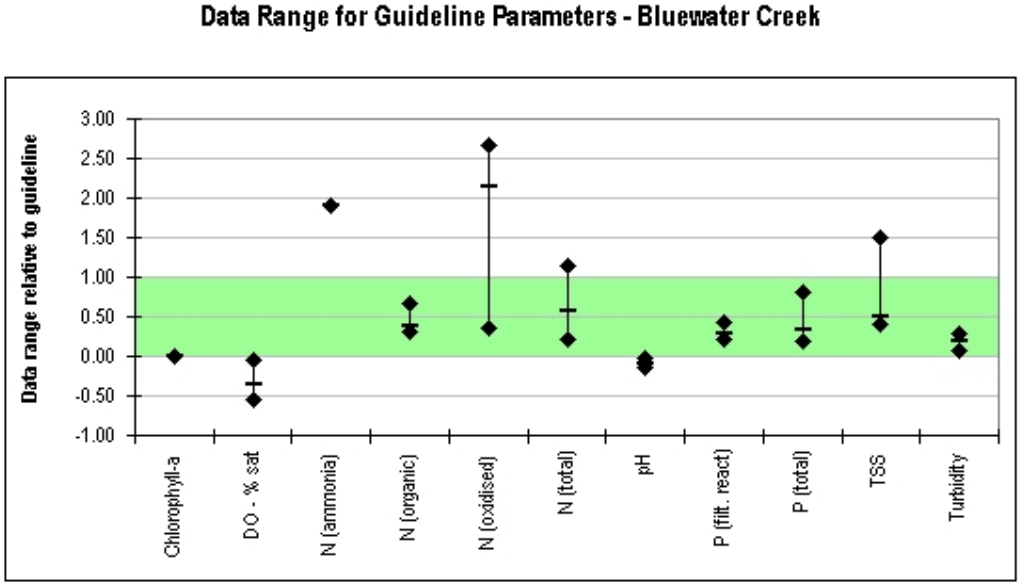


Figure 3-13 Summary of water quality for catchment 3-3 Bluewater Creek

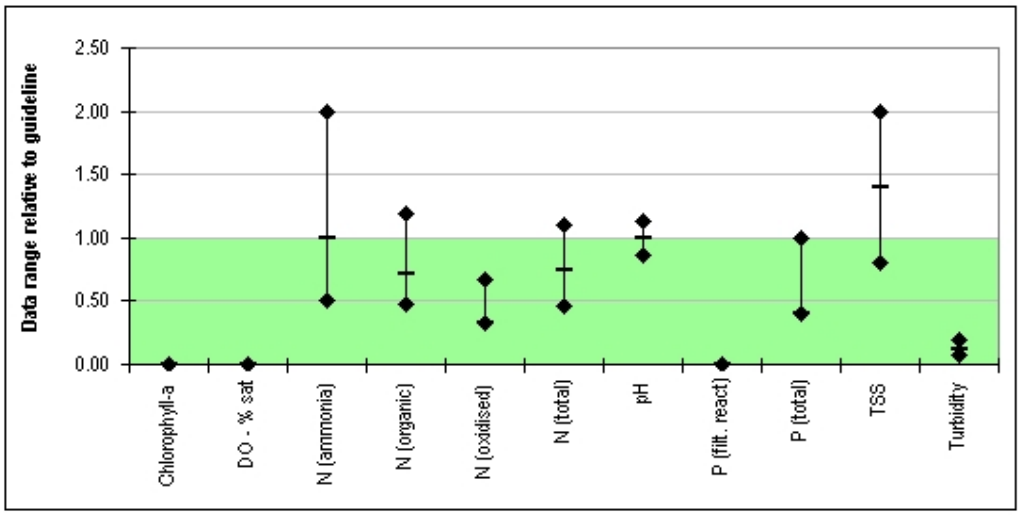


Figure 3-14 Summary of water quality for catchment 3-4 Deep Creek

Table 3-6 Data sources for Bluewater Creek sub-basin

Catchment	Source	First Event	Last Event	# of Events
3-1	EPA	26/02/1987	13/06/1990	116
	WaterWatch	27/09/2001	16/03/2003	20
3-2	EPA	15/11/1988	13/06/1990	18
3-3	ACTFR	22/01/2007	4/02/2007	17
	CVA - Creekwatch	18/04/2005	13/12/2006	89
	EPA	24/01/1982	13/02/1990	56
	NRW	28/12/1973	19/10/2006	94
	WaterWatch	26/11/2001	15/05/2004	672
3-4	EPA	18/11/1981	13/02/1990	356

3.3.4 Black River

The assessment has been performed against the guidelines for the lowland stream water type. Data sources for this sub-basin include EPA, ACTFR, and NRW. Data for this sub-basin includes monitoring undertaken from May 1973 until February 2007. A breakdown of the data sources for this sub-basin is shown in **Table 3-8**.

Water quality monitoring in this sub-basin indicates that the area is slightly impacted. The only recent data for this sub-basin shows that the TSS for the Black River is above the guideline. There is no data for the Alice River catchment. As most of the data in this sub-basin is older than 5 years old and recent data indicates that water quality has declined in terms of TSS and it is recommended that additional monitoring be undertaken in this catchment to confirm this assessment.

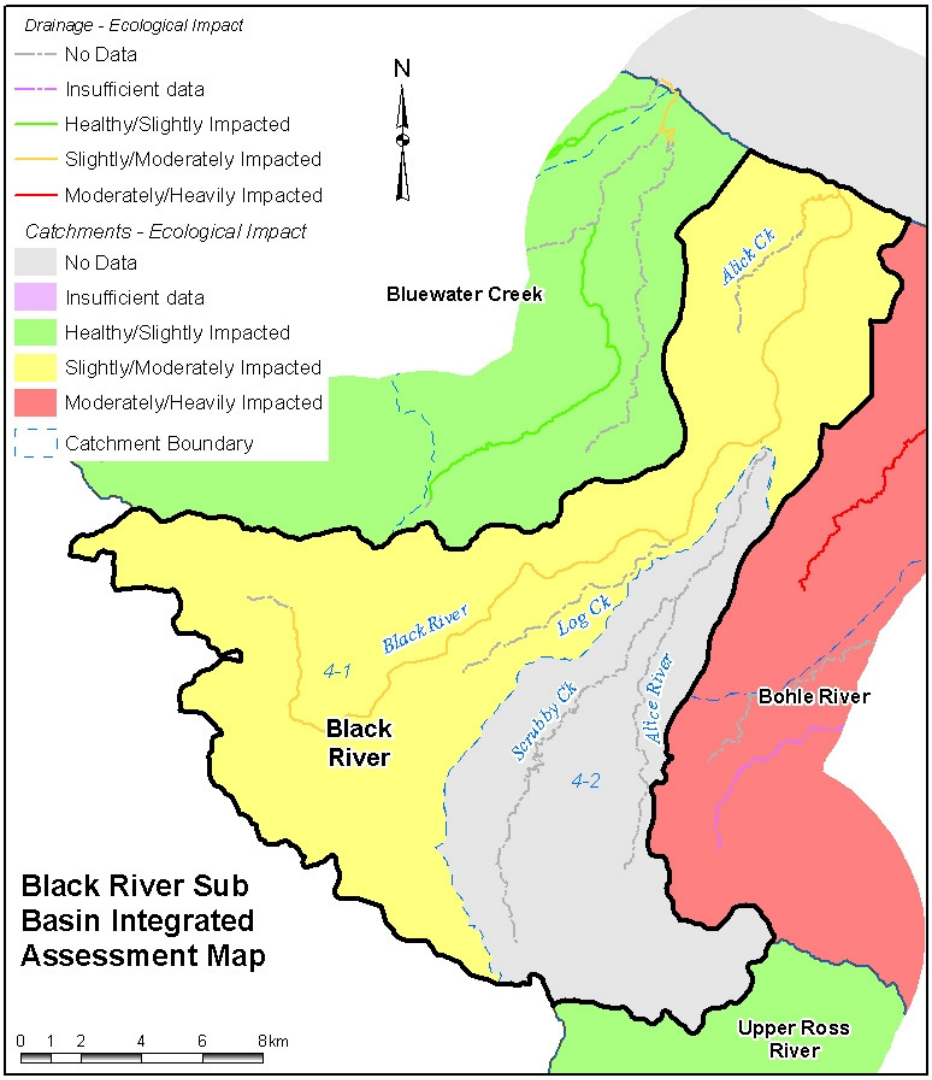


Figure 3-15 Black River sub-basin and watercourses

Table 3-7 Water quality assessment for Black River sub-basin

				Min	20th	Med	80th	Max		Confid.
	4-1	Black River – **100**								
		Nitrogen	Nitrogen (ammonia)	2.500	10	20	40	280		100
			Nitrogen (organic)	100	200	300	477.700	1200		100
			Nitrogen (oxidised)	20	20	20	51	385.500		100
			Nitrogen (total)	30	210	335	640	1240		100
		Phosphorus	Phosphorus (filterable reactive)	12.300	28.500	35.450	43.300	127		100
			Phosphorus (total)	20	20	31.800	118.900	1010		100
		Phytoplankton biomass								
		Water Clarity	Secchi depth	0.10	0.20	0.50	0.80	2.00		100
			Total Suspended Solids	1.00	6.00	16.00	179.00	1189.00		100
			Turbidity	0.50	3.50	6.00	11.00	175.00		100
		Dissolved Oxygen								
		pH		6.2	7.6	8.0	8.2	8.7		100
N/A	4-2	Alice River								

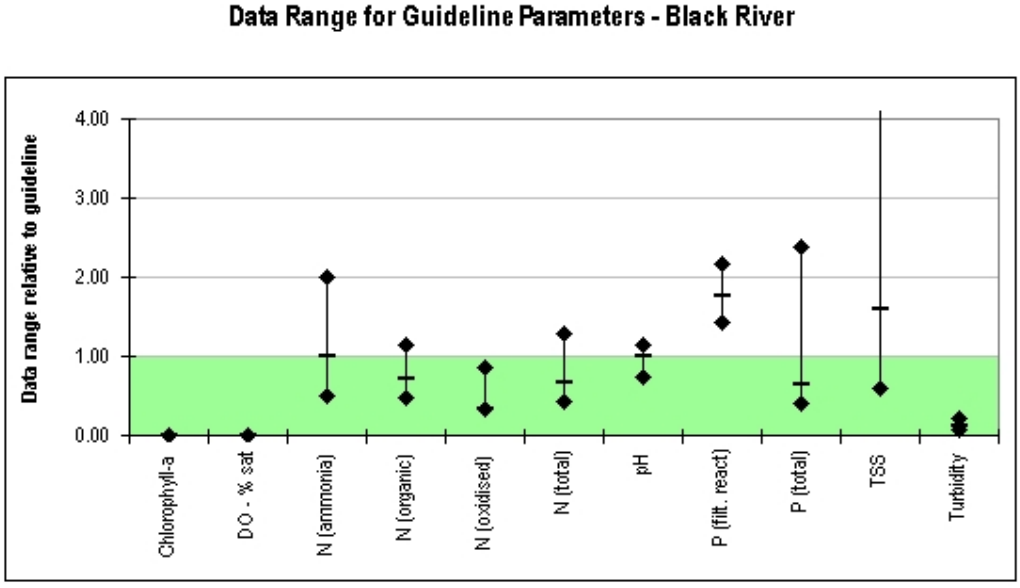


Figure 3-16 Summary of water quality for catchment 4-1 Black River

Table 3-8 Data sources for Black River sub-basin

Catchment	Source	First Event	Last Event	# of Events
4-1	ACTFR	22/01/2007	9/02/2007	15
	EPA	22/01/1985	18/08/1988	163
	NRW	16/05/1973	9/05/2006	101
4-2	No Data			

4. Ross River Basin

4.1 Basin description

The Ross River Basin is approximately 1,700 km^2 and extends from the Bohle River in the north to Alligator Creek in the south (see **Figure 4-1**). Most of the catchment is subject to cattle grazing (approximately 1400km^2) and approximately 72% of the catchment has been cleared (GBRMP 2001).

The Ross River catchment encompasses the following waterways and water bodies:

- Bohle River Lower
- Louisa Creek
- Saunders Creek
- Stoney Creek
- Bohle River Upper
- Little Bohle River
- Middle Bohle Creek
- Mundy Creek
- Esplanade
- Ross Creek
- The Lakes
- Gordon Creek
- Ross River
- Central Creek
- Ross River Dam
- Lansdowne Creek
- Anthill Creek
- Anthill Plains Creek
- Five Head Creek
- Sachs Creek
- Dick Creek
- Stuart Creek
- Sandfly Creek
- Alligator Creek
- Killymoon Creek
- Slippery Rocks Creek
- Whites Creek
- Crocodile Creek
- Cocoa Creek

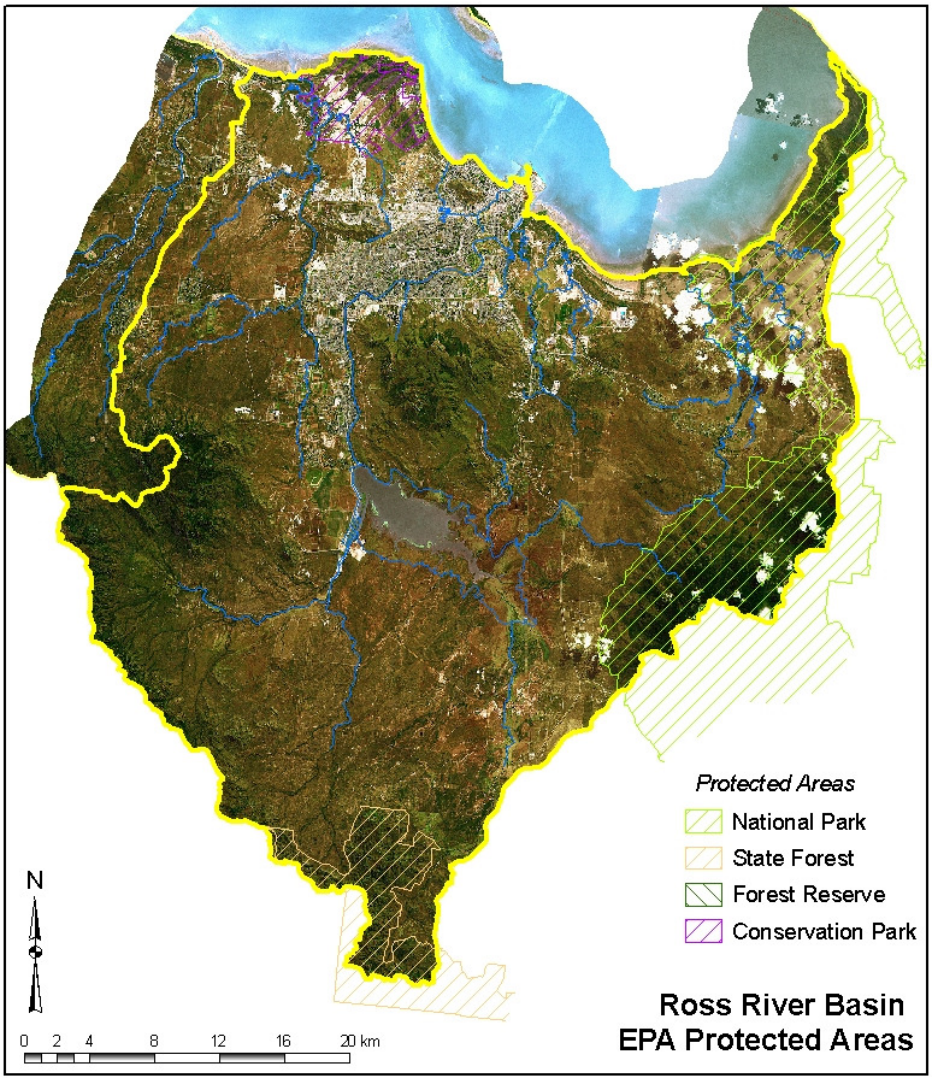


Figure 4-1 Overview of Ross River basin

Within the Ross River catchment there are a number of artificial water bodies and structures including:

- Ross River (dam and 3 weirs);
- Riverside Gardens (lagoon);
- Ross Creek (2-1 canals, 2 ponds and 2 lakes);
- Louisa Creek (5 ponds);
- Lavarack Barracks (2 lakes).

The predominantly artificial systems, which are present within the Ross River catchment, were developed for water supply, to control flooding, for stormwater management and to a lesser degree to enhance the aesthetics of urban environments.

4.2 Basin issues

As identified by the Great Barrier Reef Marine Park Authority (GBRMPA 2001) there are various issues in the Ross River catchment. These include:

- Grazing lands are in reasonably good condition with only minor gully and sheet erosion
- Most native grasses are still present
- The Ross River Dam is a major source of the Townsville water supply
- The catchment contains the heavily urbanised City of Townsville
- Significant alteration of the river has occurred through extractions of sand and gravel to supply construction sites in Townsville and for water storage
- Presence of heavy industry
- A significant area of the catchment has been cleared for grazing
- Approximately 18% of the catchment is within protected areas (**Figure 4-1**)
- Some fauna species have been subjected to pressure in the catchment
- Commercial and recreational fishery
- Marine tourism
- Commercial port
- Close proximity to seagrass and dugong protection areas

4.3 Current water quality

The assessment has shown that seven of the twenty catchments are heavily impacted (5-1, 5-2, 6-2, 6-4, 8-1, 8-2, 9-1), one catchment is moderately impacted (7-5), two catchments are slightly impacted (6-5, 7-1) and there is insufficient data to assess the remaining ten catchments (see **Figure 4-2**, **Figure 4-5**, **Figure 4-10**, **Figure 4-13** and **Figure 4-16**).

4.3.1 Bohle River

The assessment has been performed against the guidelines for the lowland stream water type. Data sources for this sub-basin include TCC, Citywater, CVA –Creekwatch, EPA, ACTFR, and NRW. Data for this sub-basin includes monitoring undertaken from January 1979 until March 2007. A breakdown of the data sources for this sub-basin is shown in **Table 4-2**.

The water quality assessment indicates that the Bohle River sub-basin is a heavily impacted area. Data indicates that nutrients, in particular dissolved reactive phosphorus is at very high levels (**Figure 4-3** and **Figure 4-4**). This trend is consistent across all of the lowland stream reaches where monitoring has occurred (see Appendix B) but it is much lower in the mid-estuarine reaches. Recent data for water clarity and pH is consistent with the entire dataset however there is no recent data for nutrients for this catchment (See Appendix C).

It is suspected that the low dissolved oxygen for the Lower Bohle Catchment is a result of incorrect units being reported. CVA – Creek Watch are a major source of data and further investigation of their data for Louisa Creek shows that the values that have been recorded for DO (% sat) are similar to the values recorded for DO (mg/L).

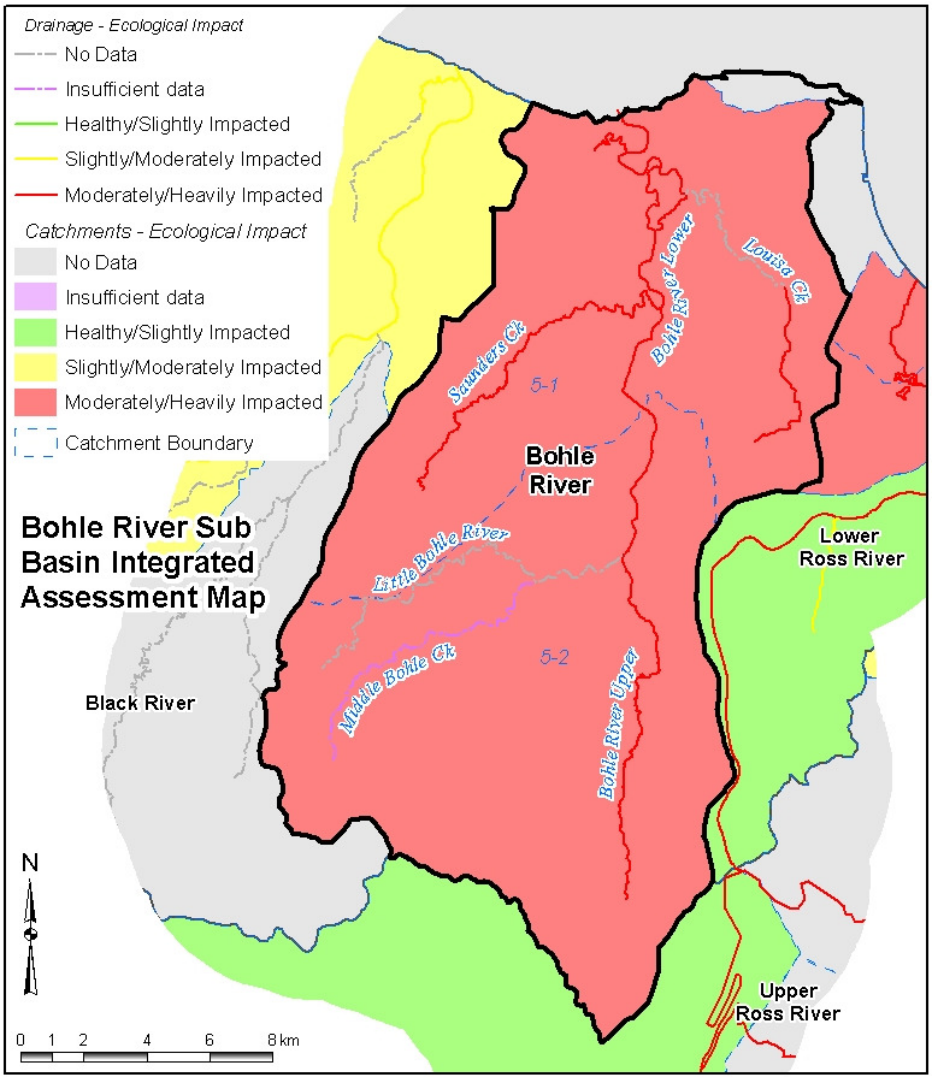


Figure 4-2 Bohle River sub-basin and watercourses

Table 4-1 Water quality assessment for Bohle River sub-basin

				Min	20th	Med	80th	Max		Confid.
	5-1	Bohle River – **96**								
		Nitrogen	Nitrogen (ammonia)	2	10	30	330	100000		100
			Nitrogen (organic)	10	200	500	1000	18000		100
			Nitrogen (oxidised)	2	12	38.600	261	17000		100
			Nitrogen (total)	48	294	620	1680	49000		100
		Phosphorus	Phosphorus (filterable reactive)	4	44	86.300	190	2700		100
			Phosphorus (total)	10	60	130	520	9300		100
		Phytoplankton biomass		0.50	2.30	4.70	10.80	127.80		100
		Water Clarity	Secchi depth	0.10	0.20	0.40	0.80	2.00		100
			Total Suspended Solids	1.00	11.00	21.00	46.00	890.00		100
			Turbidity	1.00	6.50	12.90	25.00	999.00		80
		Dissolved Oxygen		-1.4	1.9	13.5	48.6	206		20
		pH		5.5	7.0	7.6	8.1	9.3		70
	5-2	Bohle River 2 – **100**		**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (ammonia)	2	10	31	100	4800		100
			Nitrogen (organic)	200	600	1000	1400	4383.200		100
			Nitrogen (oxidised)	2	20	900	12000	35000		100
			Nitrogen (total)	128.600	830	1822	12510	36050		100
		Phosphorus	Phosphorus (filterable reactive)	2	690	4000	7200	9700		100
			Phosphorus (total)	20	210	2500	7175.800	12000		100
		Phytoplankton biomass		0.50	1.50	3.70	13.10	58.80		100
		Water Clarity	Secchi depth	0.10	0.20	0.20	0.20	1.50		100
			Total Suspended Solids	1.00	12.00	24.00	130.00	1592.00		100
			Turbidity	1.00	6.00	16.00	44.00	670.00		100
		Dissolved Oxygen								
		pH		3.8	6.9	7.3	7.8	9.6		100
N/A	5-3	Shelly Beach								

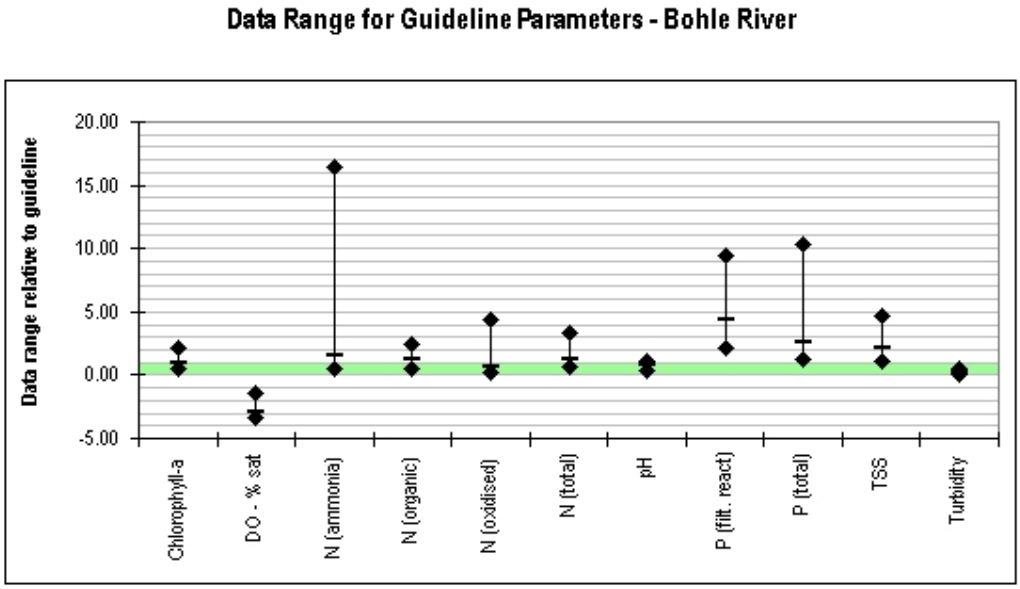


Figure 4-3 Summary of water quality for catchment 5-1 Bohle River (lower)

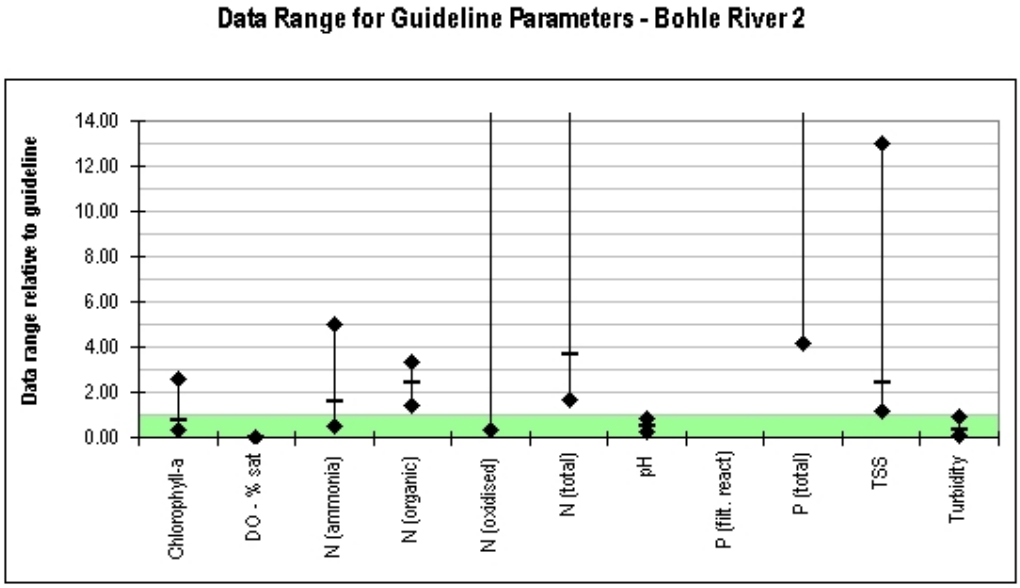


Figure 4-4 Summary of water quality for catchment 5-2 Bohle River (upper)

Table 4-2 Data sources for Bohle River sub-basin

Catchment	Source	First Event	Last Event	# of Events
5-1	ACTFR	22/01/2007	2/02/2007	24
	CitiWater	11/07/2006	31/08/2006	310
	CVA - Creekwatch	7/08/2001	6/03/2007	463
	EPA	16/01/1979	19/09/1996	1449
	TCC	29/06/2006	20/07/2006	4
5-2	EPA	20/08/1985	6/11/1996	286
	NRW	4/03/1982	4/05/2006	160
5-3	No data			

4.3.2 Ross River (Lower)

The assessment has been performed against the guidelines for the lowland stream water type. Data sources for this sub-basin include TCC, Citywater, CVA –Creekwatch, EPA, ACTFR, GBRMPA and NRW. Data for this sub-basin includes monitoring undertaken from August 1980 until March 2008. A breakdown of the data sources for this sub-basin is shown in **Table 4-4**.

The assessment for the Ross River sub-basin indicates that the area is moderately to heavily impacted. Poor water quality in The Lakes is the main reason that the Lower Ross Creek catchment is assessed as heavily impacted. While the Ross River catchment below the dam has been assessed as being slightly impacted the recent data is not consistent with the historical data. Recent data indicates the Ross River catchment is moderately to heavily impacted.

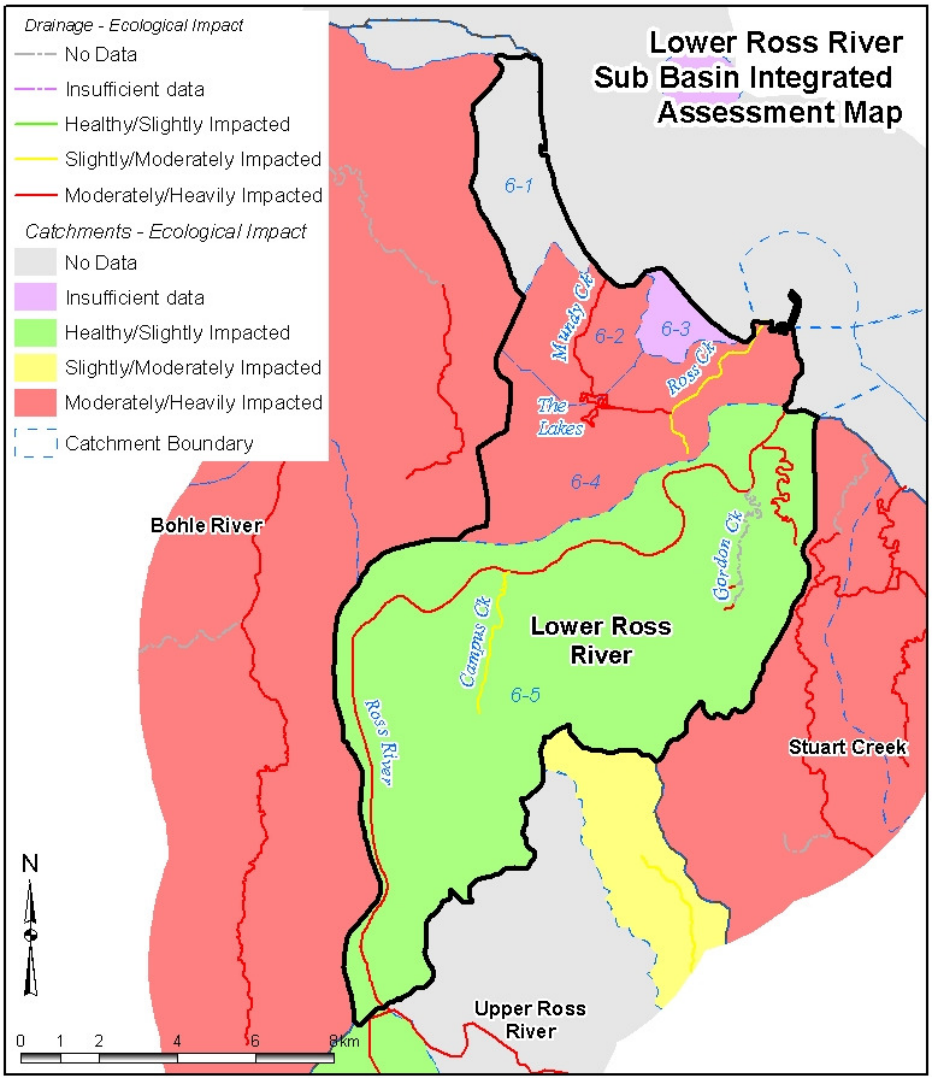


Figure 4-5 Ross River (lower) sub-basin and watercourses

Table 4-3 Water quality assessment for Ross River (lower) sub-basin

N/A	6-1	Pallarenda								
	6-2	Mundy Creek – **95**		**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (organic)	243.600	293.500	359.200	491	555.600		100
			Nitrogen (oxidised)	4	15.400	71.600	161	590.600		100
			Nitrogen (total)	456.500	479	642	938.300	1350		100
		Phosphorus	Phosphorus (filterable reactive)	82.900	97.800	137.900	161.900	165.500		100
			Phosphorus (total)	147	161.900	245	280.800	322.200		100
		Phytoplankton biomass								
		Water Clarity	Total Suspended Solids	2.90	4.40	14.86	21.07	41.80		100
		Dissolved Oxygen								
		pH		6.5	6.5	6.5	6.6	7.2		20
	6-3	Esplanade – **100**		**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (ammonia)	10	10	20	30	50		100
			Nitrogen (organic)	100	100	300	600	1200		100
			Nitrogen (oxidised)	10	10	10	20	100		100
			Nitrogen (total)	120	200	345	640	1230		100
		Phosphorus	Phosphorus (total)	10	30	40	60	120		100
		Phytoplankton biomass								
		Water Clarity								
		Dissolved Oxygen								
		pH								
	6-4	Ross Creek – **73**		**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (ammonia)	2	20	30	70	770		30
			Nitrogen (organic)	20	171.360	283.215	462	1700		100
			Nitrogen (oxidised)	1	10	27.340	70	561.720		67
			Nitrogen (total)	37.940	205.800	356	600	2390		98
		Phosphorus	Phosphorus (filterable reactive)	2.850	10	20	80	650		37
			Phosphorus (total)	0.020	12.390	40	103.763	1500		98
		Phytoplankton biomass		0.50	5.00	20.00	32.50	1071.00		24
		Water Clarity	Secchi depth	0.10	0.20	0.40	1.00	3.20		100
			Total Suspended Solids	4.00	10.90	17.50	27.00	78.00		97
			Turbidity	1.00	3.70	7.00	15.90	9999.99		29
		Dissolved Oxygen		52.1	71.6	86.9	111.7	132.1		32
		pH		4.0	7.3	7.8	8.2	10.1		29
	6-5	Ross River (btdam) – **81**		**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (ammonia)	2	10	20	50	10000		90
			Nitrogen (organic)	100	200	333.600	600	5000		100
			Nitrogen (oxidised)	2	14	20	34	338		100
			Nitrogen (total)	10	230	430	670	5070		100
		Phosphorus	Phosphorus (filterable reactive)	2	10	12	26.900	155		67
			Phosphorus (total)	7	30	46.700	80	1700		100
		Phytoplankton biomass		0.80	1.20	2.10	4.30	17.30		100
		Water Clarity	Secchi depth	0.10	0.20	0.40	1.00	3.00		100
			Total Suspended Solids	0.20	8.00	15.00	28.00	1568.00		100
			Turbidity	0.50	2.70	4.60	9.90	184.00		88
		Dissolved Oxygen								
		pH		3.5	7.5	7.9	8.1	9.2		89

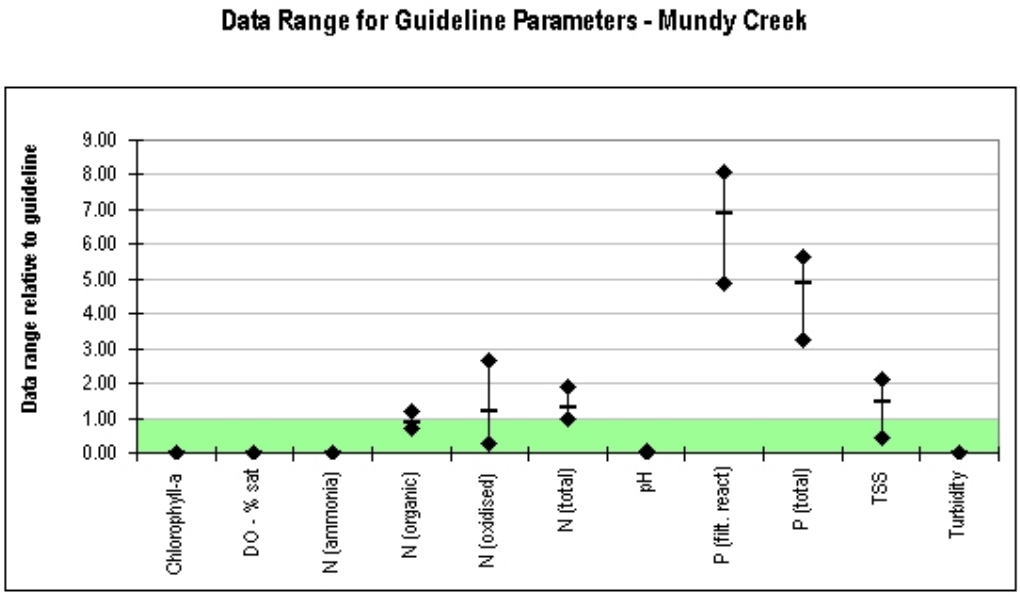


Figure 4-6 Summary of water quality for catchment 6-2 Mundy Creek

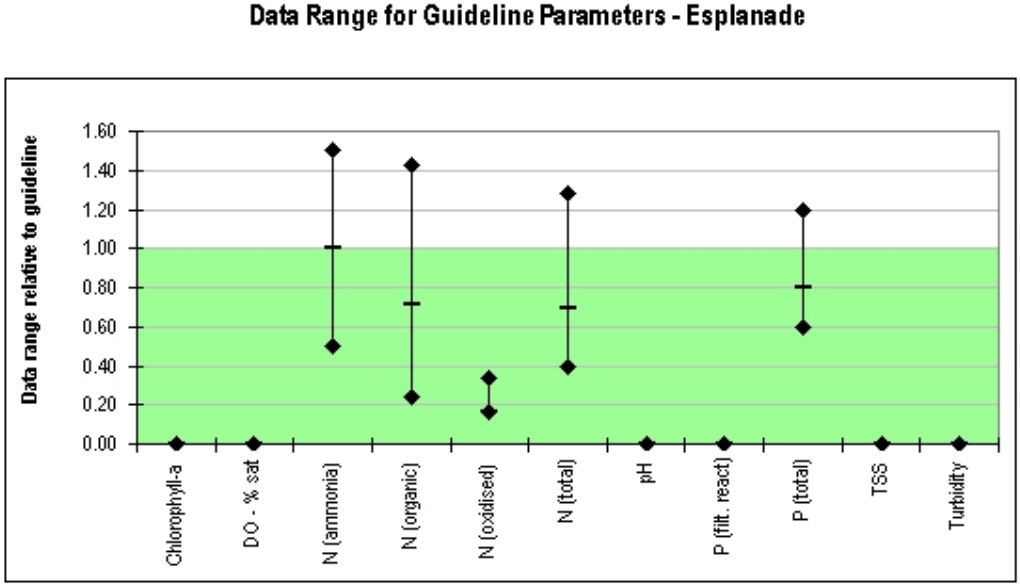


Figure 4-7 Summary of water quality for catchment 6-3 Esplanade

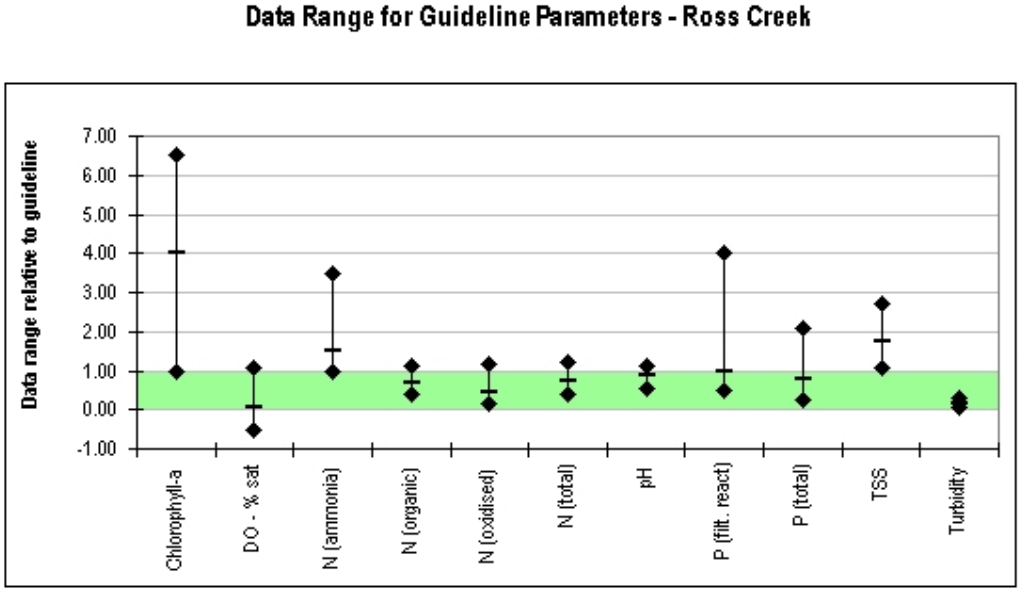


Figure 4-8 Summary of water quality for catchment 6-4 Ross Creek

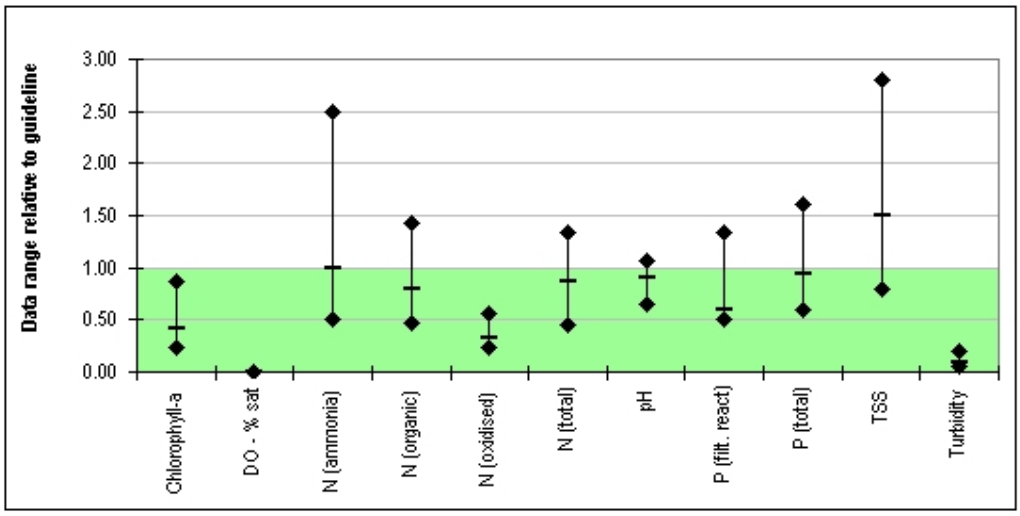


Figure 4-9 Summary of water quality for catchment 6-5 Ross River (btdam)

Table 4-4 Data sources for Ross River (lower) sub-basin

Catchment	Source	First Event	Last Event	# of Events
6-1	No data			
6-2	ACTFR	21/01/2007	2/02/2007	9
	TCC	29/06/2006	0/01/1900	6
6-3	EPA	24/09/1980	4/04/1982	22
6-4	ACTFR	21/01/2007	2/02/2007	9
	CitiWater	19/06/2006	3/03/2008	530
	EPA	24/09/1980	27/08/1990	294
	GBRMPA	13/01/2003	9/06/2005	166

Catchment	Source	First Event	Last Event	# of Events
	TCC	29/06/2006	20/07/2006	1781
	ACTFR	22/01/2007	2/02/2007	31
	CitiWater	1/07/2006	13/02/2008	79
	EPA	27/08/1980	24/08/1995	944
6-5	TCC	29/06/2006	20/07/2006	19

4.3.3 Ross River (Upper)

The assessment has been performed against the guidelines for the lowland stream water type. Data sources for this sub-basin include TCC, Citywater, CVA – Creekwatch, ACTFR and EPA. Data for this sub-basin includes monitoring undertaken from May 1977 until February 2008. A breakdown of the data sources for this sub-basin is shown in **Table 4-6**.

