



**Queensland**  
**Government**  

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**Natural Resources**  
**and Water**

**Water Monitoring**  
**Data Collection Standards**

**Version 2.1**  
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# Water Monitoring Data Collection Standards

## PART A: BACKGROUND

### 1 Introduction

These standards form the basis for consistent data collection and management to an agreed minimum standard.

These standards apply to all water resource monitoring in Queensland required under the *Water Act 2000*, and any subordinate legislation (eg: Water Resource Plan) or Department of Natural Resources and Water (NRW) policy.

Items in these standards include:

- external standards;
- responsibilities;
- requirements;
- definitions;
- accuracy of continuous time series recorded data (Appendix A);
- accuracy of intermittent recorded data (Appendix B);
- water sample analysis reference standards, methods, resolution and minimum reporting limits (Appendix C); and
- natural ecosystem monitoring methods (Appendix D)

Certain uncommon words and terms used in these standards have been defined in section 6. These words are highlighted in **bold** when they are first used in the document.

### 2 Scope

These standards specify the sampling requirements and the minimum degree of accuracy required to satisfactorily **measure** or **derive data** relating to surface water, groundwater and riverine ecosystem resources.

### 3 External Standards

These standards comply with and must be read in conjunction with the following:

- *AS/NZS ISO 9001:2000 – Quality Management Systems – Requirements;*
- *AS 2031:2001– Selection of Containers and Preservation of Water Samples for Microbiological Analysis;*
- *AS/NZS 3778 Measurement of water flow in open channels series;*
- *AS/NZS 5667 Water quality – Sampling (including the remainder of the series);*
- *AS/NZS 5667.4:1998 Water quality - Sampling - Guidance on sampling from lakes, natural and man-made;*
- *AS/NZS 5667.6:1998 Water quality - Sampling - Guidance on sampling of rivers and streams;*
- *AS/NZS 5667.11:1998 Water quality - Sampling - Guidance on sampling of groundwaters;*
- *AS 2900.1-2002 Quantities and Units Part 1: Space and time;*
- *AS 2870-1991 Certified Reference Materials;*
- *Water Monitoring Data Reporting Standards, Queensland Department of Natural Resources and Water, November 2006.*
- *Water Quality Sampling Manual, Queensland Environmental Protection Agency 1999;*
- *Queensland Water Quality Guidelines 2006, Queensland Environmental Protection Agency 2006;*
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000. Australian and New Zealand Environment and Conservation Council, Agriculture and Resource management Council of Australia and New Zealand.*
- *Standard Methods- For the Examination of Water and Wastewater manual published jointly by American Public Health Association, American Water Works Association and Water Environment Federation 20<sup>th</sup> Edition;*
- *Observation Specification No. 2013, Guidelines for the siting and exposure of meteorological instruments and observation facilities, Bureau of Meteorology, January 1997;*
- *Observing the Weather: The Australian Co-operative Observers Guide, Bureau of Meteorology 1991;*
- *Laboratory Theory and Methods for Sediment Analysis United States Geological Survey, Chapter C1-1973;*
- *AS 1289.3 6.1 –1995 Determination of the Particle Size Distribution of a Soil.*

## 4 Responsibilities

It is the duty of a **monitoring body** to ensure that all water resource data are acquired and stored to at least the standards specified in this document.

NRW may from time to time amend these standards. Monitoring bodies will be notified by NRW at least twenty business days before any substantive change is made to these standards.

## PART B: REQUIREMENTS

### 5. Requirements in Relation to Water Storage Infrastructure Impact

Unless otherwise specified in the Resource Operations Plan, monitoring to determine the impact of storage operation on aquatic ecosystems will be in accordance with this section

#### 5.1 Background

The monitoring requirements in this section focus on gathering information to assess the potential impact of water storages (**reservoirs** and **weirs**) on the ecosystem both created within the storage and the downstream receiving water system. The risk of the storage operation having an impact is generally related to the risk of the storage **stratifying**, or settling out into two chemically and physically distinct layers separated by a **thermocline**. This risk is driven largely by the physical characteristics of the storage.

Existing water quality and cyanobacteria monitoring data collected over the past 10 years has shown that:

- Most large Queensland reservoirs can be classified as warm **monomictic**, stratifying between the months of October and May; and
- There is a linear relationship between thermal **stratification** and weir pool depth.

Based on this data, an adaptive monitoring approach is to be used where the monitoring requirements will depend upon:

- How well characterised the storage is with respect to stratification;
- The propensity for stratification, where well classified;
- Whether the storage has multilevel offtakes, and whether adequate data exists to define the optimum offtake level for these structures;
- Environmental values for the stream.

The requirements also recognise that ongoing monitoring within the reservoir provides limited information beyond the characterisation of annual stratification patterns. Operational optimization of reservoir and weir pool release strategies will be better informed by the outcomes of downstream monitoring of release waters.

Note that where an Environmental Impact Assessment was carried out for the construction of the storage, water quality monitoring is to be in accordance with the following:

- any relevant requirements of a Co-ordinator General's report (issued under the *State Development and Public Works Organisation Act 1971*); or
- any development conditions; or,
- any relevant requirements of an 'Environmental Management Plan'; or,
- an alternative approach to the satisfaction of the applicable agency.

The current requirements initially restrict monitoring to physico-chemical parameters. Any biological impact monitoring triggered by these results will need to be determined on a case by case basis.

## 5.2 Detailed requirements

In accordance with a risk management approach, the specific monitoring requirements will be determined by the physical characteristics of the infrastructure.

### Monitoring Objectives

The sites and parameters monitored in the storage impact monitoring program will depend on the objectives of the monitoring being undertaken. The following broad objectives should be used to define the monitoring design under this standard:

1. Characterise the stratification pattern for a storage;
2. Determine the optimum level from which to release water (for storages fitted with multi-level offtakes);
3. On-going monitoring program for monomictic storages;
4. ongoing monitoring for polymictic storages;
5. determination of trigger values (based on reference sites)

### Well characterised, monomictic, water depth > 4 metres

Storages that are **well-characterised** and are known to exhibit a monomictic stratification pattern should be monitored during releases in the area immediately downstream subject to safe accessibility.

Cyanobacteria biomass shall be monitored in the storage pond in accordance with the NRW 'Blue-Green Algae Monitoring Standard'.

