Environment Protection Authority

Consultancy report:

Nutrient Load Modelling for the NPI Water Catchment Reporting 1999

EPA South Australia AIR NOISE WATER WASTE

Government of South Australia

Nutrient Load Modelling

for the

National Pollutant Inventory

Water Catchment Reporting 1999

Technical Report

June 2000

Environment Protection Agency
Government of South Australia

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Disclaimer

In as far as this report contains recommendations on proposals for further action it must not be assumed from this report alone that they form part of any approved policy.

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SUMMARY

Overview

This report describes the work undertaken to estimate mean annual nutrient loads (as total nitrogen and total phosphorus) for a series of sub-catchments in the City of Adelaide and the central Mount Lofty Ranges, South Australia. The mean annual nutrient loads were estimated by GIS based computer modelling calibrated against monitoring data. The results of the modelling and of the analysis of the monitoring data are presented in this report.

The modelled nutrient loads were reported to Environment Australia along with data from other jurisdictions on emissions of a range of pollutants from many different sources. This data was placed in a National Pollutant Inventory (NPI) database and made accessible to the public via the Internet (www.npi.gov.au).

The scope of this project included modelling nutrient emissions for the Adelaide area and for several regional areas. The regional areas were the Barossa, Iron Triangle, Riverland and the Southeast. The Barossa region was included in the nutrient modelling work. However, due to either a lack of surface water catchments, or due to a lack of data on nutrient generation rates the nutrient modelling was not undertaken for the remaining regional areas.

The original proposal suggested by Environment Australia was to use the program CMSS (Catchment Management Support System) to estimate nutrient emissions. This proposal was adopted by some jurisdictions. However, in South Australia it was decided to use a GIS based model that would form the basis of on-going nutrient modelling work.

The computer model was based on raster GIS and used landuse data and nutrient generation rates to estimate the nutrient loads from diffuse sources within a range of sub-catchments. Initially, the nutrient generation rates were sourced from literature and other sources. The model was then calibrated by running the model for a series of monitored catchments for which the nutrient loads were calculated. The nutrient generation rates were modified so that the model produced figures of nutrient loads that were closer to the measured figures.

This report also describes the work undertaken to calculate nutrient loads from monitoring data. This work included analysis of flows and nutrient loads of water pumped from the River Murray.

It is considered that the model produces figures that are a reasonable estimate of nutrient loads given the available data and time constraints. There is some uncertainty in the accuracy of the results that have not been quantified. These uncertainties arise mainly due to the simplicity of the model, and due to the nature of the monitoring data not permitting nutrient generation rates to be attributed to landuses or land characteristics with any reasonable degree of certainty.

An outcome of this work was a submission to the State Monitoring Sub-committee to consider expanding the monitoring program that measures pollutant loads. This proposal requires the installation of addition composite samplers at a range of locations to be determined.

There are several aspects that may be investigated as part of further work, subject to funding. One aspect is to modify the model to attribute the modelled nutrient loads to each landuse within each sub-catchment. This will enable users of the NPI database to better understand the sources of nutrients. Other aspects that may be considered for further work are concerned with quantifying

errors, increasing the complexity of the model, further analysis of monitoring data, other refinements to the methodologies, and possible extensions to the water quality monitoring program.

Presentation of Results

Several sets of results are presented in this report. The results that may be of greatest interest are listed below.

Modelled Nutrient Loads

The sub-catchments that were modelled for nutrient loads are shown in **Figure N1**. Details of each sub-catchment including modelled results are shown in **Table N4**. Modelled results are given as totals per sub-catchment (kg/y) and as nutrient loads per unit area (kg/ha/y). The later allows the rate of nutrient generation to be compared between sub-catchments of different sizes.

The modelled nutrient loads are also shown pictorially as maps in **Figure N2** (for total nitrogen) and in **Figure N3** (for total phosphorus). In these maps green indicates lower values of nutrients generated, yellow intermediate rates and oranges higher rates. It is significant to note that sub-catchments shown in yellow can be generating up to ten times the quantity of nutrients that are generated in catchments shown in dark green (containing mainly native vegetation or mature forest). Similarly, the sub-catchments shown in dark orange can be generating up to ten times the quantity of nutrients that the sub-catchments shown in yellow (which is up to one hundred times the quantity of nutrients generated by the sub-catchments shown in dark green).

Calibration Results

The modelled results and the nutrient loads calculated for each catchment analysed from monitoring data are shown in **Table N3**. Also shown are the error ratios (modelled loads divided by calculated loads) for each monitored catchment, and statistics calculated for these error ratios are shown in the box and whisker diagrams. The error ratios show the accuracy of the modelled results relative to the loads calculated from monitoring data. The errors range from twice the calculated load (error ratio = 2) to one quarter the calculated load (error ratio = 0.25). The modelled load for Sturt Creek (upstream of Minno Creek) is ignored in this assessment as this catchment has nutrients discharged from Heathfield waste water treatment plant. This is a point source not included in the model.

Original and Modified Nutrient Generation Rates

Table N2 shows the nutrient generation rates obtained from literature and other sources. Also shown are the modified nutrient generation rates changed as a result of model calibration, together with the basis on which the changes were made.

Monitored Catchments

The catchments that were monitored for stream flow and pollutant loads (using composite samplers) are shown in **Figure M1** with details in **Table M1**. The monitoring data for the catchments within the Patawalonga catchment and Sixth Creek (stations numbered 1 to 9 and 16) was analysed by the AWQC (Australian Water Quality Centre). The monitoring data for the other monitored catchments was analysed in this project. The results for First Creek are given in **Tables M1.2 and M2**. The results for the other six monitored catchments are given in **Tables M1.3, M3a and M3b**.

Landuses and Nutrient Generation Rates for the Monitored Catchments

The percentage of the major categories of landuses in each of the monitored catchments, and the unit-area nutrient loads calculated from the monitored data are shown in **Table N1**. Examination of the unit-area nutrient loads and percentage landuses enables conclusions to be made on nutrient generation rates for some landuses. These conclusions are given in the Discussion section.

INTRODUCTION

Overview

This report describes the work undertaken to estimate mean annual nutrient loads (as total nitrogen and total phosphorus) for a series of sub-catchments in the City of Adelaide and the central Mount Lofty Ranges, South Australia. The mean annual nutrient loads were estimated by GIS based computer modelling calibrated against monitoring data. The results of the modelling and of the analysis of the monitoring data are presented in this report.

In addition, the modelled nutrient loads were reported to Environment Australia along with data from other jurisdictions on emissions of a range of pollutants from many different sources. This data was placed in a National Pollutant Inventory (NPI) database and made accessible to the public via the Internet (www.npi.gov.au).

The scope of this project included modelling nutrient emissions for the Adelaide area and for several regional areas. The regional areas were the Barossa, Iron Triangle, Riverland and the Southeast. The Barossa region was included in the nutrient modelling work. However, due to either a lack of surface water catchments, or due to a lack of data on nutrient generation rates the nutrient modelling was not undertaken for the remaining regional areas.

The original proposal suggested by Environment Australia was to use the program CMSS (Catchment Management Support System) to estimate nutrient emissions. This proposal was adopted by some jurisdictions. However, in South Australia it was decided to use a GIS based model that would form the basis of on-going nutrient modelling work.

The computer model was based on raster GIS and used landuse data and nutrient generation rates to estimate the nutrient loads from diffuse sources within a range of sub-catchments. Initially, the nutrient generation rates were sourced from literature and other sources. The model was then calibrated by running the model for a series of monitored catchments for which the nutrient loads were calculated. The nutrient generation rates were modified so that the model produced figures of nutrient loads that were closer to the measured figures.

This report also describes the work undertaken to calculate nutrient loads from monitoring data. This work included analysis of flows and nutrient loads of water pumped from the River Murray.

Report Structure

This report is divided into several sections as follows:

- **Introduction.** This introductory section provides background information on several issues and describes the study area.
- **Nutrient Load Modelling.** Describes the GIS-based nutrient load model; the sources of all data; the methods used to process this data; model calibration; and presents results in a table and on maps.
- **Monitoring Data.** Provides a map showing location of the monitoring sites; describes the methods used to analysis the monitoring data; and presents results of nutrient loads (as total

nitrogen and total phosphorus) for each year and annual means; and discusses development of a climate correction factor.
- **Discussion.** A discussion of the modelling results; of the calculated nutrient loads from monitoring data; and recommendations for further work.
- **Further Work.** Summary of possible further work as presented in the report.
- **Conclusions.**
- **References.**
- **Glossary.**
- **Appendices.** Speadsheets used in analysis of monitoring data.

Study Area

The accompanying map (Figure T1) shows the general area of interest for this project together with outlines of the Adelaide area and the Barossa region that were modelled for nutrient loads. The Adelaide area included the larger part of metropolitan Adelaide, the Patawalonga catchment and all the catchments for the metropolitan reservoirs. The Barossa region includes the wine growing districts in and around the Barossa Valley. Figures for modelled nutrient loads for the Adelaide and Barossa regions were reported separately to Environment Australia.

The scope of this project also included modelling nutrient emissions for the regional areas of the Iron Triangle, the Riverland and the Southeast. However, as explained in more detail later in this report, due to either a lack of surface water catchments, or due to a lack of data on nutrient generation rates the nutrient modelling was not undertaken for these regional areas.

The National Pollutant Inventory (NPI)

The National Pollutant Inventory (NPI) is a national internet database that provides the community, industry and government with information on the types and amounts of chemicals that are being emitted to the environment (to air, to land and to water).

Larger Australian facilities (that use or emit substances over given thresholds) are required to estimate and report their emissions for the NPI on an annual basis. Estimated of emissions from smaller industry, household and everyday activities (these are known as aggregate emissions) are being made by State and Territory environment authorities.

For the first reporting year (1998/99) there was an initial list of thirty-six substances. This will be increased in future years to ninety substances. The range of sources will not be complete for the first reporting year but will be increased to cover all known sources in future years.

The NPI has been developed as a National Environment Protection Measure (NEPM) by the National Environment Protection Council (NEPC). The Council is a national statutory body which aims to ensure that all people in Australia enjoy equivalent protection from air, water, soil and noise pollution. It also aims to ensure that Australian markets are not distorted by variations in environment protection measures between the States and Territories. The Council is currently made up of the Commonwealth, State and Territory Environment Ministers. It is chaired by the Commonwealth.

The methodology and list of substances on the NPI reporting list was developed by an independent Technical Advisory Panel and a national consultation process. A non-government organisational

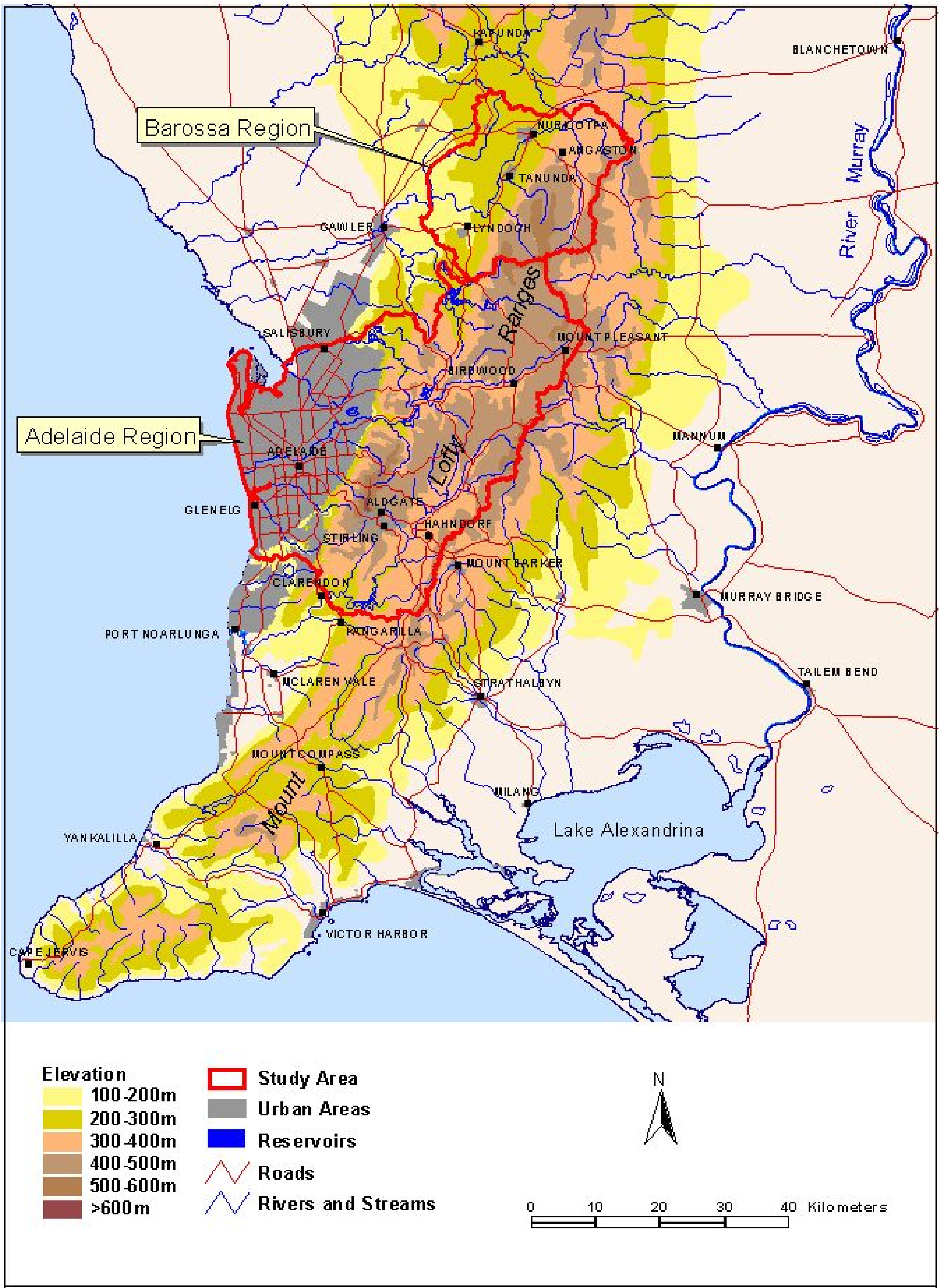


Figure T1. The Study Area - Adelaide and Central Mt Lofty Ranges, South Australia

advisory group was established to ensure industry, environment and community concerns were considered by the Council.

In summary, the main objectives of the NPI are to:

- Provide information to industry and government to assist in environmental planning and management;
- Satisfy community demand for accessible information on emissions to the environment; and
- Promote waste minimisation, cleaner production, and energy and resources savings.

The forgoing description of the NPI was extracted from the "National Pollutant Inventory Guide 1998" produced by the Commonwealth and available from State and Territory environmental authorities. The reader should refer to this document for further information.

Nutrients

The term "nutrient" applies to a group of compounds containing nitrogen and phosphorus. These compounds are important sources of food for plant life and micro-organisms, hence the term nutrient. It is natural to find nutrients in streams and rivers, and they need to be there in appropriate quantities to maintain a healthy riparian ecosystem. An ecosystem is an assemblance of land-based and aquatic plants and animals such as fish, insects and micro-organisms.

Nutrients are released in larger quantities by anthropogenic landuses such as urban development and agriculture. If nutrients occur in sufficiently large quantities, and if other conditions such as temperature are suitable, a growth (or bloom) in the numbers of toxic strains of blue-green algae (or more correctly, species of cyanobacteria) can occur. The toxic substances released by these algae can, in large enough quantities, be a danger to the health of animals and people if the water is drunk. Hence the need to monitor nutrient levels in streams and rivers.

For this project nutrients were considered in two groups these being total nitrogen (TN) and total phosphorus (TP). Total nitrogen refers to the sum of total Kjeldahl nitrogen (TKN) and oxides of nitrogen (NOX). Oxides of nitrogen include nitrate (NO_3) and nitrite (NO_2). TKN includes all forms of non-oxidised nitrogen, ie both organic nitrogen and ammonia. Organic nitrogen can occur in water in both soluble and particulate forms. The tests for nitrogen nutrients normally measure TKN and NOX separately.

Total phosphorus refers to numerous organic and inorganic forms that can occur in water in both soluble and particulate forms. Total phosphorus most often occurs as phosphate. Tests for phosphorus nutrients often measure soluble phosphorus (PS) in addition to total phosphorus.

Nutrient Loads and Nutrient Emissions

This section provides a short discussion on the definition of the terms "nutrient loads", "nutrient emissions" and "nutrient generation rates". The following considerations result from discussions at a workshop held in Hobart 14-18 February 2000. NPI representatives from States and Territories attended this workshop to discuss methods and issues relating to estimations of aggregate emissions to water and to air. The Implementation Working Group had not considered the recommendations from this workshop (NPI 2000) at the time of writing (in May 2000).

The term "nutrient load" refers to the mass of nutrients in a water body. In this report the term "nutrient load" is used synonymous with the term "nutrient export" and refers to the mass or quantity of nutrients that pass out of a catchment or sub-catchment via a stream per unit of time. Nutrient loads are usually expressed as T/y (Tonnes per year) or kg/y (kilograms per year).

Nutrient loads represent the emissions and inputs of nutrients from all sources (diffuse and point sources) upstream and include the effects of nutrient transport losses (e.g. from assimilation, chemical breakdown and storage due to sedimentation). The work described in this report was concerned with diffuse sources of nutrients. Point sources were not considered.

The term “nutrient emission” refers to the potential for different landuses to generate nutrients diffusely assuming no transport losses.

The term “nutrient generation rate” usually refers to the nutrient emissions (assuming no transport losses) of each landuse per unit area. Nutrient generation rates are usually expressed as kg/ha/y (kilogram per hectare per year). In the work described in this report, the nutrient generation rates were modified in order to calibrate the model against the monitoring data (which are nutrient loads). The modified nutrient generation rates therefore contain an allowance for nutrient transport losses based on the average of the transport losses in all the monitored catchments.

Nutrient *loads* can be measured by monitoring the outputs from catchments and sub-catchments. A nutrient load model can then be calibrated against this monitoring data. However, there are difficulties in measuring nutrient *emissions* if these are not to include any effect of transport loss.

Nutrient emissions can be thought of as the nutrient loads exported from an infinitely small area of land. If the area of land is infinitely small there will be no transport losses and nutrient emissions are the same as nutrient loads. Although it may be possible to calculate theoretical nutrient emissions (by methods unknown), it is clearly impossible to confirm the theoretical calculations by measuring the nutrient emissions or nutrient loads from an infinitely small area of land.

All studies into nutrient generation rates, it is assumed, measure the nutrients exported from a finite area (or areas) of land. The measured results will include the effects of transport losses over the finite area(s) of land even those these may be small. Therefore, the results from these studies may not be true nutrient emissions.

It seems that the major difference between nutrient *emissions* reported in the literature and nutrient *loads* (that can be measured by monitoring outputs from catchments) is a matter of scale. Scale refers to the size of the area of land used for measurement.

A re-evaluation of nutrient generation rates is recommended as part of further work arising from this study. A review of nutrient generation rates was discussed at the Hobart workshop although this was not reported in the recommendations (NPI 2000). It would seem appropriate that a review of nutrient generation rates should consider the area of land (and possibly shape or aspect ratio) used in each study when comparing results from different studies. The effect of transport losses in varying areas of land may explain, in part, the wide variation in reported nutrient generation rates for the same landuse.

Overall, the NPI database contains emissions of pollutants from a range of sources to land, to air and to water. As discussed and generally agreed at the Hobart workshop, the NPI database is about *emissions*. Therefore, for consistency the aggregate figures for nutrients should also be emissions and not loads. However, the recommendations from the workshop provide some latitude to jurisdictions to make individual decisions on what figures are reported and the methods used to obtain those figures. For South Australia, it was decided (well before the Hobart workshop and without fully appreciating the aims for the NPI database) that the most useful figures to report were nutrient *loads* from sub-catchments. Further work should review this decision in relation to any revised NPI specifications, the value of the data to South Australia, and available data.

Catchment Management Support System (CMSS)

The Catchment Management Support System (CMSS) is a computer program design to assist land managers in making decisions on landuse and land management practices in relation to nutrient loads emitted to streams.

CMSS is based on a decision support system (DSS). A DSS helps or supports a manager solve a problem for which human judgement is required in the decision making process. Such decisions usually require an explorative or iterative process whereby the manager runs a series of scenarios using a range of management options. A well designed DSS enables the manager to interact with the program in a natural manner, provides clear options to decisions and uses plain language. During the development of a DSS the opinions of a panel of experts are sort. These options are built into the program so that the final program is capable of providing realistic results.

CMSS incorporates a wide range of policy statements in relation to nutrient emissions from a range of landuses under varying land characteristics and management options. The user inputs data for each spatial unit for each catchment to be studied. This data includes current landuses, current land management practices and land characteristics such as slope, soil erodibility and rainfall. Nutrient generation rates for different landuses are also required, although CMSS is supplied with default values that are based on local studies and a literature search. CMSS is supplied with NEXSYS a program that provides a range of nutrient generation rates for different landuses under various land management and land characteristic combinations.

Once CMSS is set up for a study catchment, the program can estimate total nitrogen and total phosphorus emissions under the current conditions. These should then be compared with monitoring data if available and the nutrient generation rates modified so as to calibrate the model. The program now allows land managers to run scenarios using different landuses or different land management practices to determine the effect on nutrient emissions. CMSS can also calculate the cost involved with each management scenario.

The algorithm that calculates nutrient emissions is a simple lumped parameter model that uses a nutrient generation rate defined for each landuse. Nutrient loads are aggregated for each spatial unit (usually sub-catchments) defined when CMSS is set up for the study catchment. The nutrient loads are calculated for total nitrogen and total phosphorus. Land characteristics are only considered if the user assigns a different nutrient generation rate for each landuse-land characteristic combination required.

Further details about CMSS can be obtained from Davis and Farley (1991) and Davis and Farley (1997).

Reasons for Developing the GIS Model

The GIS model developed to date used the same concept employed by CMSS, that is the lumped parameter concept based on nutrient generation rates. There were several reasons for developing the GIS model as opposed to using CMSS for the NPI nutrient load reporting, as described below.

CMSS requires the user to enter data for each spatial unit in each catchment to be studied. This data can be derived manually from maps although it is usually derived from GIS datasets. This can be a long process and has to be repeated for each catchment to be studied. As most data (landuse and land characteristics) required by CMSS already exists as GIS data, then a GIS nutrient load model, once developed, could be readily applied to any catchment for which GIS data exists with the minimum of further set up. It was considered that the time required to develop and run the GIS model would be less that the total time required to set up and run CMSS for the areas to be covered for the NPI reporting for 1999.

The CMSS lumped parameter model did not directly consider other factors such as slope, rainfall and soil types. A GIS model developed in-house is capable of being readily modified to incorporate these other factors. For the initial work (the subject of this report) the GIS model did not incorporate these other factors.

The GIS model produces results as GIS data that may then be readily produced as maps to provide a visual representation of nutrient emissions across the study area.

The main purpose for CMSS was to allow managers to develop land management practices based on nutrient emissions. For the NPI work it was only necessary to estimate nutrient loads. Thus the land management functions of CMSS were not required. A GIS model is still capable of being run under different scenarios by modifying the input data, although this would not be as user friendly as the DSS approach used in CMSS.

NUTRIENT LOAD MODELLING

Introduction

Nutrient loads (as total nitrogen and total phosphorus) were derived by computer modelling for a series of sub-catchments. The computer model was based on raster GIS and used landuse data and nutrient generation rates to estimate the nutrient loads from diffuse sources within each sub-catchment. The model was applied to a series of catchments for which the nutrient loads had been measured. Some of the nutrient generation rates were then modified so that the model produced figures of nutrient loads that were closer to the measured figures.

This section lists the sources of data (landuse and nutrient generation rates) and describes in some detail the methods used to process the data. A brief description of the GIS based nutrient load model is given, and the calibration procedure is described. More technical details of the GIS computer model are given in an appendix. A description of the source and processing methods for the monitoring data is given in another section.

Landuse Data

The landuse data used as the basis for nutrient load modelling was obtained from three different sources. One source dataset covered the rural areas. As this did not cover the Metropolitan area it was necessary to obtain this data from another source. Work was required to align the landuse classifications of the two datasets to a common system, and to produce a montage of the two source datasets for part of the study area. Part of the north west of the study area was surveyed as part of this work. The data sources and processing are described below.

Landuse data for the rural areas were obtained from the Department of Primary Industries and Resources South Australia (PIRSA). This data was in the form of GIS data and covered the local government areas (LGAs) within the central Mount Lofty Ranges (from the southern part of the Fleurieu Peninsular to the majority of the Gawler River catchment in the north). The classifications of landuse were based on the ANZLUC (Australian and New Zealand Land Use Code) system (Standards Australia 1999 draft). This data was based on aerial photography interpretation and on-ground surveys over periods in 1998 and 1999. It was decided for both this project and a parallel project on pollution risk assessment, that the GIS model would be based on landuse data using the ANZLUC system.

The second set of landuse data was obtained from PlanningSA (a division of the Department of Transport, Urban Planning and the Arts, South Australia). This data was in the form of GIS data and covered the Patawalonga, Port Adelaide, Dry Creek and Little Para catchments. The original source of this data was GIS data of cadastre (property boundaries) and landuse classifications derived for the purposes of property valuation, both obtained by PlanningSA from Resource Information (a division of the Department for Environment, Heritage and Aboriginal Affairs, South Australia). The data was current for 1998. The relationship between the GIS cadastre data and the valuation landuse classification was one-to-many. PlanningSA processed the two source datasets to produce a GIS dataset of properties with a set of broad landuse classifications.

The landuse classification system in the landuse data obtained from PlanningSA for the urban areas was considered to be adequate for the purposes of this project. However, it was noted that for the rural areas, the landuses allocated to properties did not represent the multiple landuses taking place in separate areas or paddocks with the larger properties. The later were, however, represented in the landuse data obtained from PIRSA. Therefore, for part of the study area (the Patawalonga, Port Adelaide, Dry Creek and Little Para catchments) the two landuse datasets were combined in a way to preserve as much of the data for the rural landuse data as existed in that dataset.

The combined landuse data required further processing as follows:

- Each landuse in the landuse data from PlanningSA was allocated a code to the ANZLUC system.
- The data sourced from PlanningSA was simplified spatially. As the source data was based on cadastre, the data density was very high. It was simplified by first polygonising roads and classifying them as urban landuse. Then, using the GIS process known as "dissolve", all polygons with the same landuse code were combined. As part of this process, several other landuse categories (commerce, retail trade, wholesale trade) were combined into a single "commerce" category.
- There were some predominantly rural areas in the south of the study area that were sourced from the broadly classified data from PlanningSA. These areas were manually sub-divided where required, and re-classified based on local knowledge and topographical maps.
- The classification of National Parks, Conservation Parks, recreation areas containing mostly native vegetation, and recreation parks in urban areas were inconsistent between the two source datasets. These were all examined manually and re-classified using the ANZLUC system. The re-classification of these landuses still retained inconsistencies. Although these were considered to not introduce significant errors in the nutrient load modelling, it is recommended as part of further refinement work that the classification of these landuses is re-visited.

The landuse data obtained from PIRSA was used without further processing or modification for the remainder of the study area (the Onkaparinga, upper Torrens and South Para catchments).

The western side of the North Para catchment fell outside of the Barossa LGA and was not covered by the landuse data obtained from PIRSA. This area was surveyed as part of this project. Aerial photographs for most of this area for 1997 were available. These were interpreted for landuse as much as possible. A survey was then conducted (in April 2000) by driving along public roads to confirm the interpretation of the aerial photography and to classify the areas not covered by the aerial photographs. This data was prepared as GIS data and appended to the PIRSA landuse data.

A complete list of all landuse categories and their ANZLUC codes in the landuse data used for modelling is shown in Table N2. Table N2 also lists the nutrient generation rates (as described in the next section).

The percentage landuses with simplified landuse categories in each of the monitored catchments are shown in Table N1 (all landuse categories and percentages that existed within the monitored catchments are shown in Appendix 7). Table N1 also shows the unit-area nutrient loads (in kg/ha/y) generated in each catchment. These figures were obtained from the analysis of the monitoring data (described in the section on Monitoring Data). A discussion of the unit-area nutrient loads and relationships with landuses in each of the monitored catchments is given in the Discussion section.

Nutrient Generation Rates

Initially, nutrient generation rates were obtained from literature and other sources (Table N2). These were used for model development. In a calibration phase, several of the nutrient generation rates were modified as described in the Calibration section below. A list of initial and modified values of nutrient generation rates, together with sources and basis for modifications, are given in Table N2.

The majority of values for nutrient generation rates were obtained from Davis and Farley (1991) and Davis and Farley (1997). The former is a manual provided with the program CMSS, and the later is a published paper. Both sources describe the development and an application of CMSS, and both sources provide the same list of nutrient generation rates for a range of landuses. The nutrient generation rates quoted in these references were based on a literature search and studies undertaken in the Onkaparinga catchment (eg Clarke 1988). It was noted that the literature (eg Davies *et al* 1991; Letcher *et al* 19999; Marston 1992; Marston *et al* 1993; NSW EPA 1999) frequently quoted a wide range of values for the nutrient generation rates for any given landuse. Given this wide range, it was considered that the nutrient generation rates given in the previously quoted references were a good basis on which to commence work on the nutrient load model.

Some landuses given in the GIS landuse data were not listed in the above references. Nutrient generation rates for irrigated pasture and field crops were derived from NEXSYS, an expert system program supplied with CMSS and available separately. NEXSYS provided a range of nutrient generation rates for each landuse for a user chosen set of conditions. The choice of conditions varies with landuse, but may include a choice between, for example, high slope/low slope; high rainfall/low rainfall; irrigated/non-irrigated and many more land characteristics and land management scenarios. It was difficult to arrive at a single value for a nutrient generation rate. The course of action taken was to run NEXSYS for a range of typical conditions thought to occur for a landuse in the study area, record the range of values, and estimate the geometric mean. This was not a precise method, but was considered acceptable for initial trials.

Some landuses (eg rural living; commerce) were not given in the above references nor in NEXSYS. Values for these were assumed based on landuses considered to have similar nutrient generation rates (these are shown in Table N2).

The data on nutrient generation rates described above was assembled and processed in a spreadsheet file (NP-Generation Rates.xls). The final data was then saved as a comma delimited file (np_rates.csv) and transferred to the Unix workstaion.

Figure N1. Percentage Landuses (with simplified categories) and Unit-Area Nutrient Loads for the Monitored Catchments.
(The unit-area nutrient loads are from the monitoring data with the climate factor applied).

