

Appendix C Stage 1 and Stage 2 QA/QC Field Audit Plans

National River Health Program

AusRivAS Quality Assurance and Quality Control Project

State/Territory QA/QC – Audit Plans (Stage 1 and Stage 2)



for

**Australian Government
Department of the Environment and
Heritage**

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Project Manager:
Ross Bannister
telephone +61 3 9550 1000
email rbannister@wes.com.au

WATER ECOscience Pty Ltd
ACN 064 477 989

Head Office

68 Ricketts Road Mt Waverley Victoria 3149 Australia
Private Bag 1 Mt Waverley Victoria 3149 Australia
telephone +61 3 9550 1000
facsimile +61 3 9543 7372

Wangaratta

1st floor NETC House
90-100 Ovens Street
Wangaratta, Victoria, 3676

Carrum

Eastern Treatment Plant
Thompson Road
Bangholme Victoria 3175

Gippsland

71a Argyle Street
Traralgon Victoria 3844

Geelong

49 Carr Street
Geelong, Victoria 3220

Hobart

20 St Johns Avenue
New Town Tasmania 7008

Werribee

Western Treatment Plant
New Farm Road Werribee Victoria 3030

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Cover photo: Transect measurements of substrate heterogeneity, Queensland.
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Foreword

WATER ECOscience was engaged by the Department of the Environment and Heritage to undertake a comprehensive study of Quality Assurance / Quality Control (QA/QC) issues and procedures associated with the Australian AusRivAS program.

The study involved auditing state / territory lead agency physical, chemical and environmental data entered into the AusRivAS model and assessing lead agency QA/QC procedures for data collection and management. Audits of states / territories and analysis of results were conducted in a two-stage process.

Stage 1 was conducted during the first year of the project and involved audits of Victoria, Queensland, Western Australia and the Northern Territory. Stage 2 was conducted during the “second” year of the project and involved audits of New South Wales, the Australian Capital Territory, South Australia and Tasmania.

This report presents the audit plans for both Stage 1 and Stage 2.

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Summary

As part of the AusRivAS Quality Assurance/Quality Control (QA/QC) study, audits of state and territory procedures for physico-chemical and habitat assessment and macroinvertebrate sample processing were undertaken. To facilitate these processes, audit plans were developed and supplied to each of the state / territory agencies. These are documented in this Appendix.

1 Introduction

The National River Health Program (NRHP) is a 6-year program currently administered by Environment Australia. The key aim of the NRHP is the delivery of new, standardised methodologies for the assessment of river health. The program consists of two main components, the Australia-wide Assessment of River Health (AWARH) and the Environmental Flows Initiative (which is outside the scope of the present study). The AWARH consists of a nation-wide assessment of the condition of over 6000 river sites across Australia using the AusRivAS methodology and a series of Toolbox projects (which includes this study) aimed at developing and refining the set of existing assessment techniques.

The objectives of the AusRivAS QA/QC study are to:

- Review and report on methods and approaches used for QA/QC procedures for field collection of site environmental data, with particular emphasis given to data used as predictor variables in AusRivAS computer models.
- Based on recommendations of the previous Phase 1 NRHP QA/QC research project, and following discussions with a project steering Committee, implement and report on the external audit of macroinvertebrate sampling, sample processing procedures (with particular emphasis placed on agencies who use live-sort protocols), and sample identification for samples from all state \ territory lead agencies.

The project includes liaison with two other toolbox projects:

- AusRivAS error analysis project - provide advice on actual error magnitudes in environmental data to enable evaluation of the consequences of errors associated with this type of data.
- Training and Accreditation Project - liaison with the Principal Investigator to ensure deficiencies detected in the implementation of AusRivAS methods by lead agency staff can be addressed in any proposed training program.

This document contains details of the audit plans for each state and territory. Audit plans were developed after extensive consultation with lead agencies in each state and territory in accordance with defined key objectives based on current protocols for collection of environmental data in the field. Specific audit plans were required for each state and territory, as each uses AusRivAS models with different variables.