Details of the monitoring requirements are given in Table 1.

**Table 1 – Water quality parameters for ongoing monitoring of well characterised storages**

Parameter	Storage pond	Storage outflow
Temperature	x	✓
Dissolved oxygen	x	✓
pH	x	✓
Electrical conductivity	x	✓
Total nitrogen	x	✓
Total phosphorus	x	✓
Cyanobacteria	✓	x
Total sulphide	x	✓

Well characterised storages where the stratification pattern is consistently weak (i.e. temperature difference of less than 5°C throughout the annual stratification cycle as

defined by Chudek et al, 1997<sup>1</sup> do not require monitoring. Well characterised barrages and offstream storages do not require monitoring.

### Poorly characterised, water depth > 4 metres

Storages where the stratification pattern is not well characterised should be monitored within the storage pond and in the area immediately downstream subject to safe accessibility during releases. Within storage monitoring need only be continued until such time as the annual stratification pattern can be established with reasonable confidence.

Details of the monitoring requirements are given in Table 2.

**Table 2 – Water quality parameters for poorly characterised reservoirs**

Parameter	Storage pond	Storage outflow
Temperature	Profile	✓
Dissolved oxygen	Profile	✓
pH	x	✓
Electrical conductivity	x	✓
Total nitrogen	x	✓
Total phosphorus	x	✓
Cyanobacteria	✓	x
Total sulphide	x	✓

### Water depth < 4 metres

Storages with a depth less than 4 metres represent a low risk and should only be monitored if sensitive riverine areas requiring a high level of protection are located immediately downstream<sup>2</sup>. In this case, monitoring should be conducted during releases in the area immediately downstream of the storage, in accordance with the 'storage outflow' requirements of Table 2.

### Additional monitoring

For both reservoirs and weirs, operation of multi-level offtake structures or hypolimnetic offtake structures will need to be optimised to minimise thermal and dissolved oxygen depression in release water compared to the receiving water system. This may require within reservoir monitoring prior to releases to optimise water quality unless adequate historical data exists to inform this. Deviation from local trigger values will be used to assess operational performance (see Setting trigger values in s5.5.3).

<sup>1</sup> *Stratification Patterns in Queensland Dams: A Preliminary Assessment*. Water Resources Group, Resource Sciences Centre, Queensland Department of natural Resources

<sup>2</sup> As for instance identified in a regional planning document

**Table 3 – Water quality parameters for determining optimum offtake/ release level**

Parameter	Storage pond
Temperature	Profile
Dissolved oxygen	Profile
Cyanobacteria	Profile

**General requirements**

As the risk of stratification is seasonally based, monitoring can generally be restricted to the period October to May. During this period, if there is continual releases, monitoring frequency should be monthly.

For monitoring relating to characterisation of stratification pattern, a minimum of monthly sampling for two years is recommended. This may be supplemented by historical data.

For monitoring relating to determination of optimum off-take level, a minimum of monthly sampling for two years is recommended to establish a seasonal profile. This may be supplemented by historical data.

The following requirements are also to apply where appropriate:

- Where measurements and/or samples are required in consecutive months, these should be taken no less than three weeks apart.
- Where inflow and outflow data are compared to determine impact, measurements and/or samples for all the parameters specified in the relevant table should be taken on the same day where practicable.
- Where overtopping is occurring, no sampling is required. Overtopping events generally result in mixing water whereby the water quality of the downstream environment can be assumed to be of a similar quality to the upstream and storage water quality. Not only do overtopping events represent a safety hazard for samplers, the impact of storage operations on water quality is considered to be negligible.

All water samples are to be collected in accordance with the Queensland Environmental Protection Agency *Water Quality Sampling Manual*, AS 2031:2001 and AS/NZS 5667.1:1998.

Where water quality profiles are required, these should be taken at depth intervals of one metre throughout the profile to the maximum accessible depth of the storage.

Smaller depth intervals should be used if the storage is shallow, or if temperature or dissolved oxygen readings are changing rapidly. One of the sampling points should be in the vicinity of 100 metres upstream of the storage wall along the channel alignment at or near the deepest point where practicable.

Water quality samples are to be analysed in accordance to the reference standards outlined in Appendix C. Samples are to be analysed at a **NATA**-certified laboratory that is accredited for the appropriate categories of analyses

### **5.3 Setting trigger values**

The primary purpose of the monitoring is to determine if the operation of the storage has resulted in water quality which exceeds appropriate trigger values. Where storage and/or outflow water quality does not meet guideline values<sup>3</sup>, paired sampling of storage / outflow with inflow<sup>4</sup> should identify any significant changes in water quality. If significant changes are detected, then you will need to establish whether the appropriate trigger value has been exceeded.

Determination of appropriate trigger values should be in accordance with the requirements of the Environmental Protection (Water) Policy 1997, and in particular, the Queensland Water Quality Guidelines. Operators will need to define their own upper and lower low-risk trigger values, using the 80th and 20th percentiles, respectively, of ecosystem temperature distribution (ANZECC/ARMCANZ 2000). The Australian and New Zealand Water Quality Guidelines recommends that the computation of the 80th and 20th percentiles at reference sites be based on the most recent 24 monthly observations.

A trigger for further investigation will be deemed to have occurred when the median concentration of a particular measurement parameter in  $n$  independent samples taken at the test site exceeds the 80th percentile or is below the 20th percentile if 'less is worse' (as in the case of depressed temperature and dissolved oxygen) of the same measurement parameter at the reference site. A minimum of two years of consecutive monthly data at the reference site is required before a valid trigger value can be established based on that site's percentiles. If this requirement has not been satisfied, the median of the data values measured at the test site should be compared to the appropriate default guideline value identified in the Water Quality Guidelines (ANZECC/ARMCANZ 2000).

The advantages of using a percentile of the reference distribution are: (1) it avoids the need to specify an absolute quantity; and (2) the trigger criterion is being constantly updated as the reference site is monitored, and therefore it reflects temporal trends and the effects of extraneous factors (e.g. climate variability, seasons).

### **5.4 Monitoring program review**

The monitoring program should be reviewed annually at a minimum to ensure that the program is adequate in assessing the risk of stratification and the associated potential impacts to the impoundment and receiving ecosystems.