Station	Catchment	Simplified Landuse Categories	Urban - Adelaide Hills	Urban - Adelaide Plains	Rural Res idential Accomadation	Manufacturing	Commerce	Government Admin & Defence Services	Education	Cultural & Recreation Services	Livestock	Dairy Cattle	Horses	Field Crops	Orchards	Vegetables	Vines	Forest Plantation	Improved Pasture	Mining or Extractive Industry	Native Vegetation	Outdoor Recreation Area	Vacant land	Total Nitrogen Load (kg/ha/y)	Total Phosphorus Load (kg/ha/y)
AW503502	Scott Creek at Scott Bottom				6						35	3	3		2		1				49			1.53	0.19
AW503506	Echunga Creek u/s of Mt Bold Resv		1		12				1		35	11	8	5		1	1	3	2		16	1		1.97	0.27
AW503507	Lenswood Creek, Lenswood				1						25	2	1	1	44		9	1			16			4.57	0.32
AW503509	Aldgate Creek near railway station		61		11				4	6	9										7	1		4.33	0.49
AW503526	Cox Creek, Uraidla		9		6				1	1	20		1	7	6	20	13				14			30.23	5.68
AW504517	First Creek, Waterfall Gully		2		4					3	1										90			0.72	0.04
AW504518	Sturt River u/s of Minno Creek junction		7		26						21	1		1	3		1				40			4.11	1.56
AW504523	Sixth Creek at Castambul		1		1						25		1	1	14	1	2	3			50			5.48	0.55
AW504525	Kersbrook Creek u/s of Millbrook Resv		2		4						38	4	5		4	1		8	3		30			2.19	0.14
AW504549	Sturt River d/s of Anzac Highway		18	22	10	2	1	1	2		14				1						24	3	1	1.67	0.33
AW504576	Sturt River d/s of Sturt Road		20	1	15			1	2		21		1		1						33	2	1	1.49	0.36
AW504580	Brownhill Creek u/s of Keswick Creek		7	27	24	1	1	2	5		5			3						1	23	1	1	2.19	0.31
AW504581	Morphett Road Pipe (North Plympton)			62		9	11	1	10													3	5	10.75	2.15
AW504582	Adelaide Terrace Pipe (Edwardstown)			68		15	16																1	3.88	0.97
AW504583	Brownhill Creek at Adelaide Airport		3	44	13	3	4	2	3		3			2							14	6	1	2.56	0.41
AW504901	Brownhill Creek at Scotch College		8	4	39			1			9									1	36			1.17	0.10

Table N2. Original (from literature) and Modified (after model calibration) Nutrient Generation Rates.

ANZLUC (note 1)	Landuse Description	Total Nitrogen Orig	Total Nitrogen Mod	Total Phosphorus Orig	Total Phosphorus Mod	Source of Original Figures (see notes 2 & 3)	Basis for Change	Strength of Evidence
100000	Urban - Adelaide Hills	**9.9**	**6**	**1.3**	**0.66**	CMSS	Aldgate Creek monitoring data	moderate
100099	Urban - Adelaide Plains		**4**		**0.66**		Patawalonga monitoring data	weak
111200	Rural Residential Accomadation	**6.8**	**2.5**	**1.1**	**0.2**	Assumed (as Horse)	Aldgate, Cox & Echunga Creeks monitoring data	very weak
200000	Manufacturing	**9.9**	**4.5**	**1.3**	**0.66**	Assumed (as Urban)	Part assumed, part monitoring data (4)	very weak
211000	Meat & Meat Produce Manufacture	**1.9**	**1.9**	**0.6**	**0.6**	Assumed (100 cows, 19 ha)		
300000	Commerce	**4.9**	**3**	**0.65**	**0.33**	Assumed (half Urban)	Assumed (half Urban - Adelaide Hills)	
440000	Government Admin & Defence Services		**3**		**0.33**		Assumed (half Urban - Adelaide Hills)	
442100	Army Base	**6.2**	**7.5**	**0.8**	**0.83**	Assumed (mean of Urban and Grazing)	Assumed (1.25 x Urban - Adelaide Hills)	
451000	Education	**6.2**	**4.5**	**0.8**	**0.5**	Assumed (mean of Urban and Grazing)	Assumed (0.75 x Urban - Adelaide Hills)	
460000	Cultural & Recreation Services	**6.2**	**4.5**	**0.8**	**0.5**	Assumed (mean of Urban and Grazing)	Assumed (0.75 x Urban - Adelaide Hills)	
481400	Cemetery / Crematorium	**4.7**	**7.5**	**0.3**	**0.83**	Assumed (as Horticulture)	Assumed (1.25 x Urban - Adelaide Hills)	
510000	Livestock	**2.5**	**2**	**0.3**	**0.12**	CMSS	Monitoring data from several catchments (5)	weak
512300	Dairy Cattle	**6.8**	**3.4**	**1.1**	**0.55**	CMSS	Assumed (half CMSS values)	
513000	Horses	**6.8**	**3.4**	**1.1**	**0.55**	CMSS	Assumed (half CMSS values)	
520000	Field Crops	**3**	**3**	**0.7**	**0.7**	NEXSYS		
520022	Field Crops - Irrigated	**5**	**5**	**1.1**	**1.1**	NEXSYS		
520025	Field Crops - Temporal	**3**	**3**	**0.7**	**0.7**	Assumed (as Field Crops)		
520026	Field Crops - Summer	**3**	**3**	**0.7**	**0.7**	Assumed (as Field Crops)		
530000	Horticulture - Trees	**4.7**	**7.3**	**0.3**	**0.45**	CMSS (Perennial Horticulture)	Lenswood monitoring data	weak
540099	Intensive Market Gardening (high rainfall)	**30**	**100**	**30**	**20**	CMSS	Cox Creek monitoring data	moderate
541300	Vegetables - Brassicas	**8**	**30**	**9**	**6**	CMSS	Assumed (0.3 x high rainfall Market Gardening)	
541600	Vegetables - Lettuce	**8**	**30**	**9**	**6**	CMSS	Assumed (0.3 x high rainfall Market Gardening)	
541900	Vegetables - other	**8**	**30**	**9**	**6**	CMSS	Assumed (0.3 x high rainfall Market Gardening)	
542100	Root Vegetables - Potatoes	**8**	**30**	**9**	**6**	CMSS	Assumed (0.3 x high rainfall Market Gardening)	
542200	Root Vegetables - Onions	**8**	**30**	**9**	**6**	CMSS	Assumed (0.3 x high rainfall Market Gardening)	
542800	Root Vegetables - Carrots	**8**	**30**	**9**	**6**	CMSS	Assumed (0.3 x high rainfall Market Gardening)	
543000	Vine Fruit	**4.7**	**7.3**	**0.3**	**0.45**	CMSS (Perennial Horticulture)	Assumed (as Horticulture - Trees)	
552000	Forest Plantation	**1.8**	**0.55**	**0.09**	**0.03**	CMSS	Assumed (as Native Vegetation)	
560000	Aquaculture	**0**	**0**	**0**	**0**	Assumed (zero)		
579000	Improved Pasture	**4**	**4.5**	**0.7**	**0.24**	NEXSYS	Assumed (2 x Livestock)	
600000	Mining or Extractive Industry	**0**	**0**	**0**	**0**	CMSS		
710000	Protected Area	**1.8**	**0.55**	**0.09**	**0.03**	CMSS	First Creek monitoring data	moderate
715000	Landscape/Seascape/Cons Rec Area	**1.8**	**0.55**	**0.09**	**0.03**	CMSS	Assumed (as Native Vegetation)	
719000	Protected Area NEC	**1.8**	**0.55**	**0.09**	**0.03**	CMSS	First Creek monitoring data	moderate
730000	Outdoor Recreation Area	**6.2**	**9**	**0.8**	**1**	Assumed (mean of Urban and Grazing)	Part assumed (1.5x Urban), part monitoring data (4)	very weak
790000	Mainly Native veg	**1.8**	**0.55**	**0.09**	**0.03**	CMSS	First Creek monitoring data	moderate
813500	Marina / Boat Mooring	**0**	**0**	**0**	**0**	Assumed (zero)		
814100	Airport / Airstrip	**2.5**	**2**	**0.3**	**0.12**	Assumed (as Grazing)	Assumed (as Grazing)	
830000	Utilities	**9.9**	**4.5**	**1.3**	**0.4**	Assumed (as Urban)	Assumed (0.75 x Urban - Adelaide Hills)	
834100	Water Storage - Reservoir, Dam etc	**0**	**0**	**0**	**0**	Assumed (zero)		
835900	Sewage Facility	**0**	**0**	**0**	**0**	Not reported for 1999		
836100	Rubbish Dump	**0**	**0**	**0**	**0**	Assumed (zero)		
911000	Vacant land	**3.6**	**1.2**	**0.2**	**0.08**	Assumed (double Native Vegetation)	Assumed (double Native Vegetation)	

Notes:
1 – ANZLUC – Australian and New Zealand Land Use Codes (ANZLUC 1999 draft)
2 – CMSS – Catchment Management Support System (Davis and Farley 1991, 1997)
3 – NEXSYS – Expert system program provided with CMSS for estimating nutrient generation rates.
4 – North Plympton & Edwardstown monitoring data (used to refine nutrient generation rates for Manufacturing and Outdoor Recreation).
5 – Echunga, Kersbrook, Lenswood and Scott Creeks (used to refine nutrient generation rates for Livestock).

GIS Model - Concepts

The figures for total nitrogen and total phosphorus generated in sub-catchments were estimated with a GIS model working on the principle of unit loading (alternatively, a lumped parameter model that uses a single lumped parameter). Unit loads are the nutrient generation rates, expressed as mass per unit area per unit time (kg/ha/y), for each of a series of landuse classes.

The model calculated the nutrient loads independently for total nitrogen and total phosphorus for each of the sub-catchments. The model applied the nutrient generation rate to each landuse in turn and then summed the total nutrient load for the area of each landuse within each sub-catchment. The result was the total nutrient load exported from each sub-catchment expressed as nutrient mass per unit time (kg/y).

The model algorithm can be expressed as the following formula:

$$\text{NutrientMass}(j) = \sum_{k=1}^{n} [\ \text{NutrientEmissionRate}(k) \times \text{Area}(jk)\ ]$$

Where:

NutrientMass(j) = the total nutrient load exported from sub-catchment J;
NutrientEmissionRate(k) = the nutrient emission rate for landuse K;
Area(jk) = the total area occupied by landuse K within the sub-catchment J.

The concept behind this method is the same as that employed by the program CMSS. This was intentional so that the results would be compatible with nutrient loads estimated by other States for the NPI. A description of the program CMSS and the reasons for developing the GIS nutrient load model are given in an earlier section of this report.

The model did not explicitly consider nutrient assimilation in streams. For this reason, it is not valid to add the nutrient loads generated by a series of sub-catchments to obtain the nutrients generated by a whole catchment. Nutrient assimilation in streams can be expected to result in a lower nutrient export from a whole catchment that the sum of nutrient exports from all the sub-catchments within a catchment.

The nutrient load model utilised raster GIS. The landuse data was divided into a grid of small cells such that each cell contained only a single landuse. Each cell was processed one at a time. For each cell, the appropriate nutrient generation rate for that cell's landuse was multiplied by that cell's area. The result was the nutrient generated per cell and this was stored as a new GIS raster dataset. This process was repeated for each of the nutrients to produce two sets of GIS data, one for total nitrogen and one for total phosphorus.

The next step of the model was to divide the whole study area into a series of sub-catchments. Within each sub-catchment, the nutrient generated per cell was summed for all cells that fell within the sub-catchment. The result was the total nutrient generated per sub-catchment. This was repeated for each nutrient and produced total nitrogen and total phosphorus loads in kg per year for each sub-catchment. These figures were submitted to Environment Australia for placement on the NPI web site. The figures were also added to the GIS dataset of sub-catchments so that the nutrient loads can be illustrated on maps.

Before the nutrient load figures were published, the model was applied to a series of catchments for which the nutrient loads had been measured. Some of the nutrient generation rates were then modified so that the model produced figures of nutrient loads that were closer to the measured figures. This method of calibration includes the average effect of other factors into the single lumped parameter represented by nutrient generation rates for each landuse. The model results therefore represent the nutrient exports from sub-catchments with similar characteristics as the monitored catchments.

Some technical details of the GIS model are given in the Appendices.

Calibration

When this project was proposed, the intention was to utilise published figures for nutrient generation rates and undertake only cursory refinements and model calibration. It was also proposed that a re-evaluation of the type of model and model calibration would take place as part of future work (subject to funding). When the initial modelled results (using the initial values of nutrient generation rates) were compared with the nutrient loads derived from the monitoring data, some results were in reasonable agreement and many deviated considerably. For example, the model considerably over-estimated the nutrient loads for the predominantly urban catchments in the Patawalonga catchment. In contrast, the model considerably under estimated the total nitrogen load for Cox Creek (predominantly intensive vegetable production).

It was decided to undertake some model calibration in this first stage of the work. It was considered that, if a systematic approach was taken, the model could be calibrated by modifying at least some of the nutrient generation rates. Time constraints, however, necessitated that the procedure followed was rapid. There are, therefore, several areas that require a re-visit as part of future work.

The nutrient load model was run for a series of catchments for which nutrient monitoring data was available. A list of these catchments and a description of the methods used to derive the nutrient loads for these catchments is described in the section on Monitoring Data. The model results were compared to the nutrient loads calculated from the monitored data. In two passes of an iterative process, the nutrient generation rates for several landuses were changed to achieve an improvement in the accuracy of the modelled results.

Note that as explained earlier, the model includes the effect of factors other then landuse in the single lumped parameter represented by nutrient generation rates for each landuse. The model results therefore represent the nutrient exports from sub-catchments with similar characteristics as the monitored catchments.

Native Vegetation

Many of the monitored catchments contained a large percentage of native vegetation and/or forestry. Although these landuses generate low levels of nutrients and would not make very large differences to the model results, it was considered appropriate to calibrate the nutrient generation rates for these landuses as the first step. Data from First Creek was used. Although this data was based only on grab samples (see the section on Monitoring Data for information on this data), the catchment contained mostly (90%) native vegetation. The nutrient generation rates were reduced so the model produced results close to the values from the monitored data. The rates for forestry were made the same as for native vegetation. These changes reduced the model results for Kersbrook (30% native vegetation; 8% forestry) by around 10% for both TN (Total Nitrogen) and TP (Total Phosphorus). The confidence in the final values of nutrient generation rates for native vegetation was limited only by uncertainties in the use of grab sampling data to estimated nutrient loads.

Grazing, Rural Living

Several of the monitored catchments (Echunga; Kersbrook; Lenswood; Scott and Sixth) contained large percentages of non-dairy grazing (sheep, beef cattle) as well as large percentages of native vegetation and/or forestry. The nutrient generation rates for grazing were changed (reduced) so that the model produced better results for these catchments.

As part of this process, the nutrient generation rates for dairy grazing, horses and rural living were reduced by similar percentages. None of the monitored catchments contained large enough percentages of these landuses for the nutrient generation rates to be refined with any certainty. It was considered appropriate therefore, that the nutrient generation rates for these landuses were modified by similar percentages.

In the second iteration, it was decided to make the nutrient generation rates for dairy grazing and horses half of the original values obtained from CMSS (there was a similar reduction in the rates for non-dairy grazing). Also in the second iteration, there was some (weak) evidence (from the data for Aldgate, Cox and Echunga catchments) to reduce the nutrient generation rates for rural living still further.

Urban

The nutrient generation rates for urban landuse were reduced based on the monitored loads for Aldgate Creek with 61% urban landuse. There was moderate evidence for the refined values of nutrient generation rates for urban landuse in the Aldgate catchment, as the nutrient generation rates for most of the other landuses (11% rural living; 9% grazing; 7% native vegetation) had already been refined as described above. There was uncertainty due to the presence of recreational areas at 6% of the catchment, and due to uncertainties in the refined values for rural living.

During the second iteration it became evident that it was necessary to divide the urban landuse into two categories. One category was created for “Urban – Adelaide Hills” with the nutrient generation rates derived from Aldgate Creek data as described above. The second category created was “Urban – Adelaide Plains” with the nutrient generation rates based on data for catchments within the Patawalonga catchment. The rate for TN was different for the two categories and the rate for TP was the same. The evidence for the rates for Urban – Adelaide Plains was not strong due to the inconsistencies in the model results compared to the monitored data for different catchments.

Horticulture

The reference sources gave two sets of nutrient generation rates for intensive vegetables, one set of rates for intensive vegetables in Cox Creek and one set for intensive vegetables in other areas. In this study, the nutrient generation rates for intensive vegetables in Cox Creek were changed (the rate for TN increased by a factor of three, the rate for TP reduced by two-thirds) based on data for Cox Creek (with 20% intensive vegetable production). The evidence for these changes was moderate. Although the majority of other landuses in Cox Creek had been refined, there was some uncertainty in the refinement of the nutrient generation rates for grazing (20% of Cox creek).

The rates for intensive vegetables in other areas were set to one-third of the rates for Cox Creek on the basis that the original figures were in this ratio. There were not any other monitored catchments with large areas of intensive vegetable production on which to base any refinements to the nutrient generation rates for this landuse.

The nutrient generation rates for orchards were changed (increased) based on data for Lenswood Creek with 44% orchards and 9% vines. The evidence for these changes was reasonably strong, as the majority of other landuses in Lenswood Creek had been refined.

The rates for vines were set to be the same as the rates for orchards. There were not any monitored catchments with large areas of vines on which to base any refinements to the nutrient generation rates for this landuse.

Other Landuses

The nutrient generation rates for all other landuses could not be refined due the absence of monitored catchments with large areas of these landuses. The rates for several landuses (commerce and several service landuses) were assumed to be a proportion of the rates for urban. The remaining rates were left unchanged from the original values (see Table N2).

Second Iteration

The procedure described above was repeated in a second iteration. However, before the second iteration was undertaken, it was realised that the monitoring data for several catchments covered only a short period and may, therefore, not be typical of long term trends. It was at this point that the climate correction factor was developed as described in the section on Monitoring Data.

At the end of the second iteration it was considered that the nutrient generation rates could not be further refined using this informal method. The modelled results showed inconsistencies that might be due to other factors not incorporated in the simple single parameter model (such as runoff differences between catchments and nutrient assimilation in streams).

Results of the Calibration Stage

The modelled results for each of the monitored catchments, after refinement of the nutrient generation rates, are shown in Table N3, together with the nutrient loads calculated from monitoring data. The calculated loads have the climate correction factor applied. Also shown in Table N3 are error ratios. These error ratios are the modelled results divided by the nutrient loads derived from monitoring data. An error ratio close to unity indicates that the model produced an accurate result. An error ratio greater than unity indicates that the modelled result was high. An error ratio less than unity indicates that the modelled result was low. Statistics were calculated for these error ratios and are shown in the box and whisker diagrams in the lower section of Table N3.

A discussion of these results is given in the Discussion section of this report.

Results for NPI Sub-Catchments

The sub-catchments that were modelled for nutrient loads are shown in **Figure N1**. Details of each sub-catchment including modelled results are shown in **Table N4**. Modelled results are given as totals per sub-catchment (kg/y) and as nutrient loads per unit area (kg/ha/y). The later allows the rate of nutrient generation to be compared between sub-catchments of different sizes.

The modelled nutrient loads are also shown pictorially as maps in **Figure N2** (for total nitrogen) and in **Figure N3** (for total phosphorus). In these maps green indicates lower values of nutrients generated, yellow intermediate rates and oranges higher rates. It is significant to note that sub-catchments shown in yellow can be generating up to ten times the quantity of nutrients that are generated in catchments shown in dark green (containing mainly native vegetation or mature forest). Similarly, the sub-catchments shown in dark orange can be generating up to ten times the quantity of nutrients that the sub-catchments shown in yellow (which is up to one hundred times the quantity of nutrients generated by the sub-catchments shown in dark green).

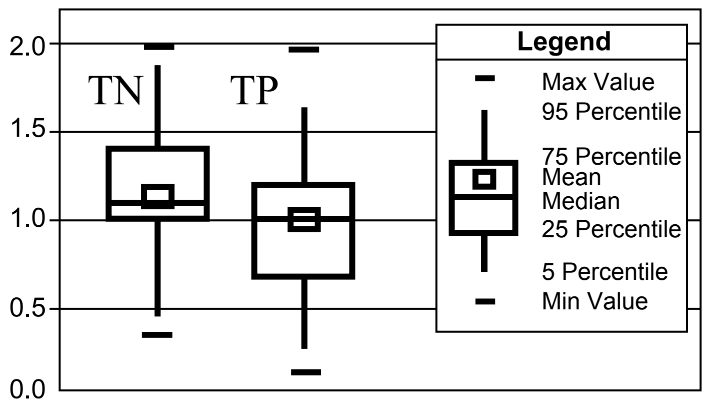
A brief comment on these results is given in the Discussion section of this report.

Table N3. Comparison of modelled results and nutrient loads calculated from monitored data.

Note that the Error Ratio is Modelled Result divided by Monitored Data.

Station	Catchment	Area (ha)	Total Nitrogen Model Results (t/y)	Total Nitrogen Monitored Data (t/y)	Total Nitrogen Error Ratio Mod/Mon	Total Phosphorus Model Results (t/y)	Total Phosphorus Monitored Data (t/y)	Total Phosphorus Error Ratio Mod/Mon
GS503509	Aldgate	763	3.59	3.31	1.08	0.38	0.38	1.00
GS503526	Cox	312	9.83	9.43	1.04	1.82	1.78	1.02
GS503506	Echunga	3403	9.87	6.70	1.47	1.23	0.91	1.35
GS504517	First	489	0.41	0.35	1.18	0.031	0.02	1.55
GS504525	Kersbrook	2286	5.09	5.01	1.02	0.49	0.32	1.54
GS503507	Lenswood	1679	7.85	7.70	1.02	0.52	0.53	0.97
GS503502	Scott	2650	4.23	4.06	1.04	0.33	0.50	0.67
GS504523	Sixth	4382	12.5	24.0	0.52	1.25	2.40	0.52
GS503504	Houlgrave	32090	125	109	1.15	14.3	14.3	1.00
GS504518	Sturt u/s Minno	1940	4.01	8.00	0.50	0.33	3.00	0.11
GS504549	Sturt, Anzac Hwy	11491	37.8	19.0	1.99	4.40	3.80	1.16
GS504576	Sturt, Sturt Rd	7413	20.4	11.0	1.85	1.93	2.70	0.71
GS504580	Brownhill u/s Keswick	3193	9.05	7.00	1.29	1.13	1.00	1.13
GS504581	North Plympton	93	0.37	1.00	0.37	0.055	0.20	0.28
GS504582	Edwardstown	103	0.40	0.40	1.01	0.062	0.10	0.62
GS504583	Browhill + Keswick	6410	22.7	16.0	1.42	3.08	2.60	1.18
GS504901	Brownhill, Scotch	1866	3.89	2.20	1.77	0.35	0.18	1.94

Statistics on Error Ratios



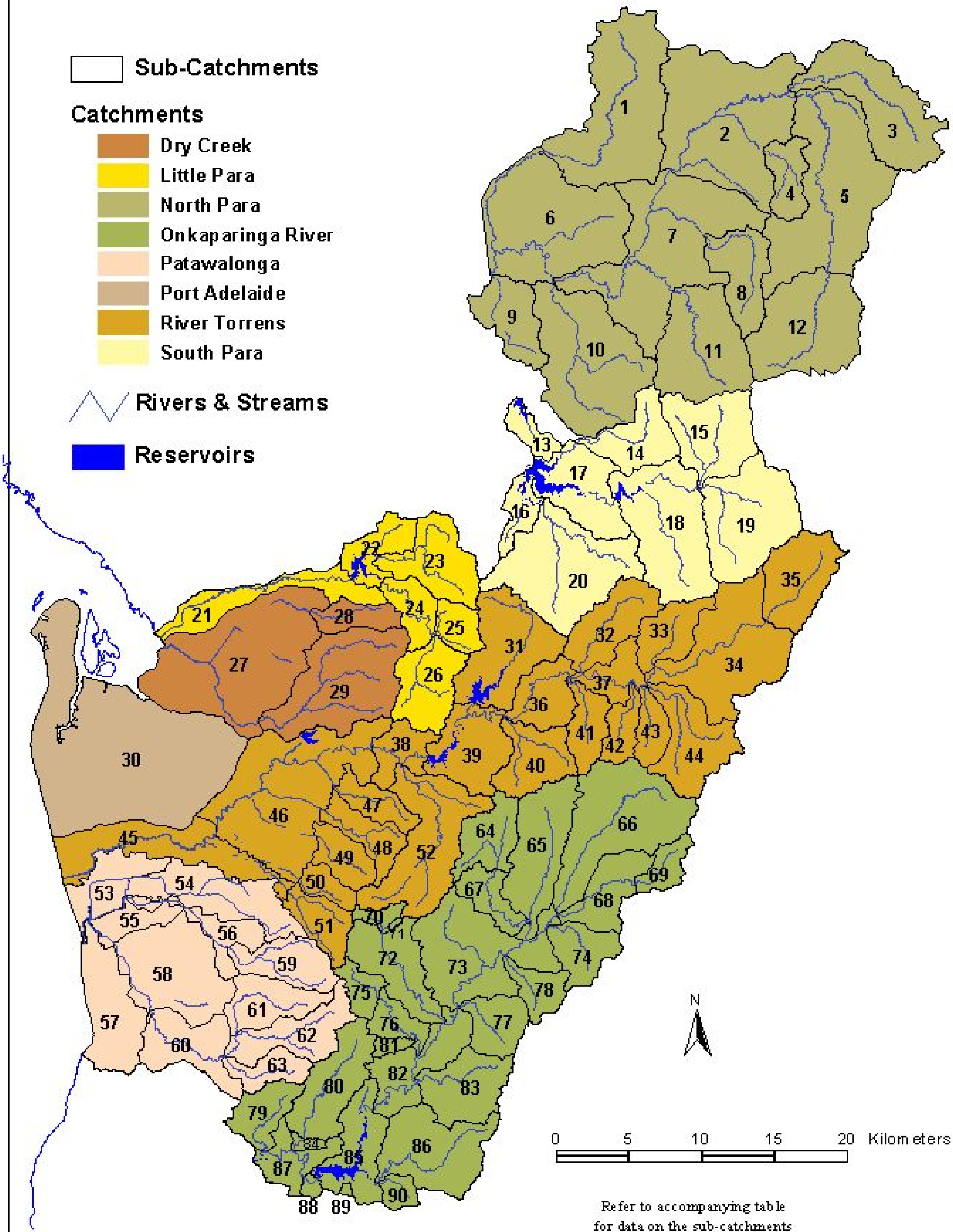


Figure N1. Catchments and Sub-Catchments Modelled for Nutrient Loads

Table N4. Modelled Annual Nutrient Loads in each Sub-Catchment.

Map Ref	NPI_id	Basin	Catchment	Sub-Catchment	Area ha	Load per Sub-Catchment Total N kg/y	Load per Sub-Catchment Total P kg/y	Load per Sub-Catchment Total N kg/ha/y	Load per Sub-Catchment Total P kg/ha/y
1	505009	505	North Para	Greenock Creek	6477	25596	3220	3.95	0.50
2	505010	505	North Para	Barossa Valley North	7573	38501	3010	5.08	0.40
3	505013	505	North Para	Duck Ponds Creek	4114	9350	1279	2.27	0.31
4	505011	505	North Para	Angaston Creek	1266	4482	349	3.54	0.28
5	505012	505	North Para	Lower Flaxman Valley	7212	18656	1819	2.59	0.25
6	505014	505	North Para	Rosedale	6631	20331	3961	3.07	0.60
7	505015	505	North Para	Barossa Valley South	7586	28528	2852	3.76	0.38
8	505016	505	North Para	Tanunda Creek	2099	4010	250	1.91	0.12
9	505017	505	North Para	Sandy Creek	1975	4604	807	2.33	0.41
10	505018	505	North Para	Lyndoch Creek	5879	18305	1715	3.11	0.29
11	505019	505	North Para	Jacob Creek	4028	7861	482	1.95	0.12
12	505020	505	North Para	Upper Flaxman Valley	4505	11620	935	2.58	0.21
13	505003	505	South Para	Barossa Reservoir	723	474	27	0.66	0.04
14	505002	505	South Para	Victoria Creek	2006	4197	264	2.09	0.13
15	505001	505	South Para	Portuguese Bridge	2946	6287	381	2.13	0.13
16	505007	505	South Para	Vixen Gully	913	466	26	0.51	0.03
17	505006	505	South Para	South Para Reservoir	2706	3906	242	1.44	0.09
18	505005	505	South Para	Warren Reservoir	4749	5142	323	1.08	0.07
19	505004	505	South Para	Mount Crawford Forest	4179	5381	317	1.29	0.08
20	505008	505	South Para	Malcolm Creek	5181	9286	706	1.79	0.14
21	504027	504	Little Para	Lower Little Para	2322	8453	1073	3.64	0.46
22	504026	504	Little Para	Little Para Reservoir	1426	1652	124	1.16	0.09
23	504025	504	Little Para	Gould Creek	2458	4779	379	1.94	0.15
24	504029	504	Little Para	Little Para River	1196	2738	213	2.29	0.18
25	504028	504	Little Para	Mount Gawler	907	2001	171	2.21	0.19
26	504032	504	Little Para	Lower Hermitage	2250	6728	513	2.99	0.23
27	504031	504	Dry Creek	Dry Creek	7598	27240	3624	3.59	0.48
28	504030	504	Dry Creek	Cobbler Creek	1018	2389	303	2.35	0.30
29	504033	504	Dry Creek	Upper Dry Creek	4875	17940	2530	3.68	0.52
30	504034	504	Port Adelaide	Port Adelaide	12587	49267	7108	3.91	0.56
31	504007	504	River Torrens	Kersbrook Creek	3671	6800	602	1.85	0.16
32	504004	504	River Torrens	Millers Creek	2279	13213	1690	5.80	0.74
33	504003	504	River Torrens	Hannaford Creek	1558	5578	691	3.58	0.44
34	504002	504	River Torrens	Birdwood	5023	13841	1234	2.76	0.25
35	504001	504	River Torrens	Mount Pleasant	2600	6179	426	2.38	0.16
36	504006	504	River Torrens	Gumeracha Weir	1680	3264	197	1.94	0.12
37	504005	504	River Torrens	Gumeracha	1155	4674	464	4.05	0.40
38	504014	504	River Torrens	Gorge Weir	1262	2111	142	1.67	0.11
39	504013	504	River Torrens	Kangaroo Creek	2599	4196	266	1.61	0.10
40	504012	504	River Torrens	Cudlee Creek	1998	4121	290	2.06	0.15
41	504011	504	River Torrens	Kenton Valley	1285	8824	1318	6.87	1.03
42	504010	504	River Torrens	Footes Creek	934	4734	579	5.07	0.62
43	504009	504	River Torrens	McCormick Creek	942	5691	859	6.04	0.91
44	504008	504	River Torrens	Angas Creek	2760	9937	1187	3.60	0.43
45	504041	504	River Torrens	River Torrens	3606	17028	2383	4.72	0.66
46	504035	504	River Torrens	River Torrens	7314	27859	4129	3.81	0.56
47	504036	504	River Torrens	Fifth Creek	1122	2055	162	1.83	0.14
48	504037	504	River Torrens	Forth Creek	1392	2472	167	1.78	0.12
49	504038	504	River Torrens	Third Creek	1235	2393	198	1.94	0.16
50	504039	504	River Torrens	Second Creek	713	842	62	1.18	0.09
51	504040	504	River Torrens	First Creek	1377	1289	111	0.94	0.08
52	504015	504	River Torrens	Sixth Creek	4428	12478	1247	2.82	0.28
53	504061	504	Patawalonga	Airport Drain Catchment	1737	7029	878	4.05	0.51
54	504060	504	Patawalonga	Keswick Creek	3078	13052	1854	4.24	0.60
55	504063	504	Patawalonga	Local Patawalonga Catchment	966	4187	616	4.33	0.64
56	504062	504	Patawalonga	Lower Brownhill Creek	1327	5161	782	3.89	0.59
57	504066	504	Patawalonga	Coastal Catchment	2857	10505	1628	3.68	0.57
58	504065	504	Patawalonga	Lower Sturt River	4079	17415	2474	4.27	0.61
59	504064	504	Patawalonga	Upper Brownhill Creek	1859	3854	347	2.07	0.19
60	504069	504	Patawalonga	Middle Sturt River	2295	7634	781	3.33	0.34
61	504067	504	Patawalonga	Minno Creek	1818	4896	476	2.69	0.26
62	504068	504	Patawalonga	Upper Sturt River	2227	5155	445	2.31	0.20
63	504070	504	Patawalonga	Chambers Creek	1062	2588	218	2.44	0.21

Table N4 (cont). Modelled Annual Nutrient Loads in each Sub-Catchment.