Audits of state and territory lead agencies were conducted in two stages or groups. Stage 1 comprised Queensland, Victoria, Western Australia and the Northern Territory and audits were conducted in 1999/2000. Stage 2 involved New South Wales, the Australian Capital Territory, Tasmania and South Australia and audits were conducted during spring 2002.

2 Queensland - Department of Natural Resources and Mines (DNRM)

2.1 Model variables

Variables entered into the Queensland Models are:

Map Variables	Habitat Variables	Physico-chemical Variables
Latitude	Cobble %	Alkalinity
Longitude	Pebble %	Water temperature
Slope	Bedrock %	MDMR (mean dry season monthly rainfall)
Stream Order	Stream width	RAWD (range mean wet season monthly rainfall)
Distance from source	Reach category	
	Soil Class	
	Habitats present	
	Substrate categories present	

2.2 Methods for assessment of variables

Map Work:

- Based on DNRM latitude and longitude, distance from source and slope will be measured using the same techniques as DNRM for a number of randomly chosen reference sites. Stream Order will be calculated for the sites using Strahler's Method.

Field based measurements:

- Stream width will be measured for riffle and pool habitats at sites visited by WATER ECOscience. Comparisons of inter-operator variation between visual estimates of width (made by WES staff) and measurement of width will be made.
- Substrate heterogeneity will be measured using a transect method at pool and riffle habitats at each site. This involves setting up stakes on either side of the stream and connecting them with rope flagged at even intervals for fifty points across the area of stream sampled. At each point the substrate is identified using size templates for the larger categories (ie. cobble, pebble) and sieves for the smaller gravel, sand, silt and clay particles. Percentages of each substrate type are then calculated for each habitat at a site and compared with results from visual estimates made by WATER ECOscience staff (a field visit with DNRM staff was not possible at the time of WES's visit).
- Variables such as percentage emergent macrophytes, submerged macrophytes, detritus, overhanging vegetation will be measured using a point quadrat method.

- The number of substrate categories will be assessed in the field and recorded at sites that have been surveyed during this sampling season to determine error rates. Data entry will be checked in the laboratory.
- The number of habitats at a site will be assessed in the field and recorded.
- Rainfall, WETR, MDMR, RAWD and soil class are all calculated using DNRM database and will be recalculated and double checked for data entry errors.

Physico-chemical variables:

- These variables cannot be directly compared using field measurements and laboratory visits will be conducted to check the accuracy of meters used for those physico-chemical measurements. Alkalinity – check error rates for test kits used in field.

Data entry:

- For the randomly selected 10% subset of reference sites, values for model environmental variables from original data sheets will be compared with those entered in the DNRM Queensland database. Error types will be classified into different categories and the frequency of each will be analysed for statistical significance using logistic regression analysis.

3 New South Wales - Environment Protection Authority (EPA)

3.1 Model variables

Variables entered into the New South Wales (NSW) models are:

Map/Office Variables	Habitat Variables	Physico-chemical Variables
Latitude	Percentage bedrock	Alkalinity
Longitude	Percentage boulder	
Altitude	Percentage cobble	
Distance from source	Mode depth (riffle)	
Slope	Mode width(stream)	
Mean annual rainfall		

3.2 Methods for assessment of variables

Field based measurements:

- This information will be verified against data collected by the lead agency at the time of sampling
- Mode stream width will be measured using a laser range finder at a number of different points in the reach and the mode recorded.
- Mode stream depth will be measured using a measuring pole at a number of different points in the riffle and the mode recorded.
- Percentage values of the various substrate types will be measured using a transect method at pool and riffle habitats at each site visited. This will involve setting up stakes on either side of the stream, connecting them with rope flagged at even intervals for fifty points across the area of stream sampled. At each point, the substrate will be identified using size templates. Percentages of each substrate type will then be calculated for each habitat at a site.

Physico-chemical variables:

- Accuracy of meters used for alkalinity measurements will be checked. Specifications of laboratory tests or field test kits will be obtained.