Where storages are found to have a low risk of impact, monitoring may reduce or cease. Storages defined as having a moderate risk should continue to monitor in

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<sup>3</sup> Queensland Water Quality Guidelines 2006. Queensland environmental Protection Agency.

<sup>4</sup> If the storage has multiple inputs, it may be adequate to determine an average value.

accordance with the above programs. Storages defined as having a high risk should extend the monitoring program to enable a comprehensive assessment of the potential impact of releases to the downstream environment and the extent of such an impact.

## **6. Other Requirements**

### **6.1 Continuous Time Series Data**

**Continuous time series data** for streamflow, rainfall, water height/depth, conductivity, water temperature, pH, and dissolved oxygen must be recorded by independently verifiable and calibrated means (such as by using technical instrumentation) and will be measured or derived in accordance with the accuracies outlined in Appendix A.

### **6.2 Intermittent Data**

**Intermittent data** for water height/depth, current meter measurements, conductivity, temperature, pH, dissolved oxygen, turbidity and alkalinity will be measured in accordance with the accuracies outlined in Appendix B.

### **6.3 Natural Ecosystem Monitoring**

Accepted methods for natural ecosystem monitoring are outlined in Appendix D.

### **6.4 Calibration of Instruments against a Certified Reference**

Reference instrument certifications must be repeatedly tested in accordance with AS/NZS ISO 9001:2000. Certified reference **instruments** and standard solutions are to be used to calibrate field instruments. Instruments and standard solutions are supplied with the manufacturer's certification of the accuracy of these instruments/solutions, that are valid for a specified time.

### **6.5 Calibration of Instrumentation in the Field**

The frequency of field calibration and maintenance of instruments will be to achieve the data accuracies specified in Appendix A and B. Calibration records will be maintained of the field calibrations of instruments.

### **6.6 Derivation of Discharge or Volume Data**

Discharge can be derived based on a depth/discharge relationship which is to be developed in accordance with the principles of AS/NZS 3778.

The volume of a storage or a waterhole can be derived based on a depth/volume relationship. Storage depth/volume relationships are to be developed in accordance with industry best practice.

## 6.7 Meteorological Data

Meteorological data are to be measured following the principles of the Bureau of Meteorology as outlined in *Observation Specification No. 2013: Guidelines for the siting and exposure of meteorological instruments and observation facilities and Observing the Weather: The Australian Co-operative Observers' Guide*.

## 6.8 Data Storage

All data are to be checked and **verified** in accordance with the principles of AS/NZS ISO 9001:2000. All data are to be stored with statements about the data quality, including any non-compliance issues, the calibration status of equipment used, the reliability of the data and explanations for any missing data.

Data for surface water should be available in a format as specified by NRW *Water Monitoring Data Reporting Standards*.

## 6.9 Records

All records required under a monitoring program are to be stored by the monitoring body for fifteen years. All records are to be made available to NRW on request for audit purposes.

## 7 Definitions

<b>Actual value</b>	<p>Value of a parameter determined by a field measurement made to the appropriate standard. Examples include:</p> <ul style="list-style-type: none"><li>• Flow determined by a field gauging;</li><li>• Water quality parameter determined by a calibrated instrument in the field;</li><li>• Stream height determined by reading a surveyed gauge in the field.</li></ul>
<b>Accuracy of data</b>	<p>The accuracy of data following verification and/or derivation.</p>
<b>Accuracy of measurement</b>	<p>The accuracy at which data are required to be measured.</p>
<b>Analysis method</b>	<p>Method to be used to analyse a water sample.</p>
<b>APHA</b>	<p>American Public Health Association.</p>
<b>AS/NZS</b>	<p>Australian Standard/New Zealand Standard.</p>
<b>Calibrated hydraulic structure</b>	<p>An engineered structure that has been calibrated to industry best practice by measured flows. Typical structures are:</p> <ul style="list-style-type: none"><li>• concrete gauging flumes</li><li>• concrete Crump gauging weirs</li><li>• concrete dam or weir spillways</li><li>• concrete or steel discharge gates</li><li>• metal valves (eg: cone or butterfly type)</li></ul>
<b>Continuous time series data</b>	<p>Data that represents what is happening through time within the specified accuracy and precision for a parameter. The minimum frequency of measurement is at least once per day.</p> <p>NOTE: Often the frequency of measurement is related to the rate of change in the parameter such that the frequency increases with the rate of change. This allows for more efficient data collection especially in circumstances where parameters do not change for long periods of time.</p> <p>Instruments and sensors which continually measure parameters require periodic maintenance and calibration to ensure that the data are complete and reliable. Measurements may need to be manually corrected if the instrument is known to have malfunctioned or become inaccurate.</p> <p>Typically, recorded continuous time series parameters are a site-specific mix of:</p>

- water level
- water flow (usually derived from the water level time series)
- storage volume (derived from the storage headwater level time series)
- rainfall
- water quality (eg: electrical conductivity, temperature, pH, dissolved oxygen, and turbidity)

<b>Cumecs</b>	Cubic metres per second, the measurement of flow rate.
<b>Data</b>	<b>Verified</b> data or derived data for specific water resource parameters for specific sites at specific times.
<b>Date and Time</b>	Applies to the actual date of an event and time is defined as Eastern Standard Time (GMT + 10 hours) to the nearest minute.
<b>Derived data</b>	Data that has been created by applying a mathematical process to verified data. Examples are the derivation of stream flows from verified stream water levels by the application of a flow/depth relationship (rating curve) and the derivation of daily and monthly rainfall figures from verified pluviograph data.
<b>Hand-held Instruments</b>	Portable instruments that are used to do “spot” measurements at one or more sites for intermittent data. Examples are thermometers, flow meters and bore level plumbs. They also may be used to calibrate in-situ or other hand-held instruments.
<b>Hydsys</b>	A proprietary data base software package for the storage and archiving of water monitoring data.
<b>Hypolimnion Hypolimnetic Identifier number</b>	<p>The body of water in a storage lying below the metalimnion</p> <p>Relating to the hypolimnion</p> <p>The water quality data parameter unique identifiers that are used in the NRW Water Databases.</p> <p>The number format of nnnn.nn where the first four digits identify the parameter and the last two digits identify the data source/monitoring body.</p>
<b>In-situ Instruments</b>	Instruments that are permanently or semi-permanently located at a site for the purpose of measuring continuous time series data. Examples are stream gauging stations and rainfall pluviographs.
<b>Instruments</b>	Instruments are either in-situ or hand-held equipment used for the collection or calibration of water monitoring measurements.
<b>Intermittent data</b>	Data collected with only sporadic data points being recorded, generally taken according to a fairly regular interval or during or following a

particular event. However, the data points are insufficient to continuously define in time the changing values of the parameter.