Map Ref	NPI_id	Basin	Catchment	Sub-Catchment	Area ha	Load per Sub-Catchment Total N kg/y	Load per Sub-Catchment Total P kg/y	Load per Sub-Catchment Total N kg/ha/y	Load per Sub-Catchment Total P kg/ha/y
64	503003	503	Onkaparinga River	Upper Lenswood Creek	1683	7853	517	4.67	0.31
65	503002	503	Onkaparinga River	Western Branch	3298	12631	1270	3.83	0.39
66	503001	503	Onkaparinga River	Charleston	5152	18052	2057	3.50	0.40
67	503006	503	Onkaparinga River	Lower Lenswood Creek	1156	4397	374	3.80	0.32
68	503005	503	Onkaparinga River	Lower Inverbrackie Creek	1845	7490	963	4.06	0.52
69	503004	503	Onkaparinga River	Upper Inverbrackie Creek	827	2485	203	3.00	0.25
70	503010	503	Onkaparinga River	Upper Cox Creek	383	9285	1729	24.23	4.51
71	503009	503	Onkaparinga River	Sutton Creek	44	549	96	12.56	2.20
72	503011	503	Onkaparinga River	Cox Creek	2462	14245	2002	5.79	0.81
73	503008	503	Onkaparinga River	Upper Onkaparinga	4713	14264	1402	3.03	0.30
74	503007	503	Onkaparinga River	Mitchell Creek	1452	7059	1020	4.86	0.70
75	503017	503	Onkaparinga River	Upper Aldgate Creek	781	3687	391	4.72	0.50
76	503016	503	Onkaparinga River	Lower Aldgate Creek	917	2619	252	2.86	0.28
77	503013	503	Onkaparinga River	Hahndorf	1468	4928	501	3.36	0.34
78	503012	503	Onkaparinga River	Balhannah	1024	3585	403	3.50	0.39
79	503020	503	Onkaparinga River	Cherry Gardens	1407	2966	210	2.11	0.15
80	503019	503	Onkaparinga River	Scott Creek	2657	4252	335	1.60	0.13
81	503015	503	Onkaparinga River	Lesley Creek	262	558	43	2.13	0.16
82	503014	503	Onkaparinga River	Mylor	2316	5055	434	2.18	0.19
83	503018	503	Onkaparinga River	Biggs Flat	2362	6467	638	2.74	0.27
84	503023	503	Onkaparinga River	Lower Scott Creek	196	388	43	1.98	0.22
85	503022	503	Onkaparinga River	Mount Bold	2327	1571	89	0.68	0.04
86	503021	503	Onkaparinga River	Echunga Creek	3412	9896	1231	2.90	0.36
87	503024	503	Onkaparinga River	Clarendon Weir	1336	2122	154	1.59	0.12
88	503027	503	Onkaparinga River	Grimwood Hill	186	173	10	0.93	0.05
89	503026	503	Onkaparinga River	Burnt Out Creek	57	33	2	0.58	0.03
90	503025	503	Onkaparinga River	Jupiter Creek	506	657	42	1.30	0.08

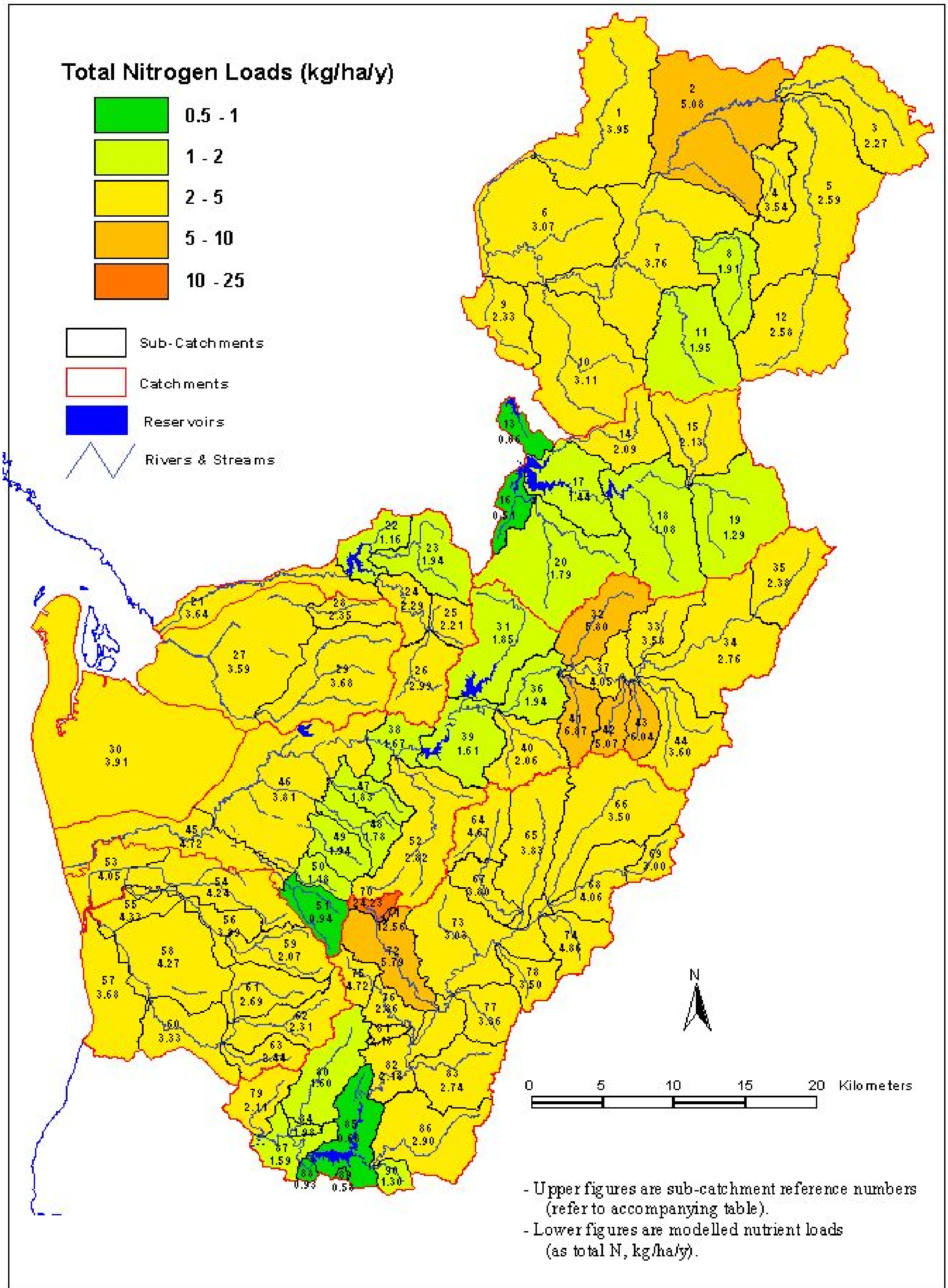


Figure N2. Modelled Total Nitrogen Loads per Sub-Catchment

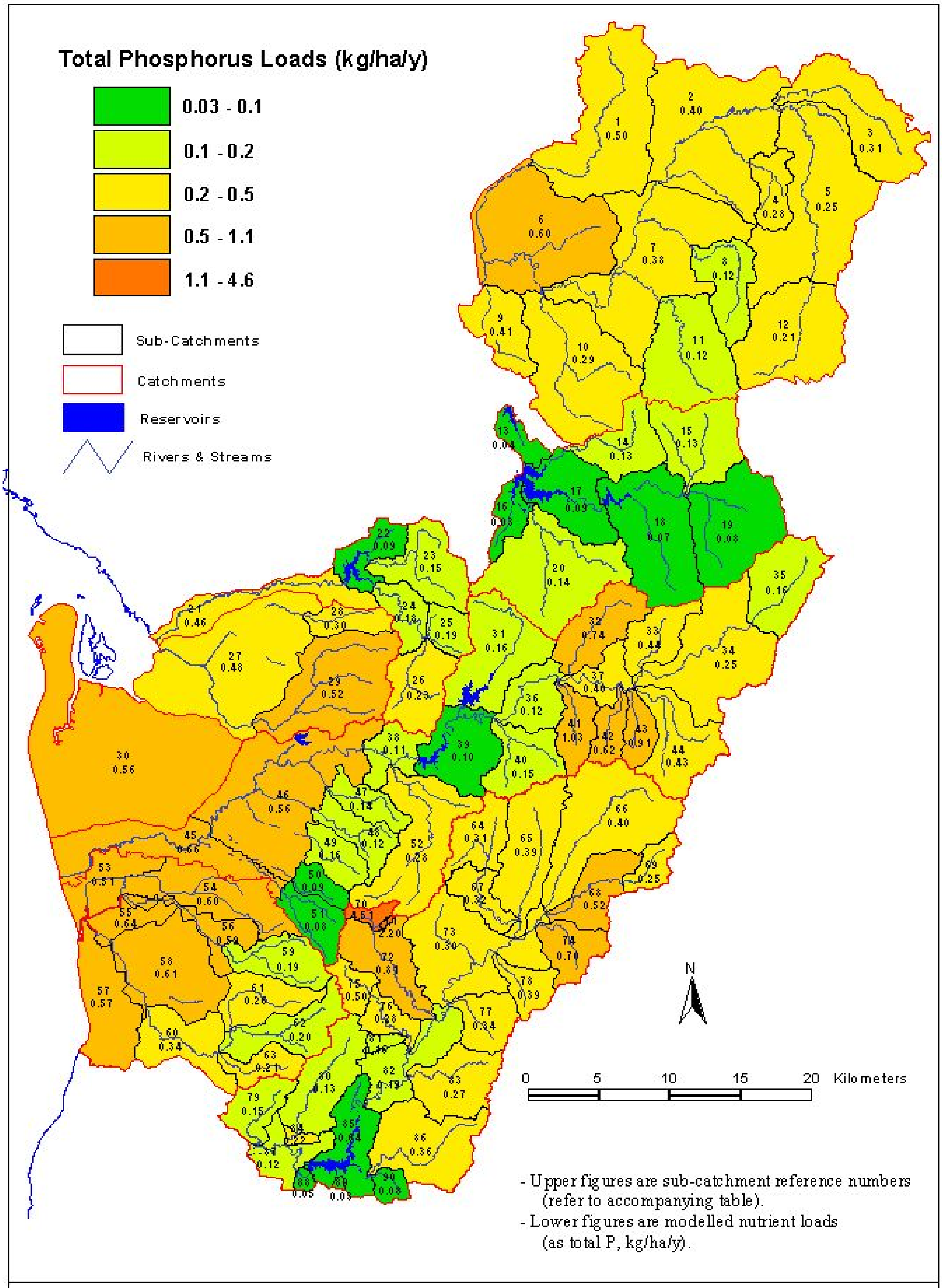


Figure N3. Modelled Total Phosphorus Loads per Sub-Catchment

Regional Areas

Several regional areas were considered for nutrient load modelling. The centres defined for aggregate work were the Barossa Valley surrounding the towns of Angaston, Nuriootpa and Tanunda; the Iron Triangle towns of Whyalla, Port Pirie and Port Augusta; the Southeast towns of Mount Gambier and Millicent; and the Riverland towns of Berri, Loxton and Barmera.

The Barossa Valley is adjacent to the Adelaide area with similar climate and topography. This area was therefore modelled for nutrients using the same model and nutrient generation rates as were used for the Adelaide area.

After an evaluation of each region, none of the other regional areas were modelled for nutrients. This was due to the areas having flat topography without any defined surface streams or catchments, and/or uncertainty in values of nutrient generation rates in these regions. The nutrient generation rates used for nutrient modelling in the Adelaide region were derived for the Mount Lofty Ranges. Each of the regional centres has different climatic conditions, different topography, and possibly different soil types and different land management practices. These differences could result in differences in nutrient generation rates that cannot be quantified due the lack of research on this topic in these areas. It was considered, due to this uncertainty in nutrient generation rates for these areas, that nutrient modelling would be of little value for nutrient management purposes.

Some effort was spent in investigating monitoring data for the Southeast. However, the conclusion was that the nutrient generation rates for this area could not be quantified with any certainty.

Each regional centre is briefly described below, and the reasons for not proceeding with nutrient load modelling are given for each regional centre.

Iron Triangle Towns

Whyalla

The town of Whyalla is located on a rise adjacent to the western shore of the upper Spencer Gulf. There are some small creeks in the hills north of the town, but there are no major creeks or waterbodies. There are mangroves to the south of the town. Four wetland schemes have been constructed or are under construction (State Water Plan 2000 draft). One of these wetlands has been constructed to capture the majority of the town stormwater in order to reduce the impact of pollution in the mangroves, and with a view to re-using the water to supplement the town's water supply. The wetland is currently incomplete.

There is an issue of water quality in regard to pollutants potentially entering the mangroves from stormwater, from the outlet from the WWTP, and from wastewater from the many shacks located along the coast. It would be useful, therefore, to model nutrients in runoff and town stormwater. However, due to the uncertainty in the nutrient generation rates for this area (as described above), the results from nutrient modelling would have a low reliability and would not be useful to management of nutrients.

Port Augusta

The town of Port Augusta is located either side of the upper reaches of Spencer Gulf. The western side of the town is located on a small rise. The general area surrounding the town has a series of low rises and dry lakes. There are no major creeks or defined catchments. The soil is generally sandy so that rainfall rapidly percolates into the ground. Stormwater from impervious areas in the town can lead to flooding problems. This stormwater is collected from low points and pumped into the dry lakes for evaporation. There is the possibility of re-using this stormwater at some time in the future.

There was no issue identified in relation to nutrients from diffuse sources entering either surface water or groundwater. Further, there was uncertainty in the nutrient generation rates for this area. It was considered, therefore, that nutrient modelling would be of little value.

Port Pirie

The town of Pt Pirie is located on the eastern shore of the upper Spencer Gulf. The area is flat with no major creeks and no definable catchments.

There was no issue identified in relation to nutrients from diffuse sources entering either surface water or groundwater. Further, there was uncertainty in the nutrient generation rates for this area. It was considered, therefore, that nutrient modelling would be of little value.

The Riverland Towns

The towns of Barmera, Berri and Loxton are located adjacent to the large U-bend in the River Murray not far from the NSW/Victoria/SA border. The land is predominantly a flat plateau dissected by the meandering river. There are some very small catchments cutting into the edge of the plateau that drain into the river. The nature of the soil and the flat terrain mean that there is very little surface water runoff. Most rainfall percolates into the ground where it enters the river via groundwater paths.

The major issue in relation to water quality in this region is salinity of the River Murray. The salinity arises from the general salinity of the underlying soils throughout the larger part of the Murray-Darling Basin. These salts are delivered to the river system by groundwater. Reducing flows in the river due to diversions of water by the upstream States gives rise to higher salt concentrations in the river in South Australia. Increasing use of irrigation within the Riverland causes larger movement of groundwater taking even more salt into the river.

Adjacent to each of these towns are areas of horticulture (mainly orchards with some viticulture) that are irrigated with water pumped from the River Murray. In order to reduce the salt loads entering the river, the excess irrigation water is collected in a network of shallow drainage channels and pipes. The collected water is feed into evaporation lagoons in the river flood plain. The salt will thus not enter the river except during the few very high flows when the evaporation lagoons are covered by floodwater. In the case of the irrigation areas adjacent to the towns of Berri and Loxton, the water is pumped from the collecting lagoons to evaporation lakes well clear of the River (the Nora Disposal Scheme). This reduces the salt entering the River still further.

As the majority of shallow drainage groundwater is captured before entering the River Murray, there is no issue in relation to nutrients entering surface water. Further, there was uncertainty in the nutrient generation rates for this area (as discussed previously). It was considered, therefore, that nutrient modelling would be of little value.

The South East Towns

The whole of the South-East of South Australia is flat land with a series of sand dunes running NW-SE created on ancient shores during times of changing sea level. The towns of Millicent and Mt Gambier are located in the southern part of the region. Calcareous sediments underlie the area with karsts being common. Significant groundwater aquifers are found in the limestone beneath the area and these are an important source of water for irrigation and town water supplies. The majority of rainfall percolates via natural karsts and drainage bores to recharge the aquifers.

There are several natural drainage channels in the region. These are supplemented by a series of constructed drains to reduce the quantity of near-surface water to facilitated primary production activities. These natural and supplemented channels are more shallow drainage channels rather than true surface water streams. There are flow gauging stations in many of these channels, and several are subject to water quality monitoring including nutrients.

Mount Gambier

Mt Gambier is situated adjacent to two crater lakes that are fed by groundwater. Blue Lake is an important tourist attraction to the town and is the prime source of the town's water supply. An important pollutant issue for this water supply is nitrates from anthropogenic activities. There are several papers on the topic both based on the situation at Mt Gambier and also from similar situations overseas.

Given the lack of surface water channels, there is no issue in relation to nutrients from diffuse sources entering surface water. However, there is an issue in relation to pollutants, particularly nitrates, entering groundwater. Groundwater is not a topic currently being addressed by the NPI. If groundwater becomes a topic for the NPI, this issue can be addressed for the Mt Gambier area at that time. Modelling of nitrates in groundwater may be a valuable exercise if sufficient data is available. This may be considered as part of further work subject to funding.

Millicent

The town of Millicent is located within the catchment for Drain 44 (Figure N4) that, along with other drainage channels, drain into Lake Bonney. Lake Bonney is important for ecological and conservation reasons and for tourist and recreational pursuits. There is therefore a potential issue in regard to pollutants (including nutrients) entering Lake Bonney. If nutrient generation rates can be estimated from the monitoring and landuse data, then modelling of nutrient loads in sub-catchments surrounding Lake Bonney can be undertaken.

There are only a few different landuse in the area (mainly grazing and forestry with some conservation areas). Some GIS landuse data was available and any gaps could have been filled from aerial photographs or local knowledge.

There is a flow gauging station close to the point where the drain 44 catchment enters Lake Bonney. There are also two other flow-gauging stations for two catchments to the south of drain 44 catchment. Water quality grab samples are taken at irregular intervals at these three gauging stations. The analysis of this grab sampling includes determinations for nutrients. There are also two flow gauging stations within drain 44 catchment but these do not have any water quality data. There are other flow gauging stations and water quality monitoring sites in the region.

A preliminary investigation into the flow and nutrient data has indicated that some of the data may be suitable for calculation of nutrient loads in some catchments where there are periods of reasonable constant flow. It was hoped that if nutrient loads could be determined then a nutrient load model could be calibrated. However, a more detailed analysis showed that the data was not suitable for determination of nutrient loads.

For Drain 44 (GS 239532 as shown in Figure N4) the majority of grab samples were taken when the flow was low compared to the volume of high flows past this station. There were some very high, short duration peak flows that were assumed to be stormwater runoff from the town of Millicent. It would not be possible to determine the nutrient loads in these high flows. A correlation between nutrient concentration and flow was not attempted, as it was not considered worthwhile. There were also many periods of missing flow data so that mean annual flows could not be determined with any confidence.

For Drain 48 (GS 239533) the data showed a very poor correlation between nutrient concentration and flow. It was thus not possible to determine nutrient loads from this catchment.

For Stony Creek (GS 239523) catchment there were some very high flows (e.g. 270 ML/d in October 1992: 150 ML/d in October 1996) whereas the majority of flows were very low (less than

10 ML/d). Only one of the grab samples (October 1996) corresponded to a high flow. A correlation between nutrient concentration and flow was not attempted as it was considered to be not worthwhile.

The flow record for several stations showed step changes in water levels. These were assumed to be due to changes in gauge board height in order to regulate the water table for agricultural purposes. This would change the calibration of the flow gauge further complicating the determination of nutrient loads.

There was the uncertainty in nutrient generation rates in this area compared to those determined for the Mount Lofty Ranges (as discussed previously). Further, it was not possible to determine nutrient loads from local monitoring data against which to calibrate a nutrient load model. It was therefore considered that nutrient load modelling for this area would involve a high degree of uncertainty in the accuracy of the results and would be of little value.

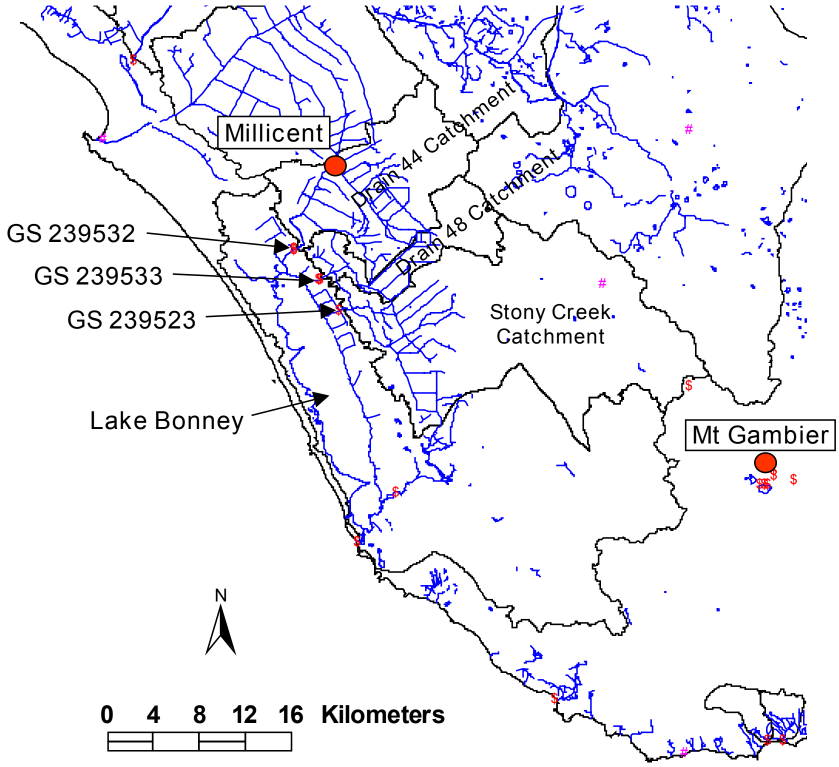


Figure N4. Gauged catchments near Millicent in the Southeast.

MONITORING DATA

Overview

Annual nutrient loads (total nitrogen and total phosphorus) were calculated from monitoring data for a series of catchments. The calculated nutrient loads, after applying a climate correction factor, were used to calibrate the nutrient load model.

Monitoring data from composite samplers were used for as many stations as could be located within the study area. Composite sampling data was used in preference to grab sampling data (that is normally used to monitor ambient pollutant levels) as it was possible to calculate nutrient loads with a high confidence in the accuracy of the results. Grab sampling data was used to estimate nutrient loads for First Creek, as this was the only monitored catchment containing predominantly native vegetation.

Data from two of the monitoring stations (Onkaparinga at Houlgrave Weir and Millbrook Intake representing the upper Torrens Catchment) contained pumping flows. The nutrient loads in these pumping flows were calculated and subtracted from the monitoring data to give nutrient loads originating from natural runoff in the catchment. Due to the complexity of the River Torrens water supply system and lack of gauges at critical points, the data for the upper Torrens catchment could not be utilised.

Nutrient loads that had already been calculated from monitoring data were obtained for some catchments from draft reports prepared by the AWQC for the Torrens and Patawalonga Catchment Water Management Boards.

Many of the monitoring stations had only a short period of record (down to one or two years). The nutrient loads calculated for these catchments may not have been representative of longer term trends. Therefore, a climate correction factor was derived from long-term flow records and used to adjust the calculated mean nutrient loads derived for the monitored catchments.

The following sections describe in detail the sources of data, methods used in calculating nutrient loads, and presents results.

Composite Sampling

A composite sampler is a combined flow measuring instrument and automatic sampler of the water in a stream. A data logger controls the sampler to extract a constant sample volume (eg 500mL) from the stream every time a predetermined volume of flow (eg 10ML) passes the sampling point (Nicholson and Clark 1992). The samples are delivered to a single composite container.

At intervals (that do not have to be regular intervals) a site visit is made and a portion of the water in the composite container is taken for analysis and the container emptied. The concentrations of any determinant in the analysed sample are the average concentrations over the time interval between site visits. The total flow over this period is recorded in the data logger. Thus, the total volume of any determinant passing the sampling point over that time period is the product of the total flow volume and the concentration of the determinant in the composite container.

The mathematical concept of composite sampling is as follows. The load of a water quality determinant is the integration of the two continuously varying records of determinant concentration and of flow rate, i.e.

$$\text{Load} = \int (c * q) \, dt$$ where c is the concentration and q is the flow rate.

The flow rate is measured on a continuous basis and recorded by the data logger. However, a method for continuously measuring concentration of determinants is not available. In a composite sampler, a discrete water quality sampling method is used as described above. The more often a sample is taken, the closer the method becomes to continuous measurement and the higher the accuracy of the load calculation. In practice the accuracy asymptotes to an upper limit so that the sampling interval is set with this in mind.

The advantage of composite sampling over grab sampling for calculating pollutant loads is that the full variation of determinant concentrations at all flow levels is captured. This permits a more accurate determination of determinant loads. The accuracy depends on correct calibration of the flow-measuring instrument over the full range of flow levels (ie the accuracy of the flow rating curve). The accuracy of load calculations is also affected by possible chemical changes of the determinants in the composite container over the time interval between site visits. This phenomenon was noted in Nicholson and Clark (1992).

Further details of composite sampling and an appraisal of the method can be found in Nicholson and Clark (1992).

Sample Sites

Composite data from seventeen sample sites was available. In addition, use was made of the data from the grab-sampling program in First Creek. The monitoring sites are listed in Table M1 and their locations within the study areas are shown on Figure M1.

Composite flow and concentration data for eight of the sites (Scott, Echunga, Lenswood, Aldgate, Cox, Kersbrook, Millbrook intake and Houlgrave) was obtained from Water Data Services in an Excel spreadsheet. This data was analysed as described in a following section.

The grab sampling data for First Creek was extracted from EDMS (Environmental Data Management System). This was analysed as described in a following section.

Composite sampling data for Sixth Creek and the catchments within the Patawalonga catchment were analysed by the AWQC (Australian Water Quality Center). The final load figures given in the draft reports for the Torrens and Patawalonga Water catchment Management Boards (Schultz and Thomas 1999 draft; Schultz et al 1999 draft) were utilised in this study. These figures are summarised in a following section.

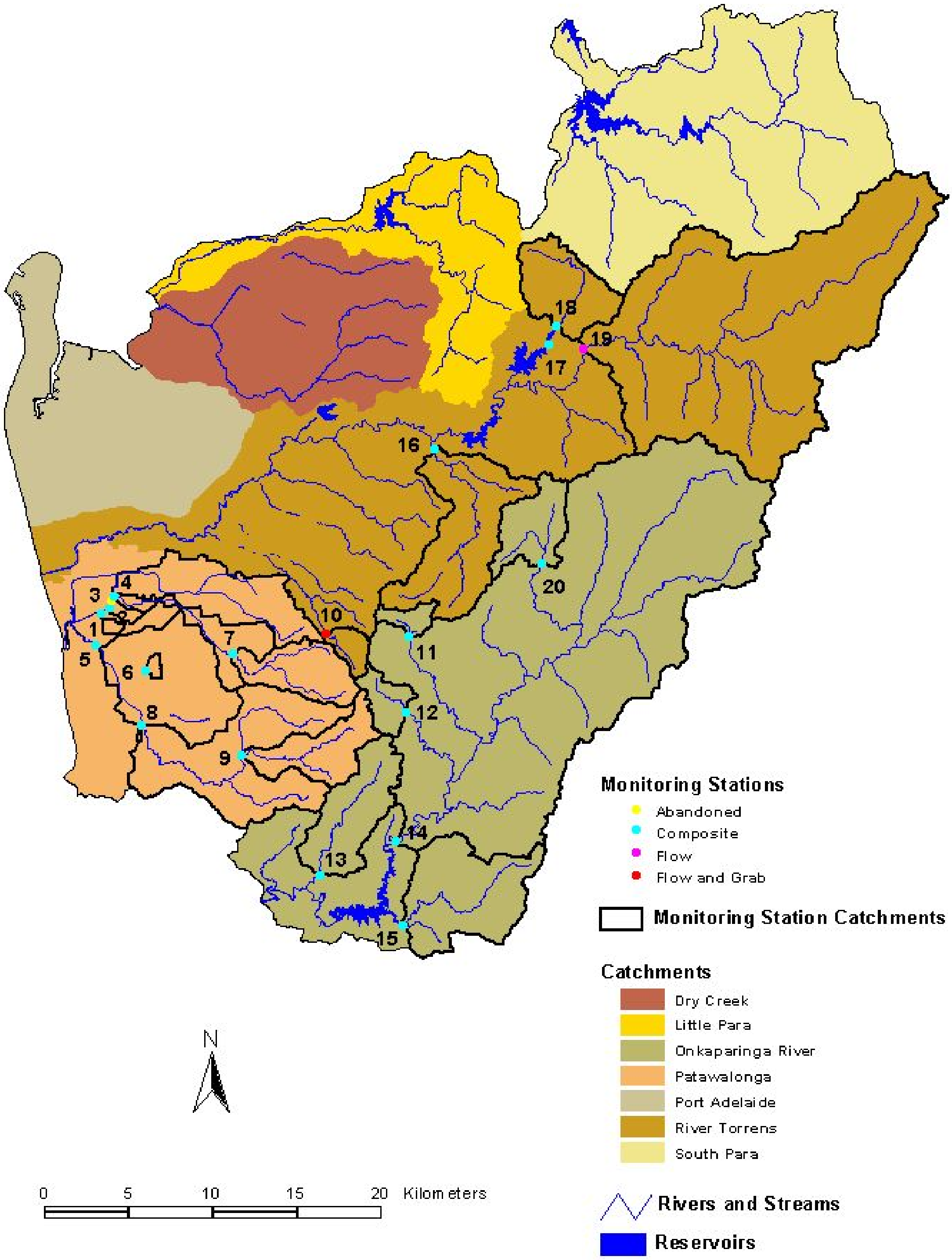


Figure M1. Monitoring Stations and Catchments

Table M1. Monitoring Stations from which data was utilised in this project.

Map Ref	Station	Location	Type of Sampling	Catchment Area (ha)	Period of Record
13	AW503502	SCOTT CREEK at Scott Bottom	Composite	2650	1989-98
14	AW503504	ONKAPARINGA RIVER at Houlgrave Weir	Composite	32090	1989-98
15	AW503506	ECHUNGA CK u/s Mt Bold Reservoir	Composite	3403	1989-98
20	AW503507	LENSWOOD CREEK at Lenswood	Composite	1679	1995-98
12	AW503509	ALDGATE CK at Railway Station	Composite	763	1995-98
11	AW503526	COX CREEK at Uraidla	Composite	312	1995-98
19	AW504500	TORRENS RIVER at Gumeracha Weir	Flow	16736	
17	AW504508	MILLBROOK RES INTAKE CHANNEL	Composite	16736	1993-98
10	AW504517	FIRST CREEK at Waterfall Gully	Flow and Grab	489	1977-82
9	AW504518	STURT RIVER u/s Minno Ck Junction	Composite	1940	1995-98
16	AW504523	SIXTH CREEK at Castambul	Composite	4382	1997-98
18	AW504525	KERSBROOK CK u/s Millbrook Res.	Composite	2286	1993-98
5	AW504549	STURT RIVER d/s Anzac Hwy	Composite	11491	1995-98
3	AW504575	BROWNHILL CREEK at Adelaide Airport	Abandoned	3193	1995-97
8	AW504576	STURT RIVER d/s Sturt Rd at Mitchell Park	Composite	7413	1995-98
4	AW504580	BROWNHILL CREEK u/s Keswick Creek	Composite	3193	1997-98
1	AW504581	MORPHETT ROAD PIPE at Transfer Station	Composite	93	1997-98
6	AW504582	ADELAIDE TCE PIPE d/s West St	Composite	103	1997-98
2	AW504583	BROWNHILL CREEK Adelaide Airport (Morphett Road)	Composite	6410	1997-98
7	AW504901	BROWNHILL CREEK at Scotch College	Composite	1866	1998

Note: Station 504575 was abandoned in mid 1997 and replaced with station 504583

Analysis of Grab Sampling Data (for First Creek)

The source data for nutrient concentrations in First Creek were extracted from EDMS. Flow data was extracted from HYDSYS. The data was analysed in a spreadsheet file (FirstCreekData.xls).