Data entry:

- For the randomly selected 10% subset of reference sites, values for model environmental variables from original data sheets will be compared with those entered in the NSW database (using the electronic spreadsheet supplied by EPA) to assess data entry errors. Error types will be classified into different categories and the frequency of each will be analysed for statistical significance using logistic regression analysis.

4 Australian Capital Territory - Environment ACT (sampling conducted by the CRC for Freshwater Ecology)

4.1 Model variables

Variables entered into the Australian Capital Territory (ACT) models are:

Map Variables	Habitat Variables	Physico-chemical Variables
Latitude	Percentage boulder	Alkalinity
Longitude	Percentage cobble	Velocity in edge habitat
Altitude	Percentage pebble	
Stream Order	Percentage gravel	
Distance from source	Percentage cover grasses, ferns, sedges	
Catchment area	Percentage cover shrubs/vines	
	Trailing bank vegetation category	
	Riparian width	
	Bank width	
	Stream width	
	% edge macrophyte cover (category)	
	Percentage shading	
	Streamside cover score	
	Percentage habitat (in reach)	
	Habitat depth	
	% Cover of trees > 10m	

4.2 Methods for assessment of variables

Habitat Variables:

- This information will be verified against data collected by the lead agency.
- Percentage values of the various substrate types will be measured using a transect method at pool and riffle habitats (where present) at each site visited. This will involve setting up stakes on either side of the stream, connecting them with rope flagged at even intervals for fifty points across the area of stream sampled. At each point, the substrate will be identified using size templates. Percentages of each substrate type will then be calculated for each habitat at a site. If only edge habitat is sampled, the transect will be along the area of edge sampled.
- Stream width will be measured using a laser range finder.
- Stream depth will be measured, using a measuring pole at the site for the habitats sampled. This information will be verified against data collected by the lead agency

- Variables such as percentage macrophytes and percentage of various classes of riparian vegetation will be measured with the aid of schematics of various percentage covers of vegetation (from the Victorian Index of Stream Condition field manual).
- Shading categories will be calculated using methods described in the Index of Stream Condition documents.

Physico-chemical variables:

- These variables cannot be directly compared using field measurements and laboratory visits will be conducted to check the accuracy of meters used for those physico-chemical measurements. Velocity meter specifications - these will be obtained from the EPG and error rates taken into account. Alkalinity - specifications of laboratory tests or field test kits will be obtained.

Data entry:

- For the randomly selected 10% subset of reference sites, values for model environmental variables from original data sheets will be compared with those entered in the ACT database (using the electronic spreadsheet supplied by EPA/CRCFE) to assess data entry errors. Error types will be classified into different categories and the frequency of each will be analysed for statistical significance using logistic regression analysis.

Assessed variables and audit procedures may alter slightly after discussion with the lead agency concerned.

5 Victoria - Environment Protection Authority (EPA)

5.1 Model variables

Variables entered into the Victorian models are:

Map Variables	Habitat Variables	Physico-chemical Variables
Latitude	Mean substrate	Alkalinity
Longitude	Substrate heterogeneity	Depth
Altitude	Macrophyte taxa	pH
Streamslope	Macrophyte category	Range mean air temperature
Distance from Source		Discharge
Catchment area		Water temperature
		Stream width
		Conductivity

5.2 Methods for assessment of variables

Map work:

- Using Victorian EPA site latitude and longitude data, distance from source, streamslope, altitude and catchment area will be measured by ten different operators (from WATER ECOscience) to determine variability between operators when measuring map variables.

Field based measurements:

- Stream width will be measured, using a measuring tape, for riffle and pool habitats at sites visited by the EPA and WES. Visual estimates made by lead agency staff will be verified with measurement results.
- Substrate heterogeneity will be measured using a transect method at pool and riffle habitats at each site. This involves setting up stakes on either side of the stream and connecting them with rope flagged at even intervals for fifty points across the area of stream sampled. At each point the substrate is identified using size templates for the larger categories (ie. cobble, pebble) and sieves for the smaller gravel, sand, silt and clay particles. Percentages of each substrate type are then calculated for each habitat at a site and compared with results from visual estimates.
- Variables such as percentage emergent macrophytes, submerged macrophytes, detritus, overhanging vegetation will be measured using a point quadrat method.