There is little data for most of this sub-basin. Where there is data it indicates that the sub-basin is slightly to moderately impacted. The data associated with catchment 7-1 is all from Ross Dam so it is not representative of the catchment area. The data for Sachs Creek (7-5) is generally less than 5 years old and is consistent with the historical data.

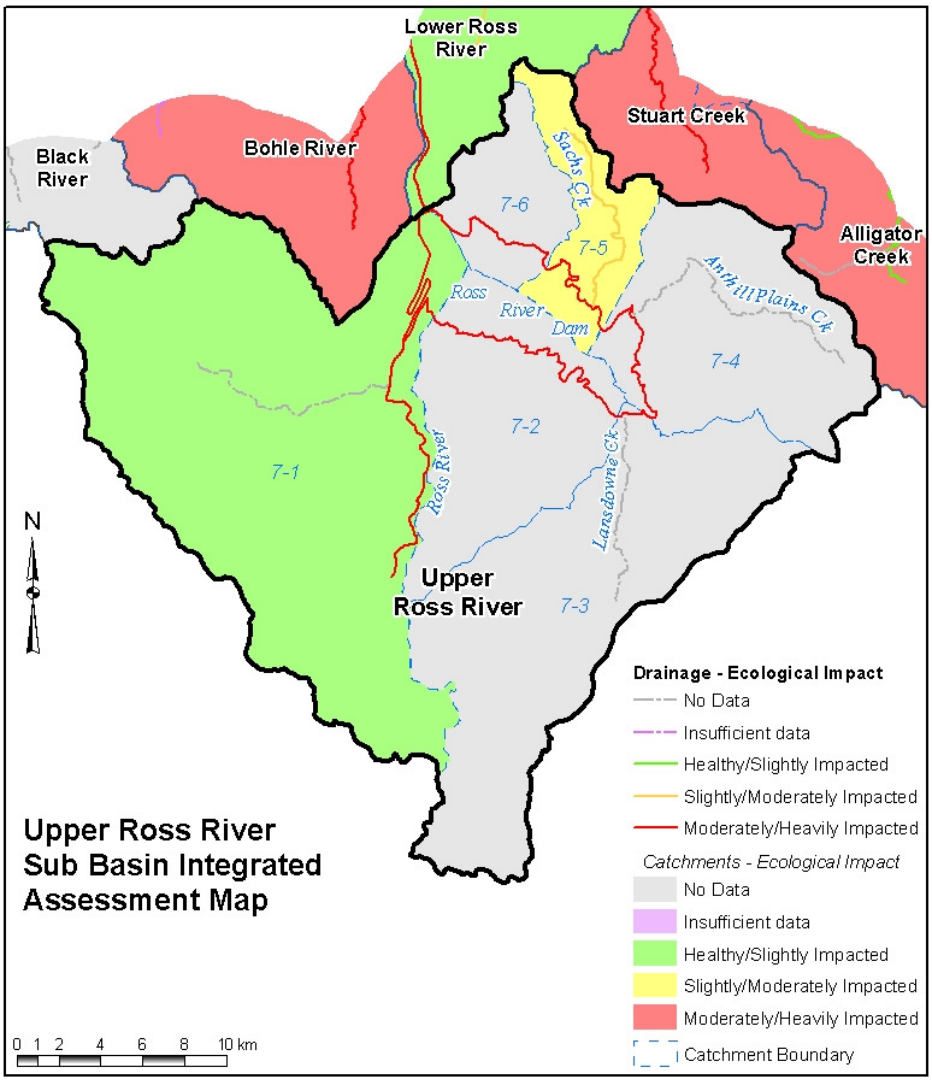


Figure 4-10 Ross River (upper) sub-basin and watercourses

Table 4-5 Water quality assessment for Ross River (upper) sub-basin

				Min	20th	Med	80th	Max		Confid.
	7-1	Ross River (atd) – **56**								
		Nitrogen	Nitrogen (ammonia)	8	10	20	60	10000		85
			Nitrogen (organic)	10	360	500	700	70000		100
			Nitrogen (oxidised)	1	10	20	30	15000		100
			Nitrogen (total)	10	420	560	830	2580		100
		Phosphorus	Phosphorus (filterable reactive)	10	10	14.800	50	80		25
			Phosphorus (total)	10	20	30	50	230		100
		Phytoplankton biomass		1.10	3.40	6.95	10.10	22.10		100
		Water Clarity	Secchi depth	1.00	1.20	1.60	2.20	3.40		100
			Total Suspended Solids	1.00	1.00	2.00	5.00	458.00		100
			Turbidity	0.50	2.00	3.10	7.10	85.80		76
		Dissolved Oxygen								
		pH		6.7	7.2	7.5	8.0	8.3		44
N/A	7-2	Six Mile Creek								
N/A	7-3	Toonpan Lagoon								
N/A	7-4	Antill Plains Creek								
				Min	**20th**	**Med**	**80th**	**Max**		**Confid.**
	7-5	Sachs Creek – **72**								
		Nitrogen	Nitrogen (organic)	136.700	163.500	248	318.700	503.600		100
			Nitrogen (oxidised)	40	48	181	360.400	522.900		100
			Nitrogen (total)	245.300	268.500	564	798	956		100
		Phosphorus	Phosphorus (filterable reactive)	14.800	19.100	29.100	39.200	114.800		100
			Phosphorus (total)	25.600	31.600	49.700	78.300	215		100
		Phytoplankton biomass								
		Water Clarity	Total Suspended Solids	1.30	1.60	7.10	17.00	268.00		100
			Turbidity	2.00	3.50	11.75	28.00	200.00		20
		Dissolved Oxygen		23.4	54.6	77.6	93	191.8		20
		pH		4.7	6.8	7.1	7.6	8.9		20
N/A	7-6	Mt Stuart								

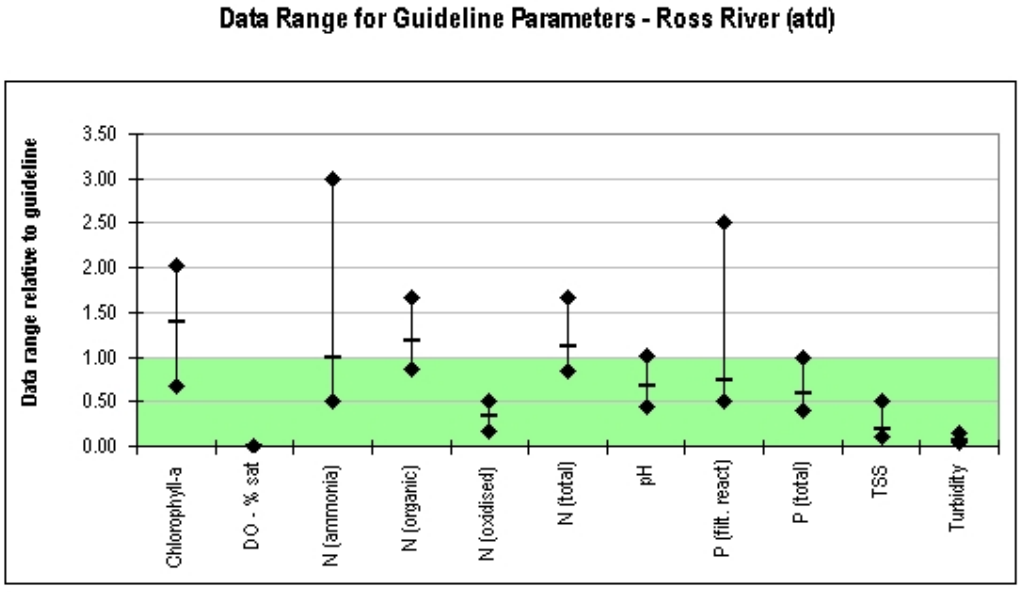


Figure 4-11 Summary of water quality for subsection 7-1 Ross River (atdam)

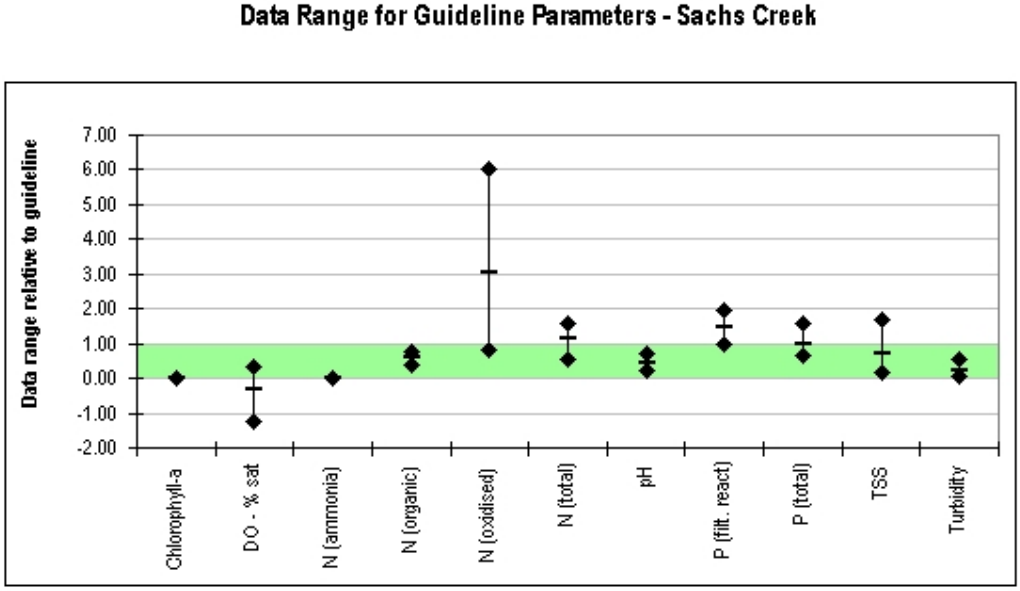


Figure 4-12 Summary of water quality for subsection 7-5 Sachs Creek

Table 4-6 Data sources for Ross River (upper) sub-basin

Catchment	Source	First Event	Last Event	# of Events
7-1	ACTFR	1/02/2007	2/02/2007	2
	CitiWater	1/07/2006	13/02/2008	36
	EPA	23/05/1977	8/02/1984	133
7-2	No data			
7-3	No data			
7-4	No data			
7-5	ACTFR	22/01/2007	3/02/2007	13
	CVA - Creekwatch	11/07/2002	25/04/2007	91
7-6	No data			

4.3.4 Stuart Creek

The assessment has been performed against the guidelines for the mid estuarine water type. Data sources for this sub-basin include TCC, Citywater, ACTFR and EPA. Data for this sub-basin includes monitoring undertaken from August 1980 until August 2007. A breakdown of the data sources for this sub-basin is shown in **Table 4-6**.

The assessments indicate that this sub-basin is heavily impacted, with high levels of nutrients and suspended solids. The data may not be representative of the entire sub-basin as the main data contributor for this area is CitiWater and their monitoring is associated with the sewerage treatment plant.

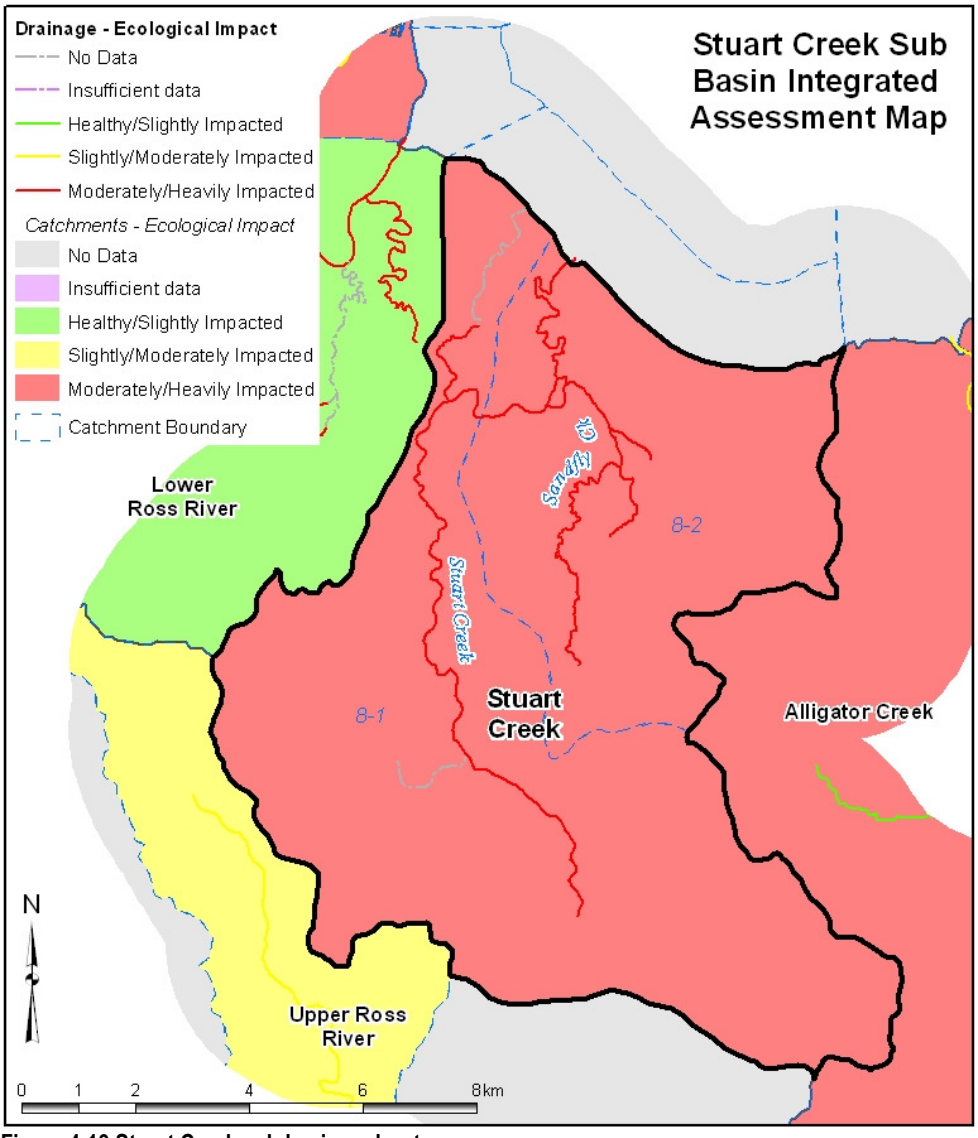


Figure 4-13 Stuart Creek sub-basin and watercourses

Table 4-7 Water quality assessment for Stuart Creek sub-basin

				Min	20th	Med	80th	Max		Confid.
	8-1	Stuart Creek – **98**								
		Nitrogen	Nitrogen (ammonia)	10	10	20	60	1200		98
			Nitrogen (organic)	76.900	272.100	500	1200	4100		100
			Nitrogen (oxidised)	3.100	20	20	131.200	1500		100
			Nitrogen (total)	230	508	708	1330	4140		100
		Phosphorus	Phosphorus (filterable reactive)	8	54.500	78.500	100.400	180		97
			Phosphorus (total)	20	20	130	254.200	2000		100
		Phytoplankton biomass								
		Water Clarity	Secchi depth	0.20	0.20	0.20	0.20	0.20		100
			Total Suspended Solids	1.00	12.00	51.95	211.00	662.00		99
			Turbidity	1.00	2.00	5.00	15.00	130.00		98
		Dissolved Oxygen								
		pH		6.3	6.9	7.3	7.7	9.1		85
	8-2	Sandfly Creek – **100**		**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (ammonia)	10	80	760	3000	8800		100
			Nitrogen (organic)	100	600	1400	2600	5900		100
			Nitrogen (oxidised)	10	20	20	50	3120		100
			Nitrogen (total)	20	920	2040	5140	13020		100
		Phosphorus	Phosphorus (total)	20	150	460	1200	5400		100
		Phytoplankton biomass								
		Water Clarity	Secchi depth	0.10	0.20	0.30	0.60	1.00		100
			Total Suspended Solids	5.00	13.00	25.00	53.00	117.00		100
			Turbidity	3.20	7.60	13.20	26.00	75.00		100
		Dissolved Oxygen								
		pH		7.1	7.5	7.8	8.0	8.6		100

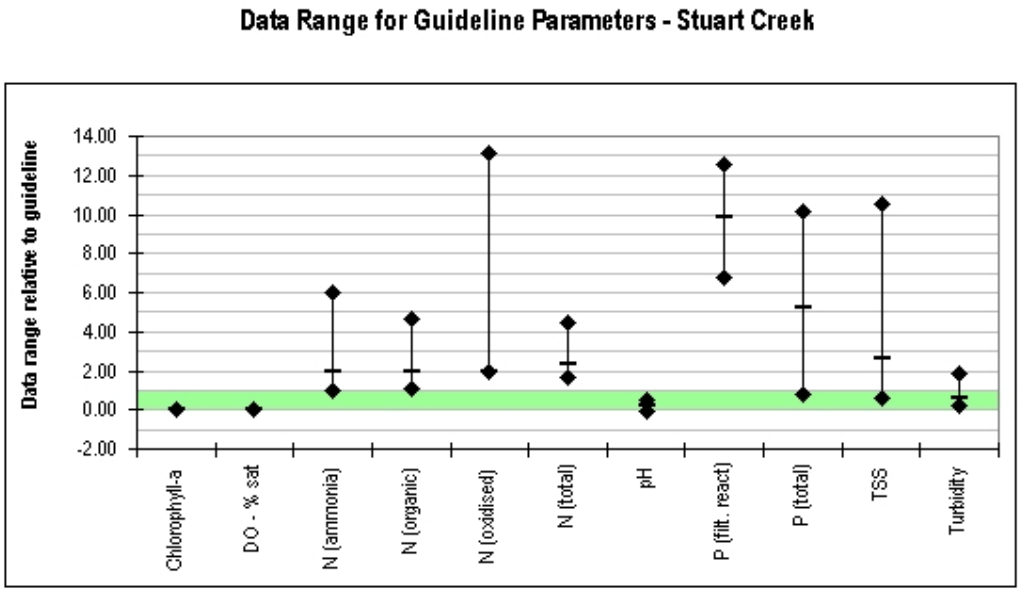


Figure 4-14 Summary of water quality for subsection 8-1 Stuart Creek

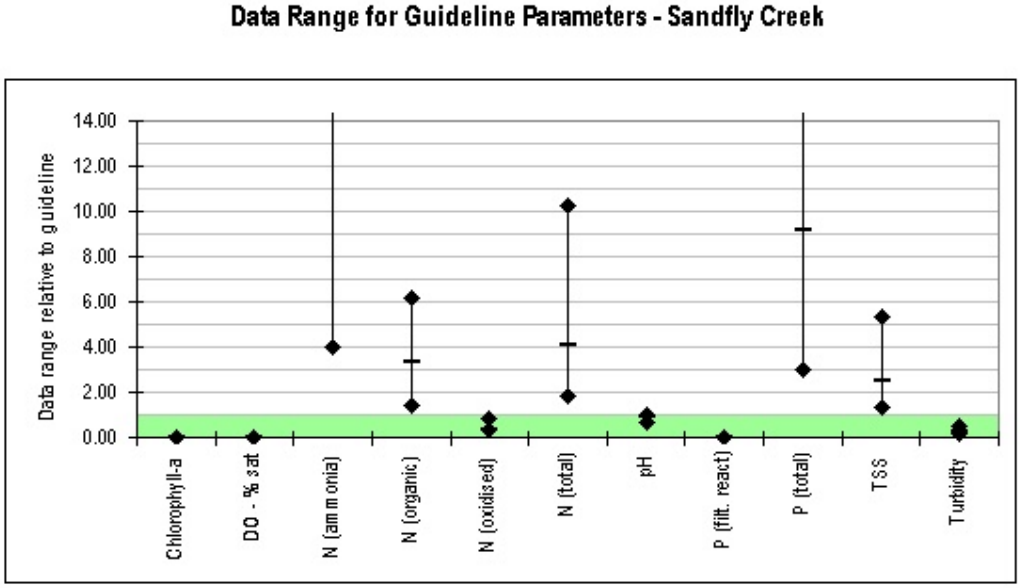


Figure 4-15 Summary of water quality for catchment 8-2 Sandfly Creek

Table 4-8 Data sources for Stuart Creek sub-basin

Catchment	Source	First Event	Last Event	# of Events
	ACTFR	22/01/2007	30/01/2007	56
	CitiWater	31/08/2007	31/08/2007	1
	EPA	22/08/1985	29/06/1988	56
8-1	TCC	29/06/2006	20/07/2006	9
8-2	EPA	27/08/1980	21/02/1989	159

4.3.5 Alligator Creek

The Alligator Creek catchment assessment has been performed against the guidelines for the mid-estuarine water type. All other catchments in this sub-basin have been assessed against the lowland stream water type.

Data sources for this sub-basin include TCC, Citywater and EPA. Data for this sub-basin includes monitoring undertaken from March 1972 until February 2007. A breakdown of the data sources for this sub-basin is shown in **Table 4-10**.

While there is a good distribution of monitoring points in the Alligator Creek (9-1) catchment for this sub-basin there is a distinct lack of data for any of the other catchments. Most of the data associated with catchment 9-1 is older than 5 years and indicated that the area was ecologically healthy.

The recent data for the Alligator Creek catchment indicates that there has been deterioration in water quality over the last 5 years compared to the previous decade

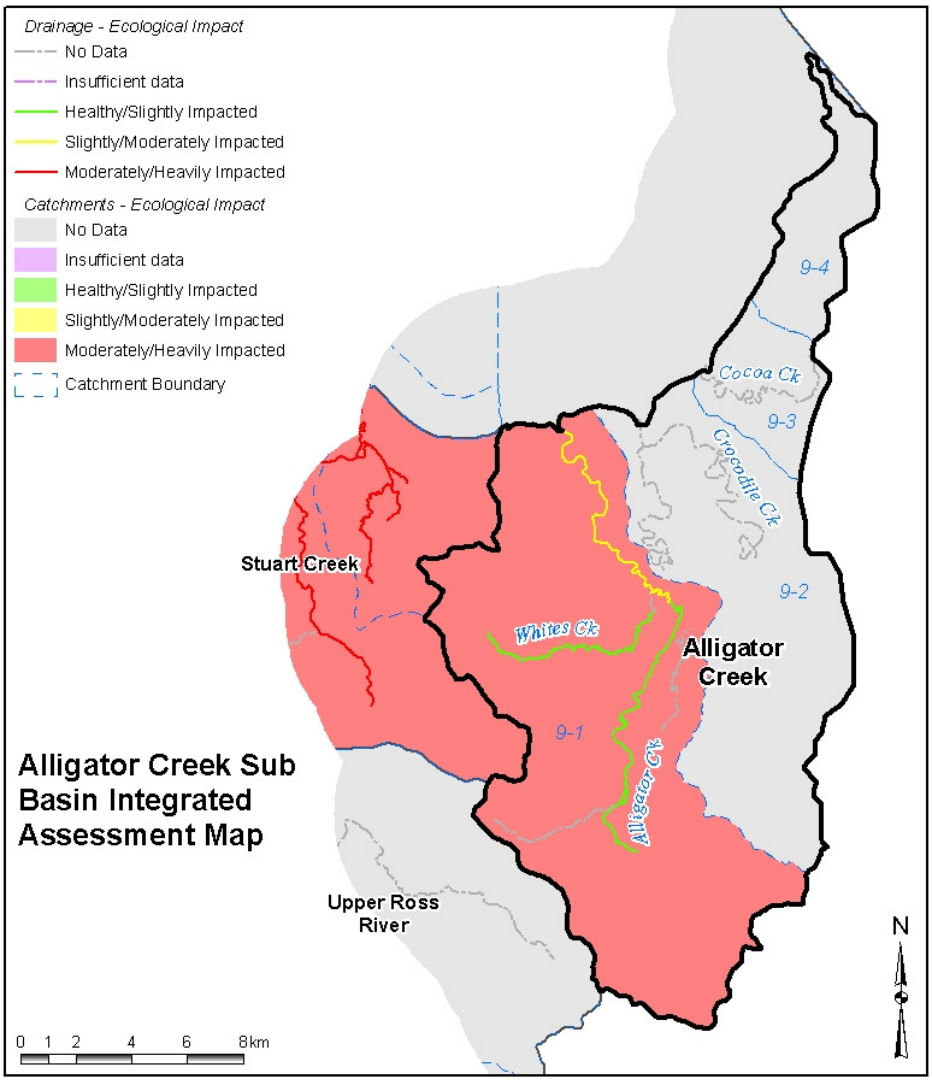


Figure 4-16 Alligator Creek sub-basin and watercourses

Table 4-9 Water quality assessment for Alligator Creek sub-basin

				Min	20th	Med	80th	Max		Confid.
	9-1	Alligator Creek – **100**								
		Nitrogen	Nitrogen (ammonia)	10	10	10	20	90		100
			Nitrogen (organic)	100	100	300	500	3600		100
			Nitrogen (oxidised)	3.600	20	20	20	297		100
			Nitrogen (total)	20	200	330	540	3700		100
		Phosphorus	Phosphorus (filterable reactive)	2.900	8	14.550	32	74		100
			Phosphorus (total)	13.600	20	30	49.900	380		100
		Phytoplankton biomass								
		Water Clarity	Secchi depth	0.10	0.20	0.80	1.40	2.20		100
			Total Suspended Solids	1.00	5.00	10.00	23.00	200.00		100
			Turbidity	1.00	2.00	4.00	8.70	68.00		100
		Dissolved Oxygen								
		pH		5.7	7.3	7.8	8.1	8.5		100
N/A	9-2	Crocodile Creek								
N/A	9-3	Cocoa Creek								
N/A	9-4	Cape Cleveland								

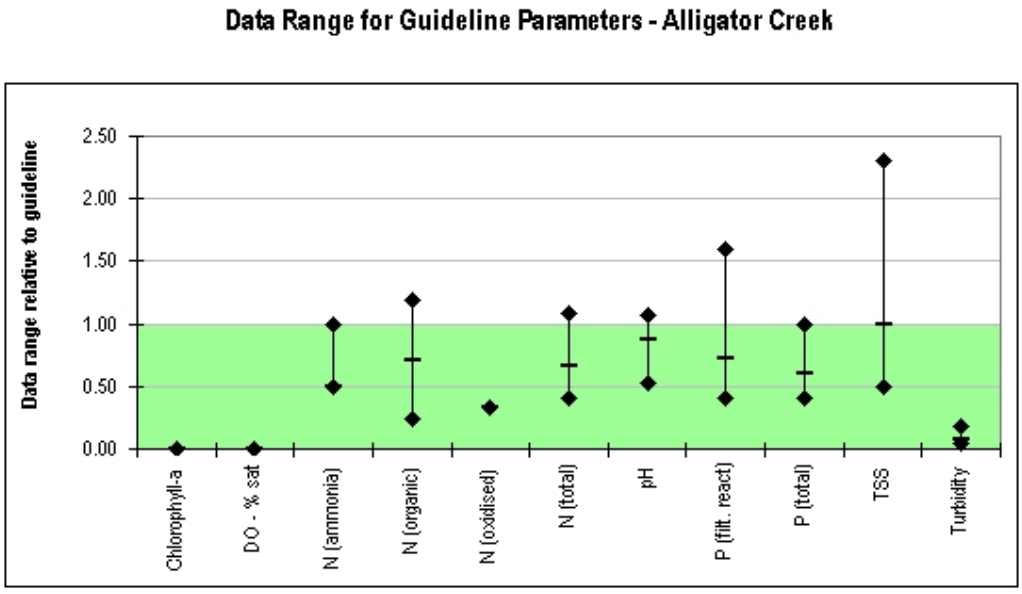


Figure 4-17 Summary of water quality for catchment 9-1 Alligator Creek

Table 4-10 Data sources for Alligator Creek sub-basin

Catchment	Source	First Event	Last Event	# of Events
9-1	ACTFR	21/01/2007	3/02/2007	12
	EPA	23/04/1982	2/06/1988	139
	NRW	17/03/1972	6/04/2004	49
9-2	No data			
9-3	No data			
9-4	No data			

5. Magnetic Island

5.1 Area description

The Magnetic Island Catchment covers approximately 52 km^2. The area is predominately used for conservation (see **Figure 5-1**) however there are urbanised areas on the coastal fringes.

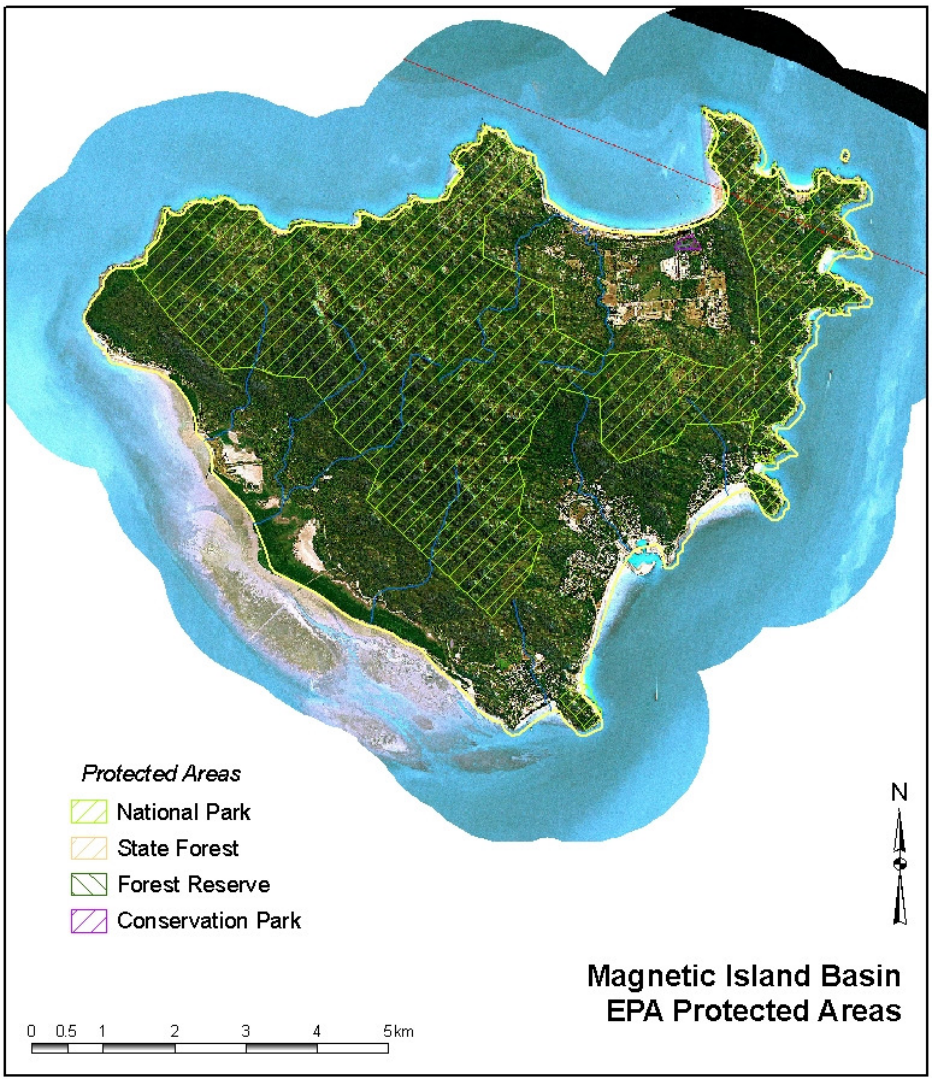


Figure 5-1 Overview of Magnetic Island

5.2 Area issues

The main issues on Magnetic Island are:

- Urbanisation of the coastal fringe
- Tourism
- Near-shore reefs and seagrass beds

5.3 Current Water Quality

The only data source for Magnetic Island is CitiWater. The confidence in the data for this area is low due to poor location information associated with the monitoring sites. Data for this sub-basin includes monitoring undertaken from June 2006 until January 2008. A breakdown of the data sources for this sub-basin is shown in **Table 5-2**. The assessment has been performed against the guidelines for lowland streams.

The assessment has shown that three of the nine catchments are heavily impacted (10-1, 10-2 and 10-6) and one catchment is slightly impacted (10-3) (see **Figure 5-2**). There is insufficient data to assess the remaining catchments.

The pH for Endeavour Creek is unusually low. It is unlikely this is a result of acid sulfate soil but it may be a result of the geology of the area. Magnetic Island is largely comprised of massive granite structures which can decompose into highly acidic soils. All of the other sites on Magnetic Island have a pH within the guideline limits.

The data for ammonia needs to be treated with caution as the Limit of Recognition (LOR) for most of the data is 20 µg/L. This is also the guideline limit for lowland streams so the catchments where the 20th percentile and median are both 20 µg/L are assessed as heavily impacted (red). If the results for ammonia are removed from the analysis the Cockle Bay and Picnic Bay catchments would both be assessed as moderately impacted (yellow).