The determinant data as extracted from EDMS contained results on several determinants. All those other than NOX (oxides of nitrogen), TKN (total Kjeldahl or organic nitrogen) and TP (total phosphorus) were deleted. For each of the periods between grab samples, the total flows were obtained from HYDSYS and entered into the spreadsheet.

For each time period the TP load was calculated as the product of flow and TP concentration, and the TN load was calculated as the product of flow and the sum of NOX concentration and TKN concentration, i.e.

TP_Load (kg) = Flow (ML) * TP_concentration (mg/L)
TN_Load (kg) = Flow (ML) * {NOX_concentration (mg/L) + TKN_concentration (mg/L)}

This method of calculating nutrient loads assumed that the nutrient concentration was constant over the time period between grab samples. For most catchments in the Mount Lofty Ranges, stream flow is highly variable with a base flow (that varies over the seasons) and a series of flow pulses related to rainfall events within the catchment. The nutrient concentration has been shown to vary over each event's hydrograph with the largest concentration occurring during the rising edge of the hydrograph (Clark and Crawley 1987; Wong *et al* 1999). Grab samples taken over a short period of record (say a few years) are likely to be taken more often between flow pulses and so will not encompass many of the higher nutrient concentrations in the leading edges of the hydrographs. The method of estimating nutrient loads from sampling data is therefore likely to under estimate nutrient loads.

Time constrains prevented an investigation into other methods of estimating loads from grab sampling data (eg as in Clark and Crawley 1987; Clark 1988). This should be undertaken as part of further work.

The nutrient concentration data from grab samples were taken at irregular intervals over the period January 1975 to December 1998. There were many instances of long periods without any recorded nutrient data. In many years only a few samples were taken. Even allowing for long periods in the drier part of the year when there is likely to be no flow, it was considered that in many of these years there were too few samples to give a good representation of nutrient concentration. There were many years (1984 – 1995) when very samples were recorded at all. There were many flow records missing and for the first two years of record, the flow monitoring equipment was not in service. The result was that there was only seven years with sufficient data with which to calculate an annual load.

The work sheets are given in Appendix 1. The annual flows and nutrient loads are given in Table M1.2. The relationships between annual flow and annual nutrient loads are graphed in Figure M2. There is a strong ($r^2 = 0.9$) linear correlation between annual total nitrogen load and annual flow. The correlation between annual total phosphorus load and flow is not strong ($r^2 = 0.1$) due to the outlier for 1979. The reasons for this outlier were not investigated due to time constraints. The correlation improves considerable ($r^2 = 0.88$) when the outlier is omitted (Figure M2).

Table M1.2. Annual Flows and Annual Nutrient Loads for First Creek (Waterfall Gully, GS504517).

Year	Annual Flow Flow (ML)	Annual Load TN (kg)	Annual Load TP (kg)
1977	405	140.21	14.82
1978	994	337.69	19.80
1979	1679	628.11	51.96
1980	689	327.48	22.70
1981	2128	579.66	10.93
1982	385	101.15	8.15
1997	418	127.74	3.80
Mean	957	320	19
Median	689	327	15
SD	694	216	16

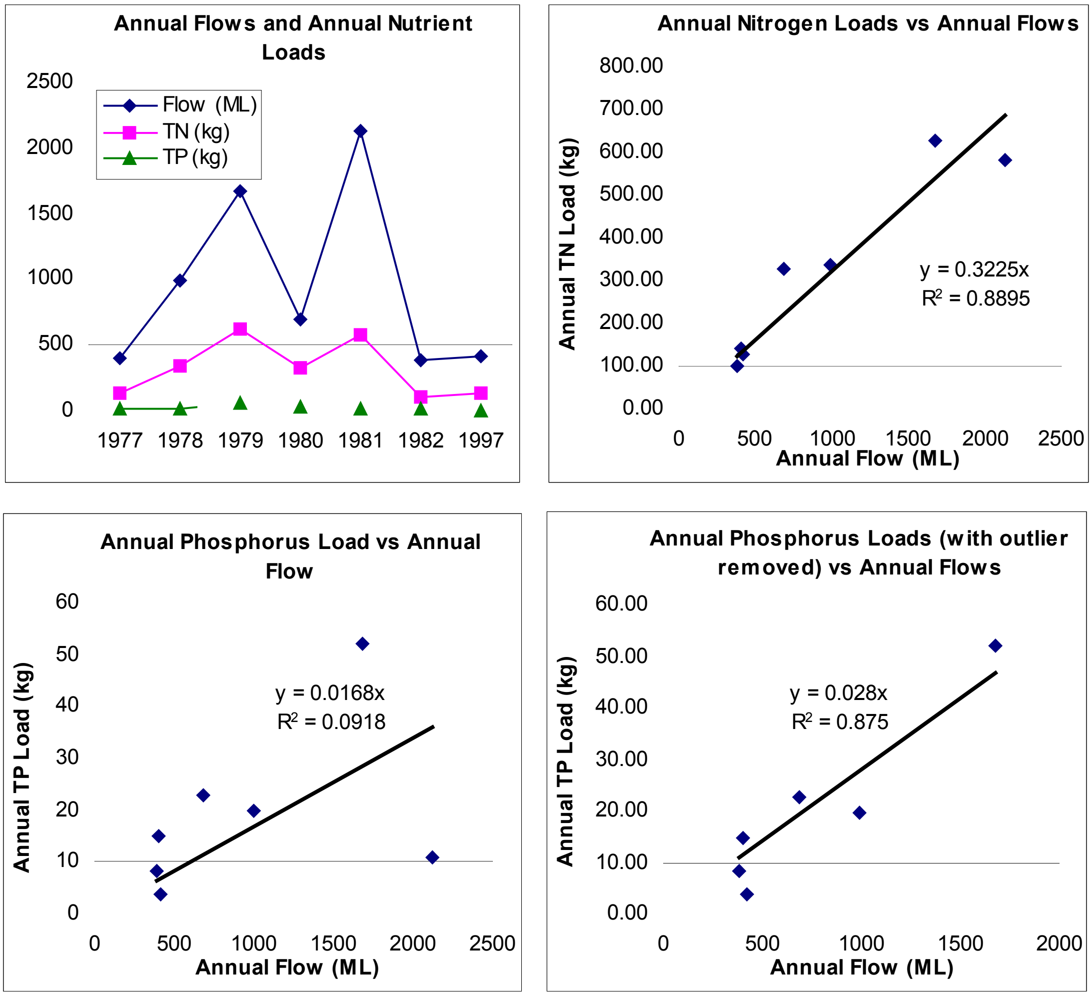


Figure M2. Relationships between Annual Flows and Annual Nutrient Loads for First Creek (Waterfall Gully, GS504517).

Analysis of Composite Sampling Data (without pumped flows)

The source data was obtained from the Water Information Unit (EPA) as a spreadsheet file (nbsres.xls). This data was copied into a working file (NP-Loads.xls). Data for the period 27/11/96 to 26/11/97 was missing for all stations. This missing data was extracted from a spreadsheet file (nbs.xls) obtained later from Water Data Services. This extracted data was grafted into the partly processed data in the working file.

The monitoring data contained the total stream flow for the period between site visits and the concentration of a range of determinants from the composite container. In order to save time for this project, all determinant data was deleted other than data for NOX, TKN and TP. The analysis derived the total loads of TN and TP for each year for which there was a complete record. The period of record varied from four to ten years. Before any analysis was carried out, the following corrections to the data and patches to missing records were made:

- There were many lines of record that were repeated for the same date range. These were deleted.

- There was a very small number of missing nutrient concentration records. These were estimated by averaging the records before and after the missing records. Due to the very low number of missing nutrient records any errors introduced by the estimates were considered to be insignificant.

- There were many periods for which the composite nutrient concentration was not available and a grab sample concentration was given in the data. The grab sample reading was used in the analysis in lieu of a composite reading as these were, generally, very similar to the composite readings of adjacent periods.

- Some nutrient concentrations were given as less than a given figure (the detection limit of the sample analysis). These were replaced with a value of half of the given value.

- There was a very small number of missing flow records. The total flows for the missing periods were obtained from HYDSYS. Many of these HYDSYS records contained estimates. However, due to the very low number of missing flow records any errors introduced by the estimates were considered to be insignificant.

- The period between site visits spanned the change of calendar year for most records. Therefore, the first composite data for a new year contained a component of flow from the end of the previous year. The total of all the composite flow records for each year were compared with the total flows obtained from HYDSYS. If the two figures agreed closely (most did agree to within a few ML) no corrections were made and no significant errors would result. In a few cases there was significant flow over the new year period (usually pumped flows). In these cases, a correction to the flows was made to the last period of the preceding year and the first period of the new year, such that the total of the composite flows for both years matched the total yearly flows obtained from HYDSYS.

Once the corrections and patches had been made the nutrient loads where calculated as follows. For each time period (the period between site visits) the TP load was calculated as the product of flow and TP concentration, and the TN load was calculated as the product of flow and the sum of NOX concentration and TKN concentration, i.e.

TP_Load (kg) = Flow (ML) * TP_concentration (mg/L)
TN_Load (kg) = Flow (ML) * {NOX_concentration (mg/L) + TKN_concentration (mg/L)}

The flows and nutrient loads for each period were summed for each calendar year and statistics (e.g. mean, median and SD) were then calculated from the annual figures.

Although no attempt was made to quantify errors, the method used to calculate the annual nutrient loads from the composite data were considered to not introduce significant errors. Errors could be present due to calibration of the flow rating curve, in chemical changes of determinants in the composite container (see the section on composite sampling) and in the tests used to measure determinant concentrations.

The work sheets are given in Appendix 2 (which also includes the analysis for Houlgrave Weir station described in a following section). The annual flows and calculated nutrient loads are shown in Table 1.3. The relationships between annual flows and annual nutrient loads are graphed in Figures M3a and M3b.

Table M1.3. Annual Flows and Annual Nutrient Loads Calculated from Composite Monitoring Data.

AW503502 Scott Creek at Scott Bottom			
Year	Flow (ML)	TN (kg)	TP (kg)
1989	4074	3389	219
1990	2463	1933	97
1991	3953	3404	291
1992	7475	7385	1902
1993	2158	1598	133
1994	1216	677	75
1995	4599	5450	542
1996	5070	9198	981
1997	1940	2467	214
1998	2467	2624	229
Mean	3542	3812	469
Median	3210	3007	224
SD	1873	2714	572

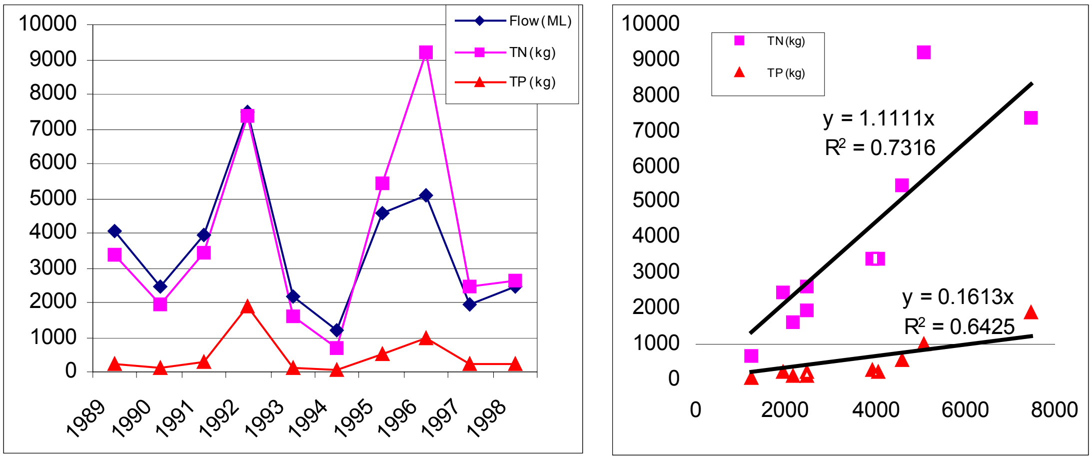
AW503506 Echunga Creek upstream of Mt Bold Reservoir			
Year	Flow (ML)	TN (kg)	TP (kg)
1989	3541	4787	565
1990	2635	3161	161
1991	2469	4242	411
1992	9081	16216	2569
1993	1483	1527	127
1994	622	625	57
1995	5118	10618	1678
1996	5765	15845	2321
1997	1275	3004	322
1998	1639	2927	347
Mean	3363	6295	856
Median	2552	3701	379
SD	2609	5790	956

AW503507 Lenswood Creek, Lenswood			
Year	Flow (ML)	TN (kg)	TP (kg)
1995	4336	10012	740
1996	6069	10286	709
1997	1187	2746	135
1998	1805	4281	314
Mean	3349	6831	474
Median	3070	7146	512
SD	2268	3884	298

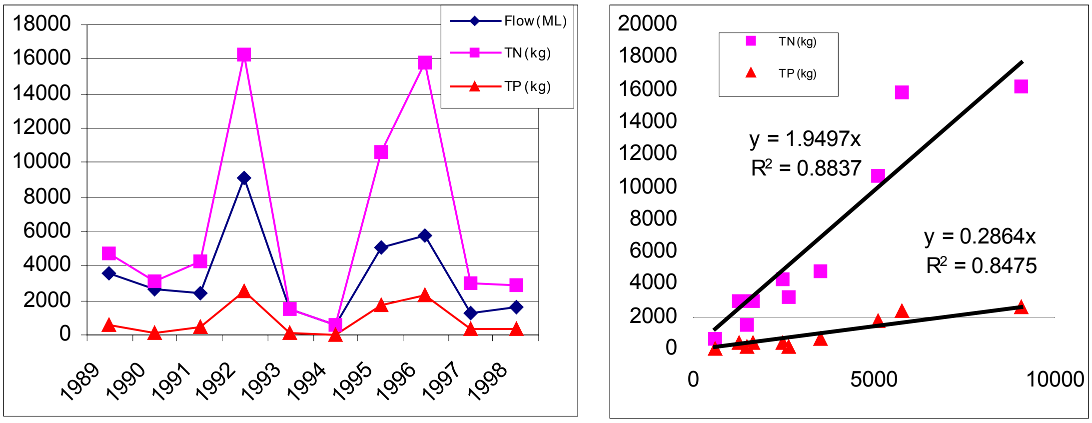
AW503509 Aldgate Creek near Railway Station			
Year	Flow (ML)	TN (kg)	TP (kg)
1995	2361	3520	343
1996	2924	4491	555
1997	1242	1906	215
1998	1446	1857	209
Mean	1993	2943	331
Median	1904	2713	279
SD	789	1289	162

AW503526 Cox Creek, Uraidla			
Year	Flow (ML)	TN (kg)	TP (kg)
1995	1457	9559	1715
1996	1913	10718	2273
1997	807	5569	943
1998	999	7729	1378
Mean	1294	8394	1577
Median	1228	8644	1547
SD	495	2250	561

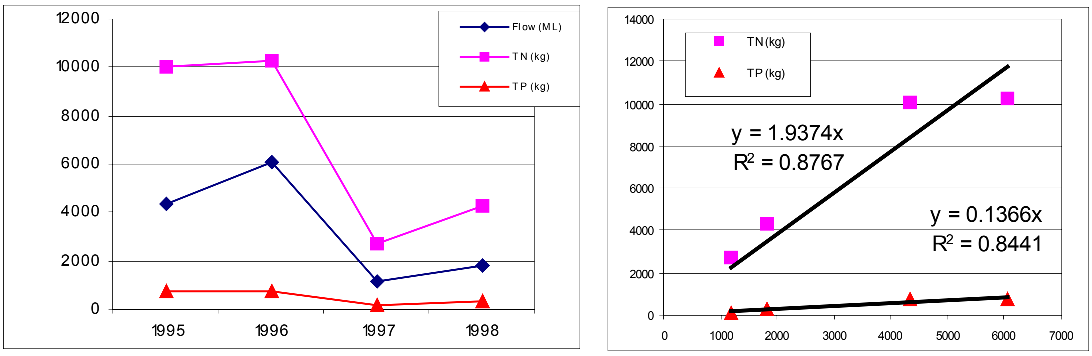
AW504525 Kersbrook Creek upstream of Milbrook Reservoir			
Year	Flow (ML)	TN (kg)	TP (kg)
1993	927	1388	59
1994	278	620	18
1995	2896	6851	491
1996	4595	9072	548
1997	627	1548	99
1998	1401	2464	192
Mean	1787	3657	234
Median	1164	2006	145
SD	1651	3457	229



AW503502 Scott Creek at Scott Bottom

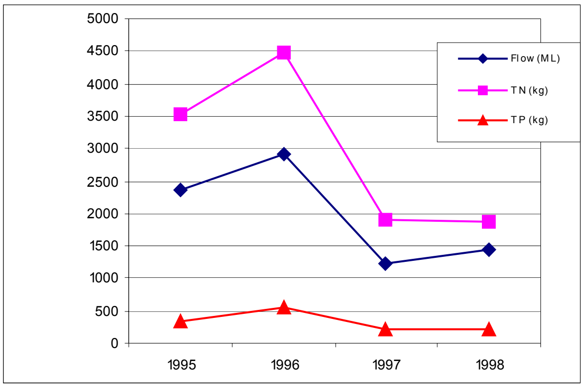


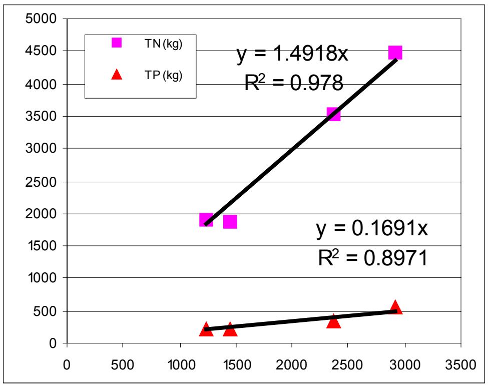
AW503506 Echunga Creek upstream of Mt Bold Reservoir



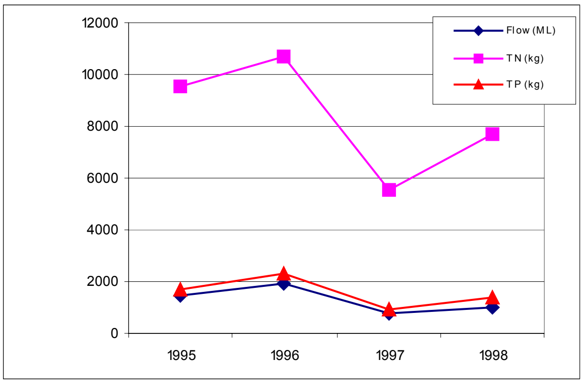
AW503507 Lenswood Creek, Lenswood

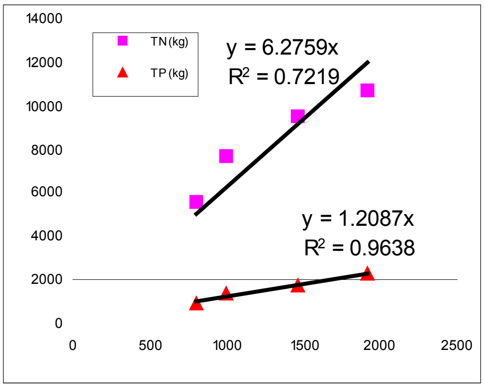
Figure M3a. Relationships between Annual Flows and Annual Nutrient Loads.



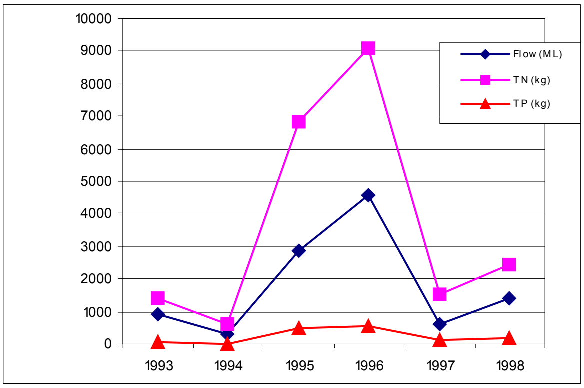


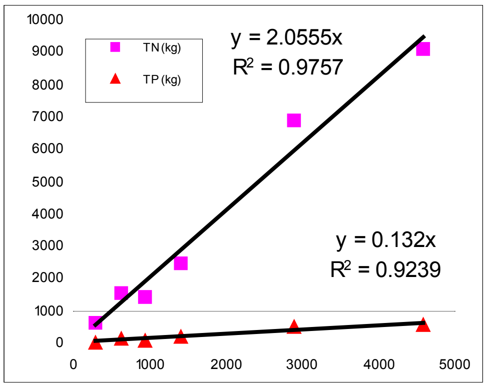
AW503509 Aldgate Creek near Railway Station





AW503526 Cox Creek, Uraidla





AW504525 Kersbrook Creek upstream of Milbrook Reservoir

Figure M3b. Relationships between Annual Flows and Annual Nutrient Loads.

There is generally a strong linear correlation ($r^2 = 0.64$ to 0.98) between annual nutrient loads and annual flow. There is a large variation between the catchments in nutrient output per unit flow. The relationship (i.e. the coefficient of the trendline) between total nitrogen load and flow ranges from 1.11 (kg of nutrient/ML of flow) for Scott Creek (with mostly grazing and native vegetation landuses) to 6.28 for Cox Creek (with mostly intensive horticulture landuses). The relationship between total phosphorus load and flow ranges from 0.13 for Kersbrook Creek (with a similar value for Lenswood Creek, both with predominantly grazing landuses) and 1.21 for Cox Creek. These differences are assumed to be mainly due to the variations in landuse within the catchments.

Additional Analysis of Sampling Data with Pumped Flows

The data for Houlgrave (Onkaparinga River) and Millbrook Intake (River Torrens) contained pumped flows (water pumped from the River Murray to supplement natural runoff). The initial analysis of this data (to calculate annual nutrient loads) was identical to that for the other composite data described in the preceding section. Additional work was required to allow for the nutrient loads in the pumped flows, and in the case of Millbrook Intake, to allow for overtopping of Gumeracha Weir.

Nutrient Loads in Water Pumped from the River Murray

Data for nutrient concentrations at sampling stations close to the pump intakes at Mannum and Murray Bridge were obtained from EDMS. Generally, nutrient concentrations were taken monthly at both sites. Monthly pumping volumes up to 1996 were obtained from spreadsheet files held by the Water Monitoring Unit (EPA). Monthly pumping volumes for 1997 and 1998 were obtained from SAWater.

The data were entered into a spreadsheet file (PumpedWaterN&Ploads.xls). The dates for the nutrient concentration samples (taken generally on a monthly basis) were aligned by manual manipulation with the appropriate months in the data for the pumped flows. There were a small number of months for which nutrient concentrations were not available. These were estimated by taking the mean of the values for the preceding and following months.

Nutrient concentration data was not available for 1998. For this missing data the mean values of all nutrient concentrations for all previous readings (1988 – 1997) were substituted. For the Onkaparinga River there was very little water pumped from Murray Bridge in this year so this substitution of mean nutrient concentrations would not cause significant error. The calculated nutrient loads for the River Torrens were not used as described later.

The nutrient loads in the pumped water were calculated by multiplying the monthly pumped volumes by the nutrient concentrations for the corresponding months, and summing the monthly nutrient loads for each calendar year.

This method of calculating nutrient loads in pumped water assumes that the monthly nutrient concentration represents the mean nutrient concentrations over the whole month. As flow in the River Murray is not subject to wide variations in short time periods as with the Mount Lofty Ranges Catchments, the use of monthly grab samples does not suffer from the same deficiencies. An informal examination of the nutrient concentrations showed that there were consistent seasonal variations. This justified the use of a monthly load calculation. The month to month variations for total nitrogen were generally less than 10%, sometimes up to 20%. The month to month variations in total phosphorus concentrations were in many instances much larger. The errors likely to be introduced by these variations were not quantified in this study due to time constraints. However, the resultant nutrient load figures for the River Torrens were not used, and those for the Onkaparinga River were not critical to this project.

The work sheets are given in Appendix 3 and the annual pumped flows and nutrient loads are tabulated in Table M2.

Table M2. Annual Volumes of, and Nutrient Loads in, Water Pumped from the River Murray.

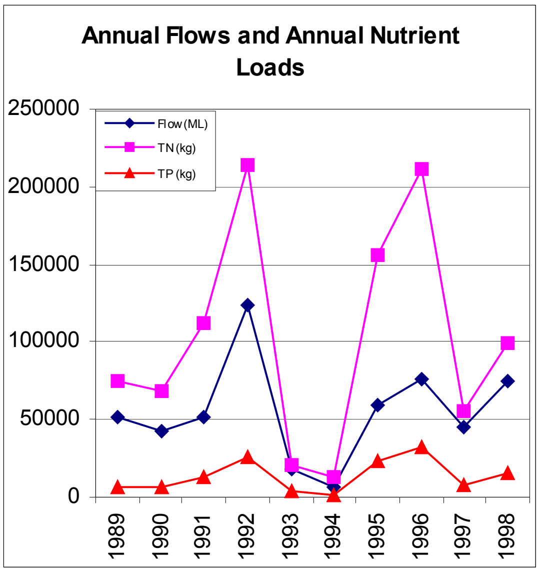
Year	Mannum to Millbrook			Murray Bridge to Mt Bold		
	Pumped ML	TN ann kg	TP ann kg	Pumped ML	TN ann kg	TP ann kg
1988	2796	2298	231	13224	13972	2364
1989	1695	1622	290	12100	10029	1805
1990	15936	15198	2283	26388	27739	4793
1991	29369	29271	3615	33481	32681	3950
1992	5041	5009	519	8093	6187	901
1993	20508	19950	3004	19656	22101	3119
1994	22895	14630	1562	71977	40507	5312
1995	18655	10877	1261	23484	12095	1733
1996	4058	2847	314	18991	13895	1815
1997	30454	24930	4836	9281	8500	1090
1998	29171	25670	3792	31	27	4
Mean	16416	13846	1973	21519	17067	2444
Median	18655	14630	1562	18991	13895	1815
SD	11295	10154	1636	19172	12282	1672

Houlgrave (Onkaparinga River)

The annual flows and annual nutrient loads were calculated from the composite sampling data as described for the other composite sampled catchments in a previous section. These calculated figures included pumping flows. Therefore, the annual pumping volumes and nutrient loads, calculated as described above, were subtracted from the figures calculated from the composite data. The result is the yield and nutrient loads resulting from natural runoff within the catchment. The calculations are shown as part of Appendix 2 and the results are shown in Figure M2.2. The relationships between annual flows and annual nutrient loads are graphed in Figure M4.

Table M2.2. Annual Flows, Annual Nutrient Loads, Pumped Flows and Pumped Nutrient Loads for the Onkaparinga River Catchment to Houlgrave Weir.

	Monitoring Data			River Murray Pumping			Catchment Yield		
Year	Annual Flow ML	Annual Load TN (kg)	Annual Load TP (kg)	Volume Pumped ML	Annual Load TN (kg)	Annual Load TP (kg)	Annual Yield Flow (ML)	Annual Load TN (kg)	Annual Load TP (kg)
1989	63019	84260	8226	12100	10029	1805	50919	74231	6421
1990	68982	95542	11077	26388	27739	4793	42594	67803	6284
1991	84484	145162	17131	33481	32681	3950	51003	112481	13181
1992	131706	220509	26768	8093	6187	901	123613	214322	25867
1993	37558	43144	6517	19656	22101	3119	17902	21043	3398
1994	77873	53893	6501	71977	40507	5312	5896	13385	1189
1995	83350	168116	25265	23484	12095	1733	59866	156022	23531
1996	95413	224610	33526	18991	13895	1815	76422	210715	31711
1997	53945	64281	8253	9281	8500	1090	44664	55781	7163
1998	74789	98893	15925	31	27	4	74758	98866	15921
						Mean	54764	102465	13467
						Median	50961	86548	10172
						SD	32763	71457	10473



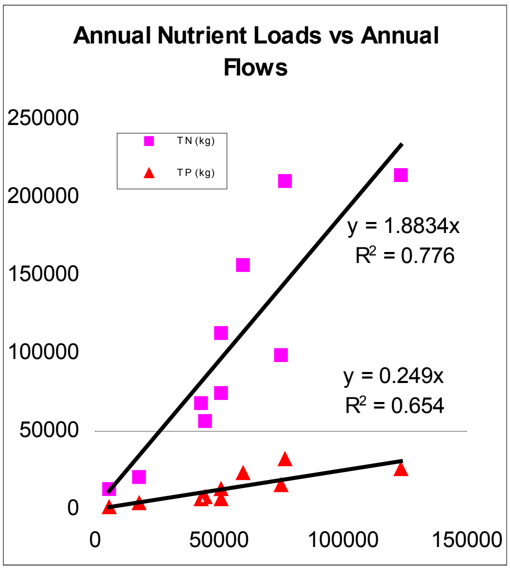


Figure M4. Relationships between Annual Flows and Annual Nutrient Loads for the Onkaparinga River Catchment to Houlgrave Weir.

This method of calculating catchment yield and nutrient loads assumes that all the volume pumped from the River Murray is discharged into the Onkaparinga River and ignores the losses as the pumped flows pass along the river channel.

An analysis of the pumped losses was undertaken as shown in the worksheets in Appendix 4. The pumped losses were calculated by subtracting the gauged flows from the pumped volumes on a monthly basis for months in which there was zero flow in adjacent catchments. The use of zero flow in adjacent catchments was used to indicate whether there was likely to be any natural flow in the Onkaparinga River. However, the resulting loss figures varied considerably, with many being negative, which could indicate some natural flow. Even if the negative values were ignored, the remaining figures had a large variation (0.5% to 26.1%). It was considered prudent to not use a loss adjustment at this stage. The reason for the variation was not investigated.

Millbrook Intake (River Torrens)

The annual flows and annual nutrient loads were calculated from the composite sampling data as described for the other composite sampled catchments in a previous section. As was the case for the Onkaparinga data, these flows contain pumping flows that needed to be subtracted. In addition, there was an extra complication as the monitoring station at Millbrook Intake is off-stream as shown in the simplified schematic of the River Torrens waster supply system in Figure M5.