Physico-chemical variables:

- These variables cannot be directly compared using field measurements and laboratory visits will be conducted to check the accuracy of meters used for physico-chemical measurements. Alkalinity – check error rates for test kits

used in field; Conductivity – check meter calibration methods/regularity; pH – check meters and calibration.

Data entry:

- For the randomly selected 10% subset of reference sites, values for model environmental variables from original data sheets will be compared with those entered in the EPA Victorian database. Error types will be classified into different categories and the frequency of each will be analysed for statistical significance using logistic regression analysis.

These methods are based on information available from the AusRivAS manual and may be subject to change once the procedures manuals are available and after discussion with the lead agency concerned.

6 Tasmania - Department of Primary Industries and Environment (DPIE)

6.1 Model variables

Variables entered into the Tasmanian models are:

Map Variables	Habitat Variables	Physico-chemical Variables
Latitude	% Boulder in habitat	Conductivity
Longitude	% Cobble in habitat	
Altitude	% Pebble in habitat	
Catchment area	Mean width of water	
DFS	Riparian vegetation (category)	
Stream order	% Riffle habitat in reach	
Slope of reach (m/km)	Mean Water depth of habitat	
	% River shaded at midday (category)	
	Trailing bank vegetation (category)	

6.2 Methods for assessment of variables

Field based measurements:

- Stream width and depth will be measured, using a laser range finder and measuring pole, at the site for the habitats sampled. This information will be verified against data collected by the lead agency.
- Substrate heterogeneity will be measured using a transect method at edge and riffle habitats at each site. A transect will be run along the length of each habitat sampled, and substrate composition will be recorded at a number of points along each transect. Size templates will be used to aid estimation of substrate composition. Results will be compared with visual estimates made by DPIE staff on the day of the field visit.
- Variables such as trailing bank vegetation and riparian vegetation will be measured with the aid of schematics of various percentage covers of vegetation (from the Victorian Index of Stream Condition field manual).

Physico-chemical variables:

- These cannot be directly compared using field measurements and laboratory visits will be conducted to check the accuracy of meters used for those physico-chemical measurements. The specifications of laboratory tests or field test kits will be obtained for conductivity.

Data entry:

- For the randomly selected 10% subset of reference sites, values for model environmental variables from original data sheets will be compared with those entered in the DPIE Tasmanian database to assess data entry errors. Error

types will be classified into different categories and the frequency of each will be analysed for statistical significance using logistic regression.

7 South Australia - Environment Protection Authority (EPA)

7.1 Model variables

Variables entered into the South Australia (SA) models are:

Map Variables	Habitat Variables	Physico-chemical Variables
Latitude	% Bedrock in habitat	Alkalinity
Longitude	% Boulder in habitat	Bicarbonate
Altitude	% Cobble in habitat	Conductivity
Catchment area	% Pebble in habitat	
DFS	% Gravel in habitat	
Stream order	Medium sediment (% pebble + % gravel)	
Slope of reach (m/km)	% Habitat in reach	
	Average ranked depth of habitat	
	% Area of river covered by shade	
	Mean wetted ranked width of stream	

7.2 Methods for assessment of variables

Field based measurements:

- Habitat variables will be measured on site at three sites and compared to AWQC estimates/measurements.
- Stream width and depth will be measured, using a laser range finder and measuring pole, on site for the habitats sampled. This information will be compared against data collected by the lead agency.
- Substrate heterogeneity will be measured using a transect method at edge and riffle habitats at each site. At riffle habitats, a series of transects will be run across the riffle and substrate composition will be recorded at approximately 30 points. At edge habitats, a transect will be run along the length of the habitat and substrate composition will be recorded at approximately five points. Size templates will be used to aid estimation of substrate composition. Results will be compared with visual estimates made by AWQC staff on the day of the field visit.
- Variables such as % area of river covered by shade will be measured with the aid of schematics of various percentage covers of vegetation (from the Victorian Index of Stream Condition field manual).