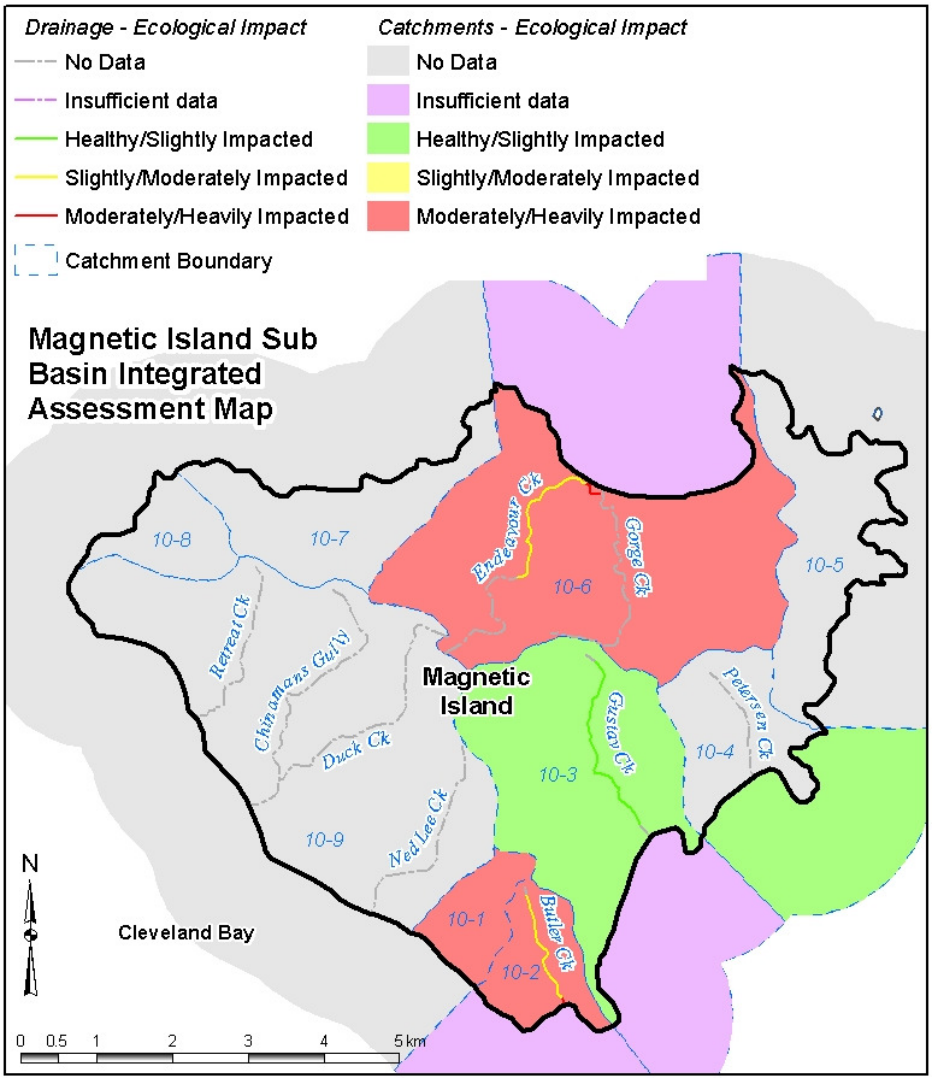


Figure 5-2 Magnetic Island catchments

Table 5-1 Water quality assessment for Magnetic Island sub-basin

				Min	20th	Med	80th	Max		Confid.
	10-1	Cockle Bay – **20**								
	Nitrogen		Nitrogen (ammonia)	20	20	20	40	100		20
			Nitrogen (total)	190	510	630	1700	3600		20
	Phosphorus		Phosphorus (filterable reactive)	10	10	10	20	40		20
			Phosphorus (total)	20	70	105	200	220		20
	Phytoplankton biomass									
	Water Clarity	Total Suspended Solids		7.00	8.00	17.00	31.00	51.00		20
	Dissolved Oxygen									
	pH			6.2	6.6	7.0	8.0	8.3		20
	10-2	Picnic Bay – **20**								
	Nitrogen		Nitrogen (ammonia)	20	20	20	200	650		20
			Nitrogen (total)	150	260	570	810	1500		20
	Phosphorus		Phosphorus (filterable reactive)	10	10	10	70	80		20
			Phosphorus (total)	20	20	120	190	390		20
	Phytoplankton biomass									
	Water Clarity	Total Suspended Solids		4.00	5.00	20.00	29.00	40.00		20
	Dissolved Oxygen									
	pH			6.5	6.6	7.4	7.9	8.1		20
	10-3	Nelly Bay – **20**								
	Nitrogen		Nitrogen (ammonia)	20	20	20	40	640		20
			Nitrogen (total)	20	80	225	430	840		20
	Phosphorus		Phosphorus (filterable reactive)	10	10	10	10	40		20
			Phosphorus (total)	20	20	20	100	500		20
	Phytoplankton biomass									
	Water Clarity	Total Suspended Solids		1.00	1.00	7.00	16.00	103.00		20
	Dissolved Oxygen									
	pH			6.0	6.3	6.6	7.3	8.0		20
N/A	10-4	Arcadia								
N/A	10-5	Radical Bay								
	10-6	Horseshoe Bay – **20**								
	Nitrogen		Nitrogen (ammonia)	20	20	40	1300	6700		20
			Nitrogen (oxidised)	10	20	50	100	890		20
			Nitrogen (total)	130	250	950	2200	8100		20
	Phosphorus		Phosphorus (filterable reactive)	10	10	10	30	690		20
			Phosphorus (total)	10	10	100	700	6100		20
	Phytoplankton biomass									
	Water Clarity	Total Suspended Solids		1.00	14.00	68.50	155.00	720.00		20
	Dissolved Oxygen									
	pH			5.6	5.8	6.2	6.9	7.2		20
N/A	10-7	Five Beach Bay								
N/A	10-8	Rollingstone Bay								
N/A	10-9	West Coast								

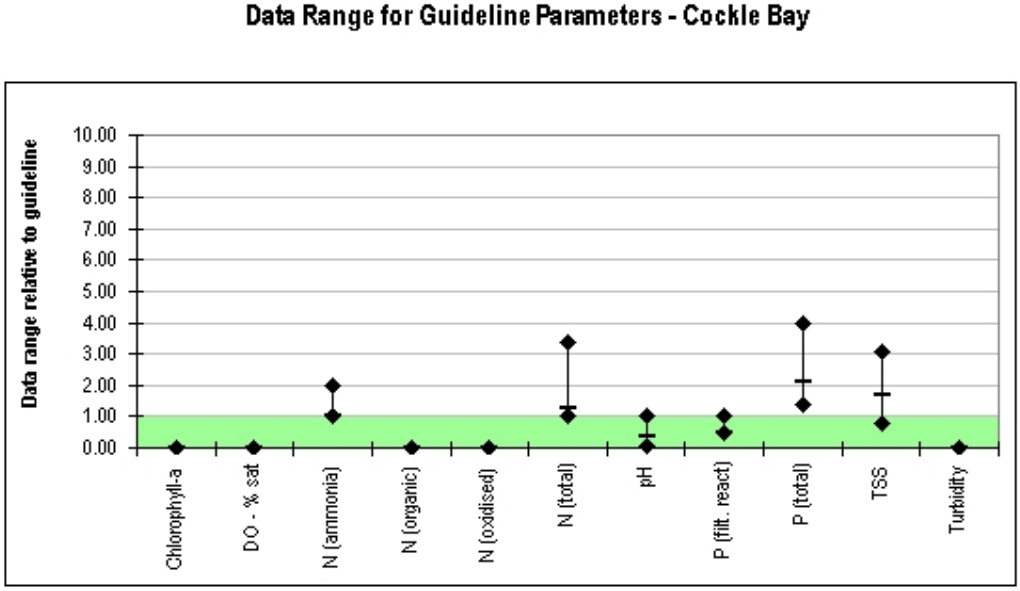


Figure 5-3 Summary of water quality for catchment 10-1 Cockle Bay

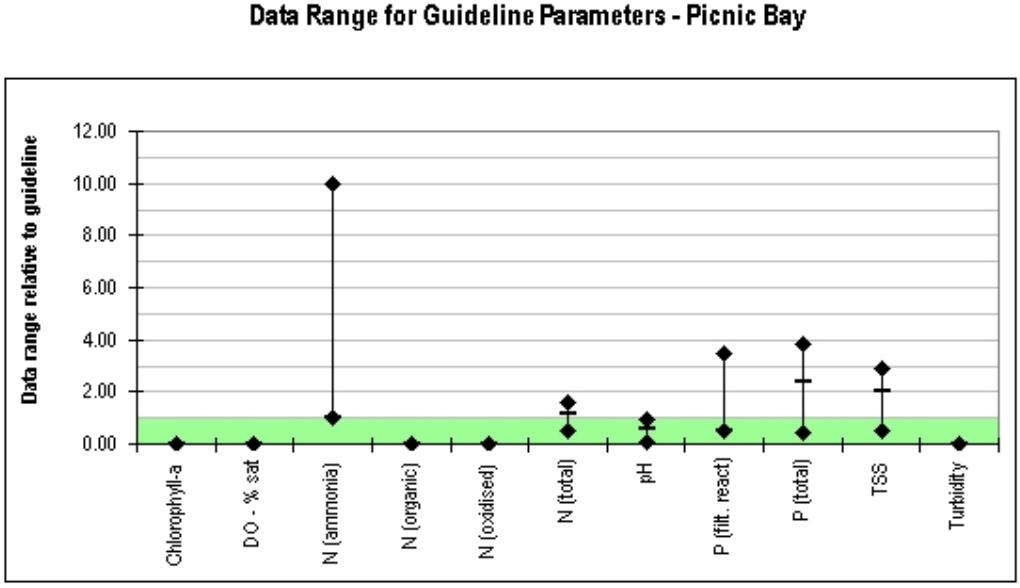


Figure 5-4 Summary of water quality for catchment 10-2 Picnic Bay

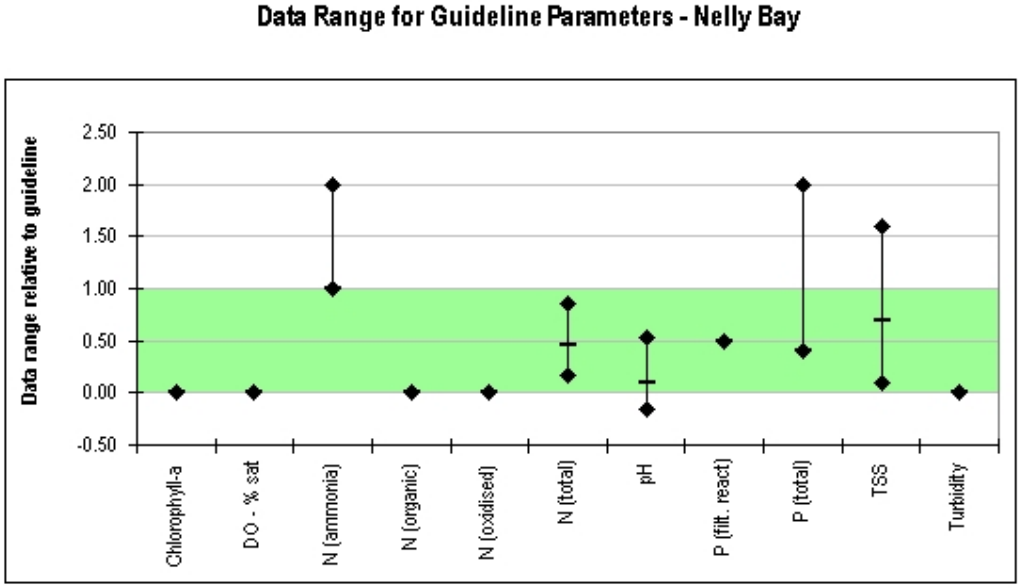


Figure 5-5 Summary of water quality for catchment 10-3 Nelly Bay

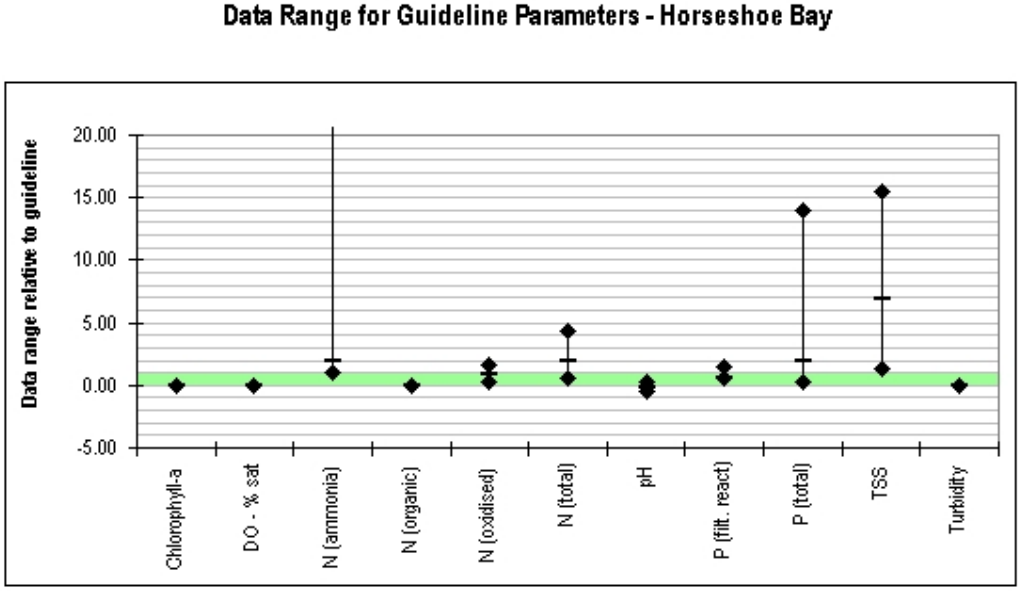


Figure 5-6 Summary of water quality for catchment 10-6 Horseshoe Bay

Table 5-2 Data sources for Magnetic Island

Catchment	Source	First Event	Last Event	# of Events
10-1	CitiWater	27/06/2006	17/01/2008	12
10-2	CitiWater	14/09/2006	17/01/2008	19
10-3	CitiWater	27/06/2006	17/01/2008	38
10-4	No data			
10-5	No data			
10-6	CitiWater	13/07/2006	24/01/2008	42
10-7	No data			
10-8	No data			

Catchment	Source	First Event	Last Event	# of Events
10-9	No data			

6. River influence area

6.1 Area description

The River influence area is approximately 1,700 km^2 and extends from Cape Cleveland in the south to Crystal Creek in the north. The area includes the Townsville Port and the coastal and marine areas that area influenced by the water bodies in the Black and Ross Basins.

6.2 Area issues

The main issues in the river influence area are:

- Commercial and recreational fisheries
- Marine tourism
- Commercial port
- Seagrass and dugong protection areas

6.3 Current water quality

The data sources for the River influence area are the EPA and GBRMPA. Data for this basin includes monitoring undertaken from February 1980 until June 2007. A breakdown of the data sources for this basin is shown in **Table 6-2**.The term 'catchment' has been used loosely for this area to group together marine sites which are related. The Harbour (11-01), Ross River Near-shore (11-02) and Sandfly Creek Near-shore (11-03) have been assessed against the guidelines for the enclosed coastal water type. All other marine areas have been assessed against the guidelines for the open coastal water type.

In general there is insufficient data to assess the water quality for the catchments in the River influence area. The data for the Harbour, Ross River near-shore and Sandfly Creek near-shore is all greater than 5 years old. While this data indicates that the Harbour has good water quality, it indicated that the other near-shore areas a heavily impacted by nutrient loads. Of the twelve catchments, three were assessed as slightly impacted (11-01, 11-09, 11-11), one was moderately impacted (11-05) and one was heavily impacted (11-02). Of the remaining catchments six have insufficient data and one has no data (see **Figure 6-1**).

The data for the other marine areas is generally less than 5 years old. Most of the recorded data for these areas is within the guidelines however the number of monitoring events and the parameters sampled makes it difficult to determine the level of impact on these areas.

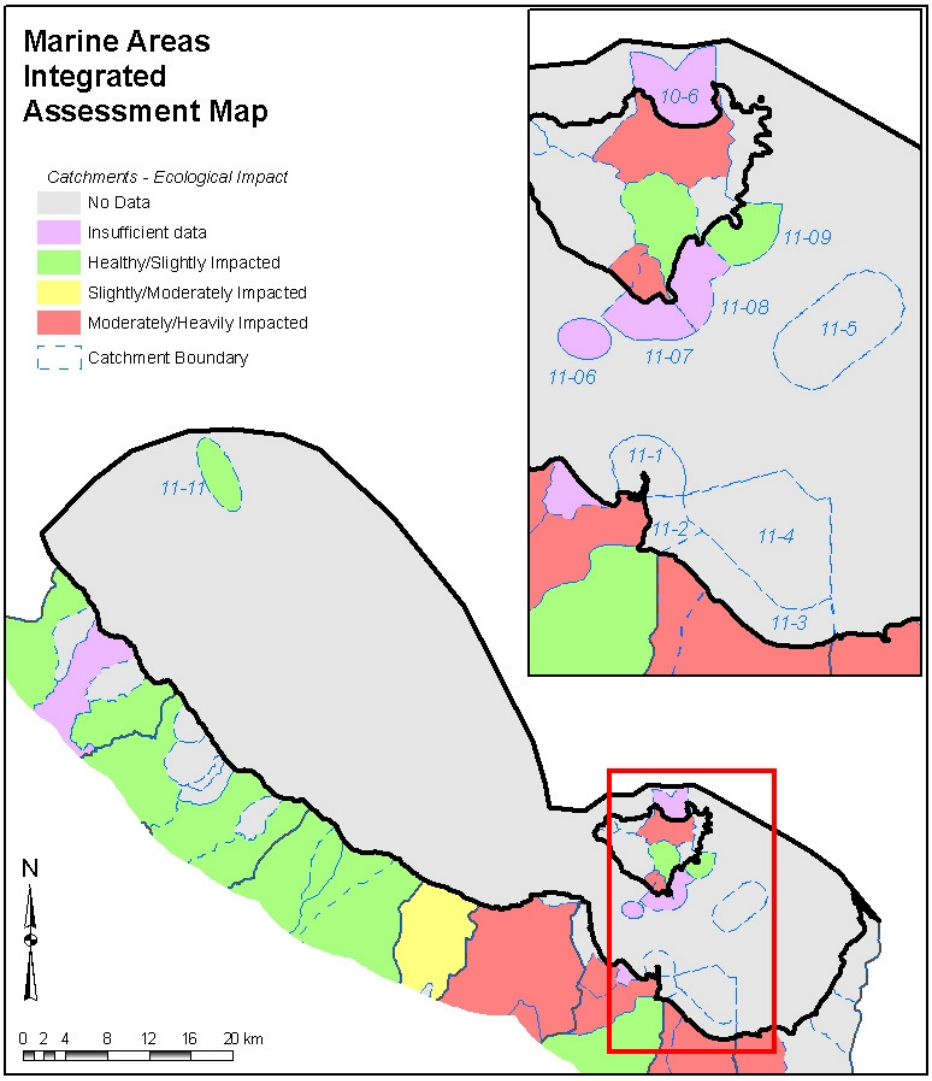


Figure 6-1 River influence catchment areas

Table 6-1 Water quality assessment for Cleveland Bay sub-basin

11-01	Harbour – **100**	**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**	
Nitrogen	Nitrogen (ammonia)	3	10	15	30	130		100
	Nitrogen (organic)	100	100	100	400	1500		100
	Nitrogen (oxidised)	2	2	8	10	70		100
	Nitrogen (total)	10	114	160	420	1542		100
Phosphorus	Phosphorus (filterable reactive)	2	3	5	11	88		100
	Phosphorus (total)	6	17	23	40	140		100
Phytoplankton biomass		0.50	1.00	1.50	2.70	7.10		100
Water Clarity	Secchi depth	0.20	0.60	1.00	1.60	3.20		100
	Total Suspended Solids	2.00	5.00	7.50	12.00	22.00		100
	Turbidity	0.25	1.00	3.00	4.50	10.00		100
Dissolved Oxygen								
pH		6.3	8.1	8.2	8.3	8.9		100
11-02	Ross River Nearshore – **100**	**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**	
Nitrogen	Nitrogen (ammonia)	10	10	40	80	2200		100
	Nitrogen (organic)	100	100	250	400	900		100
	Nitrogen (oxidised)	10	10	10	10	20		100
	Nitrogen (total)	10	10	230	500	940		100
Phosphorus	Phosphorus (total)	20	20	50	80	100		100
Phytoplankton biomass								
Water Clarity	Secchi depth	0.20	0.20	0.20	0.20	0.20		100
Dissolved Oxygen								
pH		6.2	7.9	8.2	8.3	8.6		100
11-03	Sandfly Creek Nearshore – **100**	**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**	
Nitrogen	Nitrogen (ammonia)	10	20	30	70	3000		100
	Nitrogen (organic)	100	200	400	600	3500		100
	Nitrogen (oxidised)	10	10	10	20	60		100
	Nitrogen (total)	130	230	420	830	6560		100
Phosphorus	Phosphorus (total)	20	30	30	80	840		100
Phytoplankton biomass								
Water Clarity	Secchi depth	2.20		2.50		3.60		100
Dissolved Oxygen								
pH		7.8		7.8		8.1		100
11-04	Ross Offshore – **100**	**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**	
Nitrogen	Nitrogen (ammonia)	10	10	30	50	900		100
	Nitrogen (organic)	100	200	300	500	2000		100
	Nitrogen (oxidised)	10	10	10	10	30		100
	Nitrogen (total)	120	230	360	530	2110		100
Phosphorus	Phosphorus (total)	10	20	40	60	700		100
Phytoplankton biomass								
Water Clarity								
Dissolved Oxygen								
pH								
11-05	Cleveland Bay – **100**	**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**	
Nitrogen	Nitrogen (ammonia)	4	6	11	15	50		100
	Nitrogen (organic)	100	100	100	100	500		100
	Nitrogen (oxidised)	2	2	2	2	15		100
	Nitrogen (total)	106	109	116	126	526		100
Phosphorus	Phosphorus (filterable reactive)	2	3	4	7	17		100
	Phosphorus (total)	5	10	20	20	58		100
Phytoplankton biomass		0.19	0.36	0.52	0.95	5.60		100
Water Clarity	Secchi depth	0.40	2.00	3.60	5.90	8.20		100
	Total Suspended Solids	1.00	2.30	6.00	10.00	16.00		100
	Turbidity	0.35	2.00	2.75	6.00	7.00		100
Dissolved Oxygen								
pH		8.0	8.2	8.3	8.5	8.8		100
11-06	Middle Reef – **100**	**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**	
Nitrogen	Nitrogen (ammonia)	2.304		2.997		3.689		100
Phosphorus	Phosphorus (filterable reactive)	1.955		2.795		5.017		100
Phytoplankton biomass		0.39	0.42	0.54	0.73	1.47		100
Water Clarity	Secchi depth	1.00		1.50		3.50		100
	Total Suspended Solids	3.53		4.20		10.11		100
Dissolved Oxygen								

		pH							
	11-07	Picnic Bay – **100**	**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (ammonia)	3.301		3.301		3.301	100
		Phosphorus	Phosphorus (filterable reactive)	1.164		2.483		3.802	100
		Phytoplankton biomass		0.43		0.96		1.49	100
		Water Clarity	Secchi depth	2.50		4.25		6.00	100
		Total Suspended Solids		2.21		2.48		2.74	100
		Dissolved Oxygen							
		pH							
	11-08	Nelly Bay – **100**	**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen							
		Phosphorus							
		Phytoplankton biomass		0.20	0.46	1.09	4.07	15.06	100
		Water Clarity							
		Dissolved Oxygen							
		pH							
	11-09	Arcadia – **100**	**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (ammonia)	0.052		2.829		3.826	100
		Phosphorus	Phosphorus (filterable reactive)	1.107	2.544	2.671	3.849	5.200	100
		Phytoplankton biomass		0.41	0.47	0.63	1.12	1.66	100
		Water Clarity	Secchi depth	2.00	2.00	2.75	5.00	7.00	100
			Total Suspended Solids	0.63	1.53	2.35	5.15	12.93	100
		Dissolved Oxygen							
		pH							
	11-10	Horseshoe Bay – **100**	**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen							
		Phosphorus	Phosphorus (filterable reactive)	2.809		2.809		2.809	100
		Phytoplankton biomass		0.45		0.45		0.45	100
		Water Clarity	Total Suspended Solids	4.14		4.14		4.14	100
		Dissolved Oxygen							
		pH							
	11-11	Pandora Reef – **100**	**Min**	**20th**	**Med**	**80th**	**Max**		**Confid.**
		Nitrogen	Nitrogen (ammonia)	0.272		0.279		4.103	100
		Phosphorus	Phosphorus (filterable reactive)	1.100	1.778	2.126	3.293	3.633	100
		Phytoplankton biomass		0.14	0.25	0.30	0.59	0.91	100
		Water Clarity	Secchi depth	4.00	4.00	6.00	6.50	9.00	100
		Total Suspended Solids		0.43	1.27	1.31	2.72	4.28	100
		Dissolved Oxygen							
		pH							
N/A	11-12	Other marine							