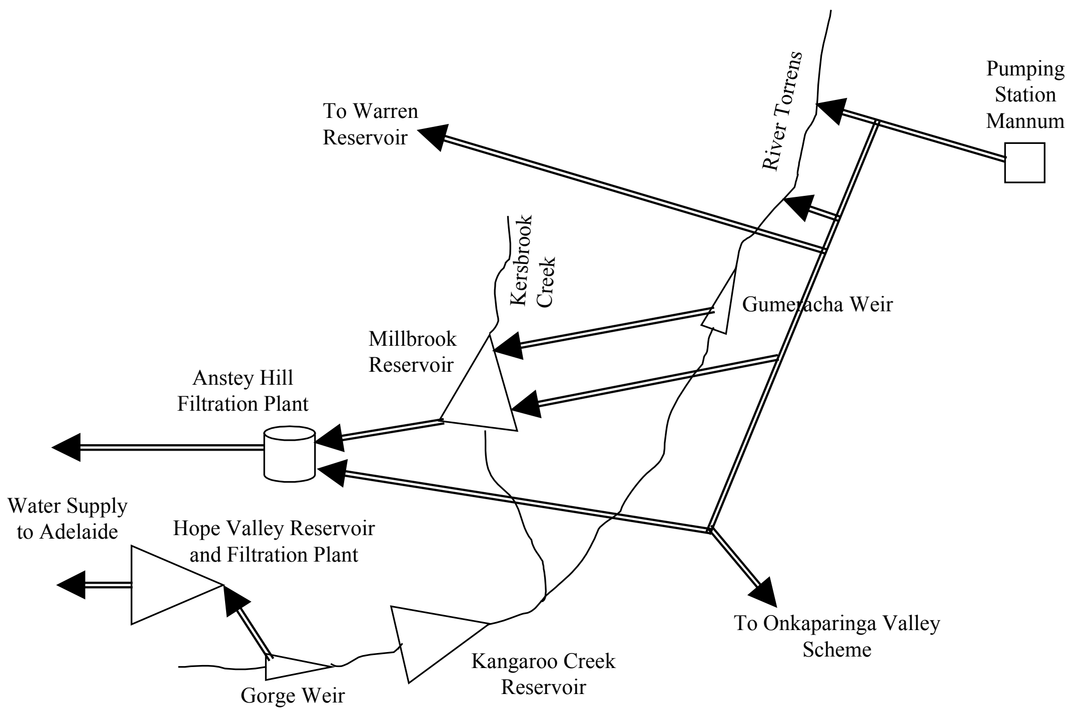


Figure M5. Simplified Schematic of the River Torrens Water Supply System.

The intention was to calculate the natural yield and nutrient loads for the River Torrens catchment at Gumeracha Weir. The monitoring station is at the end of the pipe running from Gumeracha Weir to the intake at Millbrook Reservoir. In some months, however, the flow in the River Torrens is high and runs over the Gumeracha Weir and so bypasses the monitoring station. The overflow of Gumeracha Weir is recorded but is not sampled for determinants. It was assumed that the nutrient concentration in water in the pipe was the same as the nutrient concentration in the water overflowing Gumeracha Weir. Therefore, to allow for overflow of Gumeracha Weir, the nutrient loads were multiplied by the ratio of the sum of the overflow and flow at Millbrook Intake to the flow at Millbrook Intake, i.e.:

NL' = NL * (Flow_Millbrook_Intake + Flow_Gum_Weir) / Flow_Millbrook_Intake

Where NL = Nutrient Load calculated from composite data at Milllbrook Intake;
NL' = Nutrient Load corrected for overflow of Gumeracha Weir

The above calculations were performed for each sampling period. The overflows of Gumeracha Weir were obtained from HYSYS. The worksheets are given in Appendix 5.

The next step was to subtract the flows and nutrient loads present in the pumping flows from the corrected flows and nutrient loads on an annual basis. The results are shown in Table M3 below.

Table M3. Annual Flows and Nutrient Loads for River Torrens Catchment at Gumeracha Weir.
The monitoring data is for Millbrook Intake corrected for overflow of Gumeracha Weir.

	Monitoring Data			River Murray Pumping			Catchment Yield		
Year	Annual Flow ML	Annual Load TN (kg)	Annual Load TP (kg)	Volume Pumped ML	Annual Load TN (kg)	Annual Load TP (kg)	Annual Flow (ML)	Annual Load TN (kg)	Annual Load TP (kg)
1993	17168	21582	2884	20508	19950	3004	-3340	1632	-119
1994	32664	22429	3256	22895	14630	1562	9769	7799	1694
1995	45415	83703	8815	18655	10877	1261	26760	72826	7555
1996	47852	100901	9235	4058	2847	314	43794	98055	8921
1997	26431	30437	4147	30454	24930	4836	-4023	5508	-689
1998	20940	28270	5715	29171	25670	3792	-8231	2599	1922

The negative figures result due to the incorrect assumption that all the pumping volumes are discharged into the River Torrens. This is not the case as the pumped water can be directed to several other end points as shown in Figure M5. The water discharged into the River Torrens is not directly gauged. To derive the volumes discharged into the River Torrens requires a water supply balance model of the whole River Torrens supply system. A water supply model does exist but has not been adapted to derived discharges into the River Torrens. This aspect could not be investigated further in this study due to time constraints.

An analysis of the pumped losses was undertaken as shown in the worksheets in Appendix 6. Due to uncertainties in the destination of the water pumped from the River Murray, the estimation of pumping losses in the river channel could not be pursued further.

Due to the foregoing problems the figures derived for the River Torrens at Gumeracha Weir were not used in this study.

AWQC Sampling Data

Data from composite sites that had been analysed by the Australian Water Quality Centre was available in two draft reports (Schultz and Thomas 1999 draft; Schultz et al 1999 draft) prepared for the Torrens and Patawalonga Catchment Water Management Boards. Nine of these sites were in the Patawalonga Catchment and another site was at Sixth Creek in the Torrens Catchment. The ten sites are listed in Table M4 together with the mean flows and nutrient loads as extracted from these reports.

Gauging station 504575 (Brownhill Creek at Adelaide Airport) was abandoned in mid 1997 and replaced by GS 504583 slightly further downstream (Schultz and Thomas 1999 draft). Data from the two stations was combined for the analysis (Schultz and Thomas 1999 draft).

Table M4. Mean Annual Flows and Nutrient Loads derived by the AWQC.

Station	Location	Flow (ML)	TN (kg/y)	TP (kg/y)	Period of Record
AW504518	Sturt River upstream of Minno Creek junction	2400	7100	2700	1995-98
AW504523	Sixth Creek at Castambul	7690	12000	1200	1997-98
AW504549	Sturt River downstream of Anzac Highway	11600	17100	3400	1995-98
AW504576	Sturt River downstream of Sturt Road	5100	9800	2400	1995-98
AW504580 & AW504575	Brownhill Creek upstream of Keswick Creek (Adelaide Airport)	1300	3500	500	1997-98
AW504581	Morphett Road Pipe at Transfer Station (North Plympton)	110	500	100	1997-98
AW504582	Adelaide Terrace Pipe downstream of West Street (Edwardstown)	100	200	50	1997-98
AW504583	Brownhill Creek at Adelaide Airport	4000	8200	1300	1997-98
AW504901	Brownhill Creek at Scotch College	580	1200	100	1998

Climate Correction Factor

The composite monitoring program is relatively new in South Australia. As a consequence the period of record of monitoring data for the majority of the monitoring stations covers only a few years. For these short periods it was not possible to be certain that the data represents the true long-term situation. In particular, it was noted that some stations had a record covering only the two years 1997 and 1998. Both of these years had well below average flows in many catchments as determined from flows recorded for a much longer period in HYDSYS. The nutrient loads calculated for these stations were likely to be below the true average loads for those catchments.

In order to correct for this, a climate correction factor was derived. Time constraints necessitated that the method used was simple and quick to implement. Eight catchments were chosen that covered the geographic extent of the study area and that had a reasonably long flow record. The annual flows for these catchments were extracted from HYDSYS and placed into a spreadsheet (AnnFlows.xls). The annual flows are shown in Table M5.

The means of the annual flows were then calculated for each catchment and shown in Table M5. These were used to normalise the annual flows by dividing each annual flow by the mean. With normalised flows it is possible to compare catchments that produce different volumes of runoff due to different catchment areas and/or different runoff coefficients. The results are shown in Table M6.

The mean of the normalised annual flows were then calculated for each year. These were referred to as annual climate correction factors. These are shown in Table M6 and graphically in Figure M6.

The annual climate correction factors were used to derive a mean climate correction factor for each of the monitoring stations (for the period for which there was a composite sampler operating) by calculating the mean of the annual climate correction factors for the period of record for each station. For example, GS 504576 (Sturt River downstream Sturt Road) had a period of record covering 1995 to 1998. The annual climate correction factors for these years were 1.18, 1.41, 0.44 and 0.45 respectively. The mean climate correct factor for this station became 0.87, which was the mean of the annual climate correction factors.

The mean climate correction factor for each station is given in Table M7, together with the nutrient loads determined from monitoring data and the nutrient loads with the mean climate correction factor applied. The climate-corrected nutrient loads were used to validate the nutrient load model.

As mentioned previously, the use of a simple climate correction factor was due to time constraints. It is recommended as part of refinement work that climate corrections are applied annually and based on nearby catchments whose flow correlates strongly with the subject catchment.

Table M5. Annual Flows for Gauging Stations used to derive the Climate Correction Factor.

Year	Aldgate	Cox	Echunga	First	Lenswood	Scott	Sturt	Sixth
1970						4751		
1971						8737		
1972					3001	3100		
1973	3201				5981	5579		
1974	3277				9383	4654		
1975	3212		3948		5698	4103		
1976	1503	849	1613		1890	1509		
1977	1232	885	894	398	1699	1212		
1978	2076	1326	2658	1039	2952	1442	1740	5928
1979	4052	2210	4604	1652	5331	3983	3594	11069
1980	2539	1406	1443	846	2718	1971	1976	5969
1981	4680	2377	8667	1949	8097	6125	5227	14761
1982	1052	740	357	374	709	619	963	3640
1983	2523	1502	2554	1277	3679	2613	2622	8403
1984	2191	1361	3484	1069	3218	3769	2865	7150
1985	1836	1182	2226		2243	2808	3090	6663
1986	3377	2077	4831	1462	4801	6156	4627	11691
1987	3234	1977	5660	1338	5521	5724	3787	12876
1988	2410	1409	3804	847	3984	3208	2497	8182
1989	2637	1491	3416	956	3786	4048	2856	9049
1990	2037	1241	2644	792	3168	2505	2152	7656
1991	2596	1616	2470		4038	3914	2610	9185
1992	5910	3796	9082		9193	7623	4770	21565
1993	856	902	1364		1331	2037	1668	5123
1994	722	659	614		850	1182	1205	3419
1995	2366	1464	5116		4335	4599	3636	10223
1996	2919	1908	5764		6069	5070	3647	13274
1997	1242		1275	415	1186	1938	1439	3720
1998	1445		1639	455	1805	2467	1757	4491
Mean	2505	1542	3339	991	3951	3705	2797	8764
Median	2467	1409	2651	956	3679	3769	2622	8182

Table M6. Normalised Annual Flows and Mean Normalised Annual Flows used to derive the Climate Correction Factor.

Year	Aldgate	Cox	Echunga	First	Lenswood	Scott	Sturt	Sixth	MEAN
1970						1.28			1.28
1971						2.36			2.36
1972					0.76	0.84			0.80
1973	1.28				1.51	1.51			1.43
1974	1.31				2.38	1.26			1.65
1975	1.28		1.18		1.44	1.11			1.25
1976	0.60	0.55	0.48		0.48	0.41			0.50
1977	0.49	0.57	0.27	0.40	0.43	0.33			0.42
1978	0.83	0.86	0.80	1.05	0.75	0.39	0.62	0.68	0.75
1979	1.62	1.43	1.38	1.67	1.35	1.08	1.29	1.26	1.38
1980	1.01	0.91	0.43	0.85	0.69	0.53	0.71	0.68	0.73
1981	1.87	1.54	2.60	1.97	2.05	1.65	1.87	1.68	1.90
1982	0.42	0.48	0.11	0.38	0.18	0.17	0.34	0.42	0.31
1983	1.01	0.97	0.77	1.29	0.93	0.71	0.94	0.96	0.95
1984	0.87	0.88	1.04	1.08	0.81	1.02	1.02	0.82	0.94
1985	0.73	0.77	0.67		0.57	0.76	1.10	0.76	0.77
1986	1.35	1.35	1.45	1.47	1.22	1.66	1.65	1.33	1.44
1987	1.29	1.28	1.70	1.35	1.40	1.54	1.35	1.47	1.42
1988	0.96	0.91	1.14	0.85	1.01	0.87	0.89	0.93	0.95
1989	1.05	0.97	1.02	0.96	0.96	1.09	1.02	1.03	1.01
1990	0.81	0.80	0.79	0.80	0.80	0.68	0.77	0.87	0.79
1991	1.04	1.05	0.74		1.02	1.06	0.93	1.05	0.98
1992	2.36	2.46	2.72		2.33	2.06	1.71	2.46	2.30
1993	0.34	0.58	0.41		0.34	0.55	0.60	0.58	0.49
1994	0.29	0.43	0.18		0.22	0.32	0.43	0.39	0.32
1995	0.94	0.95	1.53		1.10	1.24	1.30	1.17	1.18
1996	1.17	1.24	1.73		1.54	1.37	1.30	1.51	1.41
1997	0.50		0.38	0.42	0.30	0.52	0.51	0.42	0.44
1998	0.58		0.49	0.46	0.46	0.67	0.63	0.51	0.54

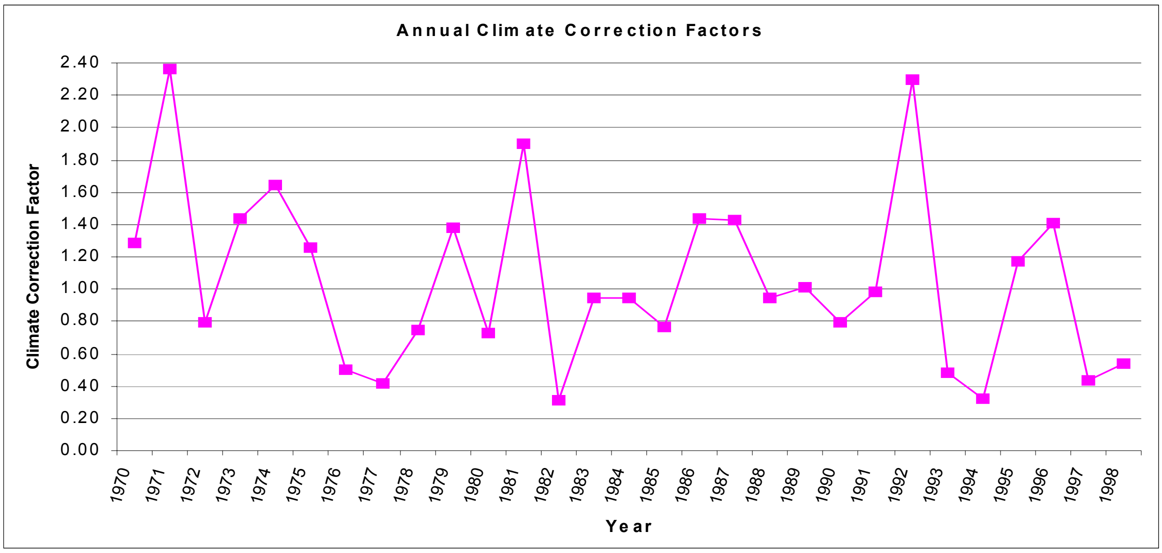


Figure M6. Annual Climate Correction Factors (mean of the normalised annual flows of eight gauged catchments).

Table M7. Mean Annual Nutrient Loads from Monitoring Data without and with the Climate Correction Factor Applied for each of the Monitoring Stations used in this study.

Station	Location	Mean Annual Nutrient Loads from Monitored Data			Mean Climate Correction Factor	Nutrient Loads with Climate Correction Factor Applied	
		kg/y TN	TP	Period of Record		kg/y TN	TP
AW503502	Scott Creek at Scott Bottom	3812	469	1989-98	0.94	4055	499
AW503504	Onkaparinga River at Houlgrave Weir	102465	13467	1989-98	0.94	109005	14327
AW503506	Echunga Creek upstream of Mt Bold Reservoir	6295	856	1989-98	0.94	6697	911
AW503507	Lenswood Creek, Lenswood	6831	474	1995-98	0.87	7675	533
AW503509	Aldgate Creek near railway station	2943	331	1995-98	0.87	3307	372
AW503526	Cox Creek, Uraidla	8394	1577	1995-98	0.87	9431	1772
AW504517	First Creek, Waterfall Gully	320	19	1977-82	0.91	352	21
AW504518	Sturt River upstream of Minno Creek junction	7100	2700	1995-98	0.87	7978	3034
AW504523	Sixth Creek at Castambul	12000	1200	1997-98	0.5	24000	2400
AW504525	Kersbrook Creek upstream of Millbrook Reservoir	3657	234	1993-98	0.73	5010	321
AW504549	Sturt River downstream of Anzac Highway	17100	3400	1995-98	0.87	19213	3820
AW504576	Sturt River downstream of Sturt Road	9800	2400	1995-98	0.87	11011	2697
AW504575 AW504580	Brownhill Creek upstream of Keswick Creek	3500	500	1997-98	0.5	7000	1000
AW504581	Morphett Road Pipe at Transfer Station (North Plympton)	500	100	1997-98	0.5	1000	200
AW504582	Adelaide Terrace Pipe downstream of West Street (Edwardstown)	200	50	1997-98	0.5	400	100
AW504583	Brownhill Creek at Adelaide Airport	8200	1300	1997-98	0.5	16400	2600
AW504901	Brownhill Creek at Scotch College	1200	100	1998	0.55	2182	182

DISCUSSION

Results for Nutrient Loads derived from the Monitoring Data

This section provides comments on the nutrient loads derived from the monitoring data. These are observations based on an informal examination of the data contained in Table N1 (percentage landuses and unit-area nutrient loads) and Table M7 (nutrient loads with climate correction factor applied – these figures are also given in Table N3).

Examination of the unit-area nutrient loads and percentage landuses given in Table N1 enables conclusions to be made on nutrient generation rates for some landuses as follows:

- The highest nutrient generation rates per catchment are from Cox Creek (TN 30.23 kg/ha/y; TP 5.68 kg/ha/y). This, it is assumed, is due to vegetable production although this landuse accounts for only 20% of the catchment.

- The next highest nutrient generation rates per catchment are from Morphett Road Pipe (TN 10.75 kg/ha/y; TP 2.15 kg/ha/y). In comparison, Adelaide Terrace Pipe is a similar catchment but with much lower nutrient generation rates (TN 3.88 kg/ha/y; TP 0.97 kh/ha/y). Both catchments are mainly urban (62%, 68% respectively), with manufacturing (9% and 15% respectively) and commerce (11% and 16% respectively). Morphett Road Pipe catchment has 10% education, 5% vacant land and 3% outdoor recreation that are not present in Adelaide Terrace Pipe catchment. This suggests that these landuses generate high nutrient loads. It is recommended as part of further work that the data for these two catchments are re-examined and that the sources of nutrients are investigated.

- Aldgate Creek generates moderate nutrient loads (TN 4.33 kg/ha/y; TP 0.49 kg/ha/y) due to urban development (61% of the catchment).

- Lenswood Creek generates moderate nutrient loads (TN 4.57 kg/ha/y; TP 0.32 kg/ha/y) due to orchards (44%) and vines (9%).

- Sixth Creek also generates moderate nutrient loads (TN 5.48 kg/ha/y; TP 0.55 kg/ha/y). Given that 50% is native vegetation, 25% is grazing and only 14% is orchard, it is assumed that the moderate nutrient loads are due to the steep nature of most of the catchment.

- The lowest nutrient generation rates are from First Creek (TN 0.72 kg/ha/y; TP 0.04 kg/ha/y). First Creek contains 90% native vegetation.

- The catchment with the next lowest nutrient generation rates is Brownhill Creek at Scotch College (TN 1.17 kg/ha/y; TP 0.10 kg/ha/y). This catchment has 36% native vegetation and 30% rural living. The later supports, in part, the decision to reduce the nutrient generation rates for rural living during the calibration stage.

- The ratio of total nitrogen to total phosphorus varies between the catchments. For First Creek (90% native vegetation) the TN/TP ration is 18:1. For Cox Creek (high nutrient loads from, it is assumed, vegetable production) the TN/TP ratio is 5.3:1. For Aldgate Creek (61% urban) the TN/TP ratio is 8.8:1. For other urban catchments the TN/TP ration is around 4:1 to 6:1. This suggests that anthropologic activities create higher total phosphorus nutrients than total nitrogen nutrients.

The examination of the monitoring data has allowed an assessment of the contribution of some sub-catchments to the nutrient loads of the catchment feeding Mount Bold Reservoir and of Sturt Creek that feeds the Patawalonga. The following figures were calculated from the values given in Table M7 using the monitored data with the climate correction factor applied (also shown in Table N3). The nutrient loads are the mean annual nutrient loads. The percentages of landuses within catchments were taken from Table N1.

- Cox Creek (a sub-catchment of Houlgrave Weir catchment) relative to the catchment of Houlgrave Weir:
  1.0% of the area; 8.7% of TN load: 12% of TP load.
  The area of Cox Creek contains 20% vegetable production, 13% vines, 9% urban and 20% grazing. The nutrient loads from this catchment are very high relative to the whole Houlgrave Weir catchment. From this result alone, any of the foregoing landuses could contribute this high nutrient generation rate. However, an informal examination of the nutrient loads from other catchments that do not contain large areas of vegetable production, suggests that the high nutrient generation rates for Cox Creek are due to vegetable production.

- Aldgate Creek (a sub-catchment of Houlgrave Weir catchment) relative to the catchment of Houlgrave Weir:
  2.4% of the area; 3.0% of TN load: 2.7% of TP load.
  The area of Aldgate Creek contains 61% urban. The nutrient loads from this catchment are 10% to 20% higher than for the whole Houlgrave Weir catchment. This suggests that urban areas contribute higher quantities of nutrients to stream pollution relative to other landuses in the Houlgrave Weir catchment.

- Lenswood Creek (a sub-catchment of Houlgrave Weir catchment) relative to the catchment of Houlgrave Weir:
  5.2% of the area; 7.1% of TN load: 3.7% of TP load.
  The area of Lenswood Creek contains 44% orchard; 9% vines; 25% grazing; 16% native vegetation. The TN generation rate for this catchment is high, and for TP low, relative to the area of the whole catchment of Houlgrave Weir. It does appear as if orchards, and possible vines, contribute more TN and less TP compared to other activities. However, due to uncertainties in the nutrient generation rates for grazing and native vegetation, it is not possible to make any definite conclusion on this result.

- Echunga Creek relative to the sum of the area of Echunga Creek and the area of the catchment of Houlgrave Weir (both catchments feed Mount Bold Reservoir separately):
  9.6% of the area; 5.8% of TN load: 6.0% of TP load.
  The area of Echunga Creek is predominantly grazing (25% general grazing; 11% dairy grazing; 8% horses) with 11% rural living and 16% native vegetation. The nutrient loads from this catchment are low compared to the Houlgrave Weir catchment. This suggests that grazing contributes lower nutrient loads to streams compared to other activities in the catchment of Houlgrave Weir. However, the land in this catchment is generally of low slope that may reduce the nutrients reaching the stream. Also, the stream reach above the monitoring site is native vegetation that may result in high nutrient assimilation. There is, therefore, considerable uncertainty in any conclusions made from these figures. This also highlights the weakness in the use of a single parameter model.

- River Sturt upstream of Minno Creek junction relative to the whole River Sturt catchment (at Anzac Hwy):
  16.9% of the area; 42% of TN load: 79% of TP load.
  These high nutrient loads are due to the contribution of Heathfield WWTP (waste water treatment plant). Refer to Schultz and Thomas (1999 draft).

- River Sturt at Sturt Road relative to the whole River Sturt catchment at Anzac Hwy):
  64.5% of the area; 57.9% of TN load: 71% of TP load.
  The catchment at Sturt Road includes the catchment of the River Sturt upstream of Minno Creek, and therefore contains nutrients originating at the Heathfield WWTP. It is thus difficult to attribute nutrient loads to any particular source within this catchment.

Results for the Sub-Catchment Modelling

The modelled nutrient loads per sub-catchment for the NPI sub-catchments are shown in TableN4. These are the figures sent to Environment Australia to place on the web site. Table N4 also lists the nutrient loads per unit area (or the nutrient generation rates per sub-catchment). These figures allow sub-catchments of different sizes to be compared for nutrient generation rate. Figures N2 and N3 are maps that show the nutrient loads per unit area for each sub-catchment.

The highest nutrient generation rates are from Cox Creek (map ref 70) and Sutton Creek (map ref 71). Sutton Creek is a sub-catchment of Cox Creek. Both catchments contain large areas of vegetable production. The lowest nutrient generation rates are from sub-catchments that contain predominantly native vegetation or forestry (native vegetation and forestry were given the same nutrient generation rates in the modelling). Examples of these sub-catchments are Barossa Reservoir (map ref 13); Vixen Gully (map ref 16); First Creek (map ref 51); Mount Bold (map ref 85); Grimwood Hill (map ref 88), and Burnt Out Creek (map ref 89).

In order to assess the reasons for particular nutrient generation rates from the other sub-catchments it is necessary to examine the landuses in each sub-catchment. The analysis of landuses in sub-catchments was not undertaken in this study. It is intended, subject to funding, that nutrient loads will be attributed to landuses in each sub-catchment in future NPI reporting periods.

Nutrient Load Model and Calibration

The nutrient load model was a lumped parameter model using a single lumped parameter, this being the nutrient generation rates for each landuse. This was a simple model with all factors likely to affect nutrient generation lumped into the single parameter. It is not intended to present a comprehensive discussion on the relative merits of simple and complex models. Suffice to say that complex models require larger quantities of input data to run the model, and adequate monitoring or measured data on which to base the model algorithms. Such data is often lacking requiring estimates to be made. This tends to reduce the accuracy (or at least reduce the confidence in the accuracy) of the results of complex models to the point where a simple model can produce similar results on average.

Any increases in model complexity are likely to introduce uncertainties due to uncertainties associated with the additional factors. However, even with the simple, single lumped parameter model there are uncertainties associated with the nutrient generation rates for each landuse. Introducing other factors into the model will compound the uncertainties. There will be an infinite range of combinations of parameter coefficients that will produce the same modelled results. It is essential, therefore, that at least one parameter is set with a reasonably high level of confidence before the model complexity is increased. This aspect must be considered as part of further work.

In this study, the accuracy of the modelled results relative to the measured nutrient loads for the monitored catchments (given in Table N3) is, on average, close to unity. This was the intention of the calibration procedure.

If the results for Sturt Creek upstream of Minno Creek are ignored (due to the presence of the Heathfield WWTP), the accuracy of the calibration results varies from 1.99 for TN and 1.94 for TP to 0.37 for TN and 0.28 for TP. In plain language, this means that the model results could be from around twice the correct value (for both TN and TP) down to around one-third (for TN) and one-quarter (for TP) the correct value.

This range of figures for the calibration results is not too untypical of model results. However, it is considered that the range is fairly large indicating that other factors are affecting the results. Several other factors about the land characteristics and land management practices could affect nutrient generation, and nutrient transport losses in streams could affect nutrient export from catchments.

As part of model calibration, many of the nutrient generation rates were changed from those obtained from the prime reference sources (Davis and Farley 1991, 1997). Several of the nutrient generation rates were changed by a large amount (see Table N2). The justification was that the model then produced results closer to the nutrient loads derived from monitoring data. However, many of the changes were based on monitoring data from only one monitored catchment. The monitored nutrient loads from these catchments may have been biased due to factors not incorporated in the model. If this were the case, then the model would produce incorrect results for sub-catchments where these factors were different. It is important to have available monitoring data that covers all combinations of factors that are likely to affect nutrient generation. It is recommended as part of further work that a wider range of references (e.g. Davies *et al* 1991; Letcher *et al* 19999; Marston 1992; Marston *et al* 1993; NSW EPA 1999) are studied to examine the range of nutrient generation rates for each landuse, and re-consider the changes made during model calibration.

Analysis of the monitored data has shown a strong correlation between annual flow and annual nutrient loads. Runoff can only be determined for gauged catchments. However, another project (South Central Project) has produced a model of runoff based on catchment characteristics. It is recommended as part of future work that the incorporation of this (or another) runoff model into the nutrient load model is trialled. This may reduce the variation of modelled nutrient loads compared to monitored data for catchments that have different runoff characteristics.

A previous study (Clark 1987) has shown that nutrients are present in rainfall. Further work should determine from this study whether the quantities of nutrients in rainfall are significant. If they are, consideration should be given to incorporate a factor for this into the model.

Nutrient transport loss (e.g. from assimilation, chemical breakdown and storage due to sedimentation) in streams may also account for some of the calibration errors. In order to incorporate nutrient assimilation into the nutrient load model, it is necessary to have data on the rate of nutrient transport loss. There appears to be very little data on this for the Mount Lofty Ranges. It is recommended as part of further work that the topic of nutrient transport loss is investigated, and that future monitoring programs address the lack of data in this area.

Estimation of Errors

Due to time constraints there was no attempt made to estimate errors. Errors could be present in the monitoring data due to, for example, errors in the flow rating curve, chemical changes in the composite sampling chamber, errors in the determinant concentration tests, errors in data recording, errors in the calculation of nutrient loads. These errors will lead to errors in the nutrient load figures for the monitored catchments. These need to be known for all load monitoring data not just for nutrient loads, particularly if the errors are likely to be different between monitored catchments.

Errors will also be present in the modelled results due to the model not representing all factors that affect nutrient generation and nutrient export from sub-catchments. It is unlikely that the errors in the modelled results can be precisely quantify for each sub-catchment, other than the monitored catchments, as there are many factors that could affect nutrient generation and not all can be determined in practice. However, it should be possible to investigate potential sources of errors and prepare a statement on the level of confidence in the modelled results.

It is recommended that all sources of errors are identified and quantified where possible as part of further work.

Monitoring Data

The major problem encountered in model calibration was that there was insufficient data that was applicable to the task. With the exception of First Creek (90% native vegetation), all monitored catchments contained a mix of landuses. It was, therefore, not possible to attribute nutrient loads to particular landuses with a high degree of certainty. Even for First Creek the nutrient loads were estimated from grab sampling data that was intended for monitoring ambient pollutant levels not for determining nutrient loads.

Previous studies (Clark and Crawley 1987; Clark 1988) have developed and used a method for determining nutrient loads from grab sampling data. If this method can produce reasonable estimate of nutrient loads, then the number of monitored catchments that can be used for model calibration is increased. This and any other method for determining nutrient loads from grab sampling data should be investigated as part of further work.

Another area of uncertainty with the nutrient loads calculated from monitored data is with the climate correction factor. A climate correction factor was used due to the short period of record from most of the monitoring sites that may not represent the long-term situation. Future work should consider applying a separate correction factor applied to each monitored catchment derived from nearby catchments that are highly correlated.

First Creek was the only monitored catchment containing predominantly native vegetation. It is considered desirable to determine the nutrient generation rates for native vegetation as this will be a benchmark against which to judge the nutrient exports form catchments containing anthropologic activities. It is recommended that consideration be given to installing a composite sampler at the First Creek gauging station, and possible also at other suitable sites.

The period of record of the monitoring sites varied from two to ten years. It was noted by comparing the 1993 GIS landuse data with the 1999 GIS landuse data that there was a change in landuse in several catchments. Changing landuses may affect the nutrients generated within some of the monitored catchments. This aspect was not investigated in this study and should the subject of further work.

Monitoring Program

The following remarks are the result of this project’s work into modelling nutrient loads. Many of the remarks will also apply to other pollutant types.