Physico-chemical variables:

- These cannot be directly compared using field measurements and laboratory visits will be conducted to check the accuracy of meters used for those physico-chemical measurements. The specifications of laboratory tests or field test kits will be obtained for alkalinity, bicarbonate and conductivity.

Data entry:

- For the randomly selected 10% subset of reference sites, values for model environmental variables from original data sheets will be compared with those entered in the SA database (using the electronic spreadsheet supplied by the AWQC or EPA) to assess data entry errors. Error types will be classified into different categories and the frequency of each will be analysed for statistical significance using logistic regression.

8 Western Australia - Conservation and Land Management (CALM)

8.1 Model variables

Variables entered into the Western Australian models are:

Map Variables	Habitat Variables	Physico-chemical Variables
Latitude	Habitat area	Flow type
Longitude	Bedrock %	Discharge
Altitude	Boulder %	Water temperature
Streamslope	Cobble %	Stream width
Distance from Source	Pebble %	Conductivity
	Gravel %	Alkalinity
	Sand %	Depth
	Silt %	pH
	Clay %	
	Mineral substrata %	
	Emergent macrophytes %	
	Submerged macrophytes %	
	Floating macrophytes %	
	Algal cover %	
	Detritus %	
	Riparian vegetation	
	Minimum velocity	
	Maximum velocity	

8.2 Methods for assessment of variables

Map Work:

- Based on CALM latitude and longitude, altitude, slope and distance from source will be measured using the same techniques as CALM Western Australia for a number of randomly chosen reference sites.

Field based measurements:

- Stream width will be measured, using a measuring tape, for the habitats sampled at the site. This information will be verified against data collected by the lead agency.
- Substrate heterogeneity will be measured using a transect method at pool and riffle habitats at each site. This involves setting up stakes on either side of the stream and connecting them with rope flagged at even intervals for fifty points across the area of stream sampled. At each point the substrate is identified using size templates for the larger categories (ie. cobble, pebble) and sieves for the smaller gravel, sand, silt and clay particles. Percentages of

each substrate type are then calculated for each habitat at a site and compared with results from visual estimates made by CALM staff on the day of the field visit.

- Variables such as percentage emergent macrophytes, submerged macrophytes, detritus, overhanging vegetation will be measured using a point quadrat method.
- A point quadrat method will be used to assess the percent cover of riparian vegetation in the habitat

Physico-chemical variables:

- These cannot be directly compared using field measurements and laboratory visits will be conducted to check the accuracy of meters used for physico-chemical measurements. Alkalinity – check error rates for test kits used in field; Conductivity – check meters calibration methods/ regularity; pH – check meters and calibration; Water temperature - check calibration of meters.

Data entry:

- For the randomly selected 10% subset of reference sites, values for model environmental variables from original data sheets will be compared with those entered in the CALM Western Australian database. Error types will be classified into different categories and the frequency of each will be analysed for statistical significance using logistic regression analysis.

These methods are based on information available from the AusRivAS manual and may be subject to change once the procedures manuals are available and after discussion with the lead agency concerned.

9 Northern Territory - Department of Lands, Planning and Environment (DLPE)

9.1 Model variables

Variables entered into the Northern Territory Models are:

Map Variables	Habitat Variables	Physico-chemical Variables
Latitude	Percentage cobbles	Alkalinity
Longitude	Percentage pebbles	Minimum velocity
Altitude	Percentage sand	Average velocity
Stream Order	Total area macrophytes	Maximum velocity
Distance from source	Total area riffle	Average habitat depth
Catchment area	Total area pool/unknown	Sampling depth
		Transect average river width

9.2 Methods for assessment of variables

Map Work:

- Based on Northern Territory latitude and longitude, altitude, distance from source and catchment area will be measured using the same techniques as DLPE for a number of randomly chosen reference sites. Stream Order will be calculated for the sites using Strahler's Method.