NOTE: Intermittent data only gives a *snapshot* of parameter values at the time of measurement or sampling. It usually augments, and adds value to continuous time series data.

Typically, recorded intermittent parameters are a site-specific mix of:

- water flow gaugings
- water quality measurements (eg: electrical conductivity, temperature, pH, dissolved oxygen, and turbidity)
- water quality samples (for later laboratory analysis, eg: major ions, nutrients, blue-green algae, chlorophyll *a*, pesticides)
- bio-indicator samples

<b>Lab Std</b>	The reference for the laboratory standard used for new types of water analysis or where no known reference is available.
<b>LRL</b> (detection limit)	(‘lowest reporting limit’) The minimum water sample parameter detection level when the sample is being analysed and therefore the minimum reporting level.
<b>Measurements</b>	Direct reading of a parameter at a specific time and location. Measurement may be taken in-situ or hand-held using a gauge or instrument. Examples are reading the water level on a gauge board or the result on a pH meter.
<b>Metalimnion</b>	The region of the water body in a storage where the rate of change of temperature is comparatively rapid
<b>Monitoring body</b>	Organisations or persons required to comply with these standards. This requirement may be specified in a Water Resource Plan, Resource Operations Plan, a Resource Operations Licence, an Interim Resource Operations Licence or an NRW policy. NRW is a monitoring body.
<b>Monomictic</b>	A storage where complete mixing regularly occurs once per year, generally in autumn
<b>NATA</b>	National Association of Testing Authorities, Australia.
<b>Natural controls</b>	A sand, gravel or rock bar at the downstream end of the gauge pool used to measure flow depth in a stream.
<b>Parameter</b>	Type of water resource feature to be measured. Examples are flow, temperature, water level, etc.
<b>Partially rated flow control</b>	Flow control that has a calibrated depth/discharge relationship, developed to industry best practice, across a limited range of measured flows. The fully calibrated depth/discharge relationship is to be established as soon as practical.

<b>Rated flow control</b>	Flow control that has a calibrated depth/discharge relationship, developed to industry best practice, across a wide range of measured flows.
<b>Stratification</b>	Layering of a body of water due to physical differences in upper and lower layers. It is common in deep, still water bodies due to the density gradient between cooler deep water and warmer upper layers that can develop in spring and summer months.
<b>Records</b>	Records are data documents stating results achieved or providing evidence of activities performed. This includes all information relating to the creation and management of data. Records may include measurements, verified data, derived data, derivations, calculations, mathematical processes, calibrations, etc.
<b>Thermocline</b>	The layer in a stratified lake within which the temperature changes most rapidly with depth.
<b>Time Studio</b>	A proprietary data base software package for the storage and archiving of water monitoring data.
<b>USEPA references</b> (Appendix C)	United States Environmental Protection Agency methods of water sample analysis.
<b>Verified data</b>	All measurements which have been checked for correctness against a calibrated meter or by other methods. Examples are water levels amended for instrument correction, discharges in streams, etc.
<b>Well-characterised storage</b>	A reservoir where temperature and dissolved oxygen profile observations existing for each calendar month over a number of years and the pattern of stratification is well-established.
<b>Weir</b>	A barrier constructed across a watercourse <u>below</u> the banks of the watercourse that hinders or obstructs the flow of water in the watercourse.

## Appendix A

### Accuracy of Continuous Time Series Data

Parameter	Identifier Number	Method	Accuracy of Data
Rainfall	10.xx	Measured	Values will be within $\pm 5\%$ or $\pm 1\text{mm}$ (whichever is the greater) of actual rainfall
Height/depth (Streams, Storages, Groundwater)	100.xx	Measured	Values will be either $\pm 10\text{ mm}$ (below 2 m range) or $\pm 30\text{ mm}$ (above 2 m range), of actual height/depth
Derived surface water flow rate (instantaneous)	140.xx	Derived	<p><b>Calibrated hydraulic structure</b> Values will be within <math>\pm 5\%</math> of <b>actual flow</b></p> <p><b>Rated flow control</b> Values will be within <math>\pm 10\%</math> of actual flow</p> <p><b>Partially rated flow control</b> Values will be within <math>\pm 10\%</math> of actual flow for rated section and Values will be within <math>\pm 20\%</math> of actual flow for unrated section</p> <p>(min absolute value will be 0.001 <b>cumecs</b>)</p>
Storage Volume	136.xx	Derived	Values will be within $\pm 10\%$ or $\pm 0.01\text{ML}$ (whichever is greater) of actual volume
Flow Volume (daily)	151.xx	Derived	As for identifier No. 140 (min absolute value will be 0.1 ML/day)
Conductivity	2010.xx	Measured	Values will be within $\pm 10\%$ or $\pm 40\ \mu\text{S/cm}$ (whichever is the greater) of actual conductivity
Temperature (water)	2080.xx	Measured	Values will be within $\pm 1^\circ\text{C}$ of actual temperature
pH	2100.xx	Measured	Values will be within $\pm 0.5\text{ pH unit}$ of actual pH, but not less than 0.5 pH unit
Dissolved Oxygen	2351.xx	Measured	Values will be within $\pm 5\%$ or $\pm 0.2\text{ mg/L}$ (whichever is the greater) of actual dissolved oxygen

Note: The accuracy in the table above is applied to the final product when it is archived following processing.

The xx at the end of the identifier number uniquely identifies the data source.