This report has made references to the monitoring program and to the availability of data suitable to this project. The general conclusion on this aspect is that the monitoring data currently available on nutrient loads is inadequate for effective modelling of nutrient loads. This is because all the monitored catchments studied in this project contained a mix of landuses, preventing the quantities of nutrient loads being attributed to individual landuses with any reasonable degree of certainty. A statistical analysis of the nutrient loads determined from monitoring data may enable a higher level of certainty to be achieved. This is recommended as part of further work.

Modelling is not an end in itself, but a means to identify pollution sources and to quantify the amounts of pollutants emitted from various sources. Such information enables targeted amelioration and management to take place based on scientifically valid data. This is preferred compared to management based on estimates or hunches. Modelling requires adequate data for calibration and also as input to run the model.

In the case of nutrients, even if modelling does not take place, it may be desirable to quantify the nutrient loads generated by each category of landuse under various land management scenario and with different land characteristic, and to determine the rate of nutrient assimilation in streams in various conditions. This exercise requires the analysis of nutrient monitoring data that is suitable to quantify nutrient loads and to attribute those loads to the sources. This is the same data requirement as for modelling.

Grab sampling has been taking place for many years in order to monitor the ambient level of pollutants in waterways. The current composite sampling program was instigated about one decade ago. The composite samplers were located at existing flow gauging stations. These were generally located so as to quantify water volumes entering reservoirs and to determine runoff characteristics for a range of catchments. These composite samplers enables nutrient loads entering reservoirs to be determined, and enabled the nutrients exported from selected sub-catchments to be determined. However, as explained previously, the current locations of the composite samplers do not permit the nutrient loads to be attributed to specific landuses or land characteristics with any reasonable degree of certainty.

It is considered that attributing nutrient loads to specific diffuse sources or landuses is part of the requirements of the current review of the water monitoring program. The objectives for the current review of the water monitoring program include “identify sources of pollution” (Objective 4, EPA 1999). Under the monitoring framework for the water monitoring program, the theme “Inland Waters – Surface Water”, and the issue “Water Quality”, the description of the third indicator (“Location/volume/quality of point discharges”) includes the wording “Inventory of licensed and diffuse point sources of pollution, as measured by the source type.”

It is strongly recommended that the review group determine whether it is necessary to attribute nutrient loads to sources with a reasonable degree of certainty. If this is the case, the installation of composite samplers at suitable locations should be considered. The sites chosen should be such that there can be no ambiguity as to the nutrient load that can attributed to a specific combination of landuse, land management practice and land characteristic. The number of sites should be such as to permit nutrient loads to be attributed to all the major landuses, all principal land management practices and all the main land characteristics that occur within the region. To be fully effective, this will require the installation of a large number of composite samplers. In most cases, a sampling period of a few years may suffice.

Consideration should also be given to installing composite samplers at suitable locations than will enable the determination of nutrient transport loss under a range of riparian conditions. Also, as mentioned previously, consideration should be given to installing composite samplers that will enable the nutrient loads generated by native vegetation to be determined. These figures represent the discharge of nutrients from natural catchments and can be used as a benchmark against which to judge modified catchments.

FURTHER WORK

The nature, extent and priorities of further work depend on further deliberations and on funding. The following are issues noted during the progress of this project, some of which have been mentioned elsewhere in this report.

- For some Patawalonga Catchment monitoring stations, re-check locations and catchment boundaries to ensure the contributing area is correctly defined. Suspected stations are Sturt River at Sturt Road (GS504576) and Brownhill Creek at Adelaide Airport (GS504580).
- Compare modelled results and monitored nutrient loads for monitored catchments outside of the study area (if available).
- Investigate the effect of catchment size on model results and attempt to derive a factor for nutrient transport loss. This is a potential method to derive a factor for nutrient transport loss that does not required further monitoring data.
- Investigate methods of determining nutrient loads from grab sampling data. If these methods are valid, the number of catchments that can be used for model calibration is increased (see Clark and Crawley 1987; Clark 1988).
- Refine the climate correction technique (the method for correcting the calculated nutrient loads for short monitoring periods).
- Re-visit the landuse classification with particular regard to the classification of all conservation and recreation areas.
- Investigate methods to allow for pumped flows, including estimating in-channel losses and Torrens pumped flows from a balance model.
- Investigate the effect of changing landuse on nutrient loads in the monitored catchments.
- Apply a formal statistical analysis to the monitoring data to attempt to better attribute nutrient generation rates to landuses within the monitored catchments.
- Study a wider range of references (eg Davies *et al* 1991; Letcher *et al* 19999; Marston 1992; Marston *et al* 1993; NSW EPA 1999) to examine the range of nutrient generation rates for each landuse, and re-consider the changes made during model calibration.
- As part of the above literature review, investigate the possibility of study are size affecting nutrient generation rates due to nutrient transport loss in the study areas.
- Identify and quantify sources of errors in the nutrient loads determined from monitoring data and the modelled results.
- Determine from previous studies whether the quantities of nutrients in rainfall are significant and incorporate a factor for this aspect into the model (see Clark 1987).
- Review whether figures reported for the NPI should be nutrient emissions or nutrient loads.
- Combine Cox Creek and Sutton Creek into one sub-catchment.
- Change sub-catchment references (item NPI_ID in the GIS dataset) to correspond to the revised map references (SC_ID).

CONCLUSIONS

A raster based GIS nutrient load model has been developed to estimate the mean annual nutrient loads from catchments and a series of sub-catchments. The model is a lumped parameter model with a single lumped parameter being the nutrient generation rates for each of the categories of landuse. The only input data required is GIS landuse data. The nutrient loads are estimated as total nitrogen and total phosphorus.

The model has been calibrated against nutrient loads calculated from a series of monitored catchments within the NPI reporting area for 1999. All but one of the monitored catchments were provided with composite samplers.

The model was used to generate nutrient loads for a series of sub-catchments within the Adelaide and Barossa regions. These figures, along with reports on other pollutants, were reported to Environment Australia and placed on a publicly accessible Internet site (www.npi.ea.gov.au).

It is considered that the model produces figures that are a reasonable estimate of nutrient loads given the available data and time constraints. There is considerable uncertainty in the accuracy of the results that have not been quantified. These uncertainties arise mainly due to the simplicity of the model, and due to the nature of the monitoring data not permitting nutrient generation rates to be attributed to landuses or land characteristics with any reasonable degree of certainty. It is recommended that sources of errors are identified and quantified as part of further work.

There are several other aspects that may be investigated as part of further work, subject to funding. One aspect is to modify the model to attribute the modelled nutrient loads to each landuse in each sub-catchment. This will enable users of the NPI data to better understand the sources of nutrients. Other aspects that may be considered for further work are concerned with increasing the complexity of the model, further analysis of monitoring data, other refinements to the methodologies, and possible extensions to the water quality monitoring program.

In relation to the monitoring of nutrients in streams and rivers, the currently available monitoring data was found to be insufficient for effective modelling of nutrient loads. This was because the majority of monitored catchments studied in this project contained a mix of landuses. This prevented the quantities of nutrient loads being attributed to individual landuses with any degree of certainty.

The currently available monitoring data allowed only the following conclusions to be made:

- Vegetable production in Cox Creek generates very high levels of nutrients;
- Urban areas in Aldgate Creek generate moderate to high levels of nutrients;
- All other anthropologic activities generate moderate levels of nutrients;
- Native vegetation generates very low levels of nutrients;
- The higher the intensity of the activity, the higher the ratio of phosphorus to nitrogen in the generated nutrients.

It is recommended that it is determined whether it is necessary to attribute nutrient loads to sources with a reasonable degree of certainty. If this is the case, the installation of additional composite samplers at suitable locations should be considered. The sites chosen should be such that there can be no ambiguity as to the nutrient load that can attributed to a specific combination of landuse, land management practice and land characteristic. The number of sites should be such as to permit nutrient loads to be attributed to all the major landuses, all principal land management practices and all the main land characteristics that occur within the region. To be fully effective, this will require the installation of a large number of composite samplers. In most cases, a sampling period of a few years may suffice.

Consideration should also be given to installing composite samplers at suitable locations than will enable the determination of nutrient assimilation under a range of riparian conditions. Also, consideration should be given to installing composite samplers that will enable the nutrient loads generated by native vegetation to be determined. These figures represent the discharge of nutrients from natural catchments and can be used as a benchmark against which to judge modified catchments.

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GLOSSARY

AML	Arc Macro Language. Macros used with the GIS program Arcinfo are referred to as "AMLS".
AWQC	Australian Water Quality Centre, a division of SAWater.
CMSS	Catchment Management Support System. A computer program to assist land managers in making informed decisions in regard to nutrient generation within catchments.
DEHAA	Department for Environment, Heritage and Aboriginal Affairs, South Australia.
DEH	Department for Environment and Heritage (previously DEHAA).
DEM	Digital Elevation Model. A computer representation of terrain, stored as a matrix of elevations.
DSS	Decision Support System. A family of computer programs designed to aid users make informed decisions in an interactive manner.
DTUPA	Department of Transport, Urban Planning and the Arts.
EDMS	Environment Data Management System. A database of environmental monitoring data held by the Environment Protection Agency (DEHAA).
EPA	Environment Protection Agency, a Division of the Department for Environment and Heritage, South Australia.
GIS	Geographic Information System. A family of computer programs designed to store, retrieve and analyse spatial data.
HYDSYS	A database held by the Environment Protection Agency containing time series data on water quantity and water quality from monitored streams and rivers.
kg	Kilograms. 1000 grams weight.
kg/ha/y	Kilograms per hectare per year.
kg/y	Kilograms per year
mg/L	Milligrams per litre. 1/1000 th of a gram weight per litre of fluid.
ML	Megalitre, 1 000 000 litres.
NEPC	National Environment Protection Council, a national statutory body.
NEPM	National Environment Protection Measure. NEPMs are produced by the NEPC.
NEXSYS	A computer program for estimating nutrient generation rates for landuses under a range of climatic, edaphic and management conditions.
NOX	Oxides of nitrogen, nitrate (NO3) and nitrite (NO2).
NPI	National Pollutant Inventory. A database of substances emitted to air, land and water.
PIRSA	Department of Primary Industries and Resources South Australia
TKN	Total Kjeldahl Nitrogen. All forms of non-oxidised nitrogen, ie both organic nitrogen and ammonia.

TN	Total Nitrogen. The sum of all types of nitrogen containing nutrients, in particular the sum of NOX and TKN.
TP	Total Phosphorus. The sum of all types of phosphorus nutrients, organic and non-organic forms, dissolved and particulate forms.

APPENDIX 1

Worksheets for analysis of flow and grab sampling data for First Creek (Waterfall Gully).

First Creek: Waterfall Gully GS504517											
DATE	Period Flow	Flow Ann	NOX	TKN	TN	TP	TN Load	TP Load	TN Ann	TP Ann
	ML	ML	mg/L	mg/L	mg/L	mg/L	kg	kg	kg	kg
8-Jan-75			0.01	0.36		0.005				
20-Jan-75			0.01	0.39	0.4	0.005				
22-Jan-75			0.01	0.27	0.28	0.016				
29-Jan-75			0.02	0.22	0.24	0.018				
3-Feb-75			0.01	0.21	0.22	0.027				
5-Feb-75			0.01	0.25	0.26	0.025				
10-Feb-75			0.01	0.32	0.33	0.025				
17-Feb-75			0.01	0.3	0.31	0.007				
24-Feb-75			0.01	0.48	0.49	0.005				
26-Feb-75			0.07	0.55	0.62	0.032				
3-Mar-75			0.02	0.08	0.1	0.005				
5-Mar-75			0.01	0.16	0.17	0.019				
10-Mar-75			0.03	0.19	0.22	0.005				
12-Mar-75			0.01	0.74	0.75	0.021				
18-Mar-75			0.01	0.16	0.17	0.005				
19-Mar-75			0.29	0.66	0.95	0.014				
24-Mar-75			0.01							
26-Mar-75				0.25	0.26	0.01				
2-Apr-75			0.01	0.22	0.23	0.014				
7-Apr-75			0.01			0.015				
9-Apr-75			0.01			0.005				
15-Apr-75			0.01	0.42	0.43	0.008				
16-Apr-75			0.02	0.7	0.72	0.005				
21-Apr-75			0.01	0.21	0.22	0.019				
23-Apr-75			0.15	0.48	0.63	0.021				
28-Apr-75			0.01	0.29	0.3	0.005				
30-Apr-75			0.01	0.18	0.19	0.005				
5-May-75			0.01	0.15	0.16	0.005				
7-May-75			0.01	0.69	0.7	0.018				
12-May-75			0.04	0.24	0.28	0.018				
14-May-75			0.03	0.09	0.12	0.04				
21-May-75			0.01	1.58	1.59	0.07				
26-May-75			0.05	1.25	1.3	0.078				
28-May-75			0.01	0.6	0.61	0.024				
2-Jun-75			0.01	0.75	0.76	0.022				
4-Jun-75			0.01	1.26	1.27	0.012				
9-Jun-75			0.01	0.47	0.48	0.01				
11-Jun-75			0.01	0.3	0.31	0.026				
18-Jun-75			0.01	0.62	0.63	0.033				
24-Jun-75			0.01	0.44	0.45	0.008				
25-Jun-75			0.01	0.65	0.66	0.005				
30-Jun-75			0.01	0.61	0.62	0.009				
7-Jul-75			0.01	0.27	0.28	0.005				
9-Jul-75			0.02	0.05	0.07	0.015				
14-Jul-75			0.14	1.32	1.46	0.079				
16-Jul-75			0.03	0.92	0.95	0.054				
21-Jul-75			0.01	0.19	0.2	0.009				
30-Jul-75			0.14	0.66	0.8	0.048				
31-Jul-75			0.12	1.13	1.25	0.037				
4-Aug-75			0.05	0.49	0.54	0.008				
6-Aug-75			0.05	0.63	0.68	0.007				
11-Aug-75			0.02	0.79	0.81	0.026				
13-Aug-75			0.1	0.43	0.53	0.03				
18-Aug-75			0.02	0.42	0.44	0.021				
20-Aug-75			0.05	0.16	0.21	0.034				
25-Aug-75			0.01	0.54	0.55	0.008				
27-Aug-75			0.72	0.55	1.27	0.1				
1-Sep-75			0.02	0.13	0.15	0.01				
3-Sep-75			0.03	0.5	0.53	0.02				
8-Sep-75			0.01	0.57	0.58	0.011				
10-Sep-75			0.01	0.46	0.47	0.015				
15-Sep-75			0.01	0.29	0.3	0.063				
17-Sep-75			0.03	0.2	0.23	0.008				
22-Sep-75			0.02	0.19	0.21	0.011				
24-Sep-75			0.01	0.21	0.22	0.006				
29-Sep-75			0.01	0.38	0.39	0.007				
1-Oct-75			0.01	0.28	0.29	0.006				
6-Oct-75			0.01	0.37	0.38	0.012				
8-Oct-75			0.01	0.99	1	0.023				
15-Oct-75			0.01	0.78	0.79	0.021				
20-Oct-75			0.01	0.84	0.85	0.011				
22-Oct-75			0.01	0.46	0.47	0.013				
27-Oct-75			0.01	0.67	0.68	0.015				
29-Oct-75			0.05	1.04	1.09	0.025				
3-Nov-75			0.02	0.92	0.94	0.029				
5-Nov-75			0.05	0.84	0.89	0.025				
10-Nov-75			0.02	0.38	0.4	0.017				
12-Nov-75			0.04	0.19	0.23	0.025				
17-Nov-75			0.01	1.03	1.04	0.019				
19-Nov-75			0.01	0.71	0.72	0.009				
24-Nov-75			0.01	0.36	0.37	0.009				
26-Nov-75			0.01	0.11	0.12	0.005				

First Creek: Waterfall Gully GS504517										
DATE	**Period Flow**	**Flow Ann**	**NOX**	**TKN**	**TN**	**TP**	**TN Load**	**TP Load**	**TN Ann**	**TP Ann**
	ML	**ML**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**kg**	**kg**	**kg**	**kg**
1-Dec-75			0.03	0.26	0.29	0.039				
3-Dec-75			0.01	0.5	0.51	0.006				
8-Dec-75			0.01	0.4	0.41	0.011				
10-Dec-75			0.04	0.27	0.31	0.013				
15-Dec-75			0.01	0.23	0.24	0.014				
17-Dec-75			0.02	0.15	0.17	0.019				
22-Dec-75			0.01	0.66	0.67	0.036				
5-Jan-76			0.01	0.85	0.86	0.007				
7-Jan-76			0.02	1.04	1.06	0.027				
12-Jan-76			0.01	0.49	0.5	0.016				
14-Jan-76			0.04	1.07	1.11	0.014				
19-Jan-76			0.01	0.28	0.29	0.038				
28-Jan-76			0.01	0.21	0.22	0.019				
2-Feb-76			0.01	0.34	0.35	0.015				
4-Feb-76			0.03	1.25	1.28	0.02				
9-Feb-76			0.01	0.2	0.21	0.008				
11-Feb-76			0.01	0.07	0.08	0.046				
16-Feb-76			0.01	0.42	0.43	0.014				
18-Feb-76			0.02	0.48	0.5	0.028				
23-Feb-76			0.01	0.15	0.16	0.009				
25-Feb-76			0.04	0.44	0.48	0.191				
1-Mar-76			0.02	1.14	1.16	0.034				
8-Mar-76			0.01	0.74	0.75	0.046				
17-Mar-76			0.01	0.07	0.08	0.008				
22-Mar-76			0.02	0.13	0.15	0.028				
24-Mar-76			0.02	0.87	0.89	0.015				
31-Mar-76			0.02	0.33	0.35	0.017				
12-Apr-76			0.01	0.21	0.22	0.03				
21-Apr-76			0.01	0.41	0.42	0.036				
24-May-76			0.02	0.2	0.22	0.044				
7-Jun-76			0.01	0.4	0.41	0.022				
21-Jun-76			0.01	0.14	0.15	0.008				
5-Jul-76			0.02	0.43	0.45	0.007				
20-Jul-76			0.015	0.15	0.18	0.006				
2-Aug-76			0.02	0.77	0.79	0.01				
16-Aug-76			0.02	0.41	0.43	0.01				
31-Aug-76			0.02	0.62	0.64	0.031				
14-Sep-76			0.02	0.75	0.77	0.079				
28-Sep-76			0.02	0.43	0.45	0.051				
12-Oct-76			0.03	0.36	0.39	0.043				
26-Oct-76	58.75		0.02	0.18	0.2	0.01				
9-Nov-76	27		0.03	0.21	0.24	0.01				
23-Nov-76	15.74		0.02	0.5	0.52	0.038				
7-Dec-76	13.14		0.02	0.44	0.46	0.016				
21-Dec-76	11.28		0.04	0.17	0.21	0.026				
11-Jan-77	12.59		0.030	0.180	0.210	0.018	2.64	0.23		
25-Jan-77	12.91		0.010	0.150	0.170	0.013	2.19	0.17		
22-Feb-77	15.1		0.030	0.810	0.840	0.047	12.68	0.71		
08-Mar-77	8.14		0.030	0.110	0.140	0.015	1.14	0.12		
22-Mar-77	8.35		0.020	0.060	0.080	0.029	0.67	0.24		
05-Apr-77	13.1		0.020	0.220	0.240	0.005	3.14	0.07		
03-May-77	24.1		0.020	0.050	0.070	0.006	1.69	0.14		
17-May-77	13.16		0.020	0.290	0.310	0.027	4.08	0.36		
31-May-77	16.56		0.040	0.280	0.320	0.014	5.30	0.23		
14-Jun-77	17.09		0.150	0.420	0.570	0.116	9.74	1.98		
22-Jun-77	13.07		0.360	0.370	0.730	0.024	9.54	0.31		
25-Jul-77	52		0.030	0.980	1.010	0.087	52.52	4.52		
12-Aug-77	65.3		0.050	0.230	0.280	0.034	18.28	2.22		
24-Aug-77	21.18		0.020	0.140	0.160	0.009	3.39	0.19		
13-Oct-77	58.5		0.030	0.050	0.080	0.021	4.68	1.23		
07-Dec-77	43.44		0.020	0.130	0.150	0.016	6.52	0.70		
		395					0.00	0.00	138.21	13.42
14-Feb-78	30.87		0.010	0.280	0.290	0.013	8.95	0.40		
22-Mar-78	3.91		0.010	0.160	0.170	0.006	0.66	0.02		
28-Jun-78	114		0.020	0.640	0.660	0.039	75.24	4.45		
05-Jul-78	12.84		0.120	4.070	4.190	0.320	53.80	4.11		
10-Aug-78	453.66		0.020	0.210	0.230	0.013	104.34	5.90		
25-Oct-78	378.78		0.010	0.240	0.250	0.013	94.70	4.92		
		994							337.69	19.80
21-Mar-79	91.76		0.015	0.190	0.205	0.012	18.81	1.10		
23-Jul-79	155.1		0.070	0.400	0.470	0.022	72.90	3.41		
27-Aug-79	241.6		0.020	0.330	0.350	0.133	84.56	32.13		
04-Sep-79	94.07		0.035	0.470	0.505	0.012	47.51	1.13		
06-Sep-79	129.06		0.040	0.470	0.510	0.035	65.82	4.52		
20-Nov-79	967.19		0.010	0.340	0.350	0.010	338.52	9.67		
		1679							628.11	51.96
27-Mar-80	65.59		0.010	0.040	0.050	0.017	3.28	1.12		
15-May-80	30.86		0.010	0.140	0.150	0.072	4.63	2.22		
15-Jul-80	214.36		0.010	0.260	0.270	0.016	57.88	3.43		

First Creek: Waterfall Gully GS504517										
DATE	**Period Flow**	**Flow Ann**	**NOX**	**TKN**	**TN**	**TP**	**TN Load**	**TP Load**	**TN Ann**	**TP Ann**
	ML	**ML**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**kg**	**kg**	**kg**	**kg**
29-Aug-80	225.5		0.010	0.280	0.290	0.003	65.40	0.56		
02-Oct-80	34.89		0.010	0.230	0.240	0.010	8.37	0.35		
06-Oct-80	5.31		0.010	0.380	0.390	0.016	2.07	0.08		
05-Nov-80	112.3		0.055	1.600	1.655	0.133	185.86	14.94		
		689							327.48	22.70
30-Jun-81	660.26		0.010	0.300	0.310	0.008	204.68	5.28		
13-Aug-81	979.31		0.010	0.220	0.230	0.003	225.24	2.45		
16-Sep-81	399.75		0.005	0.290	0.295	0.005	117.93	2.00		
23-Oct-81	62.99		0.005	0.250	0.255	0.006	16.06	0.38		
04-Dec-81	25.61	2128	0.005	0.610	0.615	0.032	15.75	0.82	579.66	10.93
12-Jan-82	25.19		0.005	0.250	0.255	0.006	6.42	0.15		
31-May-82	98.06		0.005	0.470	0.475	0.073	46.58	7.16		
14-Jul-82	98.44		0.005	0.200	0.205	0.003	20.18	0.25		
24-Aug-82	91.25		0.010	0.160	0.170	0.003	15.51	0.23		
30-Sep-82	34.44		0.005	0.210	0.215	0.003	7.40	0.09		
09-Nov-82	22.46		0.005	0.200	0.205	0.008	4.60	0.18		
14-Dec-82	14.92	385	0.005	0.025	0.030	0.007	0.45	0.10	101.15	8.15
27-Jan-83	18.73		0.005	0.260	0.265	0.010	4.96	0.19		
01-Mar-83	13.69		0.005	4.000	4.005	0.935	54.83	12.80		
02-Mar-83	0.74		0.005	0.850	0.855	0.029	0.63	0.02		
15-Mar-83	23.13		0.010	1.130	1.140	0.076	26.37	1.76		
22-Mar-83	5.05		0.310	2.090	2.400	0.147	12.12	0.74		
13-Jul-83	278.5		0.810	0.320	1.130	0.010	314.71	2.79		
03-Aug-83	295.12		0.850	0.380	1.230	0.026	363.00	7.67		
24-Aug-83	126.63		0.250	0.290	0.540	0.008	68.38	1.01		
17-May-84	597.12		0.020	0.070	0.090	0.003	53.74	1.49		
10-Aug-84	229.62		0.080	0.480	0.560	0.033	128.59	7.58		
28-Aug-84	419.47		0.030	0.210	0.240	0.018	100.67	7.55		
04-Sep-84	103.82		0.030	0.240	0.270	0.009	28.03	0.93		
16-May-85	306.56		0.005	0.200	0.205	0.010	62.84	3.07		
06-Jun-85	49.04		0.060	0.280	0.340	0.017	16.67	0.83		
13-Aug-87	NA		0.005	0.510	0.515	0.012	#VALUE!	#VALUE!		
20-May-88	333.23		0.005	0.560	0.565	0.017	188.27	5.66		
16-Aug-90	2141.83		0.060	0.270	0.330	0.006	706.80	12.85		
12-May-94	NA		0.005	0.080	0.085	0.015	#VALUE!	#VALUE!		
26-Oct-94	177.91		0.020	0.150	0.170	0.017	30.24	3.02		
16-May-95	NA		0.010	0.050	0.060	0.020	#VALUE!	#VALUE!		
01-Jun-95	12.04		0.005	0.060	0.065	0.003	0.78	0.03		
16-Jun-95	NA		0.005	0.170	0.175	0.005	#VALUE!	#VALUE!		
14-Jul-95	NA		0.130	0.440	0.570	0.014	#VALUE!	#VALUE!		
25-Aug-95	NA		0.030	0.270	0.300	0.007	#VALUE!	#VALUE!		
01-Sep-95	6.74		0.040	0.220	0.260	0.007	1.75	0.05		
20-Oct-95	41.95		0.005	0.140	0.145	0.012	6.08	0.50		
10-Nov-95	11.18		0.005	0.460	0.465	0.014	5.20	0.16		
13-Nov-95	1.24		0.010	0.200	0.210	0.013	0.26	0.02		
17-May-96	67.38		0.005	0.640	0.645	0.014	43.46	0.94		
27-Jun-96	41.36		0.020	0.380	0.400	0.011	16.54	0.45		
11-Jul-96	96.76		0.110	0.430	0.540	0.012	52.25	1.16		
09-Aug-96	NA		0.046	0.280	0.326	0.003	#VALUE!	#VALUE!		
06-Sep-96	NA		0.003	0.230	0.233	0.003	#VALUE!	#VALUE!		
18-Oct-96	230.9		0.019	0.210	0.229	0.007	52.88	1.62		
08-Nov-96	19.23		0.003	0.200	0.203	0.005	3.89	0.10		
05-Dec-96	13.5		0.003	0.140	0.143	0.006	1.92	0.08		
16-Jan-97	14.94		0.003	0.130	0.133	0.003	1.98	0.04		
07-Feb-97	9.28		0.003	0.320	0.323	0.009	2.99	0.08		
20-Mar-97	12.28		0.007	0.350	0.357	0.014	4.38	0.17		
11-Apr-97	8.78		0.011	0.100	0.111	0.003	0.97	0.02		
09-May-97	12.76		0.003	0.160	0.163	0.003	2.07	0.03		
22-May-97	6.53		0.028	0.170	0.198	0.008	1.29	0.05		
05-Jun-97	10.84		0.014	0.140	0.154	0.010	1.67	0.11		
03-Jul-97	18.53		0.008	0.130	0.138	0.003	2.56	0.05		
10-Jul-97	3.75		0.003	0.330	0.333	0.006	1.25	0.02		
15-Aug-97	65.45		0.014	0.410	0.424	0.015	27.75	0.98		
05-Sep-97	78.97		0.020	0.350	0.370	0.006	29.22	0.47		
16-Oct-97	128.51		0.003	0.280	0.283	0.010	36.30	1.29		
21-Oct-97	2.62		0.007	0.260	0.267	0.009	0.70	0.02		
14-Nov-97	36.46		0.011	0.320	0.331	0.010	12.07	0.36		
04-Dec-97	8.27	418	0.016	0.290	0.306	0.011	2.53	0.09	127.74	3.80
15-Jan-98	10.14		0.024	0.250	0.274	0.014	2.78	0.14		
12-Feb-98	5.74		0.003	0.450	0.453	0.010	2.60	0.06		
12-Mar-98	5.66		0.006	0.090	0.096	0.003	0.54	0.01		
28-Apr-98	23.69		0.003	0.180	0.183	0.009	4.32	0.21		
06-May-98	3.58		0.003	0.140	0.143	0.003	0.51	0.01		
03-Jun-98	12.9		0.003	0.025	0.028	0.003	0.35	0.03		
23-Jul-98	71.61		0.006	0.290	0.296	0.014	21.20	1.00		
20-Aug-98	160.12		0.003	0.270	0.273	0.003	43.63	0.40		

First Creek: Waterfall Gully GS504517										
DATE	**Period Flow**	**Flow Ann**	**NOX**	**TKN**	**TN**	**TP**	**TN Load**	**TP Load**	**TN Ann**	**TP Ann**
	ML	**ML**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**kg**	**kg**	**kg**	**kg**
12-Nov-98	NA		0.003	0.620	0.623	0.050	#VALUE!	#VALUE!		
17-Dec-98	11.58		0.003	0.160	0.163	0.010	1.88	0.12		

APPENDIX 2

Worksheets for analysis of composite sampling data.