Field based measurements (where possible):

- Stream width and depth will be measured, using a measuring tape, at the site for the habitats sampled. This information will be verified against data collected by the lead agency.
- Substrate heterogeneity will be measured using a transect method at pool and riffle habitats at each site. This involves setting up stakes on either side of the stream, connecting them with rope flagged at even intervals for fifty points across the area of stream sampled. At each point the substrate is identified using size templates for the larger categories (ie. cobble, pebble) and sieves for the smaller gravel, sand, silt and clay particles. Percentages of each substrate type are then calculated for each habitat at a site and compared with results from visual estimates made by DLPE staff on the day of the field visit.
- Variables such as percentage emergent macrophytes, submerged macrophytes, detritus, overhanging vegetation will be measured using a point quadrat method.

Physico-chemical variables:

- These cannot be directly compared using field measurements and laboratory visits will be conducted to check the accuracy of meters used for those physico-chemical measurements. Velocity meter specifications - these will be obtained from the lead agency and error rates taken into account. Alkalinity - specifications of laboratory tests or field test kits will be obtained

Data entry:

- For the randomly selected 10% subset of reference sites, values for model environmental variables from original data sheets will be compared with those entered in the DLPE Northern Territory database to assess data entry errors. Error types will be classified into different categories and the frequency of each will be analysed for statistical significance using logistic regression analysis.

These methods are based on information available from the AusRivAS manual and may be subject to change once the procedures manuals are available and after discussion with the lead agency concerned.

10 Macroinvertebrate Sample Processing

The audit plan for macroinvertebrate sample processing is to be common to all states / territories, with the live-sort audit only to be completed for those states using this approach.

Data Entry:

This part of the audit is to assess the accuracy of entry of biological into agency databases. This will be performed by comparing the taxa and their abundance as recorded on the macroinvertebrate identification sheets (at the time of identification) against entries in the database.

Approximately ten percent of sites will be randomly selected for assessment from all sites sampled during the 1997 – 1999 FNARH program. The lead agencies will be requested to provide copies of macroinvertebrate identification sheets for these sites, together with an electronic copy of the final stored data. The electronic data will be printed in a format to match the identification sheets and any errors or discrepancies between the two marked on the sheets. Data entry errors will be assessed as missing or extra taxa, and incorrect abundances.

Live-sorting:

Based on sites selected for the data entry audit approximately 250 residue samples will be requested from the five states conducting live-sort picking (Table 15). The live-sort residues are to be sub-sampled in the WATER ECOscience laboratory using equipment and procedures described by Marchant (1989). A total of 200 individual macroinvertebrates were subsampled in this manner according to the following criteria. The first 50 animals were identified, picked into vials and recorded. The following 150 animals were identified, but only new taxa not represented in the first 50 animals collected were picked and recorded. Finally, the remaining residue was placed in a large white sorting tray and scanned for 15 minutes with the aid of a magnification lamp. Any new taxa observed were picked and recorded. Recorded information includes a breakdown of what was collected during each component and the total overall percentage of residue that was subsampled. Pick results for each residue were later used to calculate the WSE for the sample from which the residue originated.

Macroinvertebrate identification was to family level, except for Chironomidae (Diptera), which was identified to subfamily, and Collembola, Arachnida, and Oligochaeta which were identified to class or order level in accordance with accepted convention. Data was entered, validated and stored on the Zoological Database (MS Access) maintained by WATER ECOscience.

Data Manipulations for Live-sort Assessment

The data will be manipulated into a format for input to the WISE database for assessment of the live-sort performance after checking the data to ensure that site, date and habitat details matched on both the live-sort and residue data for each sample.

The WISE procedure will then be run through one iteration to generate a printed output of the combined live-sort / residue data. These summary output tables are to

be assessed for taxonomic anomalies and appropriate corrections made to the database. The WISE procedure will then be re-run through one hundred iterations.