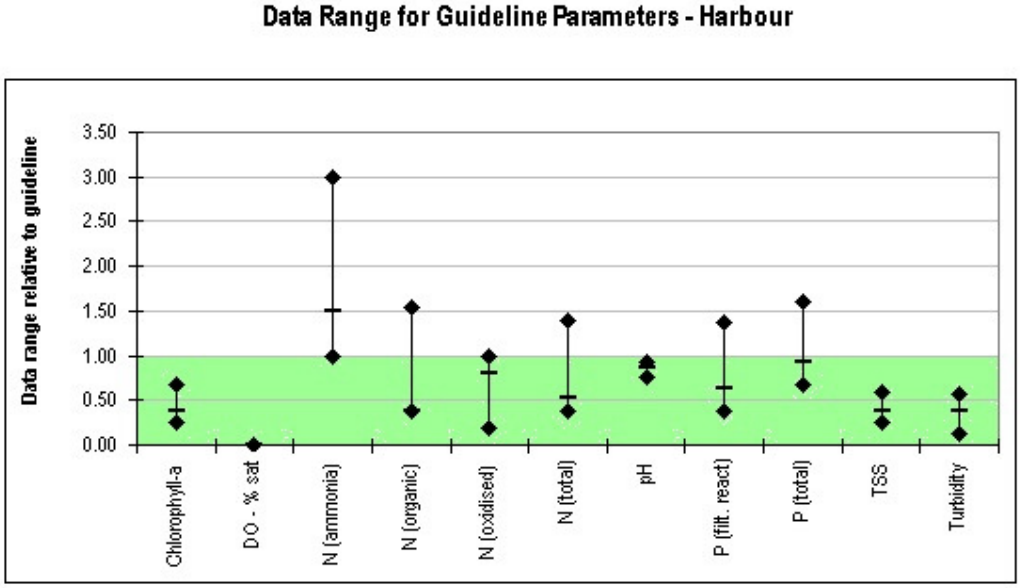


Figure 6-2 Summary of water quality for catchment 11-1 Townsville Harbour

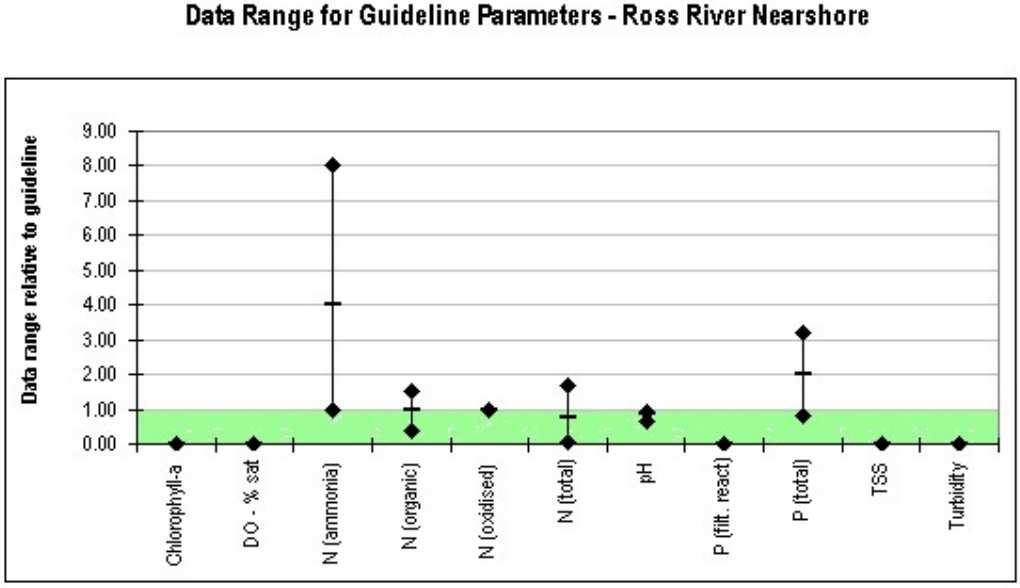


Figure 6-3 Summary of water quality for catchment 11-2 Ross River Near Shore

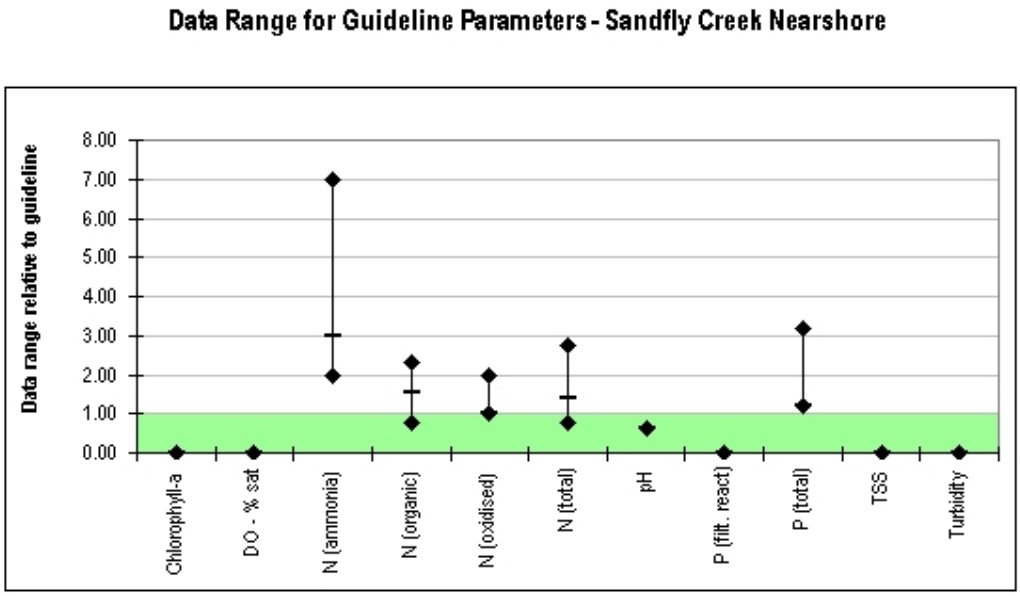


Figure 6-4 Summary of water quality for catchment 11-3 Sandfly Creek Near Shore

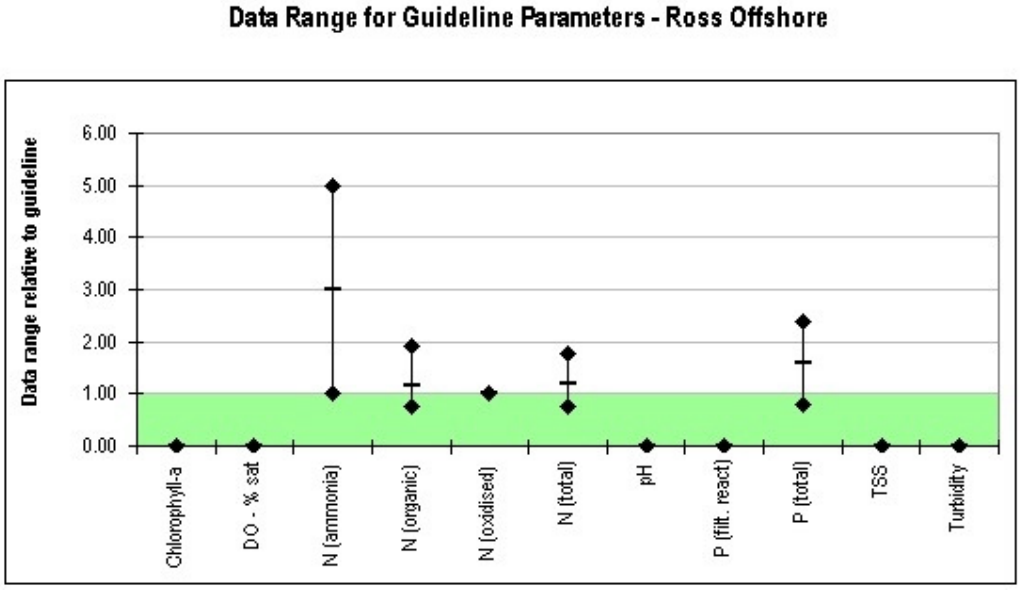


Figure 6-5 Summary of water quality for catchment 11-4 Ross Offshore

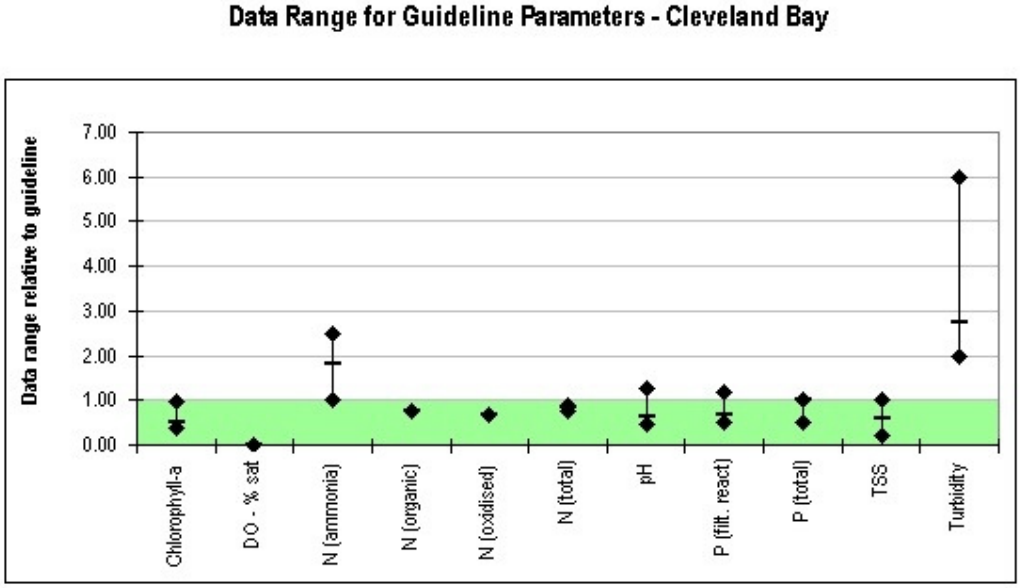


Figure 6-6 Summary of water quality for catchment 11-5 Cleveland Bay

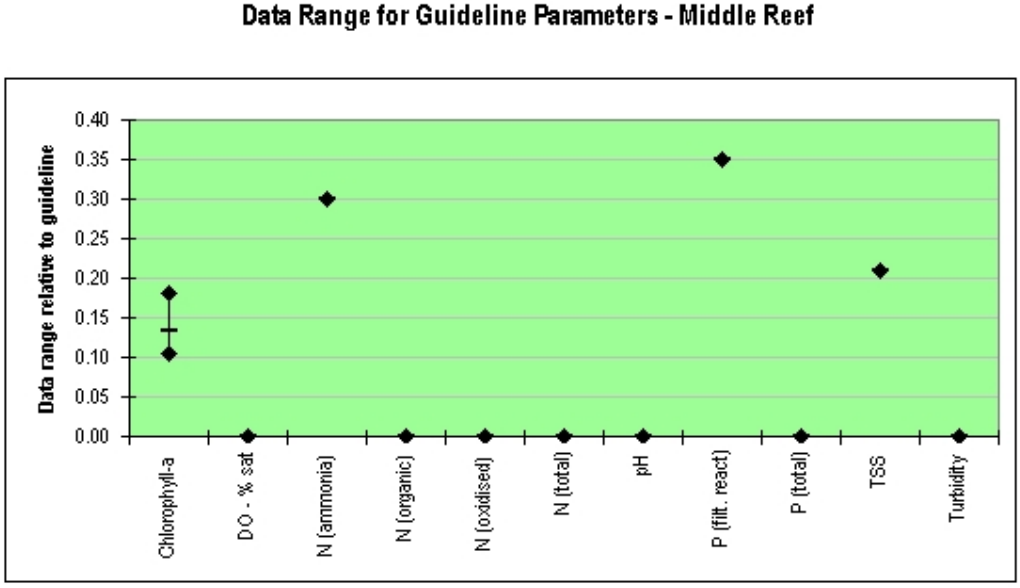


Figure 6-7 Summary of water quality for catchment 11-6 Middle Reef

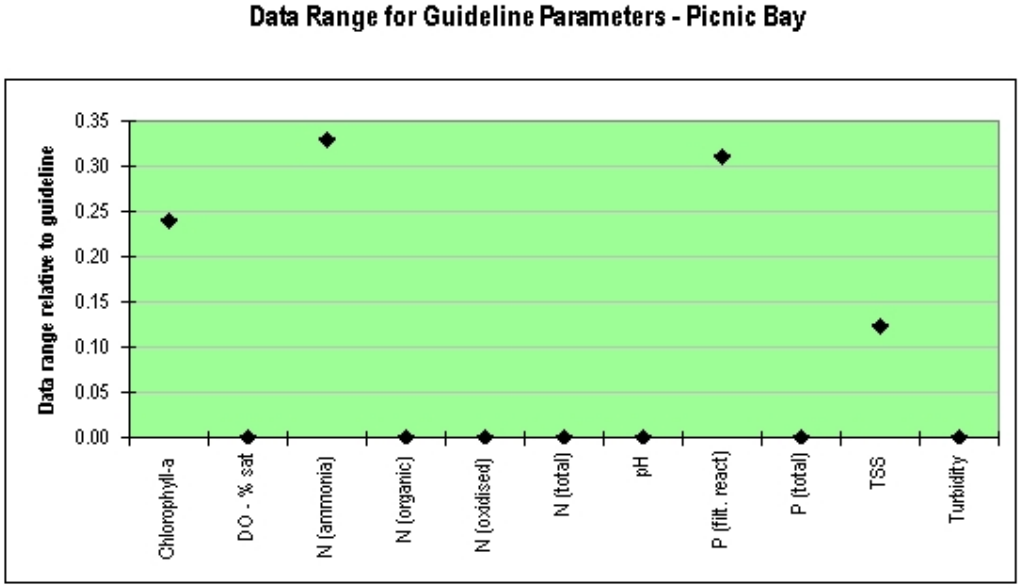


Figure 6-8 Summary of water quality for catchment 11-7 Picnic Bay

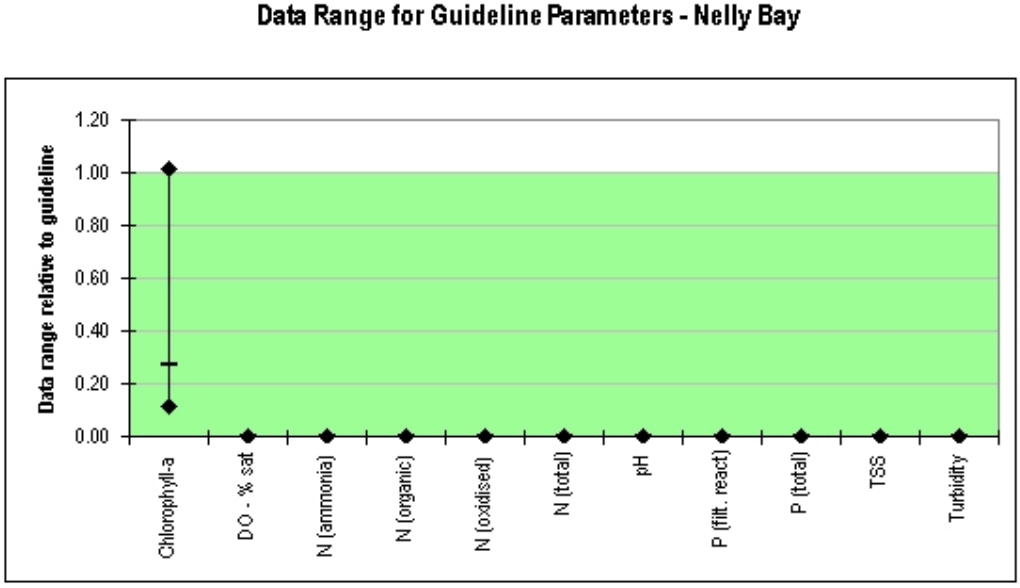


Figure 6-9 Summary of water quality for catchment 11-8 Nelly Bay

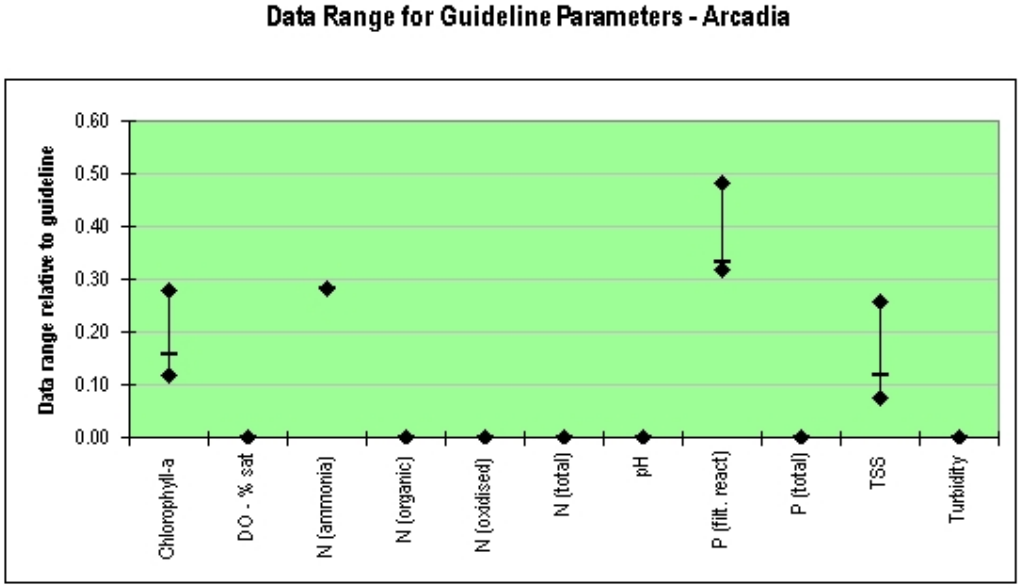


Figure 6-10 Summary of water quality for catchment 11-9 Arcadia

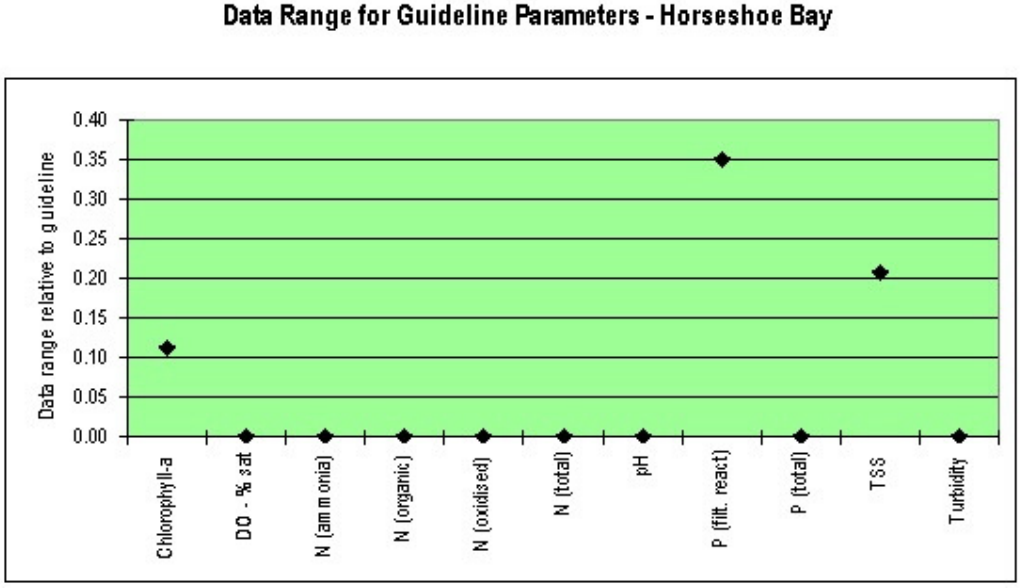


Figure 6-11 Summary of water quality for catchment 11-10 Horseshoe Bay

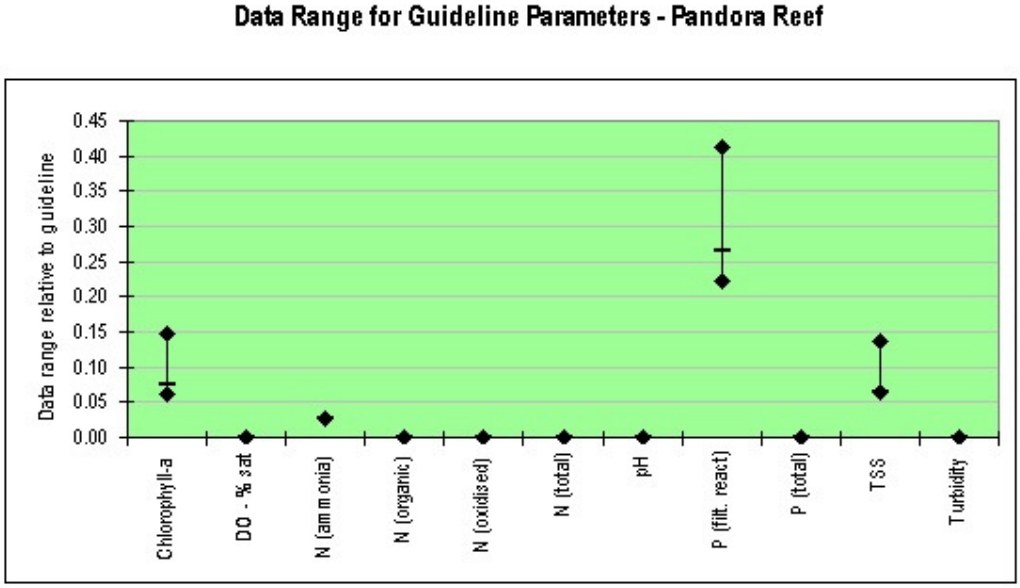


Figure 6-12 Summary of water quality for catchment 11-11 Pandora Reef

Table 6-2 Data sources for River influence area

Catchment	Source	First Event	Last Event	# of Events
11-01	EPA	27/08/1980	27/08/1990	186
11-02	EPA	22/10/1980	11/06/1985	128
11-03	EPA	18/02/1980	9/08/1985	68
11-04	EPA	28/10/1980	4/04/1982	42
11-05	EPA	2/04/1992	15/11/1994	52
11-05	GBRMPA	21/09/2005	10/04/2003	59
11-06	GBRMPA	20/09/2005	6/06/2007	18
11-07	GBRMPA	21/09/2005	31/01/2006	2
11-08	GBRMPA	23/10/2005	9/03/2007	20
11-09	GBRMPA	21/09/2005	6/06/2007	8
11-10	GBRMPA	21/09/2005	21/09/2005	1
11-11	GBRMPA	20/09/2005	31/10/1996	18

7. Conclusions

For a catchment to be considered as slightly impacted most of the recorded data needs to be within the guideline limits for the assessment parameters. For a catchment to be considered as moderately impacted most of the recorded data needs to overlap the guideline limits for the assessment parameters. And for a catchment to be considered as heavily impact the median must be outside the guideline limits in at least two of the six assessment categories (see Section 2.3 for a detailed explanation of the assessment criteria). Most of the catchments which are assessed as heavily impacted exceed the guidelines for nitrogen, phosphorus and water clarity.

In general the Black River Basin is slightly impacted with nine of the nineteen catchments in the basin being assessed as slightly impacted to ecologically healthy and one catchment rated moderately impacted. Of the remaining catchments, eight have no data and one catchment has insufficient data to make an assessment. There was a general trend showing low dissolved oxygen relative to the guidelines and high total suspended solids for the waterbody reaches in the basin.

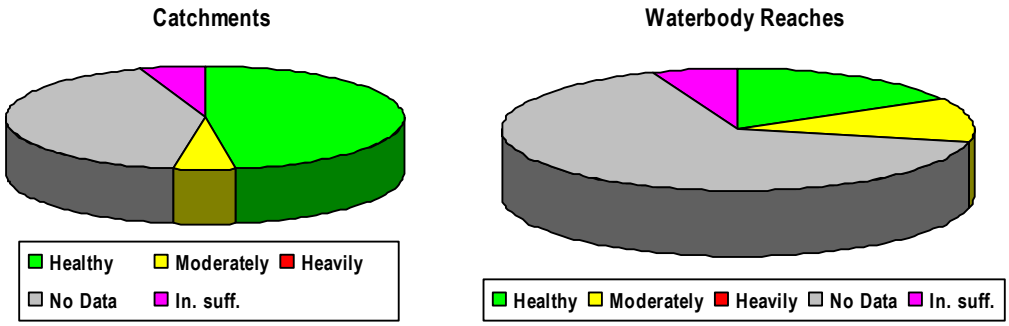


Figure 7-1 Summary of Water Quality Assessment for the Black River Basin

There are twenty catchments in the Ross River Basin. As expected the Ross River Basin performed much worse than the Black River Basin with only two catchments being rated as slightly impacted to ecologically healthy, one catchment rated moderately impacted and seven catchments rated as heavily impacted. Of the remaining catchments, nine have no data and one catchment has insufficient data to make an assessment. In general nutrient levels are high but in the Bohle River sub-basin the levels of phosphorus are extremely high compared to the EPA guidelines for low-land streams. Of the nitrogen species, ammonia was consistently high however total nitrogen was generally within or just above the guidelines.

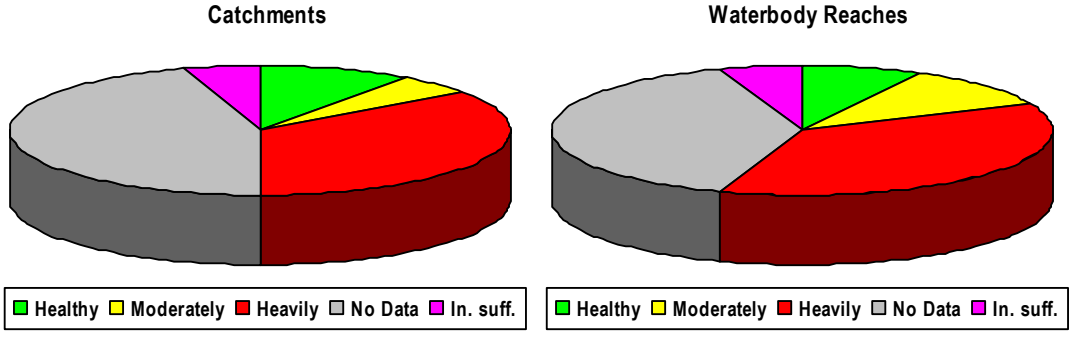


Figure 7-2 Summary of Water Quality Assessment for the Ross River Basin

Five out of the nine catchments on Magnetic Island have is no data. Only one of the catchments is rated as ecologically healthy with the remainder being heavily impacted. This assessment is consistent with the land uses on Magnetic Island. Those catchments with the worst water quality have been subject to the most urbanisation. It is likely that the water quality for the catchments where there is no data would be typical of healthy ecosystems as the areas are largely undisturbed.

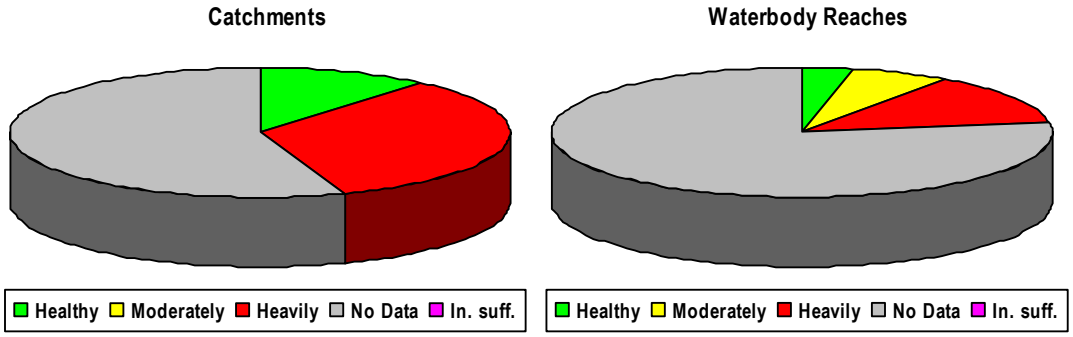


Figure 7-3 Summary of Water Quality Assessment for Magnetic Island

Similar to Magnetic Island, there is generally insufficient information in the River Influence area to make an assessment. More recent data for the areas close to the mainland shows that the marine environment is moderately to heavily impacted. There are twelve catchment areas in the River Influence area. As stated previously, the term 'catchment' has been used loosely for this area to group together marine sites which are related. In general the results around Magnetic Island, Middle Reef and Pandora Reef are within the guidelines for open water. The results for secchi depth in the River Influence areas does not correspond to the results for turbidity or total suspended solids. This would indicate that there are dissolved compounds in the water column which are absorbing light.

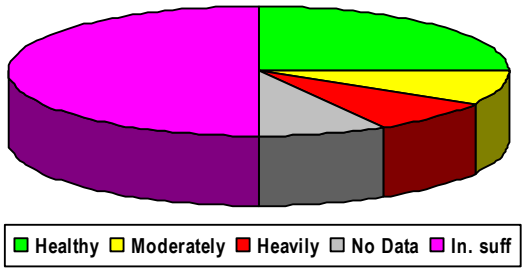


Figure 7-4 Summary of Water Quality Assessment for the River Influence area

Overall in the study area, dissolved oxygen (% saturated) was low relative to the guidelines. This may be a result of the ephemeral nature of most of the watercourses in the study area. Even in catchments that are largely undisturbed this trend persists, so it may be that watercourses are naturally low in dissolved oxygen as they are stagnant or have very low flows for much of the year. This may be linked to the low levels of Chlorophyll-a for the study area indicating low levels of photosynthesis are occurring in the aquatic environment.

Total suspended solids were high and turbidity was low relative to the guidelines for most of the freshwater environment in the study area. This would indicate that most of the sediment load is coarse and inorganic in nature. The reverse of this was true for the marine areas where the total suspended solids were low but the turbidity was high. This would indicate that most sediment is fine, and in the marine environment it is most likely to be organic in nature. These results were consistent across the entire study area so it is likely to be natural balance for waterbodies in this area.

For the majority of the study area pH was within the guideline limits, the only exception was Endeavour Creek in Horseshoe Bay on Magnetic Island, and Pine Creek in the Bluewater Creek catchment. It is possible that the pH is due to the natural acidity of the soils in the area. Soil testing in these areas would confirm this conclusion.

Where it had been monitored, Chlorophyll-a was generally within the guideline limits. This seems contradictory to the nutrient data. Those areas that had high nutrient levels did not necessary have high levels of Chlorophyll-a. For example the Bohle River has high nutrient levels but the values for Chlorophyll-a are within the guideline. It may have been that monitoring of Chlorophyll-a has not coincided with high nutrient loads or that the guideline limit for Chlorophyll-a is too high. Plant growth may also be inhibited by another factor (that is only one nutrient may be high). A more detailed analysis of Chlorophyll-a, plant growth factors and ecosystem health is necessary to draw any conclusions.

For those catchments that are heavily impacted Ammonia is generally high. This may be a result of the low dissolved oxygen which seems to be consistent across all mainland areas. The lack of oxygen may be preventing the oxidation of ammonia. In tropical Australian rivers, dissolved oxygen levels are affected by seasonal floods and runoff from nutrient rich soils.

Much of the nutrient data in the database is at the limit of recognition (LOR). The LOR is the lower limit at which a parameter can be detected. In the past for most nutrient species this was 20µg/L but in more recent years this has been improved to 10µg/L. This is most clearly demonstrated in the parameter graphs in Appendix E. Ten of the twenty-seven lowland stream reaches and eight of the sixteen mid-estuarine reaches have a median of 20µg/L for ammonia. There is a similar trend for most of the other nutrient species. This is a problem for the water quality analysis because the guideline limits for most of the nutrient species is less than or equal to 20µg/L. **Table 7-1** highlights which guideline limits are less than or equal to 20µg/L. These means that for most water types, at best, the assessment for ammonia, oxidised nitrogen and filterable reactive phosphorus will be moderately impacted (yellow). This result skews the assessment for the nutrient categories.

Table 7-1 Comparison of guideline limits to LOR for nutrients

Central region water type	Shaded if >= LOR					
	Amm N	Oxid N	Org N	Total N	FiltR P	Total P
	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Open coastal	6	3	130	140	6	20
Enclosed coastal	8	3	180	200	6	20
Mid-estuarine	10	10	260	300	8	25
Upper Estuarine	30	15	400	450	10	40
Lowland streams	20	60	420	500	20	50
Upland streams	10	15	225	250	15	30
Freshwater lakes/reservoirs	10	10	330	350	5	10

8. Recommendations

In order to improve the water quality data set for the Ross and Black River catchments so that current water quality conditions can be more accurately assessed, the following improvements to current water quality monitoring are recommended:

- Monitoring in catchments where there is no data; 1-2, 1-3, 1-4, 2-2, 2-3, 2-4, 2-5, 2-7, 4-2, 5-3, 6-1, 7-2, 7-3, 7-4, 7-6, 9-2, 9-3, 9-4, 10-4, 10-5, 10-7, 10-8, 10-9
- Conduct monitoring during different flow regimes to capture seasonality to better assess water quality conditions across all conditions
- Nearly all areas require additional nutrient monitoring however additional monitoring should focus on the following:
    - Bohle River – ammonia, total nitrogen, filterable reactive phosphorus and total phosphorus
    - Mid-estuarine reaches – dissolved oxygen (% sat)
    - Louisa Creek – dissolved oxygen (% sat)
    - Magnetic Island marine – nitrogen species and total phosphorus
    - Endeavour Creek – pH
- Additional surface water monitoring is needed for Magnetic Island for a more accurate assessment.
- Establish representative monitoring locations for each waterbody reach. Sampling locations should include areas that are undisturbed to provided baseline conditions for waterbodies in the study area.
- Work in conjunction with the Department of Natural Resources and Water to establish flow gauging sites at representative locations
- Summarise locations that are close together eg the various locations around The Lakes
- Establish a sampling methodology that can be easily distributed to volunteer organisations which includes a standardised recording format.
- Include photo documentation in the sampling methodology. Photos should be taken of the sampling location and any significant activities in the watershed which may influence water quality

The guideline limit for turbidity for lowland streams needs to be revised as all waterbodies were well below the current EPA guideline.

The guideline limit for turbidity for enclosed coastal and open coastal needs to be revised. The current guidelines are not representative of the current condition of marine areas in the study area. The high turbidity is like to be a result of a high proportion of fine suspended solids as the total suspended solids is generally low. The fine suspended solids may be as a result of pollution or it may be the natural state for marine waters in this area. Further testing of high ecological value sites in enclosed coastal and open coastal waters would help to resolve this.

The guideline limit for turbidity for lowlands streams needs to be revised as all waterbodies in the study area were well below the current EPA guideline.

The guideline limit for ammonia and oxidised nitrogen for most water types needs to be revised as the current the current laboratory LOR for these parameters is 10µg/L. Similarly the guideline limit for filterable-reactive phosphorus also needs to be revised as its LOR is also 10µg/L.

Further analysis and testing of the relationship between dissolved oxygen, ammonia and total nitrogen should be undertaken to see if low dissolved oxygen is preventing the oxidation of ammonia. It is recommended that the Bohle sub-basin be used for this study as there is good historical data. If this is the case then stream restoration works that aim to increase dissolved oxygen could improve nitrogen cycling.

The sources of phosphorus in the Lower Bohle River need to be identified and targeted for action. The phosphorus load from this catchment far exceeds that produced by all other catchments in the project area.

The relationship between Chlorophyll-a, nutrient loads and ecosystem health needs to be investigated to determine if the guideline limit for Chlorophyll-a needs to be revised.

A monitoring program needs to be established for Magnetic Island at key locations in all of the urbanised catchments. These locations need to be well documented and marked so to improve the confidence in the data for Magnetic Island.

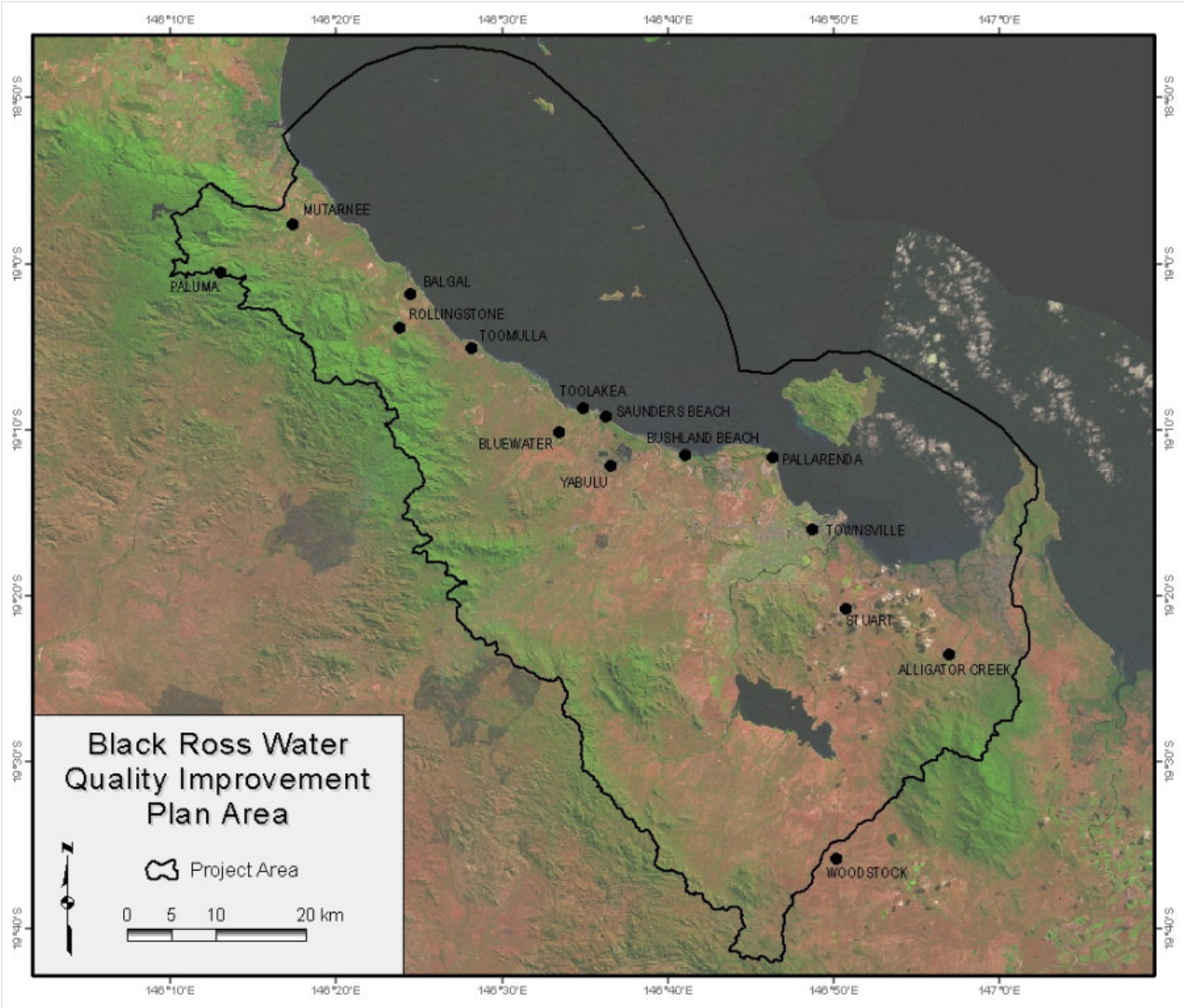
A monitoring program needs to be established for the marine areas adjacent to the Black River basin, and around the Bohle River to better characterise the influence of these watercourses on the marine environment.

Appendix A

Map of project area

Appendix A

Map of project area



Appendix B

Water Quality Assessment by catchment (2004 – present)

Appendix B

Water Quality Assessment by waterbody

No Data	1	Alice River	Lowland streams	**0**							
No Data	34	Alick Creek	Lowland streams	**0**							
	74	Alick Creek	Mid-estuarine	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	10.0	10.0	20.0	30.0	70.0		100	
			Nitrogen (organic)	100.0	200.0	300.0	400.0	700.0		100	
			Nitrogen (oxidised)	20.0	20.0	20.0	40.0	50.0		100	
			Nitrogen (total)	130.0	210.0	340.0	450.0	750.0		100	
		Phosphorus	Phosphorus (total)	20.0	20.0	30.0	60.0	240.0		100	
		Phytoplankton biomass									
		Water Clarity	Secchi depth	0.10	0.40	0.60	1.00	2.00		100	
			Total Suspended Solids	2.00	7.00	13.50	31.00	55.00		100	
			Turbidity	2.20	3.50	6.35	10.00	25.00		100	
		Dissolved Oxygen									
		pH		6.7	7.6	8.0	8.1	8.2		100	
	25	Alligator Creek	Lowland streams	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	10.0	10.0	10.0	50.0	80.0		100	
			Nitrogen (organic)	100.0	142.3	224.3	400.0	3600.0		100	
			Nitrogen (oxidised)	3.6	20.0	20.0	38.9	297.0		100	
			Nitrogen (total)	130.0	264.0	330.0	673.0	3700.0		100	
		Phosphorus	Phosphorus (filterable reactive)	2.9	8.0	14.6	32.0	74.0		100	
			Phosphorus (total)	13.6	20.0	30.0	53.5	380.0		100	
		Phytoplankton biomass									
		Water Clarity	Secchi depth	0.20	0.20	0.20	1.00	2.00		100	
			Total Suspended Solids	1.00	4.90	8.00	19.00	60.00		100	
			Turbidity	1.00	1.70	3.00	6.80	12.00		100	
		Dissolved Oxygen									
		pH		5.7	6.5	7.1	7.7	8.5		100	
	75	Alligator Creek	Mid-estuarine	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	10.0	10.0	10.0	20.0	90.0		100	
			Nitrogen (organic)	100.0	100.0	300.0	500.0	700.0		100	
			Nitrogen (oxidised)	20.0	20.0	20.0	20.0	30.0		100	
			Nitrogen (total)	20.0	140.0	330.0	530.0	730.0		100	
		Phosphorus	Phosphorus (total)	20.0	20.0	30.0	40.0	160.0		100	
		Phytoplankton biomass									
		Water Clarity	Secchi depth	0.10	0.40	1.00	1.40	2.20		100	
			Total Suspended Solids	4.00	7.00	10.00	35.00	200.00		100	
			Turbidity	1.30	2.50	4.80	13.00	68.00		100	
		Dissolved Oxygen									
		pH		7.2	7.7	8.0	8.2	8.4		100	
	26	Althaus Creek	Lowland streams	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	10.0	10.0	20.0	40.0	8000.0		100	
			Nitrogen (organic)	100.0	200.0	300.0	500.0	1600.0		100	
			Nitrogen (oxidised)	10.0	20.0	20.0	50.0	1200.0		100	
			Nitrogen (total)	70.0	240.0	390.0	570.0	10800.0		100	
		Phosphorus	Phosphorus (total)	10.0	20.0	20.0	40.0	300.0		100	
		Phytoplankton biomass									
		Water Clarity	Secchi depth	0.10	0.40	0.50	1.00	1.40		100	
			Total Suspended Solids	1.00	8.00	14.00	20.00	39.00		100	
			Turbidity	1.00	4.00	5.60	9.00	35.00		100	
		Dissolved Oxygen									
		pH		6.3	7.7	8.0	8.1	8.4		100	
No Data	76	Althaus Creek	Upland streams	**0**							

No Data	77	Anthill Creek	Lowland streams	**0**							
No Data	2	Anthill Plains Creek		Lowland streams			**0**				
No Data	78	Anthill Plains Creek		Upland streams			**0**				
	170	Arcadia Bay	Open coastal	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	0.1		2.8		3.8		100	
		Phosphorus	Phosphorus (filterable reactive)	1.1	2.5	2.7	3.8	5.2		100	
		Phytoplankton biomass		0.41	0.47	0.63	1.12	1.66		100	
		Water Clarity	Secchi depth	2.00	2.00	2.75	5.00	7.00		100	
			Total Suspended Solids	0.63	1.53	2.35	5.15	12.93		100	
		Dissolved Oxygen									
		pH									
	28	Black River	Lowland streams	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	2.5	10.0	20.0	50.0	280.0		100	
			Nitrogen (organic)	100.0	200.0	353.1	500.0	1200.0		100	
			Nitrogen (oxidised)	20.0	20.0	40.0	111.2	385.5		100	
			Nitrogen (total)	90.6	160.3	427.0	784.2	1240.0		100	
		Phosphorus	Phosphorus (filterable reactive)	12.3	28.5	35.5	43.3	127.0		100	
			Phosphorus (total)	20.0	21.1	40.0	153.1	1010.0		100	
		Phytoplankton biomass									
		Water Clarity	Secchi depth	0.20	0.20	0.20	0.50	1.00		100	
			Total Suspended Solids	1.00	6.00	16.00	306.00	1189.00		100	
			Turbidity	0.50	3.00	5.45	11.00	60.00		100	
		Dissolved Oxygen									
		pH		6.2	7.4	7.8	8.2	8.7		100	
	79	Black River	Mid-estuarine	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	10.0	10.0	10.0	40.0	120.0		100	
			Nitrogen (organic)	100.0	200.0	300.0	400.0	600.0		100	
			Nitrogen (oxidised)	20.0	20.0	20.0	40.0	80.0		100	
			Nitrogen (total)	30.0	240.0	330.0	540.0	650.0		100	
		Phosphorus	Phosphorus (total)	20.0	20.0	20.0	50.0	160.0		100	
		Phytoplankton biomass									
		Water Clarity	Secchi depth	0.10	0.20	0.50	0.80	1.60		100	
			Total Suspended Solids	2.00	8.00	15.50	34.00	445.00		100	
			Turbidity	1.50	4.70	6.00	15.00	175.00		100	
		Dissolved Oxygen									
		pH		7.5	7.9	8.1	8.2	8.5		100	
No Data	80	Black River	Upland streams	**0**							
	29	Bluewater Creek		Lowland streams			**91**				
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	9.7		38.2		66.7		100	
			Nitrogen (organic)	71.8	127.0	162.4	281.6	1239.9		100	
			Nitrogen (oxidised)	4.2	21.0	128.8	160.6	427.8		100	
			Nitrogen (total)	53.9	105.6	280.0	576.1	5812.0		100	
		Phosphorus	Phosphorus (filterable reactive)	2.3	4.5	5.5	8.6	15.9		100	
			Phosphorus (total)	2.0	9.2	16.8	40.7	4008.5		100	
		Phytoplankton biomass									
		Water Clarity	Total Suspended Solids	0.50	4.00	5.00	15.00	620.00		100	
			Turbidity	2.00	4.00	9.00	14.00	35.00		94	
		Dissolved Oxygen		30.9	66.2	85.9	95.6	128		20	
		pH		5.8	6.3	6.7	7.2	8.4		39	
No Data	81	Bluewater Creek		Mid-estuarine			**0**				
No Data	82	Bluewater Creek		Upland streams			**0**				
	3	Bohle River Lower		Lowland streams			**100**				
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	10.0	10.0	30.0	60.0	300.0		100	
			Nitrogen (organic)	10.0	240.0	500.0	800.0	4500.0		100	
			Nitrogen (oxidised)	10.0	20.0	20.0	100.0	410.0		100	
			Nitrogen (total)	130.0	350.0	630.0	920.0	4560.0		100	

	Phosphorus	Phosphorus (filterable reactive)	4.8	48.9	78.8	157.8	390.2		100
		Phosphorus (total)	10.0	50.0	100.0	150.0	949.3		100
	Phytoplankton biomass		1.70		1.95		2.20		100
	Water Clarity	Secchi depth	0.10	0.20	0.40	0.60	2.00		100
		Total Suspended Solids	3.80	12.00	21.00	40.00	558.30		100
		Turbidity	1.00	5.60	11.00	21.00	150.00		100
	Dissolved Oxygen								
	pH		6.2	7.5	7.7	8.0	8.6		100
83	Bohle River Lower		Mid-estuarine		**100**				
			Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (ammonia)	2.0	10.0	20.0	60.0	4000.0		100
		Nitrogen (organic)	40.0	200.0	385.5	700.0	8600.0		100
		Nitrogen (oxidised)	2.0	10.0	20.0	110.0	2100.0		100
		Nitrogen (total)	70.0	240.0	440.0	830.0	14100.0		100
	Phosphorus	Phosphorus (filterable reactive)	5.0	47.0	82.0	160.0	580.0		100
		Phosphorus (total)	10.0	50.0	93.0	190.0	2700.0		100
	Phytoplankton biomass		0.60	2.30	4.35	8.60	127.80		100
	Water Clarity	Secchi depth	0.10	0.30	0.60	0.90	1.80		100
		Total Suspended Solids	3.00	10.00	20.00	45.00	890.00		100
		Turbidity	1.00	5.00	9.50	21.00	288.00		100
	Dissolved Oxygen								
	pH		6.4	7.7	8.0	8.3	9.3		100
65	Bohle River Upper		Lowland streams			**100**			
			Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (ammonia)	2.0	10.0	31.0	100.0	4800.0		100
		Nitrogen (organic)	200.0	600.0	1000.0	1400.0	4383.2		100
		Nitrogen (oxidised)	2.0	20.0	900.0	12000.0	35000.0		100
		Nitrogen (total)	128.6	830.0	1822.0	12510.0	36050.0		100
	Phosphorus	Phosphorus (filterable reactive)	2.0	690.0	4000.0	7200.0	9700.0		100
		Phosphorus (total)	20.0	210.0	2500.0	7175.8	12000.0		100
	Phytoplankton biomass		0.50	1.50	3.70	13.10	58.80		100
	Water Clarity	Secchi depth	0.10	0.20	0.20	0.20	1.50		100
		Total Suspended Solids	1.00	13.00	24.50	106.00	1592.00		100
		Turbidity	1.00	5.80	15.00	45.00	670.00		100
	Dissolved Oxygen								
	pH		3.8	6.9	7.3	7.8	9.6		100
145	Butler Creek	Lowland Streams	**20**						
			Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (ammonia)	20.0	20.0	60.0	200.0	650.0		20
		Nitrogen (total)	290.0	310.0	495.0	1300.0	1500.0		20
	Phosphorus	Phosphorus (filterable reactive)	10.0	10.0	10.0	60.0	60.0		20
		Phosphorus (total)	20.0	20.0	65.0	180.0	390.0		20
	Phytoplankton biomass								
	Water Clarity	Total Suspended Solids	4.00		9.00		40.00		20
	Dissolved Oxygen								
	pH		6.5	6.5	6.8	7.9	7.9		20
144	Butler Creek	Mid-estuarine	**20**						
			Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (ammonia)	20.0	20.0	20.0	60.0	360.0		20
		Nitrogen (total)	150.0	200.0	510.0	600.0	1200.0		20
	Phosphorus	Phosphorus (filterable reactive)	10.0	10.0	10.0	80.0	80.0		20
		Phosphorus (total)	20.0	80.0	120.0	190.0	200.0		20
	Phytoplankton biomass								
	Water Clarity	Total Suspended Solids	5.00	6.00	13.00	27.00	29.00		20
	Dissolved Oxygen								
	pH		6.6	7.1	7.5	7.9	8.1		20
No Data	146	Butler Creek	Upland Streams	**0**					