COLLMETH	CO = Composite											
	AG = Automatic Grab sample											
	MS = Manual grab taken from sampler intake											
	MD = Manual Grab taken from stream											
	ML = Manual Grab and left on site for period until next sample visit											
Codes	NA	Not Available										
	NR	No Result										
	NP	Not Processed										
STATION	**COLl**	**ExcelDateTime Oracle Format**	**Volume since last Sample MegaLitres**	**Nox mg/L**	**TKN mg/L**	**Tot N mg/L**	**Tot P mg/L**	**Total Annual Flow ML**	**TN Load kg**	**TP Load kg**	**TN Annual Load kg**	**TP Annual Load kg**
AW503502 Scott Creek at Scott Bottom												
WQ#3203												
AW503502	CO	23/08/1988 15:20	NA									
AW503502	CO	1/09/1988 13:20	158.042	0.1	0.59	0.69	0.042		109.049	6.638		
AW503502	CO	8/09/1988 13:40	84.637	0.1	0.55	0.65	0.053		55.014	4.486		
AW503502	CO	19/09/1988 15:45	532.202	0.16	0.87	1.03	0.097		548.168	51.624		
AW503502	CO	29/09/1988 12:00	133.306	0.11	0.5	0.61	0.044		81.316	5.865		
AW503502	CO	1/12/1988 14:30	263.467	0.03	0.42	0.45	0.041		118.560	10.802		
AW503502	**CO**	**8/12/1988 11:00**	**15.198**	**0.02**	**0.5**	**0.520**	**0.042**		**7.903**	**0.638**		
AW503502	**MD**	**20/01/1989 14:10**	**40.752**	**0.1**	**0.475**	**0.575**	**0.04**		**23.432**	**1.630**		
AW503502	MD	6/03/1989 12:15	5.197	0.18	0.45	0.63	0.039		3.274	0.203		
AW503502	CO	22/03/1989 13:00	2.331	0.01	0.49	0.5	0.032		1.165	0.075		
AW503502	CO	29/03/1989 13:15	1.660	0.01	0.42	0.43	0.031		0.714	0.051		
AW503502	MD	5/04/1989 14:00	5.049	0.01	0.34	0.35	0.037		1.767	0.187		
AW503502	MD	14/04/1989 14:00	10.915	0.01	0.37	0.38	0.034		4.148	0.371		
AW503502	MD	27/04/1989 14:00	23.293	0.01	0.28	0.29	0.053		6.755	1.235		
AW503502	MD	10/05/1989 13:00	39.766	0.02	0.63	0.65	0.029		25.848	1.153		
AW503502	CO	26/05/1989 13:45	47.495	0.04	0.37	0.41	0.029		19.473	1.377		
AW503502	MD	14/06/1989 15:15	110.521	0.1	0.35	0.45	0.036		49.734	3.979		
AW503502	MD	20/06/1989 13:32	156.605	0.42	0.83	1.25	0.064		195.756	10.023		
AW503502	CO	5/07/1989 12:30	144.564	0.15	0.51	0.66	0.041		95.412	5.927		
AW503502	CO	12/07/1989 14:30	304.311	0.29	0.62	0.91	0.042		276.923	12.781		
AW503502	CO	28/07/1989 15:45	195.343	0.22	0.59	0.81	0.082		158.228	16.018		
AW503502	MD	7/08/1989 14:00	880.458	0.18	0.74	0.92	0.077		810.022	67.795		
AW503502	MD	11/09/1989 14:40	1253.089	0.14	0.73	0.87	0.052		1090.187	65.161		
AW503502	MD	21/09/1989 12:15	301.685	0.13	0.81	0.94	0.042		283.584	12.671		
AW503502	CO	4/10/1989 10:00	172.573	0.14	0.52	0.66	0.04		113.898	6.903		
AW503502	CO	19/10/1989 14:00	160.650	0.15	0.61	0.76	0.035		122.094	5.623		
AW503502	CO	2/11/1989 12:25	80.232	0.06	0.4	0.46	0.031		36.907	2.487		
AW503502	CO	16/11/1989 11:05	71.476	0.03	0.46	0.49	0.024		35.023	1.715		
AW503502	CO	1/12/1989 12:45	37.426	0.04	0.48	0.52	0.034	4048	19.462	1.272		
AW503502	**CO**	**18/12/1989 9:00**	**28.932**	**0.05**	**0.49**	**0.540**	**0.027**	**4074**	**15.623**	**0.781**	**3389**	**219**
AW503502	**CO**	**8/01/1990 12:50**	**7.073**	**0.03**	**0.5**	**0.530**	**0.023**		**3.748**	**0.163**		
AW503502	CO	5/02/1990 11:00	5.547	0.06	0.35	0.41	0.012		2.274	0.067		
AW503502	CO	27/02/1990 11:40	10.168	0.01	0.28	0.29	0.018		2.949	0.183		
AW503502	CO	14/03/1990 11:30	5.361	0.04	0.29	0.33	0.018		1.769	0.097		
AW503502	CO	28/03/1990 15:30	2.613	0.01	0.36	0.37	0.031		0.967	0.081		
AW503502	MD	4/05/1990 13:20	33.825	0.01	0.4	0.41	0.06		13.868	2.030		
AW503502	MD	24/05/1990 15:20	28.431	0.01	0.32	0.33	0.038		9.382	1.080		
AW503502	MD	19/06/1990 11:50	62.635	0.01	0.33	0.34	0.043		21.296	2.693		
AW503502	CO	18/07/1990 14:40	548.949	0.25	0.74	0.99	0.049		543.459	26.898		
AW503502	CO	30/08/1990 12:28	1127.751	0.17	0.69	0.86	0.036		969.866	40.599		
AW503502	CO	20/09/1990 10:10	295.806	0.08	0.57	0.65	0.027		192.274	7.987		
AW503502	CO	11/10/1990 13:00	137.545	0.06	0.46	0.52	0.013		71.523	1.788		
AW503502	CO	1/11/1990 13:00	140.600	0.03	0.51	0.54	0.08	2505	75.924	11.248		
AW503502	**CO**	**7/12/1990 12:00**	**57.181**	**0.02**	**0.39**	**0.410**	**0.039**	**2463**	**23.444**	**2.230**	**1933**	**97**
AW503502	**CO**	**16/01/1991 11:25**	**50.991**	**0.01**	**0.45**	**0.460**	**0.03**		**23.456**	**1.530**		
AW503502	CO	21/02/1991 10:45	7.622	0.01	0.44	0.45	0.02		3.430	0.152		
AW503502	CO	3/04/1991 14:16	8.016	0.01	0.05	0.06	0.026		0.481	0.208		
AW503502	ML	13/05/1991 11:40	49.132	0.01	0.3	0.31	0.02		15.231	0.983		
AW503502	ML	19/06/1991 11:37	109.107	0.02	0.29	0.31	0.014		33.823	1.528		
AW503502	CO	18/07/1991 11:20	452.521	0.4	1.04	1.44	0.12		651.631	54.303		
AW503502	CO	22/07/1991 13:53	28.418	0.18	0.46	0.64	0.043		18.188	1.222		
AW503502	ML	20/08/1991 14:40	333.471	0.14	0.56	0.7	0.036		233.430	12.005		
AW503502	MD	18/09/1991 12:18	1798.079	0.08	0.96	1.04	0.096		1870.002	172.616		
AW503502	CO	17/10/1991 14:42	999.274	0.06	0.46	0.52	0.043		519.622	42.969		
AW503502	CO	18/11/1991 10:57	99.948	0.02	0.32	0.34	0.027	3914	33.982	2.699		
AW503502	**ML**	**10/12/1991 9:26**	**16.382**	**0.01**	**0.02**	**0.030**	**0.034**	**3953**	**0.491**	**0.557**	**3404**	**291**
AW503502	**CO**	**21/01/1992 10:56**	**13.207**	**0.01**	**0.37**	**0.380**	**0.028**		**5.019**	**0.370**		
AW503502	CO	11/02/1992 17:42	3.746	0.08	0.49	0.57	0.016		2.135	0.060		
AW503502	CO	26/02/1992 14:25	2.494	0.01	0.51	0.52	0.02		1.297	0.050		
AW503502	CO	24/03/1992 14:15	29.734	0.03	0.18	0.21	0.045		6.244	1.338		
AW503502	CO	29/04/1992 12:00	61.125	0.03	0.26	0.29	0.036		17.726	2.201		
AW503502	CO	28/05/1992 12:00	107.004	0.02	0.42	0.44	0.034		47.082	3.638		
AW503502	CO	23/06/1992 11:10	215.789	0.06	0.51	0.57	0.044		122.999	9.495		
AW503502	CO	21/07/1992 13:00	539.779	0.18	0.95	1.13	0.115		609.950	62.075		
AW503502	CO	18/08/1992 10:44	751.627	0.14	0.97	1.11	0.091		834.306	68.398		
AW503502	CO	22/09/1992 14:58	2940.673	0.09	1.18	1.27	0.156		3734.655	458.745		
AW503502	CO	27/10/1992 14:26	1818.813	0.074	0.015	0.089	0.59		161.874	1073.100		
AW503502	CO	24/11/1992 12:09	348.343	0.13	0.58	0.71	0.07		247.323	24.384		
AW503502	CO	19/12/1992 4:48	481.679	0.11	2.76	2.87	0.38	7622	1382.420	183.038		
AW503502	**CO**	**21/12/1992 12:41**	**160.553**	**0.09**	**1.23**	**1.320**	**0.093**	**7475**	**211.930**	**14.931**	**7385**	**1902**
AW503502	**CO**	**19/01/1993 10:09**	**221.900**	**0.14**	**0.73**	**0.870**	**0.083**		**193.053**	**18.418**		
AW503502	CO	23/02/1993 14:23	59.704	0.1	0.68	0.78	0.04		46.569	2.388		
AW503502	CO	23/03/1993 11:44	54.023	0.03	0.45	0.48	0.032		25.931	1.729		

STATION	COLL	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503502	CO	28/04/1993 14:45	57.619	0.02	0.29	0.31	0.036		17.862	2.074		
AW503502	CO	25/05/1993 14:25	57.288	0.01	0.33	0.34	0.033		19.478	1.891		
AW503502	CO	22/06/1993 13:24	130.972	0.01	0.29	0.3	0.02		39.292	2.619		
AW503502	CO	27/07/1993 12:50	370.539	0.32	0.81	1.13	0.103		418.709	38.166		
AW503502	CO	24/08/1993 15:59	305.251	0.12	0.58	0.7	0.051		213.676	15.568		
AW503502	CO	19/09/1993 13:53	217.767	0.1	0.49	0.59	0.041		128.482	8.928		
AW503502	CO	21/09/1993 9:11	65.928	0.07	0.72	0.79	0.05		52.083	3.296		
AW503502	CO	3/10/1993 12:44	138.391	0.07	0.72	0.79	0.05		109.329	6.920		
AW503502	CO	6/10/1993 10:30	70.506	0.07	0.72	0.79	0.05		55.700	3.525		
AW503502	CO	14/10/1993 15:40	64.783	0.1	0.6	0.7	0.068		45.348	4.405		
AW503502	CO	20/10/1993 14:03	68.447	0.09	0.47	0.56	0.062		38.331	4.244		
AW503502	CO	27/10/1993 16:55	45.961	0.05	0.53	0.58	0.05		26.657	2.298		
AW503502	CO	3/11/1993 10:15	46.416	0.04	0.96	1	0.035		46.416	1.625		
AW503502	CO	11/11/1993 8:24	42.093	0.04	0.67	0.71	0.138		29.886	5.809		
AW503502	CO	17/11/1993 14:55	17.709	0.03	0.34	0.37	0.04		6.552	0.708		
AW503502	CO	25/11/1993 8:30	25.379	0.04	0.32	0.36	0.039		9.137	0.990		
AW503502	CO	1/12/1993 8:15	9.604	0.03	0.42	0.45	0.052		4.322	0.499		
AW503502	CO	8/12/1993 14:55	8.384	0.02	0.44	0.46	0.059		3.857	0.495		
AW503502	CO	14/12/1993 0:14	8.617	0.03	0.48	0.51	0.057		4.394	0.491		
AW503502	CO	15/12/1993 13:30	52.854	0.07	0.81	0.88	0.09	2037	46.512	4.757		
AW503502	**CO**	**21/12/1993 12:15**	**18.129**	**0.07**	**0.81**	**0.880**	**0.09**	**2158**	**15.954**	**1.632**	**1598**	**133**
AW503502	**CO**	**7/01/1994 15:50**	**61.809**	**0.04**	**0.45**	**0.490**	**0.065**		**30.287**	**4.018**		
AW503502	MD	19/01/1994 14:30	69.212	0.01	0.78	0.79	0.126		54.677	8.721		
AW503502	CO	20/01/1994 14:00	2.107	0.01	0.78	0.79	0.126		1.664	0.265		
AW503502	CO	27/01/1994 13:50	9.368	0.05	0.53	0.58	0.066		5.433	0.618		
AW503502	CO	3/02/1994 7:00	3.034	0.03	0.44	0.47	0.054		1.426	0.164		
AW503502	CO	9/02/1994 13:20	3.642	0.03	0.41	0.44	0.06		1.603	0.219		
AW503502	CO	12/02/1994 12:51	2.988	0.03	0.33	0.36	0.057		1.076	0.170		
AW503502	CO	22/02/1994 4:13	6.343	0.03	0.56	0.59	0.042		3.742	0.266		
AW503502	CO	2/03/1994 12:35	3.284	0.02	0.39	0.41	0.044		1.346	0.144		
AW503502	CO	9/03/1994 12:55	3.261	0.01	0.34	0.35	0.04		1.141	0.130		
AW503502	CO	16/03/1994 12:20	3.554	0.01	0.29	0.3	0.041		1.066	0.146		
AW503502	CO	23/03/1994 14:55	3.060	0.02	0.22	0.24	0.047		0.734	0.144		
AW503502	CO	30/03/1994 16:00	1.859	0.02	0.25	0.27	0.039		0.502	0.073		
AW503502	CO	6/04/1994 10:03	3.778	0.01	0.38	0.39	0.044		1.473	0.166		
AW503502	MS	8/04/1994 12:26	2.003	0.02	0.2	0.22	0.057		0.441	0.114		
AW503502	CO	13/04/1994 12:35	5.633	0.07	0.29	0.36	0.048		2.028	0.270		
AW503502	MS	20/04/1994 14:55	10.002	0.01	0.34	0.35	0.037		3.501	0.370		
AW503502	CO	28/04/1994 14:00	6.192	0.03	0.3	0.33	0.056		2.043	0.347		
AW503502	CO	2/05/1994 19:10	5.458	0.01	0.29	0.3	0.091		1.637	0.497		
AW503502	CO	8/05/1994 4:12	7.667	0.02	0.25	0.27	0.029		2.070	0.222		
AW503502	CO	18/05/1994 9:55	19.886	0.01	0.19	0.2	0.041		3.977	0.815		
AW503502	CO	24/05/1994 9:45	12.430	0.02	0.22	0.24	0.045		2.983	0.559		
AW503502	CO	1/06/1994 16:15	20.188	0.02	0.25	0.27	0.049		5.451	0.989		
AW503502	CO	8/06/1994 16:45	24.251	0.02	0.28	0.3	0.053		7.275	1.285		
AW503502	CO	15/06/1994 8:00	20.816	0.01	0.22	0.23	0.049		4.788	1.020		
AW503502	CO	22/06/1994 8:50	34.001	0.01	0.3	0.31	0.041		10.540	1.394		
AW503502	CO	29/06/1994 16:10	67.452	0.12	0.51	0.63	0.066		42.494	4.452		
AW503502	CO	6/07/1994 8:50	23.490	0.05	0.41	0.46	0.053		10.806	1.245		
AW503502	CO	13/07/1994 16:20	26.334	0.02	0.29	0.31	0.032		8.164	0.843		
AW503502	CO	20/07/1994 16:00	25.705	0.02	0.32	0.34	0.041		8.740	1.054		
AW503502	CO	27/07/1994 15:40	22.273	0.02	0.41	0.43	0.036		9.578	0.802		
AW503502	CO	3/08/1994 13:30	67.822	0.14	0.58	0.72	0.065		48.832	4.408		
AW503502	CO	10/08/1994 11:30	36.418	0.02	0.37	0.39	0.032		14.203	1.165		
AW503502	CO	17/08/1994 14:05	48.240	0.03	0.39	0.42	0.046		20.261	2.219		
AW503502	CO	24/08/1994 13:35	32.938	0.01	0.26	0.27	0.026		8.893	0.856		
AW503502	CO	31/08/1994 11:55	26.009	0.01	0.34	0.35	0.033		9.103	0.858		
AW503502	CO	7/09/1994 15:40	30.725	0.01	0.27	0.28	0.029		8.603	0.891		
AW503502	CO	14/09/1994 12:20	29.153	0.01	0.43	0.44	0.047		12.827	1.370		
AW503502	CO	21/09/1994 11:00	25.407	0.01	0.28	0.29	0.031		7.368	0.788		
AW503502	CO	28/09/1994 12:35	22.020	0.01	0.4	0.41	0.039		9.028	0.859		
AW503502	CO	5/10/1994 14:00	103.286	0.13	1.01	1.14	0.143		117.746	14.770		
AW503502	CO	12/10/1994 15:15	78.379	0.08	0.83	0.91	0.054		71.325	4.232		
AW503502	CO	19/10/1994 14:15	23.097	0.02	0.46	0.48	0.044		11.087	1.016		
AW503502	CO	26/10/1994 11:25	15.983	0.03	0.44	0.47	0.048		7.512	0.767		
AW503502	CO	2/11/1994 14:05	29.762	0.03	0.46	0.49	0.054		14.583	1.607		
AW503502	CO	9/11/1994 10:40	72.643	0.06	0.63	0.69	0.06		50.124	4.359		
AW503502	CO	16/11/1994 0:00	26.808	0.02	0.6	0.62	0.061		16.621	1.635		
AW503502	CO	16/11/1994 10:00	1.231	0.02	0.6	0.62	0.061		0.763	0.075		
AW503502	CO	23/11/1994 12:10	16.960	0.03	0.48	0.51	0.06		8.650	1.018		
AW503502	CO	30/11/1994 11:28	8.980	0.03	0.39	0.42	0.054		3.772	0.485		
AW503502	CO	7/12/1994 11:20	4.437	0.03	0.3	0.33	0.047		1.464	0.209		
AW503502	CO	14/12/1994 10:36	2.275	0.03	0.35	0.38	0.052		0.865	0.118		
AW503502	CO	21/12/1994 11:15	1.094	0.02	0.4	0.42	0.077	1181	0.459	0.084		
AW503502	**CO**	**28/12/1994 8:20**	**1.331**	**0.02**	**0.39**	**0.410**	**0.072**	**1216**	**0.546**	**0.096**	**677**	**75**
AW503502	**CO**	**4/01/1995 9:00**	**0.881**	**0.03**	**0.31**	**0.340**	**0.059**		**0.300**	**0.052**		
AW503502	CO	11/01/1995 7:40	0.562	0.06	0.39	0.45	0.089		0.253	0.050		
AW503502	CO	18/01/1995 9:54	0.911	0.07	0.39	0.46	0.115		0.419	0.105		
AW503502	CO	25/01/1995 10:00	0.931	0.04	0.36	0.4	0.101		0.372	0.094		
AW503502	CO	1/02/1995 10:00	1.000	0.05	0.52	0.57	0.117		0.570	0.117		
AW503502	CO	8/02/1995 10:30	2.821	0.01	0.58	0.59	0.081		1.664	0.228		
AW503502	CO	15/02/1995 10:10	1.745	0.04	0.37	0.41	0.066		0.715	0.115		
AW503502	CO	22/02/1995 10:50	1.163	0.12	0.52	0.64	0.074		0.745	0.086		
AW503502	CO	1/03/1995 10:08	0.756	0.03	0.48	0.51	0.087		0.386	0.066		

STATION	COLL	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503502	CO	8/03/1995 10:15	0.885	0.05	0.58	0.63	0.089		0.558	0.079		
AW503502	CO	15/03/1995 10:00	0.906	0.02	0.48	0.5	0.081		0.453	0.073		
AW503502	CO	21/03/1995 10:04	0.930	0.01	8.67	8.68	0.06		8.070	0.056		
AW503502	CO	29/03/1995 11:20	1.347	0.02	0.34	0.36	0.06		0.485	0.081		
AW503502	CO	5/04/1995 11:10	5.486	0.01	0.3	0.31	0.049		1.701	0.269		
AW503502	CO	11/04/1995 14:49	8.013	0.02	0.38	0.4	0.055		3.205	0.441		
AW503502	CO	19/04/1995 11:05	12.710	0.01	0.4	0.41	0.047		5.211	0.597		
AW503502	CO	26/04/1995 11:06	8.223	0.02	0.29	0.31	0.04		2.549	0.329		
AW503502	CO	3/05/1995 11:14	13.793	0.01	0.34	0.35	0.04		4.828	0.552		
AW503502	CO	10/05/1995 11:05	16.338	0.01	0.27	0.28	0.045		4.575	0.735		
AW503502	CO	17/05/1995 11:42	13.341	0.01	0.32	0.33	0.044		4.403	0.587		
AW503502	CO	23/05/1995 14:00	10.579	0.02	0.25	0.27	0.04		2.856	0.423		
AW503502	CO	23/05/1995 14:15	0.017	0.12	0.68	0.8	0.112		0.013	0.002		
AW503502	CO	6/06/1995 11:00	82.641	0.01	0.32	0.33	0.038		27.271	3.140		
AW503502	CO	14/06/1995 15:20	152.967	0.3	0.92	1.22	0.113		186.620	17.285		
AW503502	CO	21/06/1995 14:50	43.311	0.1	0.55	0.65	0.05		28.152	2.166		
AW503502	CO	28/06/1995 14:35	53.448	0.21	0.94	1.15	0.106		61.465	5.665		
AW503502	CO	5/07/1995 14:55	364.728	0.26	1.18	1.44	0.131		525.208	47.779		
AW503502	CO	11/07/1995 13:35	80.639	0.19	0.63	0.82	0.059		66.124	4.758		
AW503502	CO	18/07/1995 12:15	669.364	0.22	1.59	1.81	0.223		1211.548	149.268		
AW503502	CO	25/07/1995 13:05	1191.327	0.15	1.27	1.42	0.155		1691.684	184.656		
AW503502	CO	1/08/1995 13:25	564.827	0.14	0.78	0.92	0.074		519.641	41.797		
AW503502	CO	8/08/1995 13:20	629.145	0.12	0.91	1.03	0.077		648.019	48.444		
AW503502	CO	15/08/1995 13:40	122.054	0.19	0.51	0.7	0.037		85.438	4.516		
AW503502	CO	22/08/1995 9:50	59.973	0.19	0.44	0.63	0.04		37.783	2.399		
AW503502	CO	29/08/1995 12:15	49.875	0.1	0.42	0.52	0.039		25.935	1.945		
AW503502	CO	5/09/1995 12:25	42.678	0.02	0.6	0.62	0.034		26.460	1.451		
AW503502	CO	12/09/1995 12:15	36.242	0.03	0.26	0.29	0.021		10.510	0.761		
AW503502	CO	20/09/1995 7:30	39.997	0.01	0.36	0.37	0.023		14.799	0.920		
AW503502	CO	26/09/1995 13:05	91.865	0.11	1.19	1.3	0.123		119.425	11.299		
AW503502	CO	3/10/1995 11:40	50.449	0.07	0.58	0.65	0.044		32.792	2.220		
AW503502	CO	10/10/1995 11:55	42.311	0.07	0.51	0.58	0.044		24.541	1.862		
AW503502	CO	17/10/1995 13:15	27.829	0.04	0.54	0.58	0.04		16.141	1.113		
AW503502	CO	24/10/1995 0:00	20.178	0.02	0.47	0.49	0.035		9.887	0.706		
AW503502	CO	31/10/1995 13:15	22.630	0.01	0.58	0.59	0.03		13.352	0.679		
AW503502	CO	7/11/1995 12:15	15.623	0.01	0.63	0.64	0.034		9.998	0.531		
AW503502	CO	14/11/1995 13:30	14.538	0.02	0.32	0.34	0.038		4.943	0.552		
AW503502	CO	21/11/1995 12:25	9.149	0.01	0.25	0.26	0.039		2.379	0.357		
AW503502	CO	28/11/1995 13:40	6.540	0.02	0.3	0.32	0.038		2.093	0.249		
AW503502	CO	5/12/1995 11:10	3.777	0.02	0.33	0.35	0.056		1.322	0.211		
AW503502	CO	12/12/1995 13:15	3.528	0.01	0.34	0.35	0.056		1.235	0.198		
AW503502	CO	19/12/1995 9:45	1.783	0.03	0.25	0.28	0.073	4598	0.499	0.130		
AW503502	**CO**	**26/12/1995 11:40**	**1.977**	**0.02**	**0.42**	**0.440**	**0.087**	**4599**	**0.870**	**0.172**	**5450**	**542**
AW503502	**CO**	**2/01/1996 14:10**	**1.422**	**0.02**	**0.54**	**0.560**	**0.134**		**0.797**	**0.191**		
AW503502	CO	9/01/1996 14:35	1.350	0.08	0.36	0.44	0.112		0.594	0.151		
AW503502	CO	23/01/1996 10:30	1.600	0.08	0.54	0.62	0.138		0.992	0.221		
AW503502	CO	6/02/1996 11:20	4.885	0.03	0.62	0.65	0.051		3.175	0.249		
AW503502	CO	13/02/1996 12:00	1.658	0.03	0.53	0.56	0.063		0.929	0.104		
AW503502	CO	20/02/1996 11:35	0.944	0.07	0.78	0.85	0.06		0.803	0.057		
AW503502	CO	27/02/1996 12:30	0.565	0.13	1.53	1.66	0.092		0.937	0.052		
AW503502	CO	5/03/1996 12:55	1.057	0.06	0.52	0.58	0.062		0.613	0.066		
AW503502	CO	12/03/1996 12:10	0.884	0.06	0.86	0.92	0.058		0.814	0.051		
AW503502	CO	19/03/1996 13:15	2.262	0.02	0.52	0.54	0.059		1.222	0.133		
AW503502	CO	26/03/1996 12:30	4.418	0.01	0.68	0.69	0.053		3.049	0.234		
AW503502	CO	2/04/1996 12:05	2.971	0.03	0.66	0.69	0.052		2.050	0.155		
AW503502	CO	9/04/1996 11:25	6.010	0.01	0.51	0.52	0.049		3.125	0.295		
AW503502	CO	16/04/1996 12:00	7.075	0.01	0.44	0.45	0.038		3.184	0.269		
AW503502	CO	23/04/1996 13:25	8.512	0.01	0.48	0.49	0.034		4.171	0.289		
AW503502	CO	1/05/1996 10:20	14.461	0.01	0.4	0.41	0.043		5.929	0.622		
AW503502	CO	14/05/1996 10:35	17.942	0.01	0.32	0.33	0.031		5.921	0.556		
AW503502	CO	17/07/1996 10:45	480.400	0.1	0.69	0.79	0.047		379.516	22.579		
AW503502	CO	24/07/1996 16:00	387.720	0.21	1.29	1.5	0.138		581.580	53.505		
AW503502	CO	31/07/1996 13:50	137.152	0.3	0.72	1.02	0.062		139.895	8.503		
AW503502	CO	6/08/1996 13:20	1260.226	0.12	2.74	2.86	0.308		3604.246	388.150		
AW503502	CO	13/08/1996 10:50	325.079	0.13	0.8	0.93	0.057		302.324	18.530		
AW503502	CO	20/08/1996 11:30	166.700	0.155	0.68	0.835	0.048		139.195	8.002		
AW503502	CO	28/08/1996 11:15	307.043	0.1	0.82	0.92	0.062		282.480	19.037		
AW503502	CO	4/09/1996 12:40	158.049	0.214	0.69	0.904	0.044		142.876	6.954		
AW503502	CO	11/09/1996 15:55	76.448	0.043	0.6	0.643	0.032		49.156	2.446		
AW503502	CO	18/09/1996 9:00	132.318	0.054	0.7	0.754	0.058		99.768	7.674		
AW503502	CO	2/10/1996 12:20	1144.823	0.077	2.68	2.757	0.372		3156.277	425.874		
AW503502	CO	9/10/1996 10:40	210.400	0.091	0.7	0.791	0.043		166.426	9.047		
AW503502	MD	16/10/1996 15:45	65.911	0.099	0.5	0.599	0.05		39.481	3.296		
AW503502	CO	30/10/1996 13:40	63.188	0.037	0.6	0.637	0.036		40.251	2.275		
AW503502	CO	6/11/1996 12:05	18.867	0.023	0.47	0.493	0.026		9.302	0.491		
AW503502	CO	13/11/1996 15:20	16.483	0.011	0.42	0.431	0.026		7.104	0.429		
AW503502	CO	27/11/1996 14:10	19.408	0.015	0.5	0.515	0.024		9.995	0.466		
AW503502	CO	4/12/1996 11:20	6.0413	0.058	0.36	0.418	0.019		2.525	0.115		
AW503502	CO	11/12/1996 11:55	10.4232	0.006	0.42	0.426	0.028		4.440	0.292		
AW503502	CO	18/12/1996 10:40	3.0468	0.006	0.56	0.566	0.022	5069	1.724	0.067		
AW503502	**CO**	**26/12/1996 11:45**	**2.7439**	**0.0025**	**0.35**	**0.353**	**0.023**	**5070**	**0.967**	**0.063**	**9198**	**981**
AW503502	**CO**	**2/01/1997 10:10**	**1.5635**	**0.0025**	**0.50**	**0.503**	**0.023**		**0.786**	**0.036**		
AW503502	CO	9/01/1997 10:45	0.9991	0.011	0.35	0.361	0.031		0.361	0.031		
AW503502	CO	16/01/1997 8:45	0.9141	0.011	0.67	0.681	0.053		0.622	0.048		