## Appendix B

### Accuracy of Intermittent Data

Parameter	Identifier Number	Method	Accuracy of Measurement
Height/depth (Streams, Storages, Groundwater)	100.xx	Measured by survey/ gauge board / reference point	Reading within 5mm accuracy
Surface water flow rate (instantaneous)	140.xx	Measured by current meter	Gauging conducted in accordance with AS/NZS 3778
Conductivity	2010.yy	Measured	Values will be within $\pm 1.5\%$ or $\pm 20$ $\mu\text{S}/\text{cm}$ (whichever is greater) of actual conductivity
Temperature	2080.yy	Measured	Values will be within $\pm 1^\circ \text{C}$ of actual temperature
pH	2100.yy	Measured	Values will be within $\pm 0.1$ of a pH unit of actual pH, but not less than 0.1 of a pH unit
Dissolved Oxygen	2351.yy	Measured	Values will be within $\pm 0.5\%$ or $\pm 0.2$ $\text{mg}/\text{L}$ (whichever is greater) of actual dissolved oxygen
Turbidity	2030.yy	Measured	Values will be within $\pm 5\%$ or $\pm 1$ NTU (whichever is greater) of actual turbidity
Alkalinity	2113.yy	Derived	Values will be within $\pm 5\%$ or $\pm 1$ $\text{mg}/\text{L}$ (whichever is greater) of actual alkalinity

Note: The xx at the end of the identifier number uniquely identifies the data source.

The yy at the end of the identifier number uniquely identifies the field water quality data source.

## Appendix C

### Water Quality Analysis - Reference Standards

#### Major Ions

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Colour - true	2051.	Colorimetric	Hack DR 2000	1	Hazen
Turbidity	2030.	Nephelometric	APHA 2130B	1	NTU
Silica as SiO <sub>2</sub> - soluble	2762.	ICP	APHA 3120B	1	mg/L
Total Suspended Solids	2172.	Gravimetric	APHA 2540D	10	mg/L
Total Alkalinity as CaCO <sub>3</sub>	2113.	Titrimetric	APHA 2320B	2	mg/L
Sodium as Na	2391.	ICP	APHA 3120B	0.3	mg/L
Potassium as K	2381.	ICP	APHA 3120B	0.1	mg/L
Calcium as Ca - soluble	2302.	ICP	APHA 3120B	0.1	mg/L
Magnesium as Mg - soluble	2322.	ICP	APHA 3120B	0.1	mg/L
Chloride as Cl	2311.	IC/Titration	APHA 4110B	2	mg/L
Fluoride as F	2641.	Ion Selective Electrode	APHA 4500-F.C	0.05	mg/L
Nitrate as No <sub>3</sub>	2331.	IC	APHA 4110B	0.5	mg/L
Sulphate as SO <sub>4</sub>	2401.	IC	APHA 4110B	2	mg/L
Iron as Fe	2682.	ICP	APHA 3120B	0.02	mg/L
Manganese as Mn	2712.	ICP	APHA 3120B	0.02	mg/L
Zinc as Zn	2822.	ICP	APHA 3120B	0.02	mg/L
Aluminium as Al	2502.	ICP	APHA 3120B	0.05	mg/L
Boron as B	2551.	ICP	APHA 3120B	0.1	mg/L
Copper as Cu	2622.	ICP	APHA 3120B	0.03	mg/L
pH	2100.	electrometric	APHA 4500-H	0.1	
E. Conductivity @25	2010.	Cond cell	APHA 2510B	1.0	µS/cm
Carbonate as Co <sub>3</sub>	2124.	Calc		0.1	mg/L
Hydrogen as H	2141.	Calc		0.1	mg/L
Hardness as CaCo <sub>3</sub>	2132.	Calc		0.1	mg/L
Bicarbonate as HCo <sub>3</sub>	2125.	Calc		0.1	mg/L
Hydroxide as OH	2123.	Calc		0.1	mg/L
Total Dissolved Ions	2170.	Calc		10.0	mg/L
Total Dissolved Solids	2169.	Calc		10.0	mg/L

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Total Sulphide	2405.	Methylene blue		0.05	mg/L

## Metals unfiltered

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Arsenic as As	2524.	CFAAS	APHA 3113B	0.005	µg/L
Mercury as Hg	2721.	CVAAS	APHA 3112B	0.2	µg/L
Cadmium as Cd	2574.	ICP	APHA 3120B	0.6	µg/L
Copper as Cu	2624.	ICP	APHA 3120B	5	µg/L
Chromium as Cr	2605.	ICP	APHA 3120B	1	µg/L
Iron as Fe	2684.	ICP	APHA 3120B	20	µg/L
Manganese as Mn	2714.	ICP	APHA 3120B	10	µg/L
Nickel as Ni	2744.	CFAAS	APHA 3120B	5	µg/L
Lead as Pb	2694.	CFAAS	APHA 3120B	4	µg/L
Zinc as Zn	2824.	ICP	APHA 3120B	20	µg/L

## Nutrients unfiltered

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Total Phosphorus as P	2363.	Automated Digestion	APHA 4500-P.H	0.002	mg/L
Organic Nitrogen	2339.	Calculated	APHA 4500-Norg B	0.05	mg/L
Total Nitrogen	2337.	Persulphate Digestion	APHA 4500-N C	0.05	mg/L

Any persulphate digest that had residue remaining after digest (sediment) by persulfate oxidation/digestion is to be repeated using the Kjeldahl digestion procedure.

## Nutrients filtered

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Ammonia as N	2345.	Automated Phenate	APHA 4500-NH3 G	0.002	mg/L
Nitrate + Nitrite as N	2343.	Automated Cd Red.	APHA 4500-N03 F	0.002	mg/L
React. P	2365.	Automated Digestion	APHA 4500-P.F	0.002	mg/L

## Chlorophyll a

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Chlorophyll a	7001.	Spectrophotometric	APHA 10200H	1	µg/L

## Algae

Units are cells/ml which are converted to mm<sup>3</sup>/L cell biovolume

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Blue Green Algae	As per following table	microscope-counting	APHA 10200F	1	Cells/mL