No Data	85	Camp Oven Creek		Lowland streams	**0**							
No Data	84	Camp Oven Creek		Mid-estuarine	**0**							
	176	Campus Creek	Lowland streams	**100**								
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**			
		Nitrogen	Nitrogen (organic)	158.1	191.2	195.0	300.2	420.8		100		
			Nitrogen (oxidised)	12.2	15.8	32.8	192.8	314.5		100		
			Nitrogen (total)	217.4	296.0	299.5	507.0	992.9		100		
		Phosphorus	Phosphorus (filterable reactive)	25.3	46.2	46.6	61.7	113.2		100		
			Phosphorus (total)	74.9	75.0	81.2	94.5	188.4		100		
		Phytoplankton biomass										
		Water Clarity	Total Suspended Solids	0.20	1.40	2.40	25.87	49.30		100		
		Dissolved Oxygen										
		pH										
No Data	86	Cassowary Creek		Lowland streams	**0**							
No Data	87	Central Creek	Lowland streams	**0**								
No Data	148	Chinamans Gully		Lowland Streams	**0**							
No Data	147	Chinamans Gully		Mid-estuarine	**0**							
No Data	149	Chinamans Gully		Upland Streams	**0**							
No Data	89	Christmas Creek		Lowland streams	**0**							
No Data	88	Christmas Creek		Mid-estuarine	**0**							
	72	Cleveland Bay	Open coastal	**100**								
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**			
		Nitrogen	Nitrogen (ammonia)	4.0	6.0	11.0	15.0	50.0		100		
			Nitrogen (organic)	100.0	100.0	100.0	100.0	500.0		100		
			Nitrogen (oxidised)	2.0	2.0	2.0	2.0	15.0		100		
			Nitrogen (total)	106.0	109.0	116.0	126.0	526.0		100		
		Phosphorus	Phosphorus (filterable reactive)	2.0	3.0	4.0	7.0	17.0		100		
			Phosphorus (total)	5.0	10.0	20.0	20.0	58.0		100		
		Phytoplankton biomass		0.19	0.36	0.52	0.95	5.60		100		
		Water Clarity	Secchi depth	0.40	2.00	3.60	5.90	8.20		100		
			Total Suspended Solids	1.00	2.30	6.00	10.00	16.00		100		
			Turbidity	0.35	2.00	2.75	6.00	7.00		100		
		Dissolved Oxygen										
		pH		8.0	8.2	8.3	8.5	8.8		100		
	38	Cloudy Creek	Lowland streams	**20**								
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**			
		Nitrogen										
		Phosphorus										
		Phytoplankton biomass										
		Water Clarity	Turbidity	10.00		10.00		10.00		20		
		Dissolved Oxygen		97.1	0	100	0	104.9		20		
		pH		6.6		6.7		7.5		20		
No Data	91	Cocoa Creek	Lowland streams	**0**								
No Data	90	Cocoa Creek	Mid-estuarine	**0**								
No Data	92	Cocoa Creek	Upland streams	**0**								
No Data	93	Crocodile Creek	Mid-estuarine	**0**								
	8	Crystal Creek	Lowland streams	**50**								
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**			
		Nitrogen	Nitrogen (ammonia)	2.0	2.0	3.0	7.0	70.0		86		
			Nitrogen (organic)	20.0	40.0	95.0	100.0	200.0		100		
			Nitrogen (oxidised)	2.0	4.0	11.0	40.0	230.0		100		
			Nitrogen (total)	34.0	85.0	107.5	127.0	275.0		100		
		Phosphorus	Phosphorus (filterable reactive)	2.0	2.0	2.0	10.0	30.0		83		
			Phosphorus (total)	2.0	2.0	4.0	8.0	38.0		100		
		Phytoplankton biomass		0.10	0.50	0.50	0.70	5.10		100		
		Water Clarity	Secchi depth	0.20	0.20	0.90	2.90	3.80		100		
			Total Suspended Solids	2.00		2.00		3.00		100		
			Turbidity	0.30	0.60	1.00	2.00	14.00		63		
		Dissolved Oxygen										

		pH		5.4	6.3	6.6	6.9	7.8		79
No Data	94	Crystal Creek	Mid-estuarine	**0**						
No Data	95	Crystal Creek	Upland streams	**0**						
No Data	97	Deep Creek	Lowland streams	**0**						
	96	Deep Creek	Mid-estuarine	**100**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	10.0	10.0	20.0	40.0	240.0		100
			Nitrogen (organic)	100.0	200.0	300.0	500.0	1000.0		100
			Nitrogen (oxidised)	10.0	20.0	20.0	20.0	80.0		100
			Nitrogen (total)	130.0	230.0	330.0	530.0	1290.0		100
		Phosphorus	Phosphorus (total)	10.0	20.0	20.0	60.0	250.0		100
		Phytoplankton biomass								
		Water Clarity	Secchi depth	0.10	0.20	0.60	1.00	2.40		100
			Total Suspended Solids	2.00	7.00	12.00	22.00	91.00		100
			Turbidity	1.30	3.50	5.40	9.00	60.00		100
		Dissolved Oxygen								
		pH		6.3	7.9	8.1	8.2	8.6		100
No Data	98	Dick Creek	Lowland streams	**0**						
No Data	99	Double Barrel Creek		Upland streams			**0**			
No Data	173	Duck Creek	Lowland streams	**0**						
No Data	174	Duck Creek	Mid-estuarine	**0**						
No Data	175	Duck Creek	Upland streams	**0**						
	73	Endeavour Creek		Lowland streams			**20**			
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	20.0	20.0	20.0	30.0	40.0		20
			Nitrogen (oxidised)	20.0	30.0	50.0	90.0	210.0		20
			Nitrogen (total)	160.0	200.0	250.0	320.0	410.0		20
		Phosphorus	Phosphorus (filterable reactive)	10.0	10.0	10.0	20.0	30.0		20
			Phosphorus (total)	10.0	10.0	10.0	80.0	130.0		20
		Phytoplankton biomass								
		Water Clarity	Total Suspended Solids	1.00	5.00	10.00	67.00	106.00		20
		Dissolved Oxygen								
		pH		5.6	5.8	6.1	6.5	6.8		20
	150	Endeavour Creek		Mid-estuarine			**20**			
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	20.0	20.0	20.0	40.0	90.0		20
			Nitrogen (oxidised)	10.0	20.0	25.0	50.0	80.0		20
			Nitrogen (total)	130.0	210.0	485.0	780.0	850.0		20
		Phosphorus	Phosphorus (filterable reactive)	10.0	10.0	10.0	20.0	50.0		20
			Phosphorus (total)	10.0	10.0	10.0	70.0	100.0		20
		Phytoplankton biomass								
		Water Clarity	Total Suspended Solids	7.00		33.00		111.00		20
		Dissolved Oxygen								
		pH		5.7	5.8	5.9	6.3	6.9		20
No Data	151	Endeavour Creek		Upland Streams			**0**			
	66	Esplanade	Lowland streams	**100**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	10.0	10.0	20.0	30.0	50.0		100
			Nitrogen (organic)	100.0	100.0	300.0	600.0	1200.0		100
			Nitrogen (oxidised)	10.0	10.0	10.0	20.0	100.0		100
			Nitrogen (total)	120.0	200.0	345.0	640.0	1230.0		100
		Phosphorus	Phosphorus (total)	10.0	30.0	40.0	60.0	120.0		100
		Phytoplankton biomass								
		Water Clarity								
		Dissolved Oxygen								
		pH								
	11	Gordon Creek	Lowland streams	**95**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	

	Nitrogen	Nitrogen (organic)	218.8	319.5	401.5	441.0	490.6		100
		Nitrogen (oxidised)	54.0	93.2	140.3	200.2	338.0		100
		Nitrogen (total)	469.0	570.0	694.0	833.4	1010.0		100
	Phosphorus	Phosphorus (filterable reactive)	17.8	46.3	123.8	130.6	155.0		100
		Phosphorus (total)	93.9	163.1	197.1	267.8	325.7		100
	Phytoplankton biomass								
	Water Clarity	Total Suspended Solids	85.00	89.50	351.30	600.50	1568.00		100
	Dissolved Oxygen								
	pH		3.5	6.1	7.0	7.5	8.1		20

No Data	153	Gorge Creek	Lowland Streams	**0**
No Data	152	Gorge Creek	Mid-estuarine	**0**
No Data	154	Gorge Creek	Upland Streams	**0**

				20						
	156	Gustav Creek	Lowland Streams	**Min**	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (ammonia)		20.0	20.0	20.0	40.0	640.0		20
		Nitrogen (total)		20.0	80.0	225.0	430.0	840.0		20
	Phosphorus	Phosphorus (filterable reactive)		10.0	10.0	10.0	10.0	40.0		20
		Phosphorus (total)		20.0	20.0	20.0	100.0	500.0		20
	Phytoplankton biomass									
	Water Clarity	Total Suspended Solids		1.00	1.00	7.00	16.00	103.00		20
	Dissolved Oxygen									
	pH			6.0	6.3	6.6	7.3	8.0		20

No Data	155	Gustav Creek	Mid-estuarine	**0**
No Data	157	Gustav Creek	Upland Streams	**0**
No Data	12	Healy Creek	Lowland streams	**0**

				100						
	101	Healy Creek	Mid-estuarine	**Min**	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (ammonia)		10.0	10.0	20.0	30.0	18000.0		100
		Nitrogen (organic)		30.0	200.0	300.0	500.0	1000.0		100
		Nitrogen (oxidised)		20.0	20.0	20.0	40.0	1500.0		100
		Nitrogen (total)		130.0	260.0	430.0	630.0	20500.0		100
	Phosphorus	Phosphorus (total)		20.0	20.0	20.0	50.0	740.0		100
	Phytoplankton biomass									
	Water Clarity	Secchi depth		0.10	0.30	0.60	0.80	1.20		100
		Total Suspended Solids		3.00	12.00	15.00	20.00	150.00		100
		Turbidity		2.00	4.40	6.30	10.00	65.00		100
	Dissolved Oxygen									
	pH			6.5	7.7	7.9	8.2	8.3		100

				100						
	13	Hencamp Creek	Lowland streams	**Min**	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (ammonia)		10.0	10.0	10.0	20.0	40.0		100
		Nitrogen (organic)		59.0	197.9	300.0	440.4	900.0		100
		Nitrogen (oxidised)		3.0	20.0	20.0	68.1	106.8		100
		Nitrogen (total)		103.0	250.0	340.0	530.0	940.0		100
	Phosphorus	Phosphorus (filterable reactive)		1.5	2.9	5.1	10.6	19.4		100
		Phosphorus (total)		13.4	20.0	20.0	32.9	50.0		100
	Phytoplankton biomass			2.60		3.15		3.70		100
	Water Clarity	Secchi depth		0.40		0.40		1.20		100
		Total Suspended Solids		0.30	4.00	9.30	32.00	80.80		100
		Turbidity		2.40	3.30	4.00	12.00	22.00		100
	Dissolved Oxygen									
	pH			7.8		7.9		8.4		100

				100						
	102	Hencamp Creek	Mid-estuarine	**Min**	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (ammonia)		10.0	10.0	15.0	20.0	40.0		100
		Nitrogen (organic)		200.0	200.0	300.0	400.0	1000.0		100
		Nitrogen (oxidised)		20.0	20.0	20.0	20.0	20.0		100

			Nitrogen (total)	230.0	230.0	330.0	460.0	1040.0		100
		Phosphorus	Phosphorus (total)	20.0	20.0	20.0	40.0	70.0		100
		Phytoplankton biomass		2.10		2.40		2.70		100
		Water Clarity	Secchi depth	0.30		0.35		0.80		100
			Total Suspended Solids	5.00	7.00	14.00	17.00	40.00		100
			Turbidity	2.50	3.70	4.50	13.00	18.00		100
		Dissolved Oxygen								
		pH		8.0		8.1		8.4		100
No Data	103	Hencamp Creek	Upland streams	**0**						
	49	Horseshoe Bay	Lowland streams	**20**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	20.0	20.0	875.0	1800.0	6700.0		20
			Nitrogen (oxidised)	10.0	30.0	50.0	130.0	890.0		20
			Nitrogen (total)	900.0	1400.0	2000.0	2500.0	8100.0		20
		Phosphorus	Phosphorus (filterable reactive)	10.0	10.0	20.0	110.0	690.0		20
			Phosphorus (total)	70.0	120.0	240.0	1800.0	6100.0		20
		Phytoplankton biomass								
		Water Clarity	Total Suspended Solids	1.00	17.00	88.00	237.00	720.00		20
		Dissolved Oxygen								
		pH		5.7	5.8	6.6	7.0	7.2		20
	171	Horseshoe Bay	Open coastal	**100**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen								
		Phosphorus	Phosphorus (filterable reactive)	2.8		2.8		2.8		100
		Phytoplankton biomass		0.45		0.45		0.45		100
		Water Clarity	Total Suspended Solids	4.14		4.14		4.14		100
		Dissolved Oxygen								
		pH								
No Data	104	Killymoon Creek		Lowland streams			**0**			
No Data	105	Lansdowne Creek		Lowland streams			**0**			
	15	Leichhardt Creek		Lowland streams			**71**			
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	10.0	10.0	10.0	10.0	20.0		100
			Nitrogen (organic)	100.0	100.0	300.0	400.0	400.0		100
			Nitrogen (oxidised)	20.0	20.0	20.0	20.0	20.0		100
			Nitrogen (total)	130.0	130.0	330.0	430.0	440.0		100
		Phosphorus	Phosphorus (total)	20.0	20.0	20.0	40.0	60.0		100
		Phytoplankton biomass		4.90		4.90		4.90		100
		Water Clarity	Secchi depth	0.60		1.00		1.40		100
			Total Suspended Solids	5.00	5.00	6.50	12.00	12.00		100
			Turbidity	2.40	3.00	3.00	5.00	7.00		100
		Dissolved Oxygen		48	53.9	66.8	82.8	98.9		20
		pH		6.0	6.5	6.8	7.3	8.0		32
	106	Leichhardt Creek		Mid-estuarine		**100**				
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	10.0	10.0	10.0	20.0	30.0		100
			Nitrogen (organic)	200.0	200.0	250.0	400.0	700.0		100
			Nitrogen (oxidised)	20.0	20.0	20.0	20.0	30.0		100
			Nitrogen (total)	230.0	230.0	290.0	440.0	730.0		100
		Phosphorus	Phosphorus (total)	20.0	20.0	20.0	70.0	130.0		100
		Phytoplankton biomass		1.10		1.25		1.40		100
		Water Clarity	Secchi depth	0.40	0.50	0.55	0.80	1.00		100
			Total Suspended Solids	4.00	8.00	9.50	14.00	45.00		100
			Turbidity	2.40	2.80	4.25	6.30	7.80		100
		Dissolved Oxygen								
		pH		7.8	8.1	8.1	8.4	8.5		100
No Data	107	Leichhardt Creek		Upland streams			**0**			
No Data	108	Little Bohle River		Lowland streams			**0**			
	45	Little Crystal Creek		Lowland streams			**20**			
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	

		Nitrogen								
		Phosphorus								
		Phytoplankton biomass								
		Water Clarity	Turbidity	10.00		10.00		10.00		20
		Dissolved Oxygen		85	95.8	98.5	105.2	106.6		20
		pH		7.0	7.1	7.2	7.8	7.8		20
No Data	109	Little Crystal Creek		Upland streams			**0**			
No Data	110	Log Creek	Lowland streams	**0**						
No Data	112	Lorna Creek	Lowland streams	**0**						
No Data	111	Lorna Creek	Mid-estuarine	**0**						
	46	Louisa Creek	Lowland streams	**94**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	2.0	30.0	600.0	6300.0	100000.0		100
			Nitrogen (organic)	100.0	400.0	1000.0	3000.0	18000.0		100
			Nitrogen (oxidised)	2.0	30.0	265.0	1500.0	16000.0		100
			Nitrogen (total)	140.0	590.0	2130.0	12200.0	32000.0		100
		Phosphorus	Phosphorus (filterable reactive)	18.2	86.3	158.8	890.0	2700.0		100
			Phosphorus (total)	20.0	180.0	685.0	3600.0	9300.0		100
		Phytoplankton biomass		0.90	3.40	8.40	17.00	84.20		100
		Water Clarity	Secchi depth	0.10	0.20	0.40	0.60	1.00		100
			Total Suspended Solids	2.60	14.00	25.00	54.00	410.00		100
			Turbidity	2.00	10.00	15.00	25.00	999.00		53
		Dissolved Oxygen		-1.4	1.9	13.5	48.6	206		20
		pH		5.5	6.7	7.1	7.6	9.3		39
No Data	37	Marine	Open coastal	**0**						
	113	Middle Bohle Creek		Lowland streams			**100**			
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen								
		Phosphorus								
		Phytoplankton biomass								
		Water Clarity	Total Suspended Solids	5.00	10.00	10.00	320.00	428.00		100
			Turbidity	7.00	13.00	22.00	43.00	94.00		100
		Dissolved Oxygen								
		pH		6.6	6.8	7.0	7.5	8.1		100
	167	Middle Reef	Open coastal	**100**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	2.3		3.0		3.7		100
		Phosphorus	Phosphorus (filterable reactive)	2.0		2.8		5.0		100
		Phytoplankton biomass		0.39	0.42	0.54	0.73	1.47		100
		Water Clarity	Secchi depth	1.00		1.50		3.50		100
			Total Suspended Solids	3.53		4.20		10.11		100
		Dissolved Oxygen								
		pH								
	48	Mundy Creek	Lowland streams	**95**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (organic)	243.6	293.5	359.2	491.0	555.6		100
			Nitrogen (oxidised)	4.0	15.4	71.6	161.0	590.6		100
			Nitrogen (total)	456.5	479.0	642.0	938.3	1350.0		100
		Phosphorus	Phosphorus (filterable reactive)	82.9	97.8	137.9	161.9	165.5		100
			Phosphorus (total)	147.0	161.9	245.0	280.8	322.2		100
		Phytoplankton biomass								
		Water Clarity	Total Suspended Solids	2.90	4.40	14.86	21.07	41.80		100
		Dissolved Oxygen								
		pH		6.5	6.5	6.5	6.6	7.2		20
No Data	159	Ned Lee Creek	Lowland Streams	**0**						
No Data	158	Ned Lee Creek	Mid-estuarine	**0**						
No Data	160	Ned Lee Creek	Upland Streams	**0**						
No Data	67	Nelly Bay	Lowland streams	**0**						

	169	Nelly Bay	Open coastal	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen									
		Phosphorus									
		Phytoplankton biomass		0.20	0.46	1.09	4.07	15.06		100	
		Water Clarity									
		Dissolved Oxygen									
		pH									
No Data	115	Ollera Creek	Lowland streams	**0**							
No Data	114	Ollera Creek	Mid-estuarine	**0**							
No Data	116	Ollera Creek	Upland streams	**0**							
	172	Pandora Reef	Open coastal	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	0.3		0.3		4.1		100	
		Phosphorus	Phosphorus (filterable reactive)	1.1	1.8	2.1	3.3	3.6		100	
		Phytoplankton biomass		0.14	0.25	0.30	0.59	0.91		100	
		Water Clarity	Secchi depth	4.00	4.00	6.00	6.50	9.00		100	
			Total Suspended Solids	0.43	1.27	1.31	2.72	4.28		100	
		Dissolved Oxygen									
		pH									
No Data	162	Petersen Creek	Lowland Streams	**0**							
No Data	161	Petersen Creek	Mid-estuarine	**0**							
No Data	163	Petersen Creek	Upland Streams	**0**							
No Data	52	Picnic Bay	Lowland streams	**0**							
	168	Picnic Bay	Open coastal	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	3.3		3.3		3.3		100	
		Phosphorus	Phosphorus (filterable reactive)	1.2		2.5		3.8		100	
		Phytoplankton biomass		0.43		0.96		1.49		100	
		Water Clarity	Secchi depth	2.50		4.25		6.00		100	
			Total Suspended Solids	2.21		2.48		2.74		100	
		Dissolved Oxygen									
		pH									
	53	Pine Creek	Lowland streams	**20**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen									
		Phosphorus									
		Phytoplankton biomass									
		Water Clarity									
		Dissolved Oxygen		7.57	71.4	75.8	81.4	102.2		20	
		pH		5.7	6.3	6.3	6.4	7.5		20	
No Data	117	Pine Creek	Upland streams	**0**							
No Data	165	Retreat Creek	Lowland Streams	**0**							
No Data	164	Retreat Creek	Mid-estuarine	**0**							
No Data	166	Retreat Creek	Upland Streams	**0**							
	17	Rollingstone Creek		Lowland streams			**68**				
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	10.0	10.0	20.0	20.0	40.0		100	
			Nitrogen (organic)	300.0	300.0	300.0	300.0	500.0		100	
			Nitrogen (oxidised)	20.0	20.0	20.0	30.0	50.0		100	
			Nitrogen (total)	330.0	330.0	350.0	390.0	530.0		100	
		Phosphorus	Phosphorus (total)	20.0	20.0	20.0	20.0	60.0		100	
		Phytoplankton biomass		0.90		0.90		0.90		100	
		Water Clarity	Secchi depth	0.60		0.80		1.50		100	
			Total Suspended Solids	3.00	5.00	7.00	13.00	25.00		100	
			Turbidity	2.00	2.50	2.85	7.60	12.00		100	
		Dissolved Oxygen		68.9	75	81.25	108.1	113.5		20	
		pH		5.5	6.3	6.6	8.0	8.4		37	
	118	Rollingstone Creek		Mid-estuarine		**100**					
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	10.0	10.0	20.0	40.0	70.0		100	

			Nitrogen (organic)	200.0	300.0	300.0	400.0	500.0		100
			Nitrogen (oxidised)	20.0	20.0	20.0	40.0	70.0		100
			Nitrogen (total)	310.0	330.0	345.0	430.0	550.0		100
		Phosphorus	Phosphorus (total)	20.0	20.0	20.0	30.0	70.0		100
		Phytoplankton biomass		2.50		2.50		2.50		100
		Water Clarity	Secchi depth	0.40		1.00		1.20		100
			Total Suspended Solids	4.00	5.00	5.50	15.00	16.00		100
			Turbidity	2.50	2.50	3.40	7.00	11.00		100
		Dissolved Oxygen								
		pH		7.9		8.1		8.4		100
No Data	119	Rollingstone Creek		Upland streams			**0**			
No Data	120	Rollingstone Creek (East		Lowland streams			**0**			
No Data	121	Rollingstone Creek (East		Upland streams			**0**			
	19	Ross Creek	Mid-estuarine	**99**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	2.0	9.0	20.0	60.0	680.0		100
			Nitrogen (organic)	20.0	164.2	228.5	400.0	1700.0		100
			Nitrogen (oxidised)	1.0	10.0	27.3	56.5	561.7		100
			Nitrogen (total)	37.9	177.5	287.7	478.4	2390.0		100
		Phosphorus	Phosphorus (filterable reactive)	2.8	11.4	18.0	29.8	230.9		100
			Phosphorus (total)	0.0	9.3	21.9	80.0	1500.0		100
		Phytoplankton biomass		1.10	1.40	6.00	9.00	11.60		100
		Water Clarity	Secchi depth	0.10	0.20	0.35	1.00	3.20		100
			Total Suspended Solids	4.00	11.00	20.00	27.00	42.00		100
			Turbidity	2.20	3.50	5.50	7.00	12.00		100
		Dissolved Oxygen		75.8	84.6	90.3	93.1	107		100
		pH		6.6	7.8	8.0	8.2	8.8		97
	71	Ross Offshore	Open coastal	**100**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	10.0	10.0	30.0	50.0	900.0		100
			Nitrogen (organic)	100.0	200.0	300.0	500.0	2000.0		100
			Nitrogen (oxidised)	10.0	10.0	10.0	10.0	30.0		100
			Nitrogen (total)	120.0	230.0	360.0	530.0	2110.0		100
		Phosphorus	Phosphorus (total)	10.0	20.0	40.0	60.0	700.0		100
		Phytoplankton biomass								
		Water Clarity								
		Dissolved Oxygen								
		pH								
	31	Ross River	Lowland streams	**76**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	20.0	20.0	20.0	30.0	260.0		22
			Nitrogen (organic)	207.1	250.2	318.2	332.5	502.3		100
			Nitrogen (oxidised)	9.4	46.9	94.3	120.9	125.0		100
			Nitrogen (total)	394.0	490.0	513.4	625.2	882.5		100
		Phosphorus	Phosphorus (filterable reactive)	7.7	10.0	10.0	21.0	50.0		31
			Phosphorus (total)	20.0	38.8	65.4	161.8	174.4		100
		Phytoplankton biomass								
		Water Clarity	Secchi depth	0.20	0.20	0.40	0.60	1.60		100
			Total Suspended Solids	6.50	15.00	59.10	212.00	328.00		100
			Turbidity	0.50	2.30	4.00	48.00	118.00		20
		Dissolved Oxygen								
		pH		6.2	7.3	7.7	8.0	9.2		47
	122	Ross River	Mid-estuarine	**100**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	2.0	10.0	20.0	50.0	10000.0		100
			Nitrogen (organic)	100.0	200.0	400.0	600.0	5000.0		100
			Nitrogen (oxidised)	2.0	13.0	20.0	25.0	110.0		100
			Nitrogen (total)	10.0	219.0	405.0	650.0	5070.0		100

	Phosphorus	Phosphorus (filterable reactive)	2.0	7.0	11.5	16.0	79.0		100
		Phosphorus (total)	7.0	30.0	40.0	70.0	1700.0		100
	Phytoplankton biomass		0.80	1.20	2.10	4.30	17.30		100
	Water Clarity	Secchi depth	0.10	0.20	0.40	1.00	3.00		100
		Total Suspended Solids	1.00	8.00	15.00	25.00	170.00		100
		Turbidity	1.00	3.00	4.75	9.00	184.00		100
	Dissolved Oxygen								
	pH		6.1	7.6	7.9	8.1	8.7		100

	20	Ross River Dam	Freshwater lakes			**56**			
			Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (ammonia)	8.0	10.0	20.0	60.0	10000.0		85
		Nitrogen (organic)	10.0	360.0	500.0	700.0	70000.0		100
		Nitrogen (oxidised)	1.0	10.0	20.0	30.0	15000.0		100
		Nitrogen (total)	10.0	420.0	560.0	830.0	2580.0		100
	Phosphorus	Phosphorus (filterable reactive)	10.0	10.0	14.8	50.0	80.0		25
		Phosphorus (total)	10.0	20.0	30.0	50.0	230.0		100
	Phytoplankton biomass		1.10	3.40	6.95	10.10	22.10		100
	Water Clarity	Secchi depth	1.00	1.20	1.60	2.20	3.40		100
		Total Suspended Solids	1.00	1.00	2.00	5.00	458.00		100
		Turbidity	0.50	2.00	3.10	7.10	85.80		76
	Dissolved Oxygen								
	pH		6.7	7.2	7.5	8.0	8.3		44

	69	Ross River Nearshore	Enclosed coastal			**100**			
			Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (ammonia)	10.0	10.0	40.0	80.0	2200.0		100
		Nitrogen (organic)	100.0	100.0	250.0	400.0	900.0		100
		Nitrogen (oxidised)	10.0	10.0	10.0	10.0	20.0		100
		Nitrogen (total)	10.0	10.0	230.0	500.0	940.0		100
	Phosphorus	Phosphorus (total)	20.0	20.0	50.0	80.0	100.0		100
	Phytoplankton biomass								
	Water Clarity	Secchi depth	0.20	0.20	0.20	0.20	0.20		100
	Dissolved Oxygen								
	pH		6.2	7.9	8.2	8.3	8.6		100

	21	Sachs Creek	Lowland streams			**72**			
			Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (organic)	136.7	163.5	248.0	318.7	503.6		100
		Nitrogen (oxidised)	40.0	48.0	181.0	360.4	522.9		100
		Nitrogen (total)	245.3	268.5	564.0	798.0	956.0		100
	Phosphorus	Phosphorus (filterable reactive)	14.8	19.1	29.1	39.2	114.8		100
		Phosphorus (total)	25.6	31.6	49.7	78.3	215.0		100
	Phytoplankton biomass								
	Water Clarity	Total Suspended Solids	1.30	1.60	7.10	17.00	268.00		100
		Turbidity	2.00	3.50	11.75	28.00	200.00		20
	Dissolved Oxygen		23.4	54.6	77.6	93	191.8		20
	pH		4.7	6.8	7.1	7.6	8.9		20

	55	Saltwater Creek	Lowland streams			**71**			
			Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (ammonia)	2.0	2.0	9.0	23.0	100.0		100
		Nitrogen (organic)	100.0	100.0	200.0	400.0	800.0		100
		Nitrogen (oxidised)	1.0	1.0	3.0	20.0	90.0		100
		Nitrogen (total)	103.0	113.0	244.0	510.0	830.0		100
	Phosphorus	Phosphorus (filterable reactive)	3.0	5.0	5.0	5.0	12.0		100
		Phosphorus (total)	20.0	20.0	20.0	40.0	190.0		100
	Phytoplankton biomass		0.50	0.50	2.00	8.70	39.40		100
	Water Clarity	Secchi depth	0.10	0.20	0.20	0.60	0.80		100
		Total Suspended Solids	3.00	7.00	12.00	18.00	94.00		100
		Turbidity	1.50	3.50	6.00	20.00	41.00		78
	Dissolved Oxygen		4.79	73.6	81.3	89.3	154.1		20
	pH		6.7	7.9	8.1	8.3	8.5		38

	123	Saltwater Creek	Mid-estuarine	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	2.0	4.0	11.0	24.0	190.0		100	
			Nitrogen (organic)	100.0	100.0	200.0	600.0	2000.0		100	
			Nitrogen (oxidised)	1.0	1.0	5.0	15.0	70.0		100	
			Nitrogen (total)	103.0	114.0	230.0	600.0	2030.0		100	
		Phosphorus	Phosphorus (filterable reactive)	2.0	5.0	5.0	9.0	22.0		100	
			Phosphorus (total)	20.0	20.0	20.0	50.0	260.0		100	
		Phytoplankton biomass		0.10	0.50	1.80	10.60	83.40		100	
		Water Clarity	Secchi depth	0.10	0.20	0.20	0.40	1.00		100	
			Total Suspended Solids	1.00	9.00	15.00	26.00	154.00		100	
			Turbidity	1.00	3.80	6.00	10.00	18.00		100	
		Dissolved Oxygen									
		pH		6.5	7.7	8.1	8.3	8.5		100	
No Data	124	Saltwater Creek	Upland streams	**0**							
	56	Sandfly Creek	Lowland streams	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	10.0	60.0	415.0	1900.0	3600.0		100	
			Nitrogen (organic)	500.0	1100.0	1450.0	2800.0	5900.0		100	
			Nitrogen (oxidised)	20.0	20.0	80.0	170.0	770.0		100	
			Nitrogen (total)	780.0	1460.0	2870.0	4800.0	9270.0		100	
		Phosphorus	Phosphorus (total)	30.0	330.0	765.0	1300.0	5400.0		100	
		Phytoplankton biomass									
		Water Clarity	Secchi depth	0.10	0.20	0.20	0.50	0.80		100	
			Total Suspended Solids	5.00	25.00	40.00	64.00	96.00		100	
			Turbidity	6.50	9.20	16.00	27.00	50.00		100	
		Dissolved Oxygen									
		pH		7.1	7.5	7.8	8.0	8.4		100	
	125	Sandfly Creek	Mid-estuarine	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	10.0	150.0	930.0	3400.0	8800.0		100	
			Nitrogen (organic)	100.0	600.0	1000.0	2600.0	5000.0		100	
			Nitrogen (oxidised)	10.0	10.0	20.0	30.0	3120.0		100	
			Nitrogen (total)	20.0	880.0	1890.0	5140.0	13020.0		100	
		Phosphorus	Phosphorus (total)	20.0	150.0	420.0	1000.0	2300.0		100	
		Phytoplankton biomass									
		Water Clarity	Secchi depth	0.10	0.20	0.30	0.60	1.00		100	
			Total Suspended Solids	5.00	11.00	20.50	36.00	117.00		100	
			Turbidity	3.20	6.00	11.00	19.00	75.00		100	
		Dissolved Oxygen									
		pH		7.2	7.5	7.9	8.0	8.6		100	
	70	Sandfly Creek	Nearshore	Enclosed coastal			**100**				
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	10.0	20.0	30.0	70.0	3000.0		100	
			Nitrogen (organic)	100.0	200.0	400.0	600.0	3500.0		100	
			Nitrogen (oxidised)	10.0	10.0	10.0	20.0	60.0		100	
			Nitrogen (total)	130.0	230.0	420.0	830.0	6560.0		100	
		Phosphorus	Phosphorus (total)	20.0	30.0	30.0	80.0	840.0		100	
		Phytoplankton biomass									
		Water Clarity	Secchi depth	2.20		2.50		3.60		100	
		Dissolved Oxygen									
		pH		7.8		7.8		8.1		100	
	32	Saunders Creek	Lowland streams	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	10.0	80.0	1500.0	3600.0	23000.0		100	

			Nitrogen (organic)	200.0	600.0	1400.0	2600.0	9000.0		100
			Nitrogen (oxidised)	20.0	90.0	1900.0	13000.0	17000.0		100
			Nitrogen (total)	360.0	1330.0	6800.0	13820.0	49000.0		100
		Phosphorus	Phosphorus (total)	60.0	160.0	5050.0	6900.0	8700.0		100
		Phytoplankton biomass		0.70	1.90	7.20	21.70	121.40		100
		Water Clarity	Secchi depth	0.20	0.20	0.20	0.20	0.20		100
			Total Suspended Solids	1.00	7.00	14.50	52.00	836.00		100
			Turbidity	1.50	3.00	6.50	105.00	550.00		100
		Dissolved Oxygen								
		pH		6.0	6.3	7.0	7.4	7.4		100
No Data	127	Scrubby Creek	Lowland streams	**0**						
No Data	126	Scrubby Creek	Mid-estuarine	**0**						
No Data	128	Scrubby Creek	Upland streams	**0**						
	58	Sleeper Log Creek		Lowland streams			**76**			
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	2.0	2.0	8.0	10.0	50.0		100
			Nitrogen (organic)	100.0	100.0	200.0	400.0	700.0		100
			Nitrogen (oxidised)	1.0	1.0	6.0	20.0	30.0		100
			Nitrogen (total)	103.0	137.0	240.0	470.0	730.0		100
		Phosphorus	Phosphorus (filterable reactive)	5.0	5.0	5.0	7.0	22.0		100
			Phosphorus (total)	20.0	20.0	30.0	60.0	160.0		100
		Phytoplankton biomass		0.50	0.60	1.50	4.10	8.30		100
		Water Clarity	Secchi depth	0.10	0.20	0.40	0.60	0.70		100
			Total Suspended Solids	4.00	12.00	17.50	28.00	130.00		100
			Turbidity	1.80	4.50	7.00	11.00	70.00		91
		Dissolved Oxygen		10.1	40.9	65.05	92.8	106.9		20
		pH		5.7	6.4	6.8	8.2	8.4		53
	129	Sleeper Log Creek		Mid-estuarine			**100**			
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	2.0	2.0	8.5	23.0	60.0		100
			Nitrogen (organic)	10.0	100.0	200.0	400.0	700.0		100
			Nitrogen (oxidised)	1.0	2.0	9.0	20.0	50.0		100
			Nitrogen (total)	13.0	118.0	260.0	400.0	780.0		100
		Phosphorus	Phosphorus (filterable reactive)	5.0	5.0	5.0	9.0	13.0		100
			Phosphorus (total)	20.0	20.0	20.0	60.0	120.0		100
		Phytoplankton biomass		0.50	0.50	1.10	1.90	4.30		100
		Water Clarity	Secchi depth	0.20	0.20	0.40	1.00	1.50		100
			Total Suspended Solids	2.00	11.00	16.00	23.00	102.00		100
			Turbidity	1.50	3.00	5.40	10.00	20.00		100
		Dissolved Oxygen								
		pH		7.0	7.8	8.1	8.4	8.4		100
No Data	130	Sleeper Log Creek		Upland streams			**0**			
No Data	131	Slippery Rocks Creek		Lowland streams			**0**			
No Data	133	Station Creek	Lowland streams	**0**						
No Data	132	Station Creek	Mid-estuarine	**0**						
No Data	134	Station Creek	Upland streams	**0**						
	22	Stoney Creek	Mid-estuarine	**100**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	2.0	6.0	10.0	22.0	50.0		100
			Nitrogen (organic)	30.0	140.0	198.0	310.0	669.0		100
			Nitrogen (oxidised)	2.0	2.0	3.0	63.0	160.0		100
			Nitrogen (total)	48.0	179.0	259.0	364.0	710.0		100
		Phosphorus	Phosphorus (filterable reactive)	4.0	22.0	45.0	75.0	98.0		100
			Phosphorus (total)	29.0	68.0	97.5	130.0	150.0		100
		Phytoplankton biomass		0.50	2.10	3.10	5.60	17.00		100
		Water Clarity	Secchi depth	0.10	0.20	0.40	0.60	1.10		100
			Turbidity	4.00	10.00	16.50	53.00	265.00		100
		Dissolved Oxygen								
		pH		6.9	7.7	7.9	8.1	8.8		100
	33	Stuart Creek	Lowland streams	**98**						

				Min	20th	Med	80th	Max	Confid.	
	Nitrogen	Nitrogen (ammonia)		10.0	10.0	20.0	60.0	1200.0		98
		Nitrogen (organic)		76.9	272.1	500.0	1200.0	4100.0		100
		Nitrogen (oxidised)		3.1	20.0	20.0	131.2	1500.0		100
		Nitrogen (total)		230.0	508.0	708.0	1330.0	4140.0		100
	Phosphorus	Phosphorus (filterable reactive)		8.0	54.5	78.5	100.4	180.0		97
		Phosphorus (total)		20.0	20.0	130.0	254.2	2000.0		100
	Phytoplankton biomass									
	Water Clarity	Secchi depth		0.20	0.20	0.20	0.20	0.20		100
		Total Suspended Solids		1.00	12.00	51.95	211.00	662.00		99
		Turbidity		1.00	2.00	5.00	15.00	130.00		98
	Dissolved Oxygen									
	pH			6.3	6.9	7.3	7.7	9.1		85

No Data	135	Stuart Creek	Mid-estuarine	**0**	
No Data	137	Surveyors Creek	Lowland streams	**0**	
No Data	136	Surveyors Creek	Mid-estuarine	**0**	
No Data	138	Surveyors Creek	Upland streams	**0**	

	60	The Lakes	Mid-estuarine	**70**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (ammonia)		2.0	20.0	30.0	70.0	770.0		27
		Nitrogen (organic)		30.0	200.0	400.0	509.2	1000.0		100
		Nitrogen (oxidised)		1.0	5.0	20.0	70.0	290.0		47
		Nitrogen (total)		48.0	303.0	518.0	709.0	1000.0		95
	Phosphorus	Phosphorus (filterable reactive)		5.0	10.0	26.0	90.0	650.0		27
		Phosphorus (total)		20.0	30.0	60.0	150.0	670.0		95
	Phytoplankton biomass			0.50	5.00	20.50	32.60	1071.00		23
	Water Clarity	Secchi depth		0.20	0.20	0.30	1.00	1.80		100
		Total Suspended Solids		6.00	10.90	17.00	26.00	78.00		96
		Turbidity		1.00	3.70	7.10	16.00	9999.99		27
	Dissolved Oxygen			52.1	69.9	84.6	114.6	132.1		20
	pH			4.0	7.3	7.8	8.3	10.1		21
	61	Toms Creek	Lowland streams	**20**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen									
	Phosphorus									
	Phytoplankton biomass									
	Water Clarity									
	Dissolved Oxygen			82.7	98.1	102.45	112	122		20
	pH			6.6	6.8	6.8	7.0	7.2		20

No Data	139	Toms Creek	Upland streams	**0**	

	62	Townsville Harbour		Enclosed coastal			**100**			
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (ammonia)		3.0	10.0	15.0	30.0	130.0		100
		Nitrogen (organic)		100.0	100.0	100.0	400.0	1500.0		100
		Nitrogen (oxidised)		2.0	2.0	8.0	10.0	70.0		100
		Nitrogen (total)		10.0	114.0	160.0	420.0	1542.0		100
	Phosphorus	Phosphorus (filterable reactive)		2.0	3.0	5.0	11.0	88.0		100
		Phosphorus (total)		6.0	17.0	23.0	40.0	140.0		100
	Phytoplankton biomass			0.50	1.00	1.50	2.70	7.10		100
	Water Clarity	Secchi depth		0.20	0.60	1.00	1.60	3.20		100
		Total Suspended Solids		2.00	5.00	7.50	12.00	22.00		100
		Turbidity		0.25	1.00	3.00	4.50	10.00		100
	Dissolved Oxygen									
	pH			6.3	8.1	8.2	8.3	8.9		100
	63	Two Mile Creek	Lowland streams	**100**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
	Nitrogen	Nitrogen (ammonia)		2.0	3.0	9.0	14.0	31.0		100
		Nitrogen (organic)		100.0	100.0	200.0	300.0	300.0		100
		Nitrogen (oxidised)		1.0	1.0	10.0	20.0	30.0		100
		Nitrogen (total)		112.0	160.0	228.0	344.0	350.0		100

		Phosphorus	Phosphorus (filterable reactive)	5.0	5.0	9.0	18.0	22.0		100
			Phosphorus (total)	20.0	20.0	40.0	40.0	60.0		100
		Phytoplankton biomass		0.50	0.70	1.30	2.70	4.50		100
		Water Clarity	Secchi depth	0.20		0.25		0.40		100
			Total Suspended Solids	8.00	16.00	24.50	39.00	165.00		100
			Turbidity	2.00	5.50	7.50	15.00	50.00		100
		Dissolved Oxygen								
		pH		7.3	7.4	7.5	8.2	8.3		100
	68	West Coast	Lowland streams	**20**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	20.0	20.0	20.0	40.0	100.0		20
			Nitrogen (total)	190.0	510.0	630.0	1700.0	3600.0		20
		Phosphorus	Phosphorus (filterable reactive)	10.0	10.0	10.0	20.0	40.0		20
			Phosphorus (total)	20.0	70.0	105.0	200.0	220.0		20
		Phytoplankton biomass								
		Water Clarity	Total Suspended Solids	7.00	8.00	17.00	31.00	51.00		20
		Dissolved Oxygen								
		pH		6.2	6.6	7.0	8.0	8.3		20
	24	Whites Creek	Lowland streams	**100**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	10.0	10.0	10.0	30.0	80.0		100
			Nitrogen (organic)	100.0	100.0	400.0	700.0	1000.0		100
			Nitrogen (oxidised)	20.0	20.0	20.0	20.0	20.0		100
			Nitrogen (total)	130.0	200.0	430.0	730.0	1050.0		100
		Phosphorus	Phosphorus (total)	20.0	20.0	30.0	60.0	110.0		100
		Phytoplankton biomass								
		Water Clarity	Secchi depth	0.20		0.20		0.20		100
			Total Suspended Solids	5.00	8.00	11.50	21.00	36.00		100
			Turbidity	2.50	4.50	5.10	9.00	11.00		100
		Dissolved Oxygen								
		pH		7.3	7.4	7.6	7.7	8.0		100
No Data	140	Whites Creek	Mid-estuarine	**0**						
No Data	142	Wild Boar Creek		Lowland streams			**0**			
No Data	141	Wild Boar Creek		Mid-estuarine	**0**					
No Data	143	Wild Boar Creek		Upland streams			**0**			

Appendix C

Water Quality Assessment by catchment (2004 – present)

Appendix C

Water Quality Assessment by catchment (2004-present)

	1-1	Crystal Creek	Lowland streams	**20**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	20.0	20.0	30.0	40.0	70.0		20	
		Phosphorus	Phosphorus (filterable reactive)	10.0	10.0	10.0	20.0	30.0		20	
		Water Clarity	Turbidity	0.50	0.50	0.60	1.10	1.50		20	
		pH		6.4	6.6	6.7	6.9	7.8		20	
No Data	1-2	Lorna Creek	Lowland streams	**0**							
No Data	1-3	Ollera Creek	Lowland streams	**0**							
No Data	1-4	Scrubby Creek	Lowland streams	**0**							
	1-5	Hencamp Creek	Lowland streams	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (organic)	59.0	146.8	211.3	344.0	450.1		100	
			Nitrogen (oxidised)	3.0	37.6	52.2	81.0	106.8		100	
			Nitrogen (total)	103.0	212.0	397.3	478.0	700.2		100	
		Phosphorus	Phosphorus (filterable reactive)	1.5	2.9	5.1	10.6	19.4		100	
			Phosphorus (total)	13.4	16.8	26.4	32.9	42.9		100	
		Water Clarity	Total Suspended Solids	0.30	0.80	6.40	32.50	80.80		100	
		pH									
No Data	2-1	Rollingstone Creek		Lowland streams			**0**				
No Data	2-2	Unamed	Lowland streams	**0**							
No Data	2-3	Surveyors Creek		Lowland streams			**0**				
No Data	2-4	Wild Boar Creek		Lowland streams			**0**				
No Data	2-5	Station Creek	Lowland streams	**0**							
No Data	2-6	Saltwater Creek	Lowland streams	**0**							
No Data	2-7	Cassowary Creek		Lowland streams			**0**				
No Data	2-8	Leichhardt Creek		Lowland streams			**0**				
No Data	3-1	Sleeper Log Creek		Lowland streams			**0**				
No Data	3-2	Two Mile Creek	Lowland streams	**0**							
	3-3	Bluewater Creek		Lowland streams			**86**				
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (organic)	71.8	134.1	173.5	281.6	380.2		100	
			Nitrogen (oxidised)	14.5	54.9	131.2	160.6	427.8		100	
			Nitrogen (total)	100.0	269.0	405.0	756.0	5812.0		100	
		Phosphorus	Phosphorus (filterable reactive)	2.3	4.7	5.5	8.1	11.9		100	
			Phosphorus (total)	11.0	15.2	27.0	50.3	4008.5		100	
		Water Clarity	Total Suspended Solids	0.50	4.00	5.50	48.80	239.00		100	
			Turbidity	3.00		3.50		5.00		100	
		Dissolved Oxygen	7.57	71	76.1	83.2	110.5		20		
		pH		5.7	6.3	6.3	6.4	8.3		20	
No Data	3-4	Deep Creek	Lowland streams	**0**							
	4-1	Black River	Lowland streams	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (organic)	193.1	221.9	381.9	477.7	570.9		100	
			Nitrogen (oxidised)	51.0	59.3	128.6	150.8	385.5		100	
			Nitrogen (total)	315.0	503.0	769.6	975.0	1150.0		100	
		Phosphorus	Phosphorus (filterable reactive)	22.6	28.5	37.0	43.3	127.0		100	
			Phosphorus (total)	46.6	91.9	138.8	206.3	1010.0		100	
		Water Clarity	Total Suspended Solids	8.00	105.20	198.50	322.80	710.00		100	
			Turbidity	1.00		2.00		4.00		100	
		pH		7.5		7.8		8.2		100	

No Data	4-2	Alice River	Lowland streams	**0**							
	5-1	Bohle River	Lowland streams	**93**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (organic)	125.7	271.2	346.9	512.2	686.6		100	
			Nitrogen (oxidised)	9.1	45.3	84.2	173.3	261.0		100	
			Nitrogen (total)	292.0	423.0	544.0	907.0	1590.0		100	
		Phosphorus	Phosphorus (filterable reactive)	4.8	62.0	93.8	156.9	390.2		100	
			Phosphorus (total)	79.5	127.0	166.8	270.8	949.3		100	
		Water Clarity	Total Suspended Solids	3.30	11.60	51.75	215.00	558.30		100	
			Turbidity	2.00	10.00	16.00	26.00	999.00		20	
		Dissolved Oxygen		-1.4	1.6	12.4	44.7	206		20	
		pH		5.5	6.6	6.9	7.3	9.3		20	
	5-2	Bohle River 2	Lowland streams	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (total)	664.0	683.0	1490.0	5076.0	5350.0		100	
		Phosphorus	Phosphorus (total)	1638.0	2855.5	5830.0	8900.0	8920.0		100	
		Water Clarity	Total Suspended Solids	5.00	5.00	12.00	47.00	84.00		100	
			Turbidity	5.00	6.00	12.00	25.00	94.00		100	
		pH		6.5	6.6	7.3	7.6	7.7		100	
No Data	5-3	Shelly Beach	Lowland streams	**0**							
No Data	6-1	Pallarenda	Lowland streams	**0**							
	6-2	Mundy Creek	Lowland streams	**95**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (organic)	243.6	293.5	359.2	491.0	555.6		100	
			Nitrogen (oxidised)	4.0	15.4	71.6	161.0	590.6		100	
			Nitrogen (total)	456.5	479.0	642.0	938.3	1350.0		100	
		Phosphorus	Phosphorus (filterable reactive)	82.9	97.8	137.9	161.9	165.5		100	
			Phosphorus (total)	147.0	161.9	245.0	280.8	322.2		100	
		Water Clarity	Total Suspended Solids	2.90	4.40	14.86	21.07	41.80		100	
		pH		6.5	6.5	6.5	6.6	7.2		20	
No Data	6-3	Esplanade	Lowland streams	**0**							
	6-4	Ross Creek	Lowland streams	**71**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	10.0	20.0	30.0	70.0	770.0		20	
			Nitrogen (organic)	30.2	186.2	278.3	411.6	1200.5		100	
			Nitrogen (oxidised)	5.2	25.4	50.6	103.8	561.7		94	
			Nitrogen (total)	37.9	221.6	369.6	643.0	1215.3		95	
		Phosphorus	Phosphorus (filterable reactive)	4.0	10.0	20.0	100.0	650.0		29	
			Phosphorus (total)	13.9	35.7	256.3	415.2		94		
		Phytoplankton biomass		2.20	5.00	24.00	32.60	1071.00		20	
		Water Clarity	Total Suspended Solids	8.60	9.50	24.40	35.00	63.00		75	
			Turbidity	1.00	3.60	6.59	12.20	9999.99		20	
		Dissolved Oxygen		52.1	70	84.7	114.1	132.1		21	
		pH		6.2	7.3	7.8	8.2	10.0		20	
	6-5	Ross River (btdam)		Lowland streams			**76**				
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	20.0	20.0	20.0	40.0	260.0		20	
			Nitrogen (organic)	158.1	218.8	321.6	420.8	502.3		100	
			Nitrogen (oxidised)	9.4	49.8	100.8	186.7	338.0		100	
			Nitrogen (total)	217.4	433.0	555.0	769.0	1010.0		100	
		Phosphorus	Phosphorus (filterable reactive)	7.7	10.0	14.3	39.2	155.0		44	
			Phosphorus (total)	38.8	69.5	138.9	197.1	325.7		100	
		Water Clarity	Total Suspended Solids	0.20	15.00	128.40	351.30	1568.00		100	
			Turbidity	0.50	2.30	4.00	48.00	118.00		20	
		pH		3.5	7.1	7.3	7.8	9.2		20	
	7-1	Ross River (atd)	Lowland streams	**46**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	20.0	20.0	20.0	40.0	80.0		20	
			Nitrogen (organic)	388.9		393.9		398.8		100	

			Nitrogen (oxidised)	143.2		143.6		144.1		100
			Nitrogen (total)	626.0		809.0		992.0		100
		Phosphorus	Phosphorus (filterable reactive)	10.0	10.0	14.8	50.0	80.0		25
			Phosphorus (total)	102.6		151.7		200.8		100
		Water Clarity	Total Suspended Solids	173.50		315.75		458.00		100
			Turbidity	0.50	2.80	4.15	9.20	85.80		20
		pH		6.9	7.3	7.8	8.0	8.3		20
No Data	7-2	Six Mile Creek	Lowland streams	**0**						
No Data	7-3	Toonpan Lagoon		Lowland streams			**0**			
No Data	7-4	Antill Plains Creek		Lowland streams			**0**			
	7-5	Sachs Creek	Lowland streams	**72**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (organic)	136.7	163.5	248.0	318.7	503.6		100
			Nitrogen (oxidised)	40.0	48.0	181.0	360.4	522.9		100
			Nitrogen (total)	245.3	268.5	564.0	798.0	956.0		100
		Phosphorus	Phosphorus (filterable reactive)	14.8	19.1	29.1	39.2	114.8		100
			Phosphorus (total)	25.6	31.6	49.7	78.3	215.0		100
		Water Clarity	Total Suspended Solids	1.30	1.60	7.10	17.00	268.00		100
			Turbidity	2.00	3.50	12.50	18.00	100.00		20
		Dissolved Oxygen		23.4	54.6	73	93	191.8		20
		pH		4.7	6.8	7.1	7.4	8.4		20
No Data	7-6	Mt Stuart	Lowland streams	**0**						
	8-1	Stuart Creek	Mid-estuarine	**93**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	1200.0		1200.0		1200.0		20
			Nitrogen (organic)	76.9	188.4	272.1	360.6	469.1		100
			Nitrogen (oxidised)	3.1	38.0	99.5	185.1	279.7		100
			Nitrogen (total)	282.5	454.3	624.3	752.0	1070.0		100
		Phosphorus	Phosphorus (filterable reactive)	8.0	54.5	78.5	100.4	180.0		97
			Phosphorus (total)	42.0	143.2	172.6	267.4	672.8		100
		Water Clarity	Total Suspended Solids	3.70	62.80	174.50	349.00	662.00		99
			Turbidity	64.20		64.20		64.20		20
		pH		6.3	6.7	6.7	6.9	8.0		20
No Data	8-2	Sandfly Creek	Mid-estuarine	**0**						
	9-1	Alligator Creek	Mid-estuarine	**100**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (organic)	127.1	141.4	174.1	225.8	269.0		100
			Nitrogen (oxidised)	3.6	25.1	31.4	68.7	297.0		100
			Nitrogen (total)	163.0	264.0	291.1	464.6	697.0		100
		Phosphorus	Phosphorus (filterable reactive)	2.9	8.0	14.6	32.0	74.0		100
			Phosphorus (total)	13.6	21.4	39.5	53.5	154.0		100
		Water Clarity	Total Suspended Solids	1.00	3.50	9.25	25.00	48.00		100
			Turbidity	3.00		3.00		3.00		100
		pH		6.8		6.8		6.8		100
No Data	9-2	Crocodile Creek	Lowland streams	**0**						
No Data	9-3	Cocoa Creek	Lowland streams	**0**						
No Data	9-4	Cape Cleveland	Lowland streams	**0**						
	10-1	Cockle Bay	Lowland streams	**20**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	20.0	20.0	20.0	40.0	100.0		20
			Nitrogen (total)	190.0	510.0	630.0	1700.0	3600.0		20
		Phosphorus	Phosphorus (filterable reactive)	10.0	10.0	10.0	20.0	40.0		20
			Phosphorus (total)	20.0	70.0	105.0	200.0	220.0		20
		Water Clarity	Total Suspended Solids	7.00	8.00	17.00	31.00	51.00		20
		pH		6.2	6.6	7.0	8.0	8.3		20
	10-2	Picnic Bay	Lowland streams	**20**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	

		Nitrogen	Nitrogen (ammonia)	20.0	20.0	20.0	200.0	650.0		20
			Nitrogen (total)	150.0	260.0	570.0	810.0	1500.0		20
		Phosphorus	Phosphorus (filterable reactive)	10.0	10.0	10.0	70.0	80.0		20
			Phosphorus (total)	20.0	20.0	120.0	190.0	390.0		20
		Water Clarity	Total Suspended Solids	4.00	5.00	20.00	29.00	40.00		20
		pH		6.5	6.6	7.4	7.9	8.1		20
	10-3	Nelly Bay	Lowland streams	**20**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	20.0	20.0	20.0	40.0	640.0		20
			Nitrogen (total)	20.0	80.0	225.0	430.0	840.0		20
		Phosphorus	Phosphorus (filterable reactive)	10.0	10.0	10.0	10.0	40.0		20
			Phosphorus (total)	20.0	20.0	20.0	100.0	500.0		20
		Water Clarity	Total Suspended Solids	1.00	1.00	7.00	16.00	103.00		20
		pH		6.0	6.3	6.6	7.3	8.0		20
No Data	10-4	Arcadia	Lowland streams	**0**						
No Data	10-5	Radical Bay	Lowland streams	**0**						
	10-6	Horseshoe Bay	Lowland streams	**20**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	20.0	20.0	40.0	1300.0	6700.0		20
			Nitrogen (oxidised)	10.0	20.0	50.0	100.0	890.0		20
			Nitrogen (total)	130.0	250.0	950.0	2200.0	8100.0		20
		Phosphorus	Phosphorus (filterable reactive)	10.0	10.0	10.0	30.0	690.0		20
			Phosphorus (total)	10.0	10.0	100.0	700.0	6100.0		20
		Water Clarity	Total Suspended Solids	1.00	14.00	68.50	155.00	720.00		20
		pH		5.6	5.8	6.2	6.9	7.2		20
No Data	10-7	Five Beach Bay	Lowland streams	**0**						
No Data	10-8	Rollingstone Bay		Lowland streams			**0**			
No Data	10-9	West Coast	Lowland streams	**0**						
No Data	11-01	Harbour	Enclosed coastal	**0**						
No Data	11-02	Ross River Nearshore		Enclosed coastal			**0**			
No Data	11-03	Sandfly Creek Nearshore		Enclosed coastal			**0**			
No Data	11-04	Ross Offshore	Open coastal	**0**						
	11-05	Cleveland Bay	Open coastal	**100**						
		Phosphorus	Phosphorus (filterable reactive)	3.0		3.0		3.0		100
		Phytoplankton biomass		0.32		0.32		0.32		100
		Water Clarity	Secchi depth	6.50		6.50		6.50		100
			Total Suspended Solids	2.30		2.30		2.30		100
		pH								
	11-06	Middle Reef	Open coastal	**100**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	2.3		3.0		3.7		100
		Phosphorus	Phosphorus (filterable reactive)	2.0		2.8		5.0		100
		Phytoplankton biomass		0.39	0.42	0.54	0.73	1.47		100
		Water Clarity	Secchi depth	1.00		1.50		3.50		100
			Total Suspended Solids	3.53		4.20		10.11		100
		pH								
	11-07	Picnic Bay	Open coastal	**100**						
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**	
		Nitrogen	Nitrogen (ammonia)	3.3		3.3		3.3		100
		Phosphorus	Phosphorus (filterable reactive)	1.2		2.5		3.8		100
		Phytoplankton biomass		0.43		0.96		1.49		100
		Water Clarity	Secchi depth	2.50		4.25		6.00		100
			Total Suspended Solids	2.21		2.48		2.74		100
		pH								
	11-08	Nelly Bay	Open coastal	**100**						
		Phytoplankton biomass		0.20	0.46	1.09	4.07	15.06		100
		pH								

	11-09	Arcadia	Open coastal	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	0.1		2.8		3.8		100	
		Phosphorus	Phosphorus (filterable reactive)	1.1	2.5	2.7	3.8	5.2		100	
		Phytoplankton biomass		0.41	0.47	0.63	1.12	1.66		100	
		Water Clarity	Secchi depth	2.00	2.00	2.75	5.00	7.00		100	
			Total Suspended Solids	0.63	1.53	2.35	5.15	12.93		100	
		pH									
	11-10	Horseshoe Bay	Open coastal	**100**							
		Phosphorus	Phosphorus (filterable reactive)	2.8		2.8		2.8		100	
		Phytoplankton biomass		0.45		0.45		0.45		100	
		Water Clarity	Total Suspended Solids	4.14		4.14		4.14		100	
		pH									
	11-11	Pandora Reef	Open coastal	**100**							
				Min	**20th**	**Med**	**80th**	**Max**	**Confid.**		
		Nitrogen	Nitrogen (ammonia)	0.3		0.3		4.1		100	
		Phosphorus	Phosphorus (filterable reactive)	1.1	1.8	2.1	3.3	3.6		100	
		Phytoplankton biomass		0.25	0.29	0.32	0.68	0.91		100	
		Water Clarity	Secchi depth	4.00	4.00	6.00	6.50	9.00		100	
			Total Suspended Solids	0.43	1.27	1.31	2.72	4.28		100	
		pH									
No Data	11-12	Other marine	Open coastal	**0**							

Appendix D

References

Appendix D

References

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Gunn, J., Manning, C. and Connolly, N. 2009, *Basins, Catchments and Receiving Waters of the Black and Ross River Basins Water Quality Improvement Plan Area*, Townsville City Council - Creek to Coral, Townsville

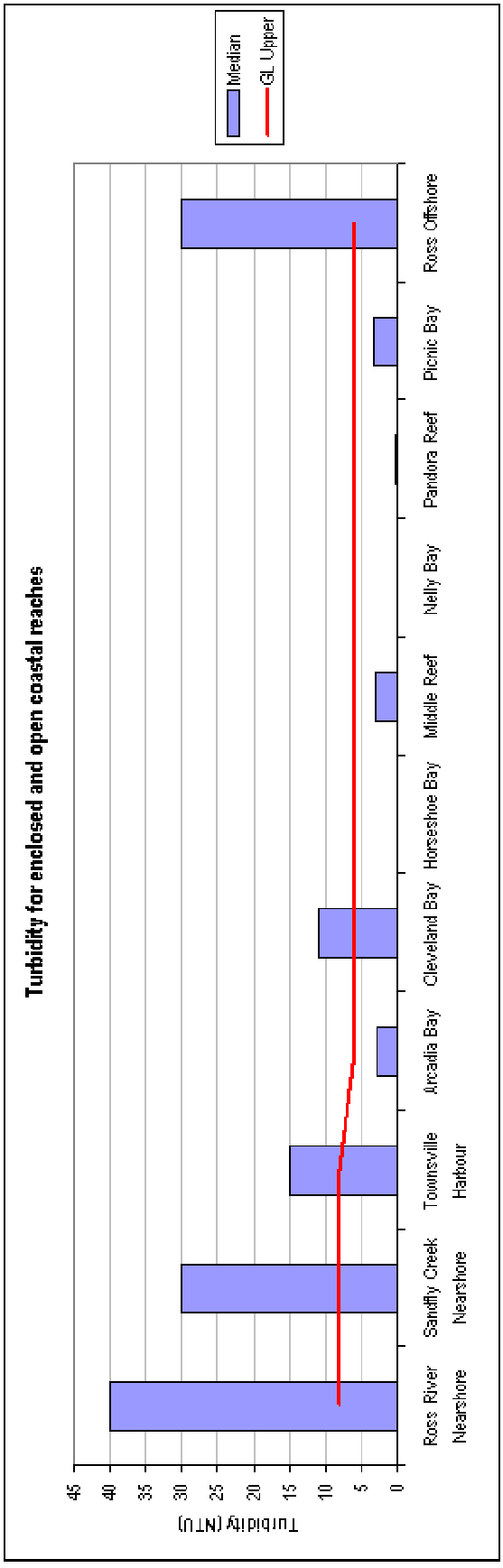
Appendix E

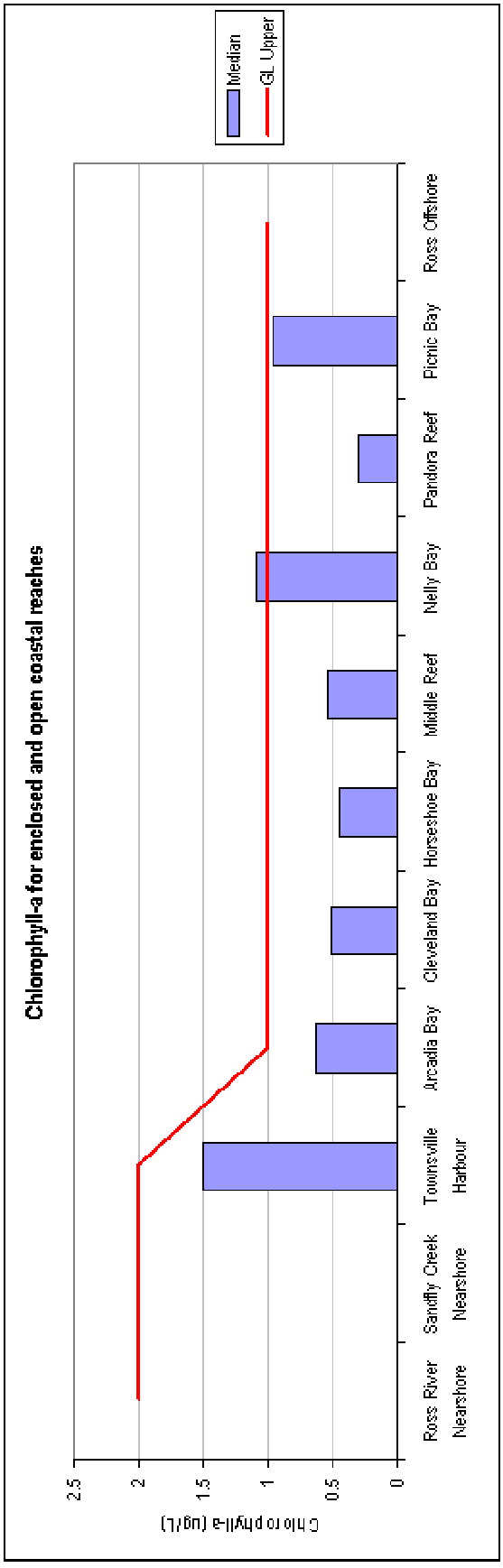
Water Quality by Parameter

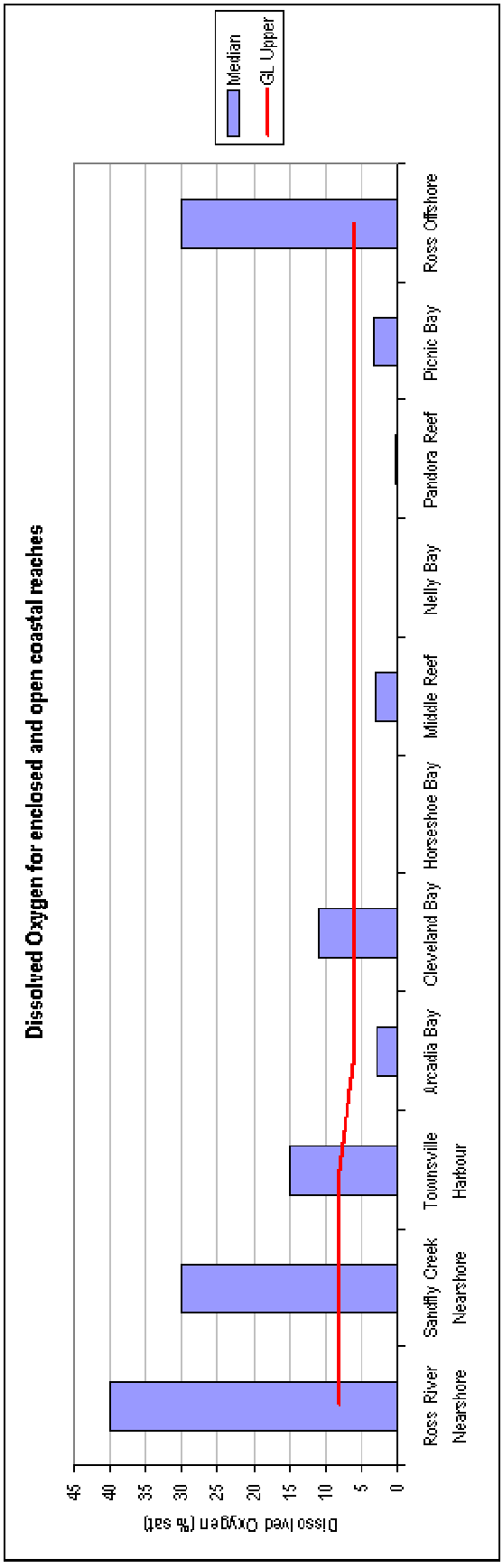
Appendix E

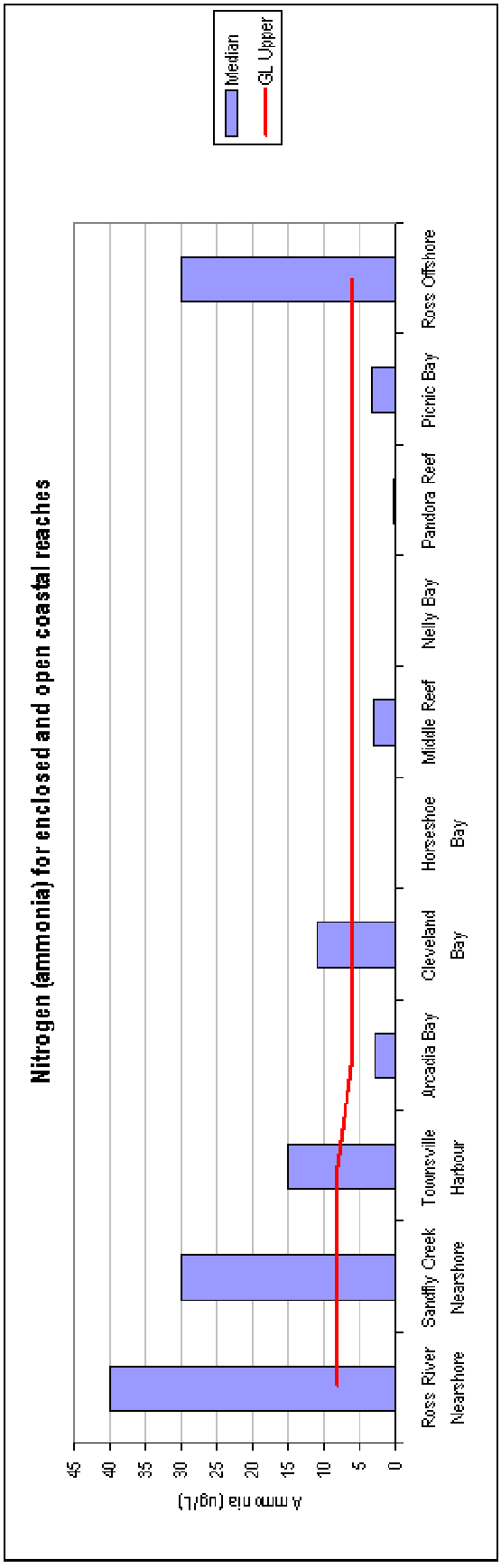
Water Quality by Parameter

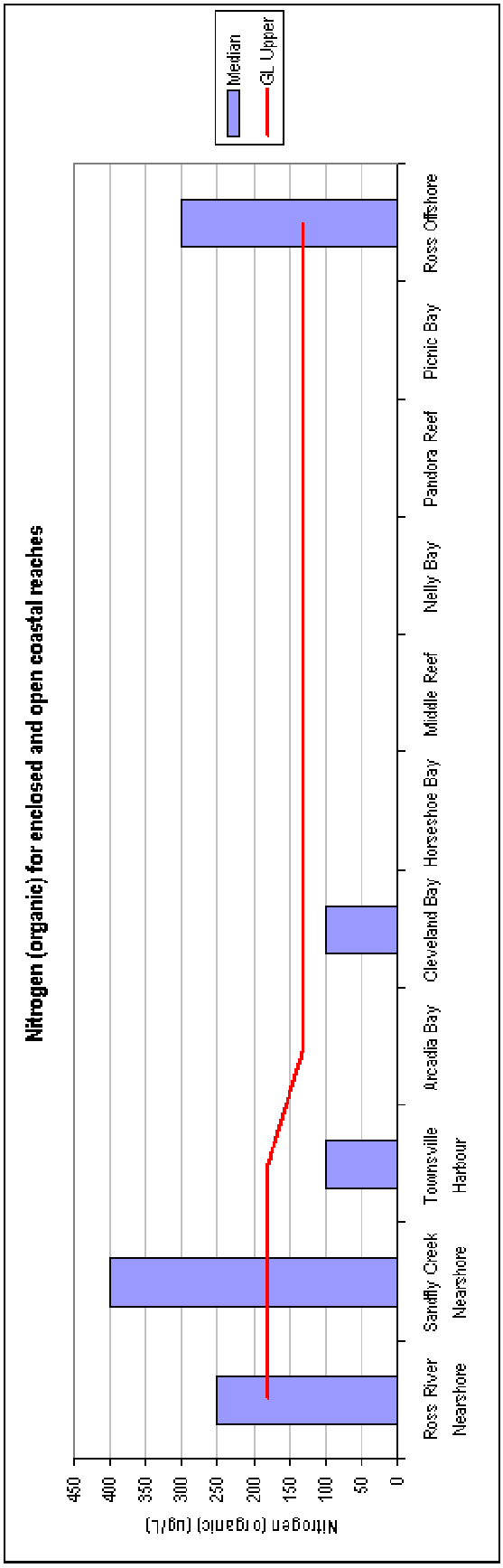
The following graphs summarise all data in the database for each guideline parameter.

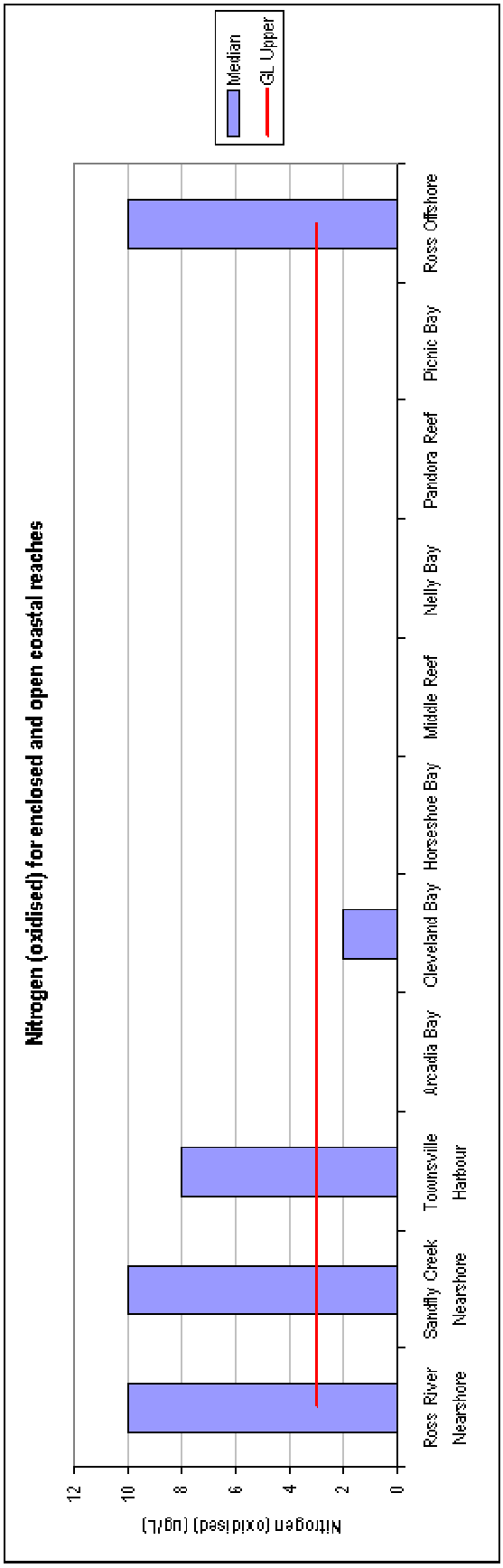

Turbidity for enclosed and open coastal reaches
Median
GL Upper
Turbidity (NTU)
0
5
10
15
20
25
30
35
40
45
Ross River Nearshore
Sandfly Creek Nearshore
Townsville Harbour
Arcadia Bay
Cleveland Bay
Horseshoe Bay
Middle Reef
Nelly Bay
Pandora Reef
Picnic Bay
Ross Offshore

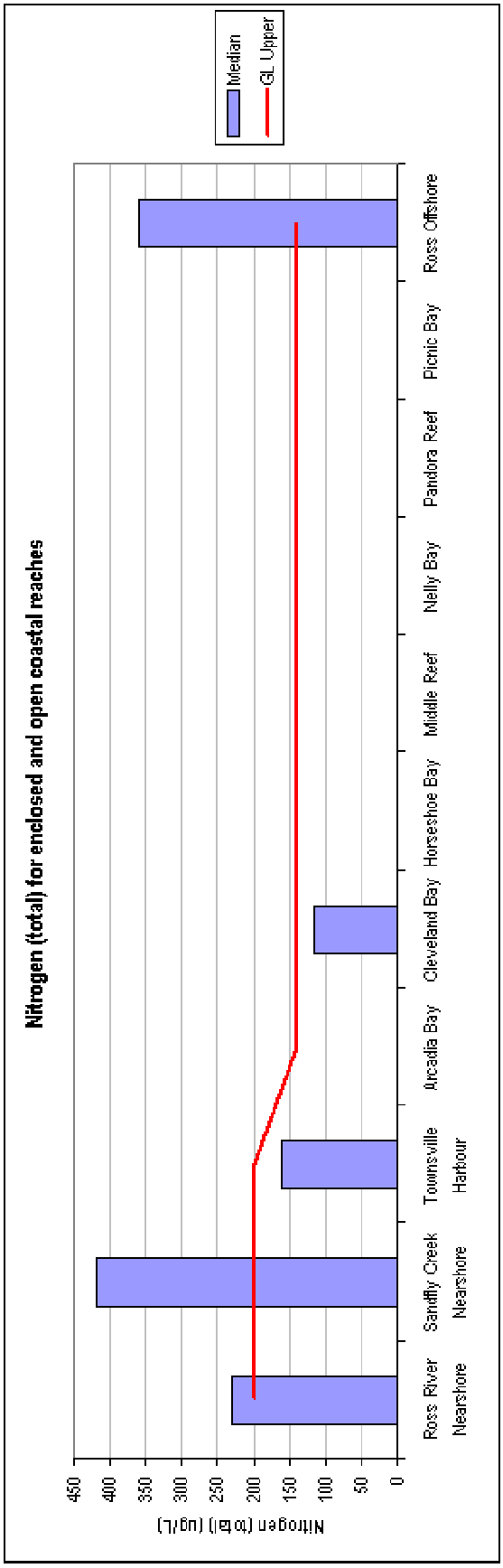

Chlorophyll-a for enclosed and open coastal reaches
Median
GL Upper
Chlorophyll-a (ug/L)
0
0.5
1
1.5
2
2.5
Ross River Nearshore
Sandfly Creek Nearshore
Townsville Harbour
Arcadia Bay
Cleveland Bay
Horseshoe Bay
Middle Reef
Nelly Bay
Pandora Reef
Picnic Bay
Ross Offshore