Parameter	Identifier Number	Cyanobacteria Order
Aphanocapsa	8833.	Chroococcales
Aphanocapsa holsatica	9049.	Chroococcales
Aphanocapsa incerta	9075.	Chroococcales
Aphanothece	8834.	Chroococcales
Aphanothece clathrata	8836.	Chroococcales
Chroococcus	8837.	Chroococcales
Chroococcus microscopicus	8850.	Chroococcales
Chroococcus minutus	8851.	Chroococcales
Coelosphaerium	8838.	Chroococcales
Coelosphaerium kuetzingianum	8852.	Chroococcales
Coelosphaerium pallidum	8853.	Chroococcales
Cyanodictyon	8917.	Chroococcales
Cyanodictyon planktonicum	8918.	Chroococcales
Gomphosphaeria	9076.	Chroococcales
Merismopedia	8843.	Chroococcales
Microcystis aeruginosa	8847.	Chroococcales
Microcystis flos-aquae	8848.	Chroococcales
Myxobaktron	8849.	Chroococcales
Rhabdoderma	8855.	Chroococcales
Snowella	8842.	Chroococcales
Snowella lacustris	8854.	Chroococcales
Anabaena	8873.	Nostocales
Anabaena aphanizomenoides	8875.	Nostocales
Anabaena bergii limnetica	8876.	Nostocales
Anabaena circinalis	8877.	Nostocales
Anabaena crassa	9077.	Nostocales
Anabaena flos-aquae	8879.	Nostocales
Anabaena inequalis	8881.	Nostocales
Anabaena oscillaroides	8885.	Nostocales
Anabaena perturbata (tumida)	9078.	Nostocales
Anabaena planktonica	8886.	Nostocales
Anabaena smithii	9080.	Nostocales
Anabaena spiroides	8888.	Nostocales
Anabaenopsis	8897.	Nostocales
Anabaenopsis elenkinii	8899.	Nostocales
Aphanizomenon	8902.	Nostocales
Aphanizomenon gracile	8903.	Nostocales
Aphanizomenon issatschenkoi	8904.	Nostocales
Aphanizomenon ovalisporum	8920.	Nostocales
Cylindrospermopsis raciborskii	8910.	Nostocales
Raphidiopsis	8915.	Nostocales
Arthrospira	8933.	Oscilatonales
Arthrospira maxima	8921.	Oscilatonales
Limnothrix	9083.	Oscilatonales
Lyngbya	8934.	Oscilatonales
Oscillatoria	8937.	Oscilatonales
Phormidium	8941.	Oscilatonales
Planktolyngbya contorta	8953.	Oscilatonales
Planktolyngbya subtilis	8943.	Oscilatonales
Planktothrix	8944.	Oscilatonales
Planktothrix perornata attenuata	8922.	Oscilatonales
Pseudanabaena	8945.	Oscilatonales
Pseudanabaena galeata	8923.	Oscilatonales
Pseudanabaena limnetica	8946.	Oscilatonales
Pseudanabaena mucicola	8947.	Oscilatonales
Romeria	8951.	Oscilatonales
Spirulina	8949.	Oscilatonales

**Pesticides (water)**

When screening for pesticides in water a class total is always reported to provide summary information, if none are found a result code of zero has been defined so that the group heading can be reported as none detected.

This applies to Organochlorine Pesticides, Organophosphorus Pesticides, Carbamate Pesticides, Phenoxy Herbicides, Triazine Herbicides, Non Phenoxy Herbicides, Substituted Urea Herbicides and Synthetic Pyrethroid Pesticides.

**Substituted Urea Herbicides**

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Herb. Tot Subs Urea	4411.	HPLC/UV Detection/LCMSMS	USEPA 3510	0.01	µg/L
Herb. Diuron	4222.	HPLC/UV Detection/LCMSMS	USEPA 3510	0.01	µg/L
Herb. Fluometuron	4221.	HPLC/UV Detection/LCMSMS	USEPA 3510	0.01	µg/L
Herb. Tebuthiuron	4019.	LCMSMS	Lab Std	0.01	µg/L

**Triazine Herbicides**

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Herb. Simazine	4021.	GC/NPD/GCMS	USEPA 507	0.1	µg/L
Herb. Tot Triazine	4002.	GC/NPD/GCMS	USEPA 507	0.1	µg/L
Herb. Atrazine	4024.	GCMS Detection	USEPA 3510/8080	0.02	µg/L
Herb. Prometryn	4025.	GC/NPD/GCMS	USEPA 507	0.1	µg/L
Desisopropylatrazine	4034.	GCMS	Lab Std	0.1	µg/L
Herb. Ametryn	4018.	GCMS/LCMSMS	USEPA 3510	0.1	µg/L

**Organophosphate Pesticides**

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
OP Chlorpyrifos	3326.	GC/FPD/GCMS	USEPA 3510/8140	0.05	µg/L
OP Chlorpyrifos-methyl	3316.	GCMS	USEPA 3501/8140	0.1	µg/L
OP Chlorfenvinphos	3320.	GC/FPD/GCMS	USEPA 3510/8140	0.1	µg/L
OP Dimethoate	3332.	GC/FPD/GCMS	USEPA 3510/8140	0.5	µg/L
OP Ethion	3393.	GCMS	USEPA 3510/8140	0.1	µg/L
OP Parathion-methyl	3341.	GC/FPD/GCMS	USEPA 3510/8140	0.5	µg/L
OP Pesticides	3202.	GC/FPD/GCMS	USEPA 3510/8140	0.5	µg/L
OP Profenofos	3342.	GC/FPD/GCMS	USEPA 3510/8140	0.5	µg/L

## Organochlorine Pesticides

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
OC Aldrin	3121.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC CIS-Chlordane	3123.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC Dieldrin	3129.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC Endosulfan alcohol	3152.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC Gamma HCH	3138.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC HCH alpha	3135.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC HCH beta	3136.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC HCH delta	3137.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC HCH total	3145.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC Heptachlor	3139.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC Heptachlor Epox.	3140.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC o-p DDD	3120.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC o-p DDT	3119.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC p-p DDD	3126.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC p-p DDE	3127.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC p-p DDT	3128.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC Total Chlordane	3122.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC Total DDT	3106.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC Trans-Chlordane	3124.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC Endosulfan Total	3151.	GC/ECD/GCMS	USEPA 3510/8080	0.01	µg/L
OC Endosulfan Ether	3150.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC Endosulfan SO4	3132.	GC/ECD/GCMS	USEPA 3510/8080	0.05	µg/L
OC Endosulfan-alpha	3130.	GC/ECD/GCMS	USEPA 3510/8080	0.01	µg/L
OC Endosulfan-beta	3131.	GC/ECD/GCMS	USEPA 3510/8080	0.01	µg/L
OC other	3118.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
OC Total	3102.			0.1	µg/L