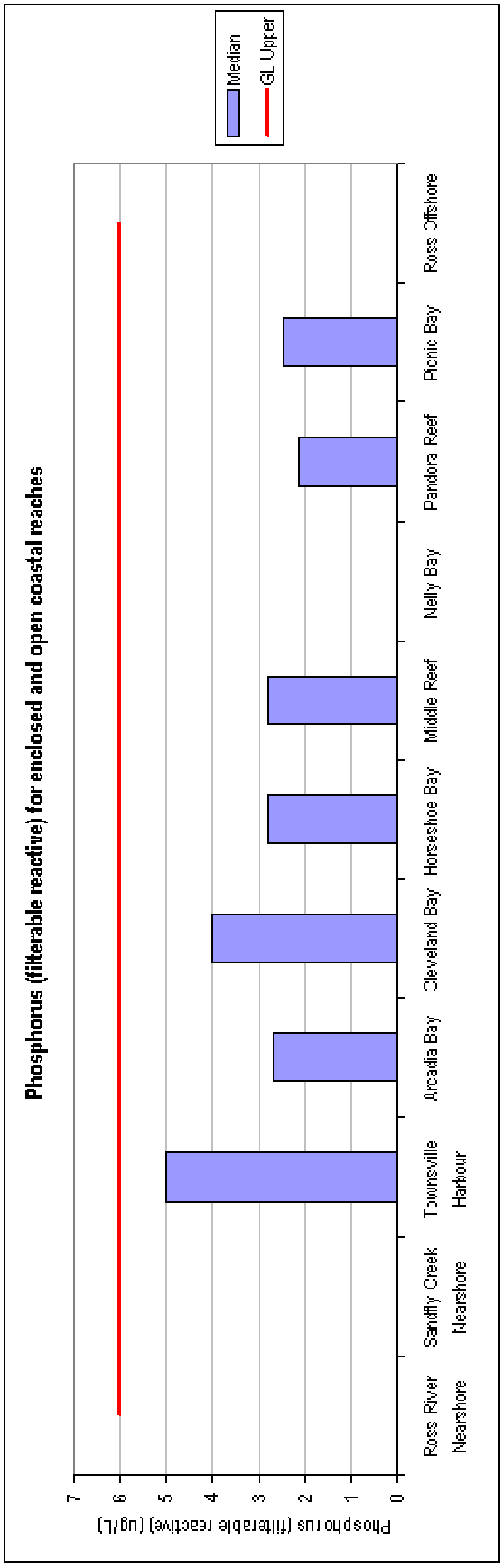

Dissolved Oxygen for enclosed and open coastal reaches
Median
GL Upper
Dissolved Oxygen (% sat)
0
5
10
15
20
25
30
35
40
45
Ross River Nearshore
Sandfly Creek Nearshore
Townsville Harbour
Arcadia Bay
Cleveland Bay
Horseshoe Bay
Middle Reef
Nelly Bay
Pandora Reef
Picnic Bay
Ross Offshore

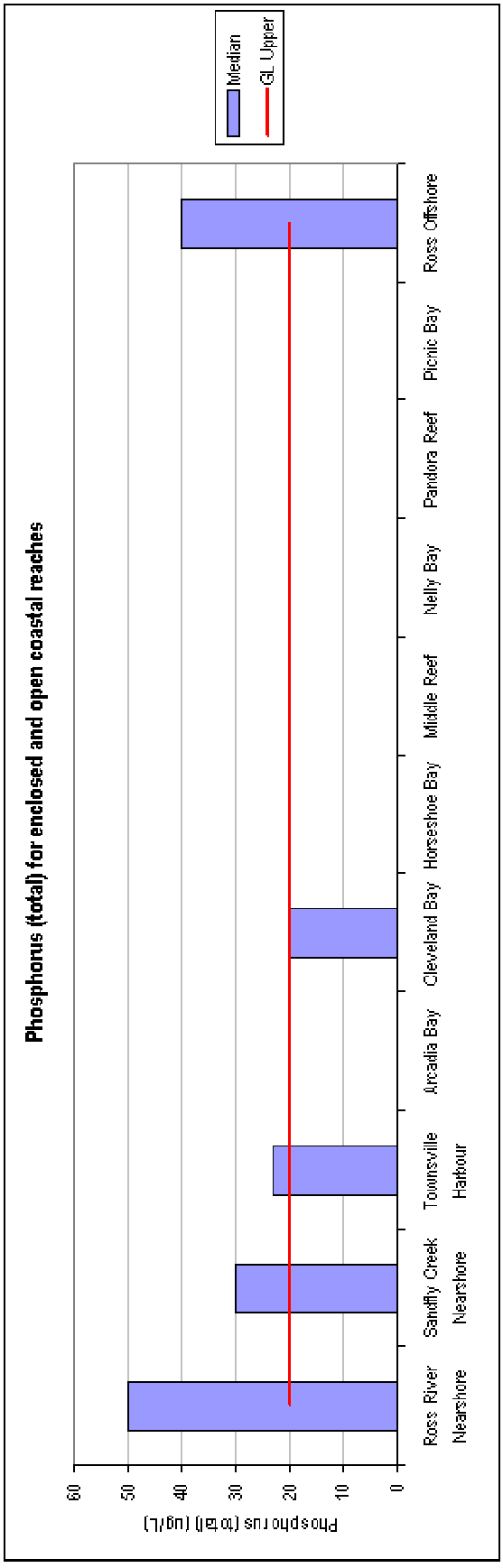

Nitrogen (ammonia) for enclosed and open coastal reaches
Median
GL Upper
Ammonia (ug/L)
0
5
10
15
20
25
30
35
40
45
Ross River Nearshore
Sandfly Creek Nearshore
Townsville Harbour
Arcadia Bay
Cleveland Bay
Horseshoe Bay
Middle Reef
Nelly Bay
Pandora Reef
Picnic Bay
Ross Offshore

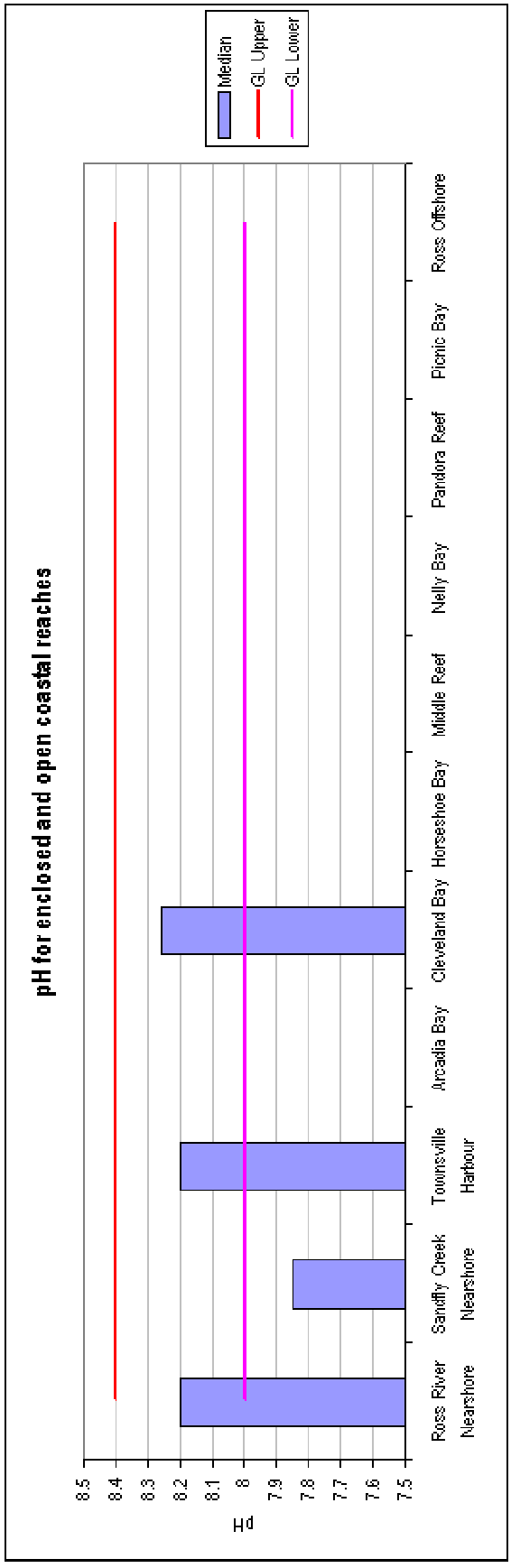

Nitrogen (organic) for enclosed and open coastal reaches
Median
GL Upper
Nitrogen (organic) (ug/L)
0
50
100
150
200
250
300
350
400
450
Ross River Nearshore
Sandfly Creek Nearshore
Townsville Harbour
Arcadia Bay
Cleveland Bay
Horseshoe Bay
Middle Reef
Nelly Bay
Pandora Reef
Picnic Bay
Ross Offshore

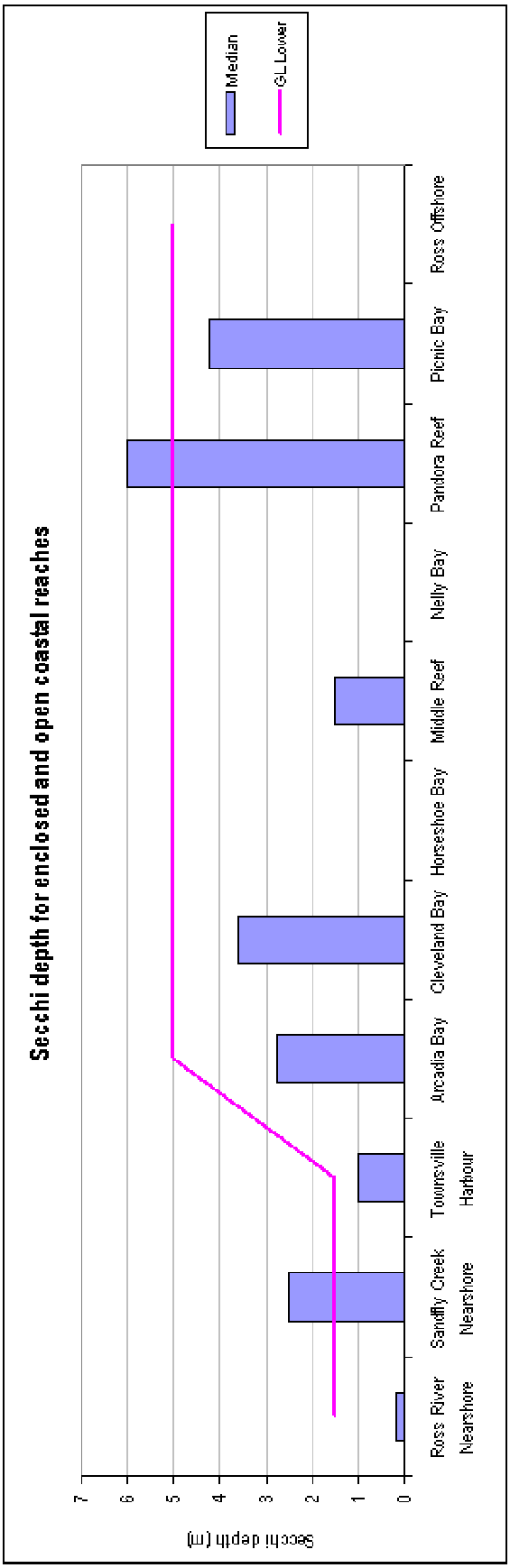

Nitrogen (oxidised) for enclosed and open coastal reaches
Median
GL Upper
Nitrogen (oxidised) (ug/L)
0
2
4
6
8
10
12
Ross River Nearshore
Sandfly Creek Nearshore
Townsville Harbour
Arcadia Bay
Cleveland Bay
Horseshoe Bay
Middle Reef
Nelly Bay
Pandora Reef
Picnic Bay
Ross Offshore

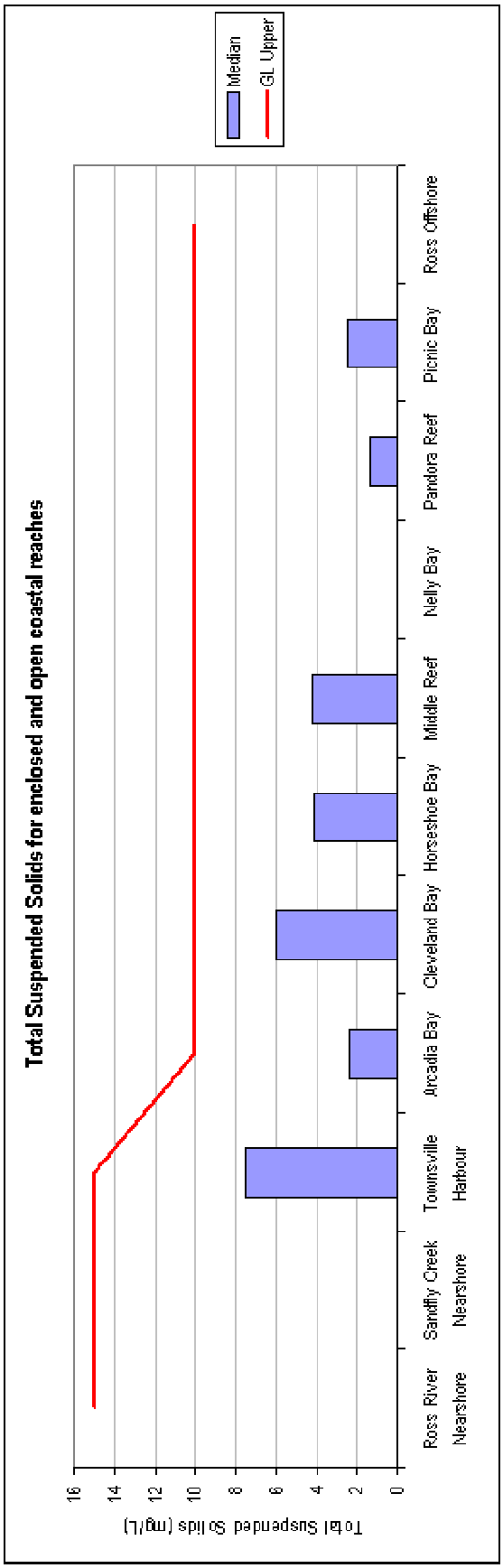

Nitrogen (total) for enclosed and open coastal reaches
Median
GL Upper
Nitrogen (total) (ug/L)
0
50
100
150
200
250
300
350
400
450
Ross River Nearshore
Sandfly Creek Nearshore
Townsville Harbour
Arcadia Bay
Cleveland Bay
Horseshoe Bay
Middle Reef
Nelly Bay
Pandora Reef
Picnic Bay
Ross Offshore

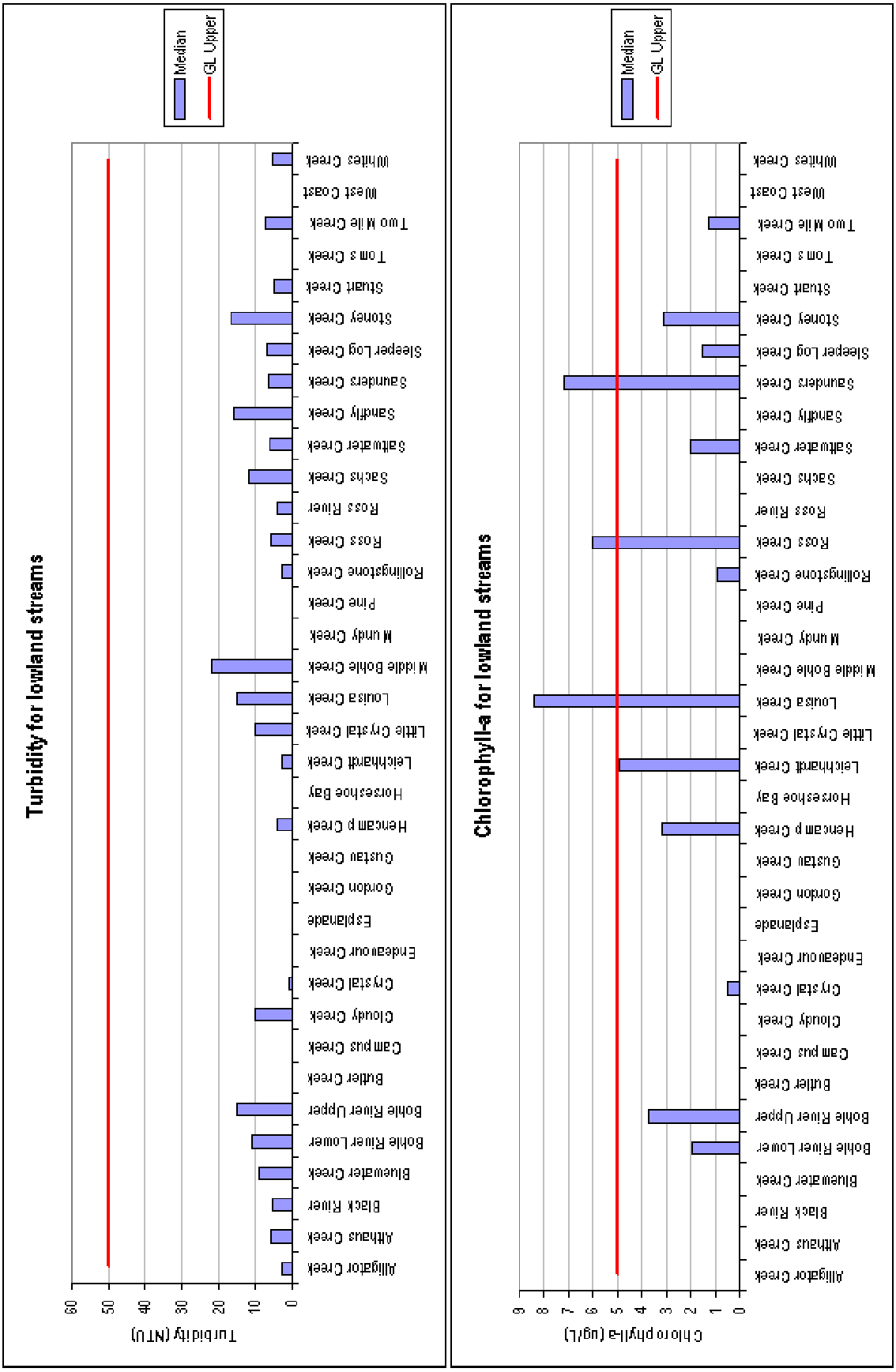

Phosphorus (filterable reactive) for enclosed and open coastal reaches
Median
GL Upper
Phosphorus (filterable reactive) (ug/L)
0
1
2
3
4
5
6
7
Ross River Nearshore
Sandfly Creek Nearshore
Townsville Harbour
Arcadia Bay
Cleveland Bay
Horseshoe Bay
Middle Reef
Nelly Bay
Pandora Reef
Picnic Bay
Ross Offshore

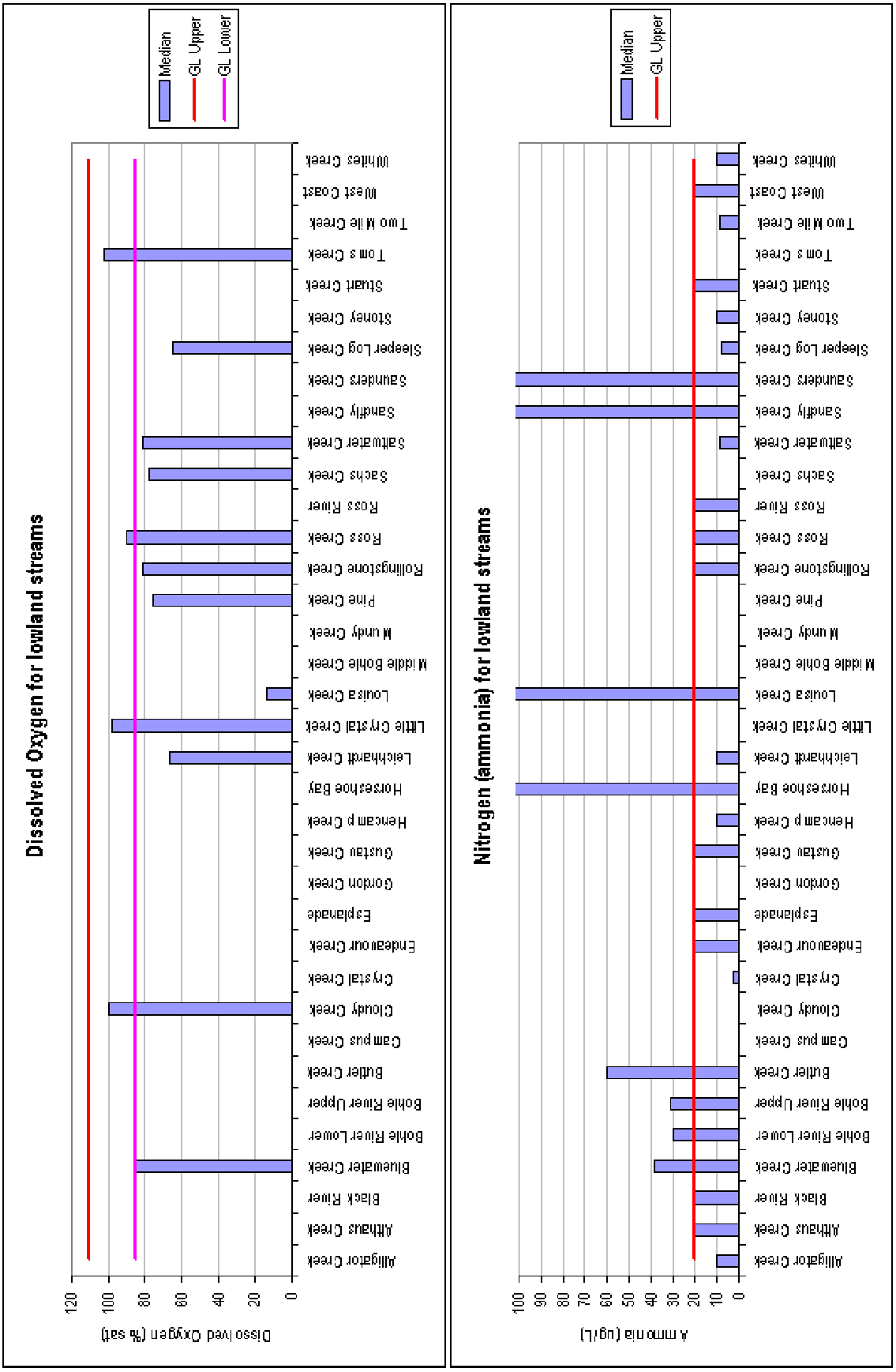

Phosphorus (total) for enclosed and open coastal reaches
Median
GL Upper
Phosphorus (total) (ug/L)
0
10
20
30
40
50
60
Ross River Nearshore
Sandfly Creek Nearshore
Townsville Harbour
Arcadia Bay
Cleveland Bay
Horseshoe Bay
Middle Reef
Nelly Bay
Pandora Reef
Picnic Bay
Ross Offshore

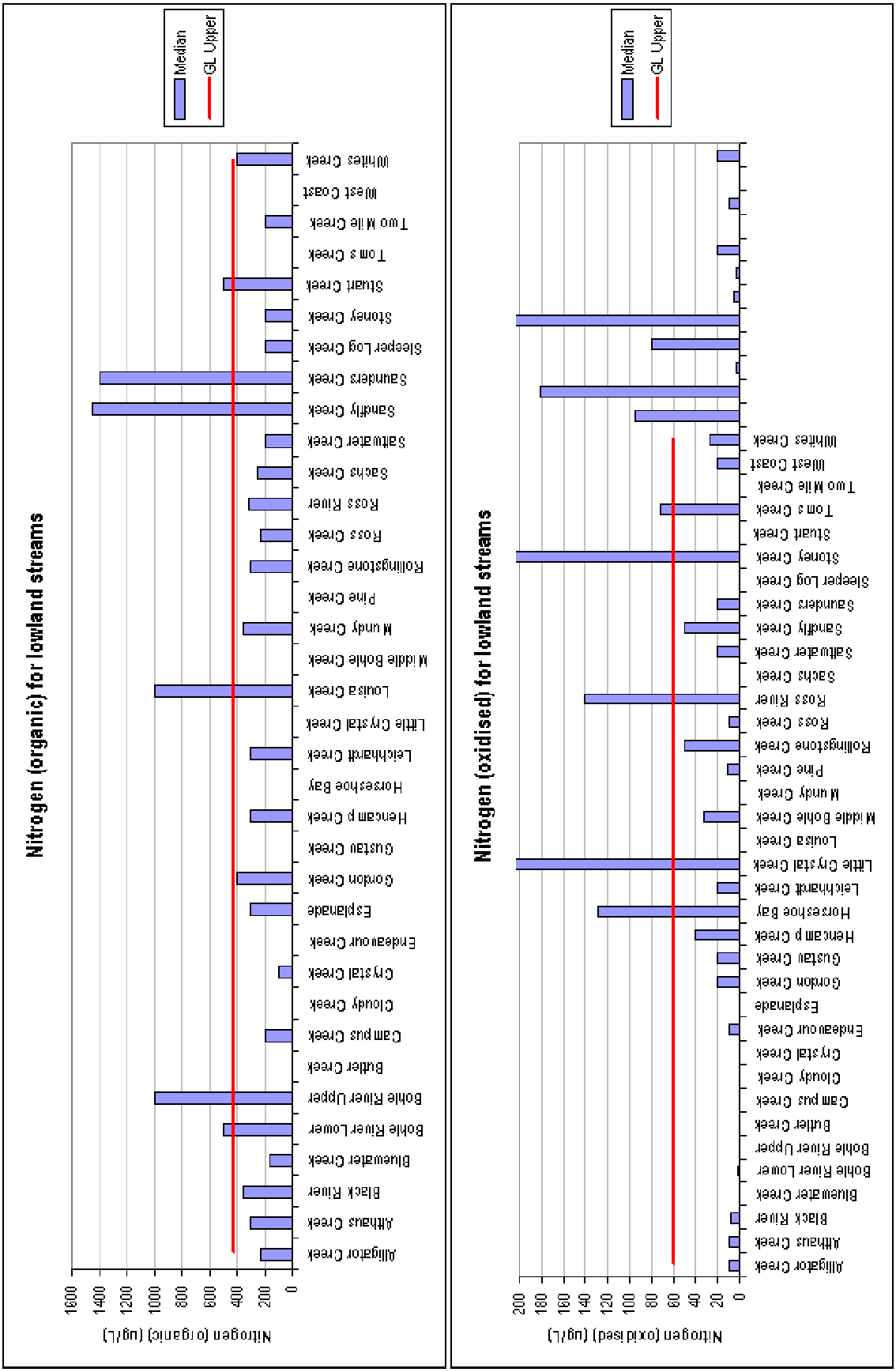

pH for enclosed and open coastal reaches
Median
GL Upper
GL Lower
pH
7.5
7.6
7.7
7.8
7.9
8
8.1
8.2
8.3
8.4
8.5
Ross River Nearshore
Sandfly Creek Nearshore
Townsville Harbour
Arcadia Bay
Cleveland Bay
Horseshoe Bay
Middle Reef
Nelly Bay
Pandora Reef
Picnic Bay
Ross Offshore

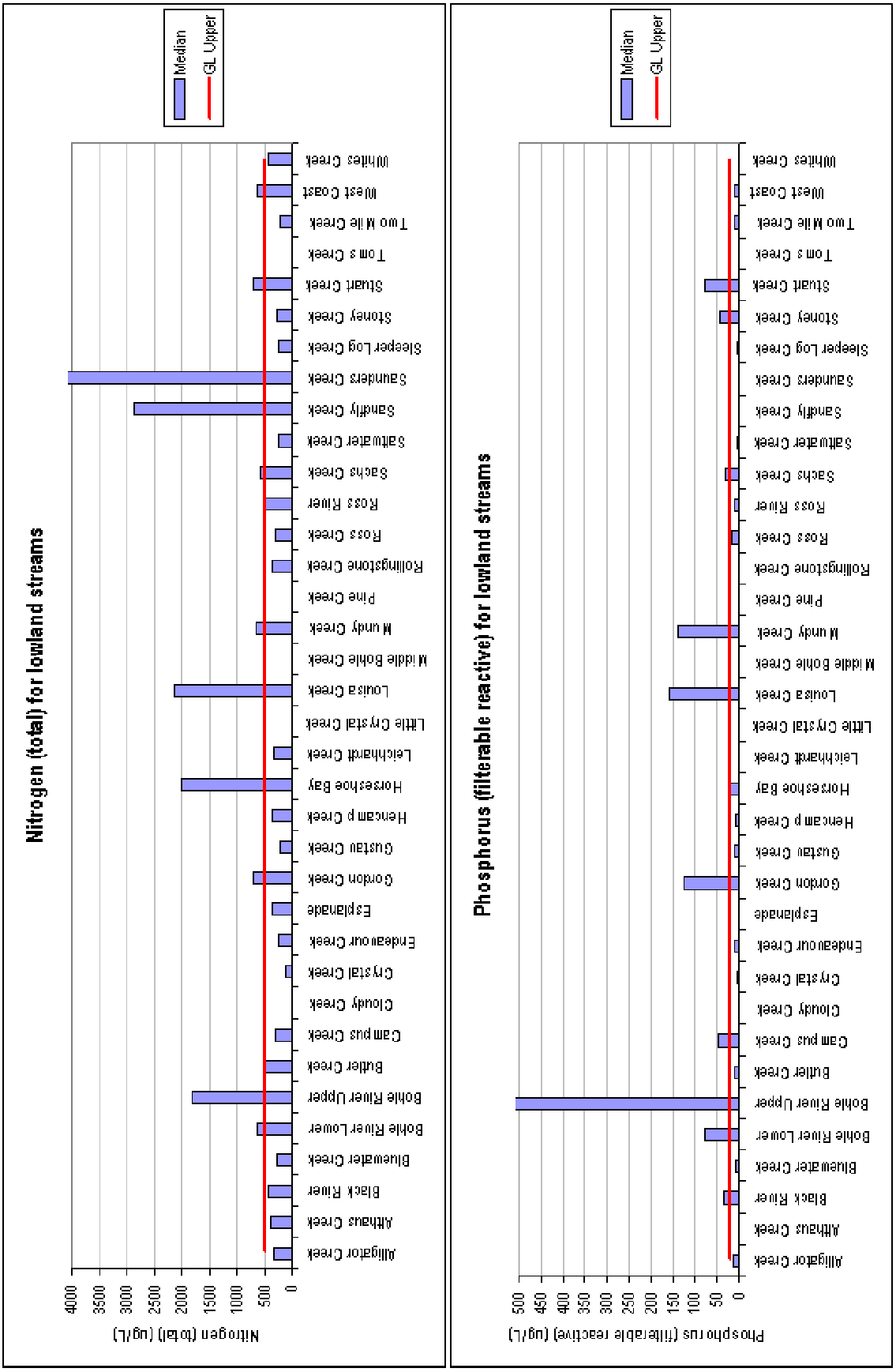

Secchi depth for enclosed and open coastal reaches
Median
GL Lower
Secchi depth (m)
0
1
2
3
4
5
6
7
Ross River Nearshore
Sandfly Creek Nearshore
Townsville Harbour
Arcadia Bay
Cleveland Bay
Horseshoe Bay
Middle Reef
Nelly Bay
Pandora Reef
Picnic Bay
Ross Offshore

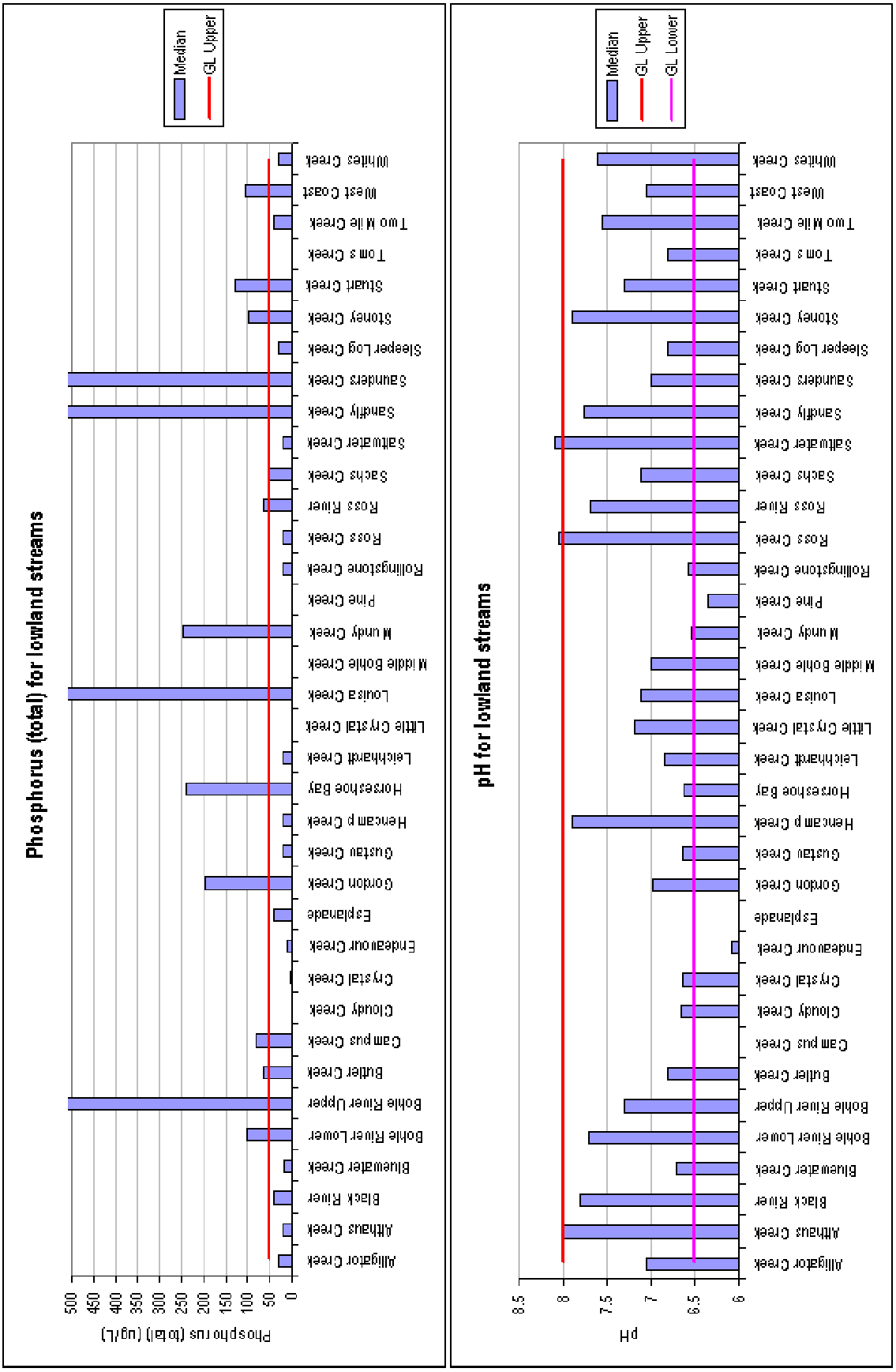

Total Suspended Solids for enclosed and open coastal reaches
Median
GL Upper
Total Suspended Solids (mg/L)
0
2
4
6
8
10
12
14
16
Ross River Nearshore
Sandfly Creek Nearshore
Townsville Harbour
Arcadia Bay
Cleveland Bay
Horseshoe Bay
Middle Reef
Nelly Bay
Pandora Reef
Picnic Bay
Ross Offshore

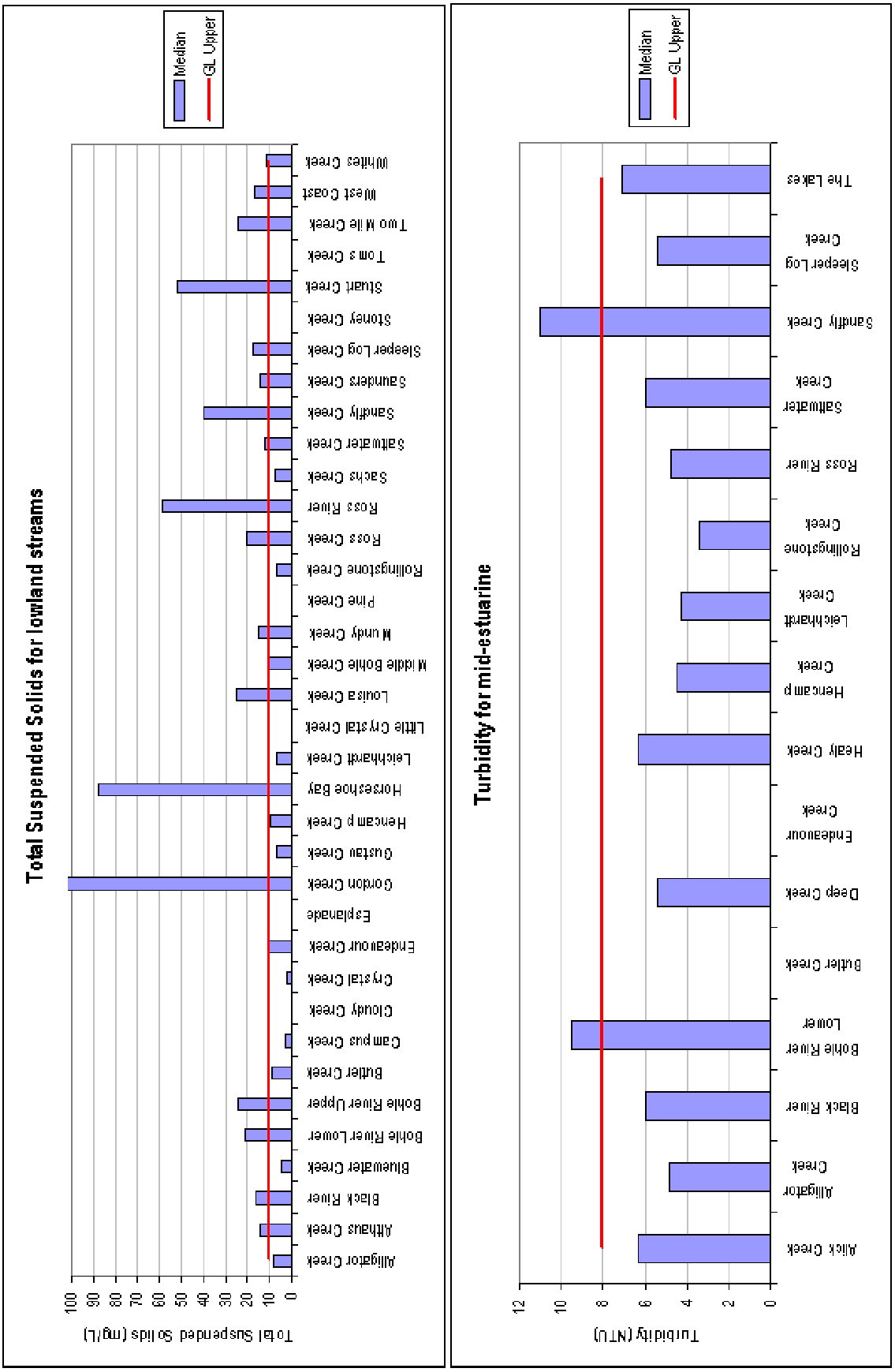

Turbidity for lowland streams
Median
GL Upper
Turbidity (NTU)
0
10
20
30
40
50
60
Alligator Creek
Althaus Creek
Black River
Bluewater Creek
Bohle River Lower
Bohle River Upper
Butler Creek
Camp us Creek
Cloudy Creek
Crystal Creek
Endeavour Creek
Esplanade
Gordon Creek
Gustav Creek
Hencam p Creek
Horseshoe Bay
Leichhardt Creek
Little Crystal Creek
Louisa Creek
Middle Bohle Creek
Mundy Creek
Pine Creek
Rollingstone Creek
Ross Creek
Ross River
Sachs Creek
Saltwater Creek
Sandfly Creek
Saunders Creek
Sleeper Log Creek
Stoney Creek
Stuart Creek
Tom s Creek
Two Mile Creek
West Coast
Whites Creek
Chlorophyll-a for lowland streams
Median
GL Upper
Chloro phyll-a (ug/L)
0
1
2
3
4
5
6
7
8
9
Alligator Creek
Althaus Creek
Black River
Bluewater Creek
Bohle River Lower
Bohle River Upper
Butler Creek
Camp us Creek
Cloudy Creek
Crystal Creek
Endeavour Creek
Esplanade
Gordon Creek
Gustav Creek
Hencam p Creek
Horseshoe Bay
Leichhardt Creek
Little Crystal Creek
Louisa Creek
Middle Bohle Creek
Mundy Creek
Pine Creek
Rollingstone Creek
Ross Creek
Ross River
Sachs Creek
Saltwater Creek
Sandfly Creek
Saunders Creek
Sleeper Log Creek
Stoney Creek
Stuart Creek
Tom s Creek
Two Mile Creek
West Coast
Whites Creek

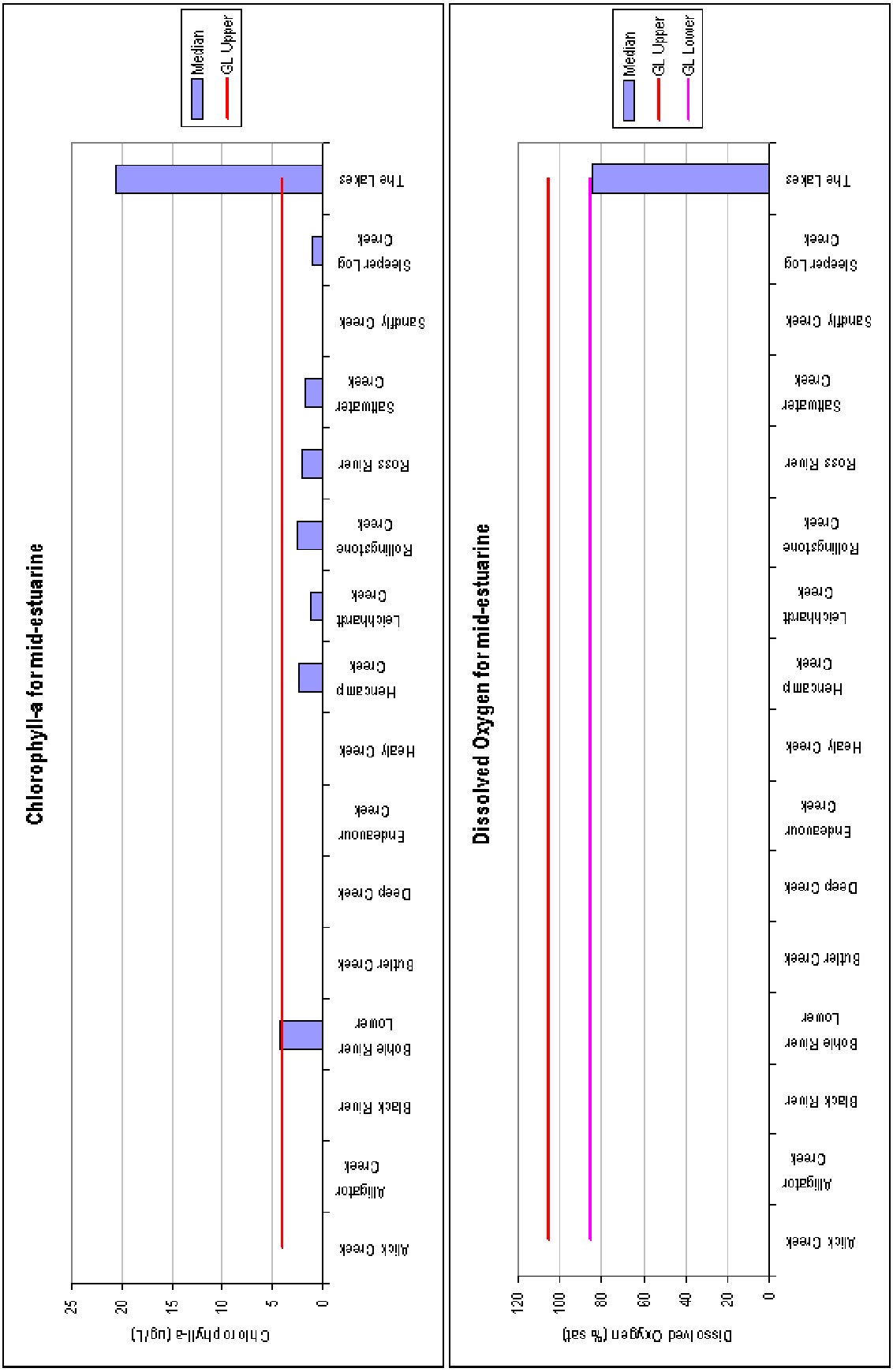

Dissolved Oxygen for lowland streams
Median
GL Upper
GL Lower
Dissolved Oxygen (% sat)
0
20
40
60
80
100
120
Alligator Creek
Althaus Creek
Black River
Bluewater Creek
Bohle River Lower
Bohle River Upper
Butler Creek
Camp us Creek
Cloudy Creek
Crystal Creek
Endeavour Creek
Esplanade
Gordon Creek
Gustav Creek
Henca m p Creek
Horseshoe Bay
Leichhardt Creek
Little Crystal Creek
Louisa Creek
Middle Bohle Creek
Mundy Creek
Pine Creek
Rollingstone Creek
Ross Creek
Ross River
Sachs Creek
Saltwater Creek
Sandfly Creek
Saunders Creek
Sleeper Log Creek
Stoney Creek
Stuart Creek
Tom s Creek
Two Mile Creek
West Coast
Whites Creek
Nitrogen (ammonia) for lowland streams
Median
GL Upper
Ammonia (ug/L)
0
10
20
30
40
50
60
70
80
90
100
Alligator Creek
Althaus Creek
Black River
Bluewater Creek
Bohle River Lower
Bohle River Upper
Butler Creek
Camp us Creek
Cloudy Creek
Crystal Creek
Endeavour Creek
Esplanade
Gordon Creek
Gustav Creek
Henca m p Creek
Horseshoe Bay
Leichhardt Creek
Little Crystal Creek
Louisa Creek
Middle Bohle Creek
Mundy Creek
Pine Creek
Rollingstone Creek
Ross Creek
Ross River
Sachs Creek
Saltwater Creek
Sandfly Creek
Saunders Creek
Sleeper Log Creek
Stoney Creek
Stuart Creek
Tom s Creek
Two Mile Creek
West Coast
Whites Creek

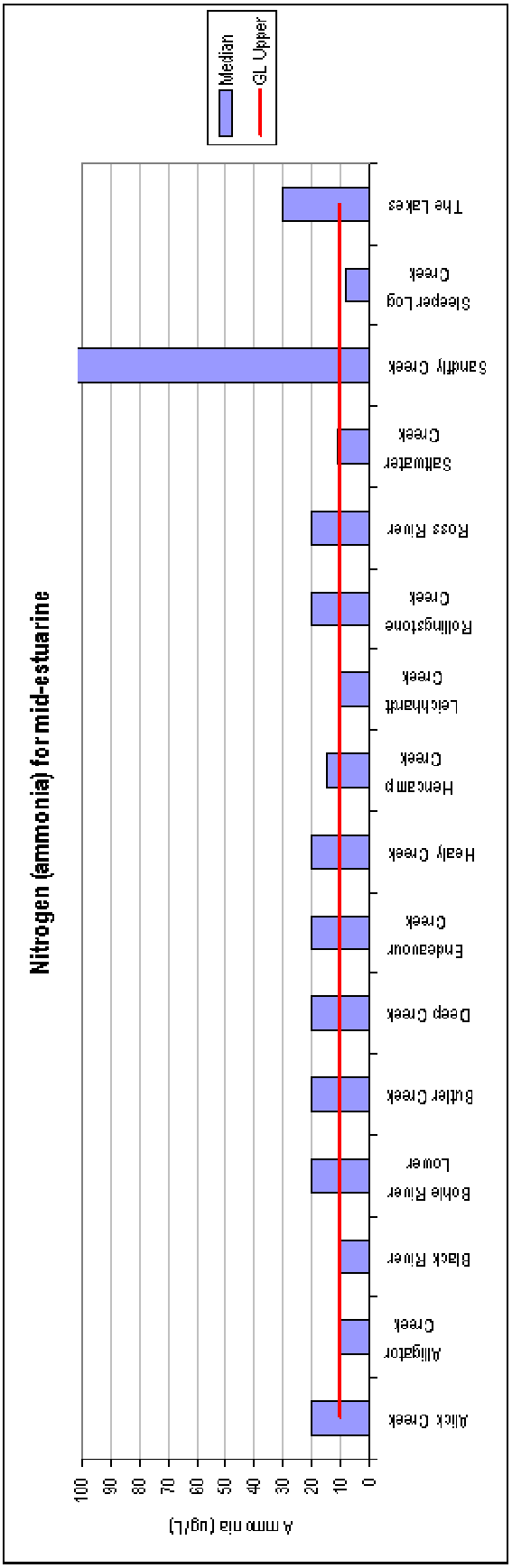

Nitrogen (organic) for lowland streams
Median
GL Upper
Nitrogen (organic) (ug/L)
0
200
400
600
800
1000
1200
1400
1600
Alligator Creek
Althaus Creek
Black River
Bluewater Creek
Bohle River Lower
Bohle River Upper
Butler Creek
Cam pus Creek
Cloudy Creek
Crystal Creek
Endeavour Creek
Esplanade
Gordon Creek
Gustav Creek
Hencam p Creek
Horseshoe Bay
Leichhardt Creek
Little Crystal Creek
Louisa Creek
Middle Bohle Creek
Mundy Creek
Pine Creek
Rollingstone Creek
Ross Creek
Ross River
Sachs Creek
Saltwater Creek
Sandfly Creek
Saunders Creek
Sleeper Log Creek
Stoney Creek
Stuart Creek
Tom s Creek
Two Mile Creek
West Coast
Wilkies Creek
Nitrogen (oxidised) for lowland streams
Median
GL Upper
Nitrogen (oxidised) (ug/L)
0
20
40
60
80
100
120
140
160
180
200
Alligator Creek
Althaus Creek
Black River
Bluewater Creek
Bohle River Lower
Bohle River Upper
Butler Creek
Cam pus Creek
Cloudy Creek
Crystal Creek
Endeavour Creek
Esplanade
Gordon Creek
Gustav Creek
Hencam p Creek
Horseshoe Bay
Leichhardt Creek
Little Crystal Creek
Louisa Creek
Middle Bohle Creek
Mundy Creek
Pine Creek
Rollingstone Creek
Ross Creek
Ross River
Sachs Creek
Saltwater Creek
Sandfly Creek
Saunders Creek
Sleeper Log Creek
Stoney Creek
Stuart Creek
Tom s Creek
Two Mile Creek
West Coast
Wilkies Creek

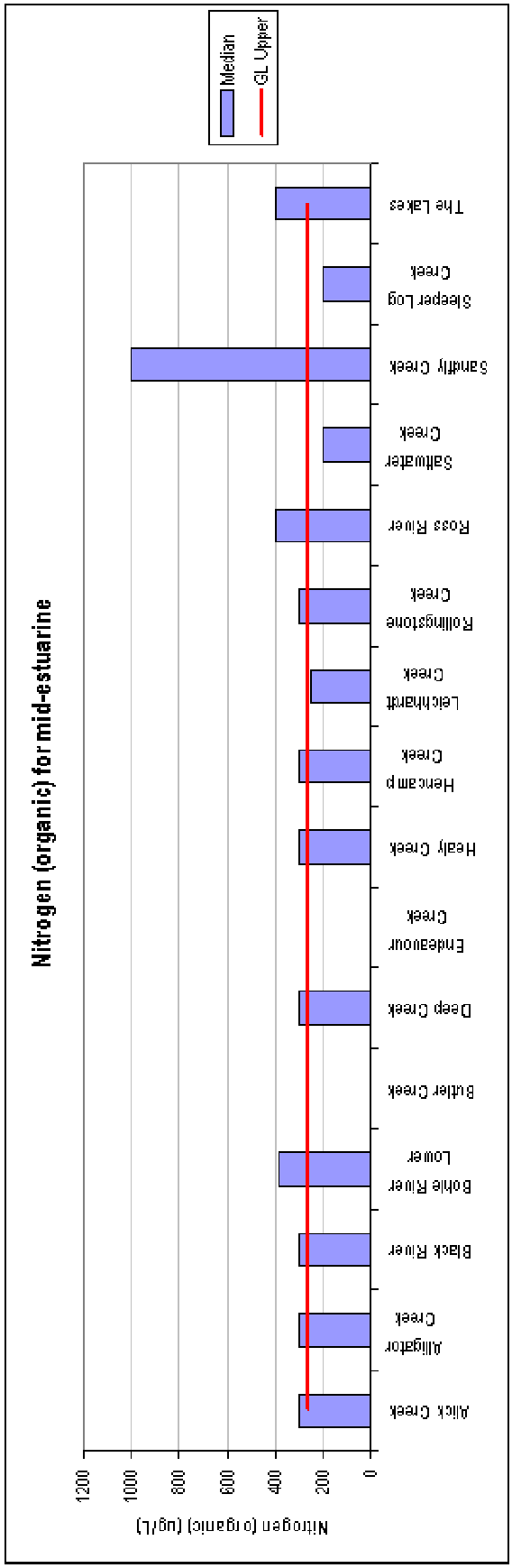

Nitrogen (total) for lowland streams
Median
GL Upper
Nitrogen (total) (ug/L)
0
500
1000
1500
2000
2500
3000
3500
4000
Alligator Creek
Althaus Creek
Black River
Bluewater Creek
Bohle River Lower
Bohle River Upper
Butler Creek
Campus Creek
Cloudy Creek
Crystal Creek
Endeavour Creek
Esplanade
Gordon Creek
Gustav Creek
Hencamp Creek
Horseshoe Bay
Leichhardt Creek
Little Crystal Creek
Louisa Creek
Middle Bohle Creek
Mundy Creek
Pine Creek
Rollingstone Creek
Ross Creek
Ross River
Sachs Creek
Saltwater Creek
Sandfly Creek
Saunders Creek
Sleeper Log Creek
Stoney Creek
Stuart Creek
Toms Creek
Two Mile Creek
West Coast
Whites Creek
Phosphorus (filterable reactive) for lowland streams
Median
GL Upper
Phosphorus (filterable reactive) (ug/L)
0
50
100
150
200
250
300
350
400
450
500
Alligator Creek
Althaus Creek
Black River
Bluewater Creek
Bohle River Lower
Bohle River Upper
Butler Creek
Campus Creek
Cloudy Creek
Crystal Creek
Endeavour Creek
Esplanade
Gordon Creek
Gustav Creek
Hencamp Creek
Horseshoe Bay
Leichhardt Creek
Little Crystal Creek
Louisa Creek
Middle Bohle Creek
Mundy Creek
Pine Creek
Rollingstone Creek
Ross Creek
Ross River
Sachs Creek
Saltwater Creek
Sandfly Creek
Saunders Creek
Sleeper Log Creek
Stoney Creek
Stuart Creek
Toms Creek
Two Mile Creek
West Coast
Whites Creek

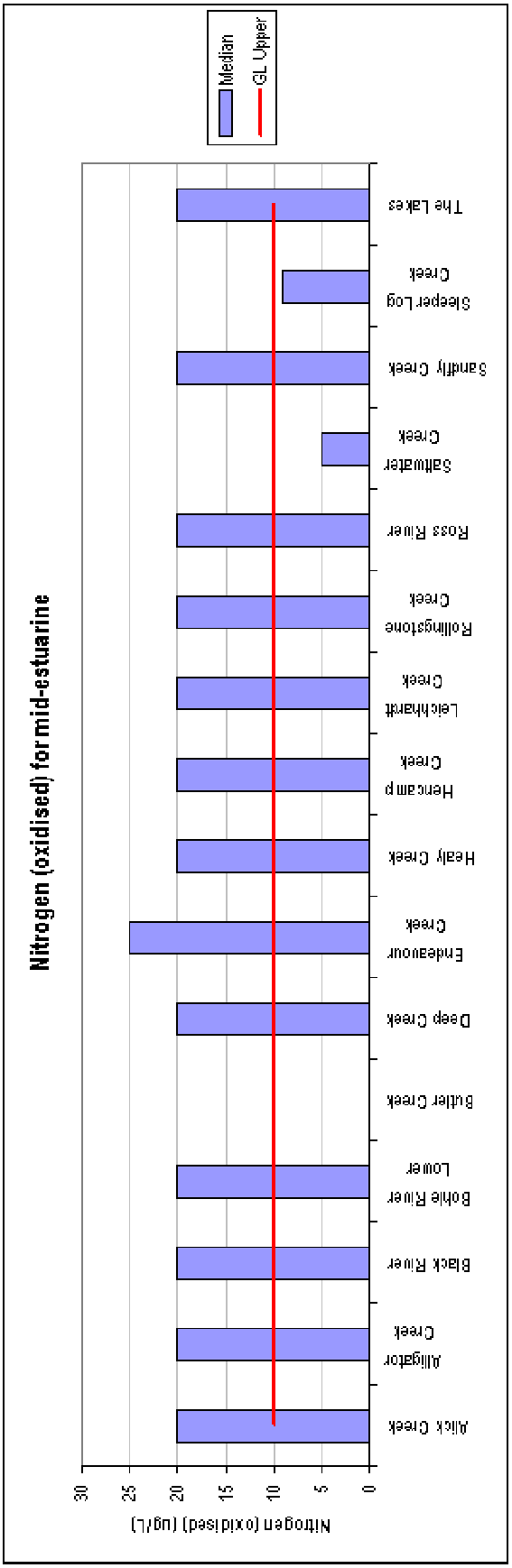

Phosphorus (total) for lowland streams
Median
GL Upper
Phosphorus (total) (ug/L)
0
50
100
150
200
250
300
350
400
450
500
Alligator Creek
Althaus Creek
Black River
Bluewater Creek
Bohle River Lower
Bohle River Upper
Butler Creek
Camp us Creek
Cloudy Creek
Crystal Creek
Endeavour Creek
Esplanade
Gordon Creek
Gustav Creek
Hencam p Creek
Horseshoe Bay
Leichhardt Creek
Little Crystal Creek
Louisa Creek
Middle Bohle Creek
Mundy Creek
Pine Creek
Rollingstone Creek
Ross Creek
Ross River
Sachs Creek
Saltwater Creek
Sandfly Creek
Saunders Creek
Sleeper Log Creek
Stoney Creek
Stuart Creek
Tom s Creek
Two Mile Creek
West Coast
Whites Creek
pH for lowland streams
Median
GL Upper
GL Lower
pH
6
6.5
7
7.5
8
8.5
Alligator Creek
Althaus Creek
Black River
Bluewater Creek
Bohle River Lower
Bohle River Upper
Butler Creek
Camp us Creek
Cloudy Creek
Crystal Creek
Endeavour Creek
Esplanade
Gordon Creek
Gustav Creek
Hencam p Creek
Horseshoe Bay
Leichhardt Creek
Little Crystal Creek
Louisa Creek
Middle Bohle Creek
Mundy Creek
Pine Creek
Rollingstone Creek
Ross Creek
Ross River
Sachs Creek
Saltwater Creek
Sandfly Creek
Saunders Creek
Sleeper Log Creek
Stoney Creek
Stuart Creek
Tom s Creek
Two Mile Creek
West Coast
Whites Creek

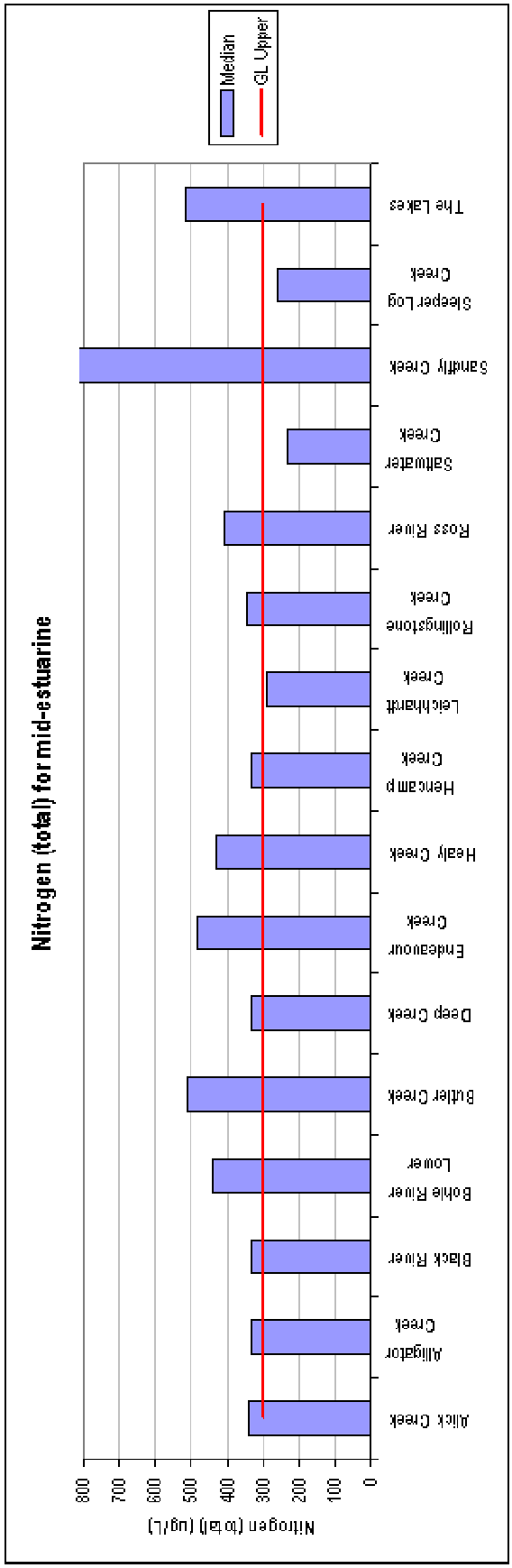

Median
GL Upper
Total Suspended Solids for lowland streams
Total Suspended Solids (mg/L)
0
10
20
30
40
50
60
70
80
90
100
Alligator Creek
Althaus Creek
Black River
Bluewater Creek
Bohle River Lower
Bohle River Upper
Butler Creek
Campus Creek
Cloudy Creek
Crystal Creek
Endeavour Creek
Esplanade
Gordon Creek
Gustav Creek
Hencamp Creek
Horseshoe Bay
Leichhardt Creek
Little Crystal Creek
Louisa Creek
Middle Bohle Creek
Mundy Creek
Pine Creek
Rollingstone Creek
Ross Creek
Ross River
Sachs Creek
Saltwater Creek
Sandfly Creek
Saunders Creek
Sleeper Log Creek
Stoney Creek
Stuart Creek
Toms Creek
Two Mile Creek
West Coast
Whites Creek
Median
GL Upper
Turbidity for mid-estuarine
Turbidity (NTU)
0
2
4
6
8
10
12
Alick Creek
Alligator Creek
Black River
Bohle River Lower
Butler Creek
Deep Creek
Endeavour Creek
Healy Creek
Hencamp Creek
Leichhardt Creek
Rollingstone Creek
Ross River
Saltwater Creek
Sandfly Creek
Sleeper Log Creek
The Lakes

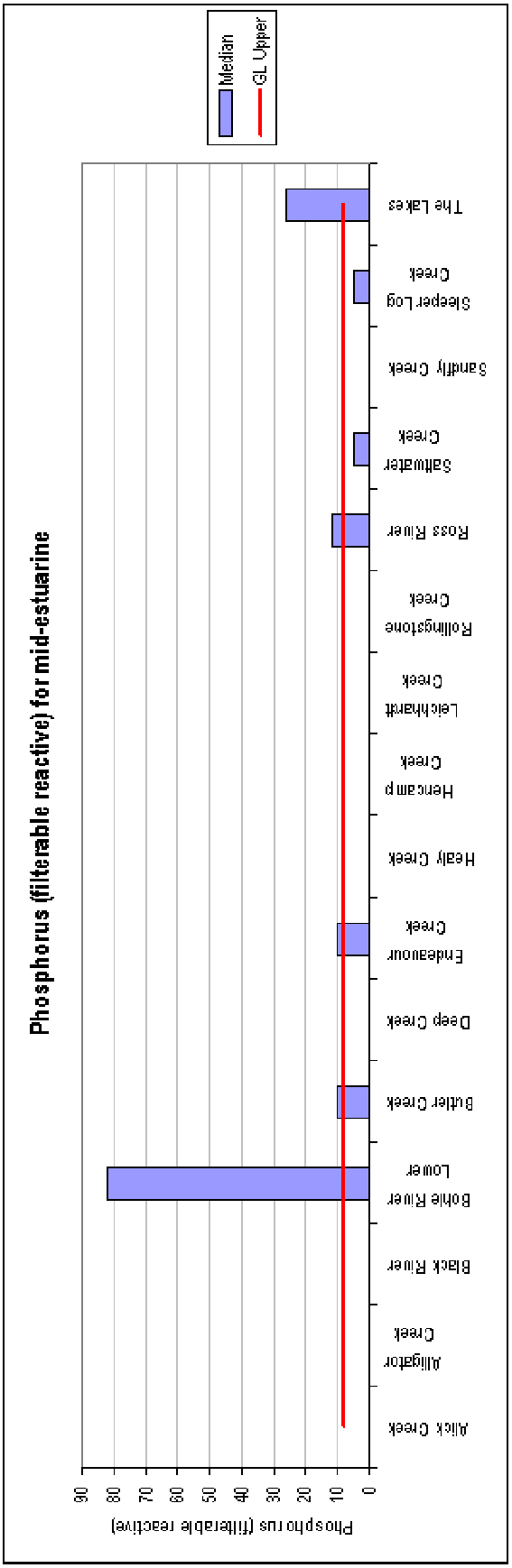

Chlorophyll-a for mid-estuarine
Median
GL Upper
Chlorophyll-a (ug/L)
0
5
10
15
20
25
Alick Creek
Alligator Creek
Black River
Bohle River Lower
Butler Creek
Deep Creek
Endeavour Creek
Healy Creek
Hencamp Creek
Leichhardt Creek
Rollingstone Creek
Ross River
Saltwater Creek
Sandfly Creek
Sleeper Log Creek
The Lakes
Dissolved Oxygen for mid-estuarine
Median
GL Upper
GL Lower
Dissolved Oxygen (% sat)
0
20
40
60
80
100
120
Alick Creek
Alligator Creek
Black River
Bohle River Lower
Butler Creek
Deep Creek
Endeavour Creek
Healy Creek
Hencamp Creek
Leichhardt Creek
Rollingstone Creek
Ross River
Saltwater Creek
Sandfly Creek
Sleeper Log Creek
The Lakes

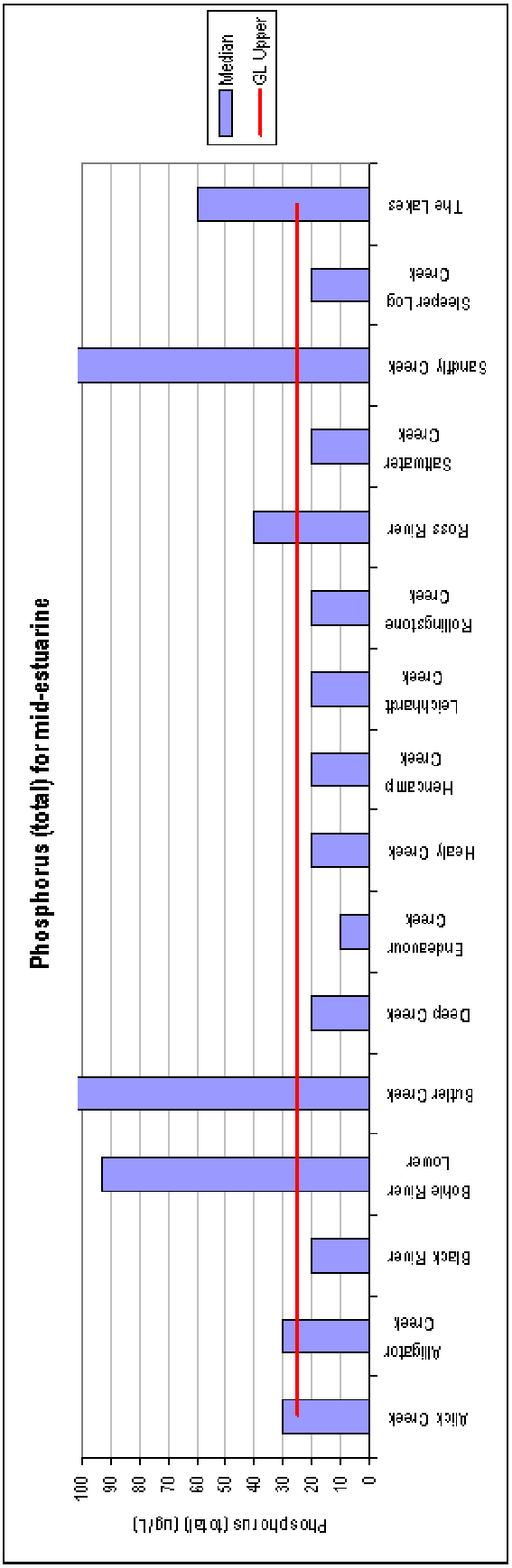

Nitrogen (ammonia) for mid-estuarine
Median
GL Upper
Ammonia (ug/L)
0
10
20
30
40
50
60
70
80
90
100
Alick Creek
Alligator Creek
Black River
Bohle River Lower
Butler Creek
Deep Creek
Endeavour Creek
Healy Creek
Hencamp Creek
Leichhardt Creek
Rollingstone Creek
Ross River
Saltwater Creek
Sandfly Creek
Sleeper Log Creek
The Lakes

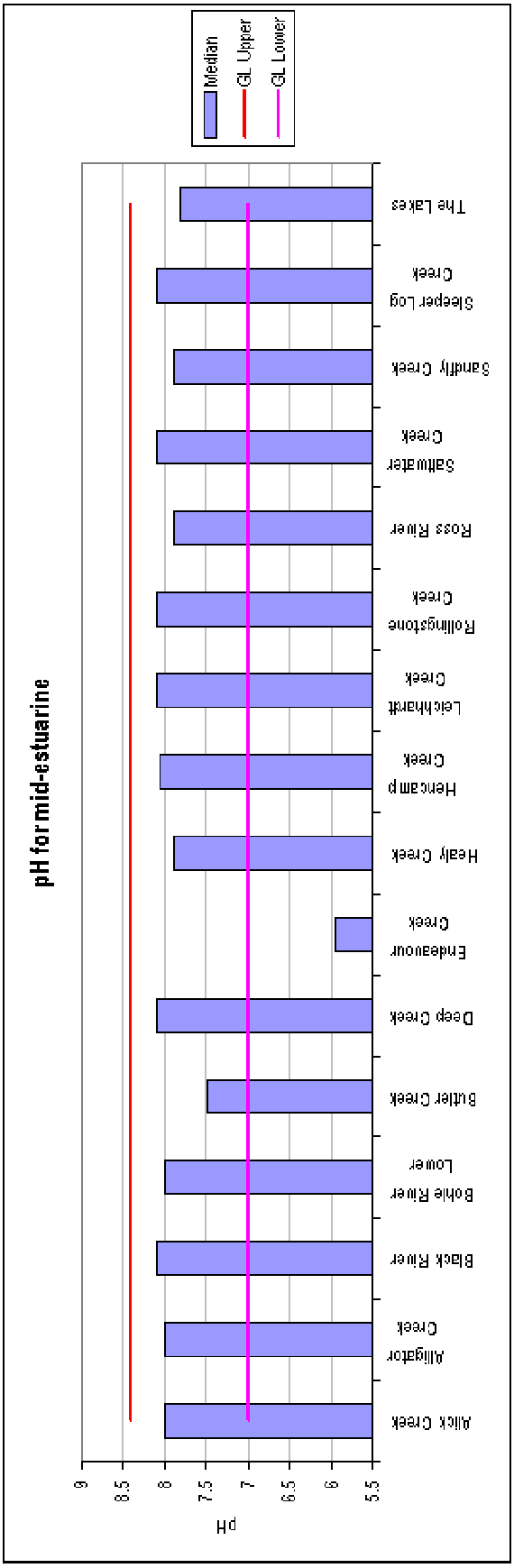

Nitrogen (organic) for mid-estuarine
Median
GL Upper
Nitrogen (organic) (ug/L)
0
200
400
600
800
1000
1200
Alick Creek
Alligator Creek
Black River
Bohle River Lower
Butler Creek
Deep Creek
Endeavour Creek
Healy Creek
Hencamp Creek
Leichhardt Creek
Rollingstone Creek
Ross River
Saltwater Creek
Sandfly Creek
Sleeper Log Creek
The Lakes

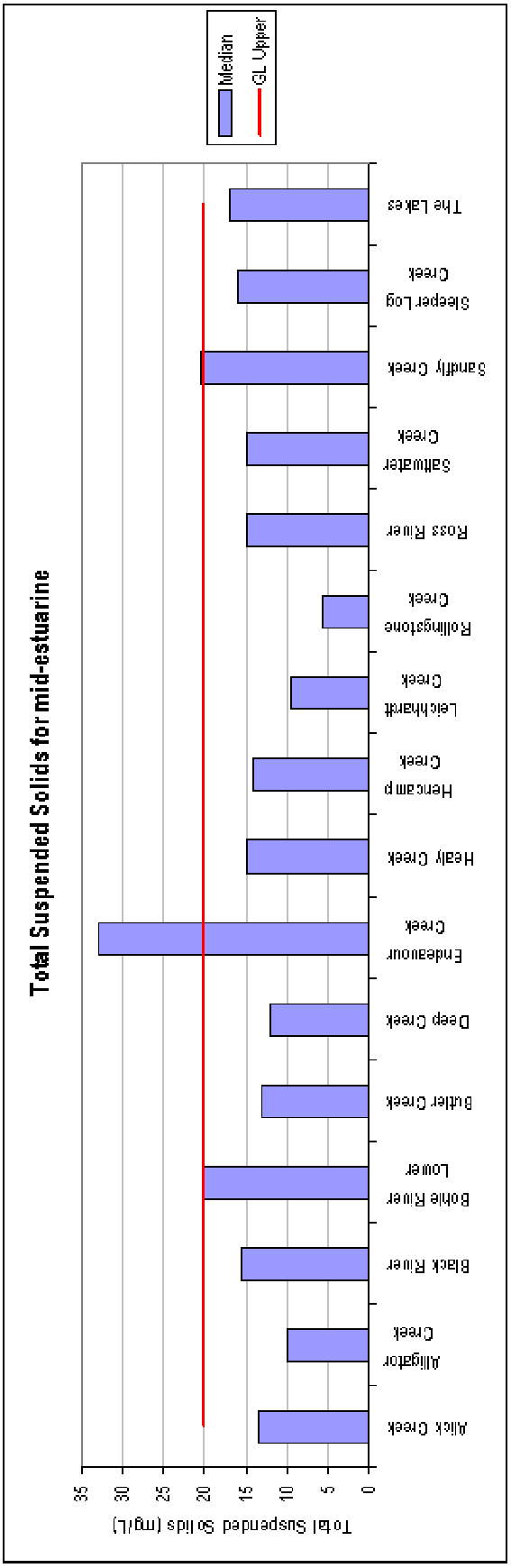

Median
GL Upper
Nitrogen (oxidised) for mid-estuarine
Nitrogen (oxidised) (ug/L)
0
5
10
15
20
25
30
Alick Creek
Alligator Creek
Black River
Bohle River Lower
Butler Creek
Deep Creek
Endeavour Creek
Healy Creek
Hencamp Creek
Leichhardt Creek
Rollingstone Creek
Ross River
Saltwater Creek
Sandfly Creek
Sleeper Log Creek
The Lakes


Median
GL Upper
Nitrogen (total) for mid-estuarine
Nitrogen (total) (ug/L)
0
100
200
300
400
500
600
700
800
Alick Creek
Alligator Creek
Black River
Bohle River Lower
Butler Creek
Deep Creek
Endeavour Creek
Healy Creek
Hencamp Creek
Leichhardt Creek
Rollingstone Creek
Ross River
Saltwater Creek
Sandfly Creek
Sleeper Log Creek
The Lakes


Phosphorus (filterable reactive) for mid-estuarine
Median
GL Upper
Phosphorus (filterable reactive)
0
10
20
30
40
50
60
70
80
90
Alick Creek
Alligator Creek
Black River
Bohle River Lower
Butler Creek
Deep Creek
Endeavour Creek
Healy Creek
Hencamp Creek
Leichhardt Creek
Rollingstone Creek
Ross River
Saltwater Creek
Sandfly Creek
Sleeper Log Creek
The Lakes


Phosphorus (total) for mid-estuarine
Median
GL Upper
Phosphorus (total) (ug/L)
0
10
20
30
40
50
60
70
80
90
100
Alick Creek
Alligator Creek
Black River
Bohle River Lower
Butler Creek
Deep Creek
Endeavour Creek
Healy Creek
Hencamp Creek
Leichhardt Creek
Rollingstone Creek
Ross River
Saltwater Creek
Sandfly Creek
Sleeper Log Creek
The Lakes


pH for mid-estuarine
Median
GL Upper
GL Lower
pH
9
8.5
8
7.5
7
6.5
6
5.5
Alick Creek
Alligator Creek
Black River
Bohle River Lower
Butler Creek
Deep Creek
Endeavour Creek
Healy Creek
Hencamp Creek
Leichhardt Creek
Rollingstone Creek
Ross River
Saltwater Creek
Sandfly Creek
Sleeper Log Creek
The Lakes


Total Suspended Solids for mid-estuarine
Median
GL Upper
Total Suspended Solids (mg/L)
35
30
25
20
15
10
5
0
Alick Creek
Alligator Creek
Black River
Bohle River Lower
Butler Creek
Deep Creek
Endeavour Creek
Healy Creek
Hencamp Creek
Leichhardt Creek
Rollingstone Creek
Ross River
Saltwater Creek
Sandfly Creek
Sleeper Log Creek
The Lakes