## Carbamate Pesticides

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Aldicarb	3522.	HPLC,Post Col. Der.	USEPA 531.1	1	µg/L
Aldicarb Sulphone	3532.	HPLC,Post Col. Der.	USEPA 531.1	1	µg/L
Aldicarb Sulphoxide	3531.	HPLC,Post Col. Der.	USEPA 531.1	2	µg/L
Bendiocarb	3527.	HPLC,Post Col. Der.	USEPA 531.1	1	µg/L
Carb. Methomyl	3524.	HPLC,Post Col. Der.	USEPA 531.1	1	µg/L
Carb. Thiodicarb	3530.	HPLC,Post Col. Der.	USEPA 531.1	1	µg/L
Carbamate pesticide	3502.	HPLC,Post Col. Der.	USEPA 531.1	1	µg/L
Carbaryl	3529.	HPLC,Post Col. Der.	USEPA 531.1	1	µg/L
Carbofuran	3523.	HPLC,Post Col. Der.	USEPA 531.1	1	µg/L
Methiocarb	3525.	HPLC,Post Col. Der.	USEPA 531.1	1	µg/L
Promecarb	3533.	HPLC,Post Col. Der.	USEPA 531.1	1	µg/L

## Synthetic Pyrethroids

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Bifentrin	3729.	GCMS/ECD	USEPA 3510	0.5	µg/L
Cypermethrin	3725.	GCMS	USEPA 3510	0.5	µg/L
Syn Pyrethroids	3702.	GCMS	USEPA 3510	0.5	µg/L

## Dinitroaniline Herbicides

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Herb. Pendimethalin	4636.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L
Herb. Trifluralin	4626.	GC/ECD/GCMS	USEPA 3510/8080	0.1	µg/L

## Chloroacetanilide Herbicide

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Herb. Metolachlor	4637.	GC/ECD/GCMS	LAB STD	0.1	µg/L

## Uracil Herbicides

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Bromacil	4634.	GC/ECD/GCMS	LAB STD	0.1	µg/L

## Triazinone Herbicides

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Herb. Hexazinone	4642.	GC/NPD/GCMS	LAB STD	0.1	µg/L

## Synergist for Pyrethrins

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Piperonyl Butoxide	3703.	GC/GCMS	LAB STD	0.5	µg/L

## PCB

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Polychlorinated Biphenyls-total	3146.00	GC/EDCD	USEPA 3510/8080	1	µg/L

## Combination of Non Phenoxy

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Total Non Phenoxy	4641.	-	-	0.10	µg/L

## Amidine Insecticide

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Amitraz	4920.	GCMS	USEPA 3510/8080	1.0	µg/L

**Bacteria**

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Faecal Coliform	6112.	Membrane filtration	AS 4276.7	0	CFU/100mL
E.coli	6114.	Membrane filtration	AS 4276.7	0	CFU/100mL

**Pesticides/Nutrients/Metals (mud)****Nutrients**

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Nitrogen, total Kjeldahl	2347.	Extract/colorimetric	APHA	5.0	mg/Kg
Phosphorus, total	2367.	Extract/colorimetric	APHA	0.5	mg/Kg

**Metals**

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Aluminium	2508.	Acid Digest/ICP	USEPA 3050	10.0	mg/Kg
Cadmium	2578.	Acid Digest/FAAS	USEPA 3050	1.0	mg/Kg
Chromium	2608.	Acid Digest/ICP	USEPA 3050	10.0	mg/Kg
Copper	2628.	Acid Digest/ICP	USEPA 3050	5.0	mg/Kg
Cyanide	2638.	Colorimetric	APHA	0.1	mg/Kg
Iron	2688.	Acid Digest/ICP	USEPA 3050	10.0	mg/Kg
Lead	2698.	Acid Digest/ICP	USEPA 3050	10.0	mg/Kg
Manganese	2718.	Acid Digest/ICP	USEPA 3050	1.0	mg/Kg
Mercury	2728.	Acid Digest/ICP	USEPA 3050	10.0	mg/Kg
Nickel	2748.	Acid Digest/ICP	USEPA 3050	10.0	mg/Kg
Selenium	2758.	Acid Digest/ICP	USEPA 3050	40.0	mg/Kg
Tot. Silica as SiO <sub>2</sub>	2767.	XRF	Norrish/Hutton	0.10	mg/Kg
Zinc	2828.	Acid Digest/ICP	USEPA 3050	10.0	mg/Kg

**Organochlorine Pesticides**

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
OC Endosulfan alpha	3161.	GC/ECD/GCMS	AOAC 970 52M	1.0	ug/Kg
OC Endosulfan beta	3162.	GC/ECD/GCMS	AOAC 970 52M	1.0	ug/Kg
OC Endosulfan SO <sub>4</sub>	3163.	GC/ECD/GCMS	AOAC 970 52M	1.0	ug/Kg
OC total DDT	3171.	GC/ECD/GCMS	AOAC 970 52M	5.0	ug/Kg
OC total Endosulfan	3170.	GC/ECD/GCMS	AOAC 970 52M	1.0	ug/Kg
OC total Organochlorine	3108.	GC/ECD/GCMS	AOAC 970 52M	5.0	ug/Kg
OC Dieldrin	3160.	GC/ECD/GCMS	AOAC 970 52M	5.0	ug/Kg
OC op-DDE	3168.	GC/ECD/GCMS	AOAC 970 52M	5.0	ug/Kg
OC op-DDD	3169.	GC/ECD/GCMS	AOAC 970 52M	5.0	ug/Kg
OC pp-DDD	3165.	GC/ECD/GCMS	AOAC 970.52M	5.0	ug/Kg
OC pp-DDE	3166.	GC/ECD/GCMS	AOAC 970.52M	5.0	ug/Kg
OC pp-DDT	3167.	GC/ECD/GCMS	AOAC 970 52M	5.0	ug/Kg

## Orthophosphate Pesticides

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
OP Parathion	3349.	GC/FPD/GCMS	AO AC 970 52M	10.0	ug/Kg
OP Profenofos	3350.	GC/FPD/GCMS	AO AC 970 52M	10.0	ug/Kg
OP Total Organophosphate	3208.	GC/FPD/GCMS	AO AC 970 52M	10.0	ug/Kg

## Triazine Herbicides

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Ametryn	4030.	GC/NPD/GCMS	LAB STD	10.0	ug/Kg
Atrazine	4031.	GCMS	AO AC 970 52M	10.0	ug/Kg
Deltamethrin	3728.	GCMS	-	20.0	ug/Kg
Simazine	4028.	GC/NPD/GCMS	LAB STD	10.0	ug/Kg
Triazine	4008.	GC/NPD/GCMS	LAB STD	10.0	ug/Kg

## Substituted Urea Herbicides

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Diuron	4228.	LCMSMS	LAB STD	10.0	ug/Kg
Fluometuron	4227.	LSMSMS	LAB STD	10.0	ug/Kg

## Carbamate Pesticides

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Carbendazim	3509.	HPLC/LCMSMS	LAB STD	10.0	ug/Kg
Total Carbamates	3508.	LCMSMS	LAB STD	50.0	ug/Kg

## Synthetic Pyrethroids

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Bifenthrin	3727.	GC/ECD/GCMS	LAB STD	20.0	ug/Kg

## Dinitroaniline Herbicides

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Pendimethalin	4649.	GC/ECD/GCMS	LAB STD	5.0	Ug/Kg

## Chloroacetanilide Herbicides

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Metolachlor	4648.	GC/ECD/GCMS	AO AC 970 52M	10.0	ug/Kg

## Phenoxy acid Herbicides

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
2,4,5-T	4432.	GC/ECD/GCMS	EPA 8150	10.0	ug/Kg
2,4-D	4431.	GC/ECD/GCMS	EPA 8150	10.0	ug/Kg
2,4-DB	4434.	GC/ECD/GCMS	EPA 8150	10.0	ug/Kg
2,4-DP	4435.	GC/ECD/GCMS	EPA 8150	10.0	ug/Kg
MCPA	4430.	GC/ECD/GCMS	EPA 8150	100.0	ug/Kg

## Pyridinecarboxylic acid Herbicides

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Picloram	4433.	GC/ECD/GCMS	EPA 8150	10.0	ug/Kg
Triclopyr	4436.	GC/ECD/GCMS	EPA 8150	10.0	ug/Kg

## Alkaloid Poison

Parameter	Identifier Number	Analysis Method	Reference	LRL	Units
Strychnine	4907.	GGCMS		0.1	µg/L

## Sediment

Parameter	Identifier Number	Analysis Method	LRL	Units
Sus Sediment –max	860.	See note	0.001	mm
Sus Sediment - <0.5 mm	861.	See note	1	%
Sus Sediment - <0.25 mm	862.	See note	1	%
Sus Sediment - <0.125 mm	863.	See note	1	%
Sus Sediment - <0.063 mm	864.	See note	1	%
Sus Sediment - <0.0312 mm	865.	See note	1	%
Sus Sediment - <0.0156 mm	866.	See note	1	%
Sus Sediment - <0.0078 mm	867.	See note	1	%
Sus Sediment - <0.0039 mm	868.	See note	1	%
Sus Sediment - <0.00195 mm	869.	See note	1	%
Bed Load Sub Wt	856.	See note	1	gm
Bed Load – max	880.	See note	0.001	mm
Bed Load - <37.5 mm	881.	See note	1	%
Bed Load - <19.0 mm	882.	See note	1	%
Bed Load - <9.50 mm	883.	See note	1	%
Bed Load - <4.75 mm	884.	See note	1	%
Bed Load - <2.36 mm	885.	See note	1	%
Bed Load - <1.18 mm	886.	See note	1	%
Bed Load - <0.60 mm	887.	See note	1	%
Bed Load - <0.30 mm	888.	See note	1	%
Bed Load - <0.15 mm	889.	See note	1	%
Bed Load - <0.075 mm	890.	See note	1	%

**Notes.**

**Suspended Sediment**

Analysis method is by the bottom withdrawal tube as used by the United States Geological Survey from their manual "Laboratory theory and methods for Sediment Analysis" Chapter C1-1973.

**Bed load**

Analysis method is by the Hydrometer analysis based on the Australian Standard method "Determination of the particle size distribution of a soil" AS 1289.3.6.1:-1995.

# Appendix D

## Natural Ecosystem Monitoring

### Methods

The monitoring of natural ecosystems is not guided or assessed by specific standards, but rather a monitoring methodology based on the requirements of the monitoring program. Generally, there are several methodologies for the monitoring of a specific ecological indicator, for example fish, which have been developed by scientists to assess different aspects of that ecological indicator. As further studies in a particular field continue, advances in the science have an impact on the development of monitoring techniques and methodologies. It is therefore important to make sure that any natural ecosystem monitoring is undertaken using a methodology that is based on the latest scientific information and research, and is specifically suited to the requirements of the monitoring program.

The Department of Natural Resources and Mines has adopted monitoring and assessment methodologies that are constantly being updated and reviewed based on the latest research findings. These are as follows:

**Blue- Green Algae Monitoring Standard**, QLD Department of Natural Resources and Mines,2005.

**Aquatic Habitat Assessment for Resource Operations Plan Monitoring**, QLD Department of Natural Resources and Mines,2005

Where the Department has no specific monitoring methodology already in place for a particular indicator, then the methodology that is developed and implemented will be based on the latest scientific research or currently implemented methodologies. This may come from several sources, for example journal articles, State Government research/monitoring programs, external research by Cooperative Research Centres or research divisions within universities. Examples of such sources are as follows:

*Aquatic Habitat Mapping* based on:

- Data collection methods from State of the Rivers Methodology

*Mangrove Habitat Mapping* based on:

- Wilton K. & Saintilan N. (2000) *Protocols for Mangrove and Saltmarsh Habitat Mapping*, Australian Catholic University.
- Duke N. *et al.* (1998) *Factors influencing biodiversity and distributional gradients in mangroves*, Global Ecology and Biogeography Letters, Vol 7, pp 27-47.

This list is not exhaustive and is just an example. Due to the continuing nature of advancements in science, this list may not indicate the latest research or most recent journal articles. It is the responsibility of the methodology developer to undertake up-to-date literature and research reviews to identify the most appropriate methodologies available for implementation. Any monitoring methodology that is based on a specific journal article or research project must make reference to that original piece of work.