STATION	COLI	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503502	CO	23/01/1997 14:25	2.1565	0.031	0.53	0.561	0.049		1.210	0.106		
AW503502	CO	30/01/1997 10:45	2.6752	0.016	0.72	0.736	0.045		1.969	0.120		
AW503502	CO	6/02/1997 10:35	1.5801	0.017	0.61	0.627	0.036		0.991	0.057		
AW503502	CO	12/02/1997 10:45	2.8346	0.010	0.63	0.64	0.060		1.814	0.170		
AW503502	CO	19/02/1997 8:10	2.4627	0.017	0.39	0.407	0.044		1.002	0.108		
AW503502	CO	26/02/1997 8:05	1.6262	0.017	0.58	0.597	0.059		0.971	0.096		
AW503502	CO	5/03/1997 15:10	1.8217	0.015	0.33	0.345	0.043		0.628	0.078		
AW503502	CO	12/03/1997 12:10	3.7324	0.003	0.36	0.3625	0.032		1.353	0.119		
AW503502	CO	19/03/1997 13:55	3.6369	0.008	0.36	0.368	0.034		1.338	0.124		
AW503502	CO	26/03/1997 8:20	3.2725	0.010	0.32	0.33	0.030		1.080	0.098		
AW503502	CO	2/04/1997 9:30	3.4263	0.011	0.31	0.321	0.024		1.100	0.082		
AW503502	CO	9/04/1997 10:10	5.5619	0.013	0.25	0.263	0.033		1.463	0.184		
AW503502	CO	16/04/1997 13:15	5.0537	0.015	0.40	0.415	0.030		2.097	0.152		
AW503502	CO	24/04/1997 12:35	5.3656	0.012	0.28	0.292	0.028		1.567	0.150		
AW503502	CO	28/04/1997 13:35	2.4829	0.007	0.96	0.967	0.030		2.401	0.074		
AW503502	CO	6/05/1997 9:10	10.4549	0.016	0.76	0.776	0.154		8.113	1.610		
AW503502	CO	14/05/1997 13:35	14.0355	0.009	0.44	0.449	0.048		6.302	0.674		
AW503502	CO	20/05/1997 14:45	11.3324	0.015	0.40	0.415	0.035		4.703	0.397		
AW503502	CO	28/05/1997 12:45	21.2343	0.013	0.35	0.363	0.041		7.708	0.871		
AW503502	CO	1/07/1997 12:00	117.2602	0.477	0.34	0.817	0.026		95.802	3.049		
AW503502	CO	8/07/1997 10:50	16.6787	0.006	0.46	0.466	0.024		7.772	0.400		
AW503502	CO	15/07/1997 8:40	24.3181	0.009	0.32	0.329	0.03		8.001	0.730		
AW503502	CO	22/07/1997 11:05	36.6405	0.022	0.47	0.492	0.036		18.027	1.319		
AW503502	CO	30/07/1997 13:30	28.9851	0.005	0.41	0.415	0.023		12.029	0.667		
AW503502	CO	6/08/1997 10:25	18.6707	0.008	0.35	0.358	0.024		6.684	0.448		
AW503502	CO	13/08/1997 9:35	342.7982	0.315	2.4	2.715	0.35		930.697	119.979		
AW503502	CO	20/08/1997 14:10	97.5136	0.168	0.72	0.888	0.048		86.592	4.681		
AW503502	CO	27/08/1997 11:45	73.9492	0.041	0.59	0.631	0.039		46.662	2.884		
AW503502	CO	3/09/1997 11:40	231.3794	0.112	1.14	1.252	0.076		289.687	17.585		
AW503502	CO	10/09/1997 12:40	296.6156	0.111	1.2	1.311	0.075		388.863	22.246		
AW503502	CO	17/09/1997 15:20	130.8748	0.104	1.2	1.304	0.056		170.661	7.329		
AW503502	CO	24/09/1997 14:00	87.7103	0.06	0.79	0.85	0.057		74.554	4.999		
AW503502	CO	1/10/1997 14:30	43.9752	0.019	0.81	0.829	0.04		36.455	1.759		
AW503502	CO	8/10/1997 12:05	27.6414	0.021	0.57	0.591	0.036		16.336	0.995		
AW503502	CO	15/10/1997 13:55	20.7674	0.008	0.56	0.568	0.034		11.796	0.706		
AW503502	CO	22/10/1997 14:00	19.2360	0.012	0.6	0.612	0.027		11.772	0.519		
AW503502	CO	29/10/1997 11:55	10.6547	0.022	0.53	0.552	0.039		5.881	0.416		
AW503502	CO	31/10/1997 14:00	28.5696	0.008	0.79	0.798	0.102		22.799	2.914		
AW503502	CO	5/11/1997 14:20	101.0150	0.126	1.16	1.286	0.113		129.905	11.415		
AW503502	CO	12/11/1997 9:00	19.5953	0.037	0.59	0.627	0.059		12.286	1.156		
AW503502	CO	19/11/1997 13:20	24.4469	0.014	0.58	0.594	0.045		14.521	1.100		
AW503502	CO	26/11/1997 7:05	8.975	0.016	0.64	0.656	0.037		5.888	0.332		
AW503502	CO	4/12/1997 16:34	6.388	0.019	0.71	0.729	0.052		4.657	0.332		
AW503502	CO	10/12/1997 13:20	4.957	0.04	0.39	0.43	0.043		2.132	0.213		
AW503502	CO	17/12/1997 11:45	4.508	0.017	0.64	0.657	0.046		2.961	0.207		
AW503502	CO	24/12/1997 7:45	5.304	0.022	0.59	0.612	0.051	1938	3.246	0.270		
AW503502	**CO**	**31/12/1997 7:20**	**1.970**	**0.028**	**0.52**	**0.548**	**0.05**	**1940**	**1.080**	**0.099**	**2467**	**214**
AW503502	**CO**	**7/01/1998 9:35**	**0.568**	**0.005**	**0.48**	**0.485**	**0.062**		**0.276**	**0.035**		
AW503502	CO	15/01/1998 8:35	0.824	0.084	0.69	0.774	0.085		0.638	0.070		
AW503502	CO	21/01/1998 11:55	0.208	0.209	1.1	1.309	0.162		0.273	0.034		
AW503502	CO	28/01/1998 10:25	0.534	0.186	0.81	0.996	0.126		0.532	0.067		
AW503502	CO	4/02/1998 11:10	0.526	0.174	0.92	1.094	0.104		0.575	0.055		
AW503502	CO	10/02/1998 11:00	0.602	0.066	0.88	0.946	0.105		0.570	0.063		
AW503502	CO	18/02/1998 10:05	0.964	0.028	0.61	0.638	0.048		0.615	0.046		
AW503502	CO	25/02/1998 6:25	0.816	0.012	0.92	0.932	0.033		0.761	0.027		
AW503502	CO	4/03/1998 14:30	0.560	0.012	0.97	0.982	0.025		0.550	0.014		
AW503502	CO	11/03/1998 8:50	0.515	0.018	0.93	0.948	0.023		0.488	0.012		
AW503502	CO	25/03/1998 8:00	1.573	0.012	0.6	0.612	0.021		0.963	0.033		
AW503502	CO	1/04/1998 0:00	1.755	0.011	0.37	0.381	0.02		0.669	0.035		
AW503502	CO	8/04/1998 9:00	3.295	0.008	0.3	0.308	0.037		1.015	0.122		
AW503502	CO	15/04/1998 9:15	13.639	0.005	0.46	0.465	0.075		6.342	1.023		
AW503502	CO	16/04/1998 12:55	1.834	0.013	0.75	0.763	0.03		1.400	0.055		
AW503502	CO	23/04/1998 9:00	23.013	0.005	0.47	0.475	0.116		10.931	2.669		
AW503502	CO	29/04/1998 9:20	26.544	0.006	0.45	0.456	0.042		12.104	1.115		
AW503502	CO	6/05/1998 8:20	13.683	0.005	0.5	0.505	0.033		6.910	0.452		
AW503502	CO	13/05/1998 10:30	11.681	0.005	0.48	0.485	0.023		5.665	0.269		
AW503502	CO	20/05/1998 9:25	12.689	0.005	0.37	0.375	0.023		4.758	0.292		
AW503502	CO	27/05/1998 9:45	24.785	0.007	0.32	0.327	0.031		8.105	0.768		
AW503502	CO	3/06/1998 9:10	15.246	0.005	0.49	0.495	0.025		7.547	0.381		
AW503502	CO	10/06/1998 14:25	37.314	0.012	0.42	0.432	0.049		16.119	1.828		
AW503502	CO	17/06/1998 15:45	53.355	0.045	0.62	0.665	0.061		35.481	3.255		
AW503502	CO	24/06/1998 15:10	130.938	0.208	1.14	1.348	0.137		176.505	17.939		
AW503502	CO	1/07/1998 13:55	68.501	0.076	0.69	0.766	0.039		52.471	2.672		
AW503502	CO	8/07/1998 9:20	98.754	0.131	0.91	1.041	0.091		102.803	8.987		
AW503502	CO	15/07/1998 9:20	112.109	0.123	0.86	0.983	0.067		110.203	7.511		
AW503502	CO	22/07/1998 9:40	63.208	0.08	0.51	0.59	0.036		37.292	2.275		
AW503502	CO	28/07/1998 12:05	211.277	0.213	1.88	2.093	0.244		442.203	51.552		
AW503502	CO	28/07/1998 15:48	58.814	0.157	1.65	1.807	0.116		106.278	6.822		
AW503502	CO	5/08/1998 10:15	330.813	0.16	1.05	1.21	0.071		400.284	23.488		
AW503502	CO	12/08/1998 4:30	120.749	0.104	0.7	0.804	0.05		97.082	6.037		
AW503502	CO	19/08/1998 9:25	82.168	0.072	0.6	0.672	0.044		55.217	3.615		
AW503502	CO	26/08/1998 15:40	186.855	0.094	0.94	1.034	0.078		193.208	14.575		
AW503502	CO	2/09/1998 8:30	93.716	0.068	0.73	0.798	0.046		74.785	4.311		
AW503502	CO	9/09/1998 9:40	81.227	0.047	0.67	0.717	0.052		58.240	4.224		

STATION	COLl	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503502	CO	16/09/1998 8:30	46.702	0.019	0.52	0.539	0.031		25.172	1.448		
AW503502	CO	23/09/1998 12:55	92.792	0.085	1.13	1.215	0.13		112.742	12.063		
AW503502	CO	30/09/1998 9:35	137.366	0.068	0.98	1.048	0.073		143.959	10.028		
AW503502	CO	11/11/1998 8:45	247.272	0.014	1.13	1.144	0.149		282.880	36.844		
AW503502	CO	18/11/1998 5:50	28.177	0.013	0.47	0.483	0.045		13.610	1.268		
AW503502	CO	25/11/1998 6:00	11.610	0.03	0.48	0.51	0.034		5.921	0.395		
AW503502	CO	2/12/1998 8:55	8.378	0.005	0.32	0.325	0.039		2.723	0.327		
AW503502	CO	9/12/1998 6:15	4.266	0.087	0.88	0.967	0.041		4.125	0.175		
AW503502	CO	16/12/1998 5:55	1.744	0.042	0.42	0.462	0.031		0.806	0.054		
AW503502	CO	23/12/1998 7:55	2.274	0.022	0.54	0.562	0.039	2466	1.278	0.089		
AW503502	**CO**	**30/12/1998 7:45**	**1.116**	**0.047**	**0.4**	**0.447**	**0.028**	**2467**	**0.499**	**0.031**	**2624**	**229**
AW503502	**CO**	**6/01/1999 5:50**	**0.640**	**0.113**	**0.6**	**0.713**	**0.031**		**0.456**	**0.020**		
AW503502	CO	13/01/1999 6:10	0.640	0.115	0.61	0.725	0.04		0.464	0.026		
AW503502	CO	20/01/1999 8:40	0.288	0.102	0.5	0.602	0.02		0.173	0.006		
AW503502	CO	27/01/1999 5:40	0.288	0.08	0.62	0.7	0.029		0.202	0.008		
AW503502	CO	3/02/1999 5:30	0.446	0.036	0.58	0.616	0.025		0.275	0.011		
AW503502	CO	10/02/1999 5:55	0.311	0.048	0.6	0.648	0.025		0.201	0.008		
AW503502	CO	17/02/1999 6:10	0.296	0.045	0.46	0.505	0.032		0.150	0.009		
AW503502	CO	24/02/1999 6:15	0.545	0.027	0.43	0.457	0.029		0.249	0.016		
AW503502	CO	3/03/1999 8:50	0.488	0.034	0.36	0.394	0.019		0.192	0.009		
AW503502	CO	10/03/1999 6:15	1.114	0.019	0.44	0.459	0.043		0.511	0.048		
AW503502	CO	17/03/1999 6:00	0.794	0.017	0.41	0.427	0.037		0.339	0.029		
AW503502	CO	24/03/1999 6:05	6.402	0.013	0.46	0.473	0.054		3.028	0.346		
AW503502	CO	31/03/1999 6:35	8.224	0.018	0.35	0.368	0.045		3.027	0.370		
AW503502	CO	7/04/1999 10:20	10.112	0.005	0.31	0.315	0.032		3.185	0.324		
AW503502	CO	14/04/1999 8:19	6.002	0.038	0.48	0.518	0.032		3.109	0.192		
AW503502	CO	21/04/1999 6:50	6.074	0.017	0.25	0.267	0.025		1.622	0.152		
Max				0.477	8.67	8.68	0.59					
Min				0.0025	0.015	0.03	0.012					
Mean				0.05935	0.59439	0.65374	0.05873					
Median				0.03	0.49	0.539	0.044					
SD				0.0711	0.55156	0.57463	0.05351					
AW503504 Onkaparinga River at Houlgraves												
WQ#3205												
AW503504	CO	25/08/1988 10:45	NA									
AW503504	MD	1/09/1988 11:30	2097.782	0.44	0.89	1.33	0.13		2790.050	272.712		
AW503504	CO	8/09/1988 12:00	1135.874	0.32	0.72	1.04	0.086		1181.309	97.685		
AW503504	CO	22/09/1988 10:35	8427.569	0.48	0.8	1.28	0.11		10787.288	927.033		
AW503504	MD	19/10/1988 12:00	1719.523						0.000	0.000		
AW503504	MD	1/12/1988 12:10	1771.739	0.14	0.7	0.84	0.13		1488.261	230.326		
AW503504	MD	8/12/1988 12:00	775.244						0.000	0.000		
AW503504	CO	9/12/1988 13:45	126.231	0.09	0.74	0.83	0.15		104.772	18.935		
AW503504	**MD**	**15/12/1988 13:00**	**573.627**	**0.1**	**0.7**	**0.800**	**0.15**		**458.901**	**86.044**		
AW503504	**MD**	**5/01/1989 12:00**	**2028.796**	**0.08**	**0.67**	**0.750**	**0.135**		**1521.597**	**273.887**		
AW503504	CO	2/02/1989 11:15	1797.934	0.06	0.63	0.69	0.12		1240.574	215.752		
AW503504	MD	12/02/1989 12:00	230.949	0.065	0.61	0.675	0.1		155.891	23.095		
AW503504	MD	2/03/1989 14:40	823.655	0.07	0.59	0.66	0.082		543.612	67.540		
AW503504	MD	22/03/1989 15:00	1049.396	0.11	0.43	0.54	0.089		566.674	93.396		
AW503504	MD	29/03/1989 11:45	423.296	0.04	0.54	0.58	0.087		245.512	36.827		
AW503504	MD	7/04/1989 14:00	563.067	0.06	0.47	0.53	0.08		298.425	45.045		
AW503504	MD	27/04/1989 11:30	1298.298	0.04	0.65	0.69	0.13		895.826	168.779		
AW503504	MD	10/05/1989 12:30	1048.032	0.02	0.8	0.82	0.17		859.386	178.165		
AW503504	MD	26/05/1989 15:00	1202.770	0.21	0.48	0.69	0.28		829.911	336.776		
AW503504	CO	14/06/1989 13:45	1127.159	0.69	0.64	1.33	0.15		1499.121	169.074		
AW503504	CO	4/07/1989 16:00	3322.552	0.98	0.6	1.58	0.12		5249.632	398.706		
AW503504	MD	12/07/1989 15:45	2640.459	1.18	0.85	2.03	0.15		5360.132	396.069		
AW503504	CO	28/07/1989 14:30	1861.644	0.94	0.8	1.74	0.14		3239.261	260.630		
AW503504	MD	7/08/1989 11:45	10574.080	0.65	1	1.65	0.13		17447.232	1374.630		
AW503504	CO	11/09/1989 11:40	17489.980	0.37	1.06	1.43	0.12		25010.671	2098.798		
AW503504	CO	21/09/1989 10:50	6352.111	0.49	1.15	1.64	0.17		10417.462	1079.859		
AW503504	CO	12/10/1989 15:20	3413.811	0.34	0.64	0.98	0.088		3345.535	300.415		
AW503504	CO	2/11/1989 14:15	2204.795	0.18	0.77	0.95	0.12		2094.555	264.575		
AW503504	MD	16/11/1989 10:00	1840.847	0.13	0.92	1.05	0.14		1932.889	257.719		
AW503504	CO	1/12/1989 11:45	1045.331	0.13	0.79	0.92	0.1	62275	961.705	104.533		
AW503504	**MD**	**19/12/1989 13:30**	**680.033**	**0.1**	**0.7**	**0.800**	**0.12**	**63019**	**544.026**	**81.604**	**84260**	**8226**
AW503504	**MD**	**10/01/1990 9:45**	**1515.905**	**0.06**	**0.52**	**0.580**	**0.097**		**879.225**	**147.043**		
AW503504	CO	5/02/1990 13:30	1881.793	0.16	0.52	0.68	0.1		1279.619	188.179		
AW503504	CO	27/02/1990 13:15	2963.687	0.04	0.49	0.53	0.083		1570.754	245.986		
AW503504	CO	14/03/1990 13:45	1685.772	0.07	0.47	0.54	0.078		910.317	131.490		
AW503504	CO	29/03/1990 13:45	872.989	0.04	0.58	0.62	0.066		541.253	57.617		
AW503504	CO	4/05/1990 11:30	95.951	0.01	0.59	0.6	0.047		57.570	4.510		
AW503504	MD	24/05/1990 12:35	882.564	0.06	0.65	0.71	0.12		626.620	105.908		
AW503504	MD	19/06/1990 14:05	3435.552	0.09	0.57	0.66	0.13		2267.464	446.622		
AW503504	MD	3/07/1990 12:00	3429.630	0.6	0.9	1.5	0.125		5144.445	428.704		
AW503504	CO	19/07/1990 11:36	6421.341	0.96	1.14	2.1	0.12		13484.816	770.561		
AW503504	MD	22/08/1990 12:00	18951.350	0.52	1.83	2.35	0.26		44535.673	4927.351		
AW503504	MD	20/09/1990 13:50	7971.246	0.18	0.84	1.02	0.11		8130.671	876.837		
AW503504	MD	11/10/1990 9:20	3365.978	0.19	0.93	1.12	0.13		3769.895	437.577		
AW503504	MD	31/10/1990 11:15	2465.592	0.17	0.28	0.45	0.19		1109.516	468.462		
AW503504	CO	7/12/1990 10:10	7212.961	0.07	0.76	0.83	0.15	68982	5986.758	1081.944		
			5830	**0.06**	**0.84**	**0.900**	**0.13**	**68982**	5247.000	757.900	**95542**	**11077**

STATION	COLL	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503504	CO	15/01/1991 12:17	9855.428	0.05	0.9	0.950	0.084					
			4025.428	0.05	0.9	0.95	0.084		3824.157	338.136		
AW503504	CO	21/02/1991 12:40	7217.475	0.03	0.63	0.66	0.041		4763.534	295.916		
AW503504	CO	3/04/1991 11:36	5257.661	0.01	0.63	0.64	0.084		3364.903	441.644		
AW503504	CO	14/05/1991 14:46	133.500	0.05	0.54	0.59	0.076		78.765	10.146		
AW503504	CO	18/06/1991 13:22	1985.230	0.27	0.6	0.87	0.12		1727.150	238.228		
AW503504	CO	17/07/1991 5:28	7537.898	0.95	1.39	2.34	0.26		17638.681	1959.853		
AW503504	CO	21/08/1991 5:22	9509.803	0.54	0.98	1.52	0.17		14454.901	1616.667		
AW503504	CO	30/08/1991 12:05	12334.050	0.55	1.47	2.02	0.23		24914.781	2836.832		
AW503504	CO	20/09/1991 8:24	24083.360	0.42	2.23	2.65	0.39		63820.904	9392.510		
AW503504	MS	16/10/1991 16:21	6891.993	0.01	0.77	0.78	0.00007		5375.755	0.482		
AW503504	CO	16/10/1991 18:03	2.211	0.42	1.54	1.96	0.00023		4.334	0.001		
AW503504	ML	13/11/1991 12:53	1783.121	0.05	0.73	0.78	0.00011		1390.834	0.196		
AW503504	CO	4/12/1991 11:50	2907.910	0.09	0.91	1	0.00015	87782	2907.910	0.436		
AW503504	**MS**	**10/12/1991 13:30**	**813.928**	**0.12**	**0.98**	**1.100**	**0.00016**	**84484**	**895.321**	**0.130**	**145162**	**17131**
AW503504	**CO**	**21/01/1992 9:24**	**5596.636**	**0.16**	**0.66**	**0.820**	**0.0001**		**4589.242**	**0.560**		
AW503504	CO	24/02/1992 14:12	3592.873	0.1	0.53	0.63	0.0001		2263.510	0.359		
AW503504	CO	25/03/1992 10:30	434.739	0.18	0.5	0.68	0.0001		295.623	0.043		
AW503504	MS	31/03/1992 10:40	11.286	0.02	0.56	0.58	0.00006		6.546	0.001		
AW503504	CO	30/04/1992 10:54	190.611	0.02	0.48	0.5	0.054		95.306	10.293		
AW503504	CO	26/05/1992 11:42	643.139	0.66	0.58	1.24	0.137		797.492	88.110		
AW503504	CO	24/06/1992 10:13	2492.373	0.65	0.98	1.63	0.205		4062.568	510.936		
AW503504	CO	21/07/1992 15:24	5144.069	0.73	1.12	1.85	0.234		9516.528	1203.712		
AW503504	CO	24/08/1992 12:11	13692.490	0.49	1.35	1.84	0.25		25194.182	3423.123		
AW503504	CO	30/08/1992 10:24	7886.781	0.55	1.52	2.07	0.288		16325.637	2271.393		
AW503504	MS	23/09/1992 11:50	44182.090	0.45	1.18	1.63	0.15		72016.807	6627.314		
AW503504	CO	25/11/1992 8:45	32604.890	0.39	1.48	1.87	0.294	131706	60971.144	9585.838		
			15234.000	**0.3**	**1.3**	**1.600**	**0.2**	**131706**	24374.400	3046.800	**220509**	**26768**
AW503504	*MS*	*24/02/1993 12:22*	*19271.050*	*0.01*	*0.83*	**0.840**	*0.12*					
			3499.000	0.01	0.83	0.84	0.12		2939.160	419.880		
AW503504	CO	24/03/1993 11:04	309.616	0.21	0.64	0.85	0.074		263.173	22.912		
AW503504	CO	29/04/1993 11:01	132.139	0.04	0.63	0.67	0.044		88.533	5.814		
AW503504	CO	26/05/1993 14:28	338.555	0.02	0.45	0.47	0.06		159.121	20.313		
AW503504	CO	22/06/1993 15:46	1012.020	0.21	0.52	0.73	0.062		738.775	62.745		
AW503504	CO	27/07/1993 14:10	4113.175	0.81	1.24	2.05	0.266		8432.009	1094.105		
AW503504	CO	24/08/1993 13:26	3111.470	0.56	0.77	1.33	0.122		4138.255	379.599		
AW503504	CO	21/09/1993 14:45	3628.975	0.29	0.94	1.23	0.147		4463.639	533.459		
AW503504	CO	6/10/1993 13:06	4352.627	0.017	0.81	0.827	0.124		3599.623	539.726		
AW503504	ML	14/10/1993 13:27	1875.464	0.09	0.67	0.76	0.132		1425.353	247.561		
AW503504	CO	20/10/1993 15:20	1899.784	0.16	0.77	0.93	0.184		1766.799	349.560		
AW503504	MD	27/10/1993 15:40	1793.210	0.09	0.86	0.95	0.152		1703.550	272.568		
AW503504	CO	3/11/1993 12:00	1141.929	0.13	0.69	0.82	0.114		936.382	130.180		
AW503504	MD	10/11/1993 15:20	1475.294	0.05	0.9	0.95	0.16		1401.529	236.047		
AW503504	ML	17/11/1993 13:14	1515.359	0.04	1.22	1.26	0.169		1909.352	256.096		
AW503504	CO	24/11/1993 11:25	1546.234	0.06	1.1	1.16	0.174		1793.631	269.045		
AW503504	ML	1/12/1993 9:00	1417.043	0.06	1.04	1.1	0.182		1558.747	257.902		
AW503504	MD	8/12/1993 12:15	1429.668	0.03	1.13	1.16	0.178		1658.415	254.481		
AW503504	CO	15/12/1993 10:10	1730.341	0.21	1.57	1.78	0.544	37558	3080.007	941.306		
AW503504	**ML**	**21/12/1993 9:25**	**1236.389**	**0.06**	**0.82**	**0.88**	**0.181**	**37558**	**1088.022**	**223.786**	**43144**	**6517**
AW503504	**CO**	**13/01/1994 7:30**	**5615.572**	**0.12**	**0.75**	**0.87**	**0.127**		**4885.548**	**713.178**		
AW503504	MD	19/01/1994 12:15	1280.434	0.06	0.75	0.81	0.12		1037.152	153.652		
AW503504	CO	27/01/1994 11:30	1591.706	0.04	0.74	0.78	0.12		1241.531	191.005		
AW503504	CO	3/02/1994 10:20	1398.058	0.03	0.76	0.79	0.11		1104.466	153.786		
AW503504	CO	9/02/1994 10:40	1076.370	0.07	0.63	0.7	0.11		753.459	118.401		
AW503504	CO	16/02/1994 11:00	1320.789	0.09	0.59	0.68	0.099		898.137	130.758		
AW503504	CO	24/02/1994 13:30	1604.217	0.06	0.57	0.63	0.087		1010.657	139.567		
AW503504	CO	2/03/1994 11:10	1200.416	0.04	0.49	0.53	0.076		636.220	91.232		
AW503504	ML	9/03/1994 10:44	1414.032	0.03	0.49	0.52	0.067		735.297	94.740		
AW503504	ML	16/03/1994 10:10	1367.879	0.03	0.59	0.62	0.075		848.085	102.591		
AW503504	ML	23/03/1994 12:15	1786.286	0.05	0.57	0.62	0.074		1107.497	132.185		
AW503504	CO	30/03/1994 13:20	1756.590	0.04	0.57	0.61	0.073		1071.520	128.231		
AW503504	ML	6/04/1994 11:50	1581.591	0.02	0.46	0.48	0.072		759.164	113.875		
AW503504	MD	13/04/1994 12:20	1785.936	0.03	0.5	0.53	0.085		946.546	151.805		
AW503504	MD	20/04/1994 12:00	1753.847	0.05	0.54	0.59	0.08		1034.770	140.308		
AW503504	MD	28/04/1994 13:15	2016.165	0.04	0.51	0.55	0.077		1108.891	155.245		
AW503504	CO	4/05/1994 14:00	1088.067	0.05	0.47	0.52	0.075		565.795	81.605		
AW503504	CO	11/05/1994 12:45	129.684	0.05	0.56	0.61	0.106		79.107	13.746		
AW503504	CO	18/05/1994 11:40	1697.267	0.06	0.42	0.48	0.069		814.688	117.111		
AW503504	CO	24/05/1994 11:10	1454.922	0.09	0.4	0.49	0.071		712.912	103.299		
AW503504	CO	1/06/1994 13:50	1721.399	0.12	0.44	0.56	0.065		963.983	111.891		
AW503504	CO	8/06/1994 13:20	1648.786	0.25	0.6	0.85	0.085		1401.468	140.147		
AW503504	ML	15/06/1994 10:00	656.150	0.15	0.41	0.56	0.072		367.444	47.243		
AW503504	MD	22/06/1994 11:10	359.153	0.8	0.75	1.55	0.124		556.687	44.535		
AW503504	CO	29/06/1994 14:00	1149.088	1.23	1.04	2.27	0.155		2608.430	178.109		
AW503504	MS	6/07/1994 12:10	281.883	1.28	0.9	2.18	0.103		614.505	29.034		
AW503504	MS	13/07/1994 13:00	216.441	1.1	0.68	1.78	0.094		385.264	20.345		
AW503504	MS	20/07/1994 14:00	701.021	0.14	0.41	0.55	0.05		385.562	35.051		
AW503504	MS	27/07/1994 13:10	879.034	0.1	0.42	0.52	0.036		457.098	31.645		
AW503504	CO	3/08/1994 11:00	1625.965	0.37	0.55	0.92	0.061		1495.888	99.184		
AW503504	CO	3/08/1994 11:02	0.257	0.37	0.46	0.83	0.064		0.214	0.016		
AW503504	CO	10/08/1994 9:46	0.117	0.26	0.41	0.67	0.056		0.078	0.007		
AW503504	MD	17/08/1994 11:50	1314.916	0.25	0.44	0.69	0.047		907.292	61.801		
AW503504	CO	24/08/1994 10:35	1526.677	0.17	0.39	0.56	0.046		854.939	70.227		
AW503504	CO	24/08/1994 10:42	0.199	0.15	0.38	0.53	0.053		0.106	0.011		

STATION	COLI	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503504	CO	31/08/1994 10:10	1922.241	0.12	0.39	0.51	0.059		980.343	113.412		
AW503504	CO	7/09/1994 11:15	2376.892	0.14	0.49	0.63	0.057		1497.442	135.483		
AW503504	CO	14/09/1994 10:05	2265.919	0.1	0.34	0.44	0.062		997.004	140.487		
AW503504	ML	21/09/1994 10:00	2153.271	0.09	0.43	0.52	0.064		1119.701	137.809		
AW503504	CO	5/10/1994 11:51	0.397	0.3	0.65	0.95	0.13		0.377	0.052		
AW503504	CO	12/10/1994 11:05	3159.187	0.24	0.58	0.82	0.075		2590.533	236.939		
AW503504	CO	19/10/1994 10:05	2388.897	0.2	0.41	0.61	0.082		1457.227	195.890		
AW503504	CO	26/10/1994 9:30	2287.967	0.2	0.56	0.76	0.092		1738.855	210.493		
AW503504	ML	2/11/1994 11:50	2482.909	0.19	0.53	0.72	0.1		1787.694	248.291		
AW503504	CO	9/11/1994 9:02	2901.694	0.35	0.54	0.89	0.09		2582.508	261.152		
AW503504	CO	16/11/1994 9:15	2042.497	0.16	0.44	0.6	0.073		1225.498	149.102		
AW503504	CO	23/11/1994 10:00	1405.800	0.1	0.65	0.75	0.079		1054.350	111.058		
AW503504	CO	30/11/1994 9:20	1438.694	0.02	0.44	0.46	0.072		661.799	103.586		
AW503504	CO	7/12/1994 9:14	1434.730	0.02	0.44	0.46	0.078		659.976	111.909		
AW503504	CO	13/12/1994 14:00	1265.013	0.02	0.69	0.71	0.077		898.159	97.406		
AW503504	MS	14/12/1994 9:20	163.482	0.05	0.62	0.67	0.095		109.533	15.531		
AW503504	CO	21/12/1994 9:00	1456.100	0.09	0.59	0.68	0.108	83304	990.148	157.259		
AW503504	**MS**	**28/12/1994 9:52**	**1726.071**	**0.14**	**0.55**	**0.69**	**0.104**	**77873**	**1190.989**	**179.511**	**53893**	**6501**
AW503504	**MS**	**4/01/1995 10:45**	**1725.987**	**0.13**	**0.5**	**0.63**	**0.094**		**1087.372**	**162.243**		
AW503504	MS	11/01/1995 10:50	1713.877	0.14	0.53	0.67	0.09		1148.298	154.249		
AW503504	MS	18/01/1995 8:30	1699.844	0.12	0.44	0.56	0.088		951.913	149.586		
AW503504	MS	25/01/1995 8:30	1712.053	0.11	0.4	0.51	0.107		873.147	183.190		
AW503504	CO	1/02/1995 8:30	1720.508	0.13	0.57	0.7	0.102		1204.356	175.492		
AW503504	CO	8/02/1995 8:40	1731.208	0.11	0.38	0.49	0.096		848.292	166.196		
AW503504	CO	15/02/1995 8:30	1716.741	0.1	0.49	0.59	0.095		1012.877	163.090		
AW503504	CO	22/02/1995 9:05	1733.466	0.07	0.57	0.64	0.085		1109.418	147.345		
AW503504	CO	1/03/1995 8:20	1710.836	0.06	0.51	0.57	0.07		975.177	119.759		
AW503504	CO	8/03/1995 9:25	7.912	0.06	0.59	0.65	0.089		5.143	0.704		
AW503504	CO	15/03/1995 9:15	7.780	0.04	0.49	0.53	0.061		4.123	0.475		
AW503504	CO	21/03/1995 8:28	1106.253	0.05	0.43	0.48	0.055		531.001	60.844		
AW503504	CO	29/03/1995 9:30	1451.838	0.05	0.44	0.49	0.071		711.401	103.080		
AW503504	CO	5/04/1995 9:40	702.773	0.05	0.42	0.47	0.055		330.303	38.652		
AW503504	CO	11/04/1995 10:45	636.601	0.02	0.29	0.31	0.058		197.346	36.923		
AW503504	CO	19/04/1995 9:20	845.647	0.04	0.42	0.46	0.044		388.998	37.208		
AW503504	CO	26/04/1995 9:36	808.286	0.06	0.38	0.44	0.05		355.646	40.414		
AW503504	CO	3/05/1995 9:25	164.700	0.06	0.32	0.38	0.045		62.586	7.412		
AW503504	CO	10/05/1995 9:20	132.647	0.12	0.47	0.59	0.068		78.262	9.020		
AW503504	MS	17/05/1995 9:20	64.735	0.21	0.47	0.68	0.08		44.020	5.179		
AW503504	CO	23/05/1995 10:35	44.484	0.27	0.55	0.82	0.082		36.477	3.648		
AW503504	CO	30/05/1995 10:10	572.755	0.98	1.07	2.05	0.254		1174.147	145.480		
AW503504	CO	6/06/1995 9:40	104.246	1.65	0.86	2.51	0.115		261.658	11.988		
AW503504	CO	14/06/1995 12:35	1594.965	1.29	1.21	2.5	0.236		3987.413	376.412		
AW503504	CO	21/06/1995 10:10	358.072	1.46	1.01	2.47	0.135		884.438	48.340		
AW503504	CO	28/06/1995 11:15	369.223	1.06	0.73	1.79	0.116		660.910	42.830		
AW503504	CO	5/07/1995 12:30	4795.344	0.98	1.07	2.05	0.206		9830.455	987.841		
AW503504	ML	12/07/1995 0:00	1264.999	0.81	1.72	2.53	0.33		3200.447	417.450		
AW503504	CO	12/07/1995 14:37	1983.026	0.8	3.3	4.1	0.68		8130.407	1348.458		
AW503504	MS	19/07/1995 14:20	8086.097	0.82	1.32	2.14	0.229		17304.248	1851.716		
AW503504	CO	26/07/1995 13:25	20464.320	0.55	3.07	3.62	0.73		74080.838	14938.954		
AW503504	CO	2/08/1995 13:20	11404.730	0.66	1.24	1.9	0.186		21668.987	2121.280		
AW503504	CO	9/08/1995 14:45	5083.576	0.62	1.19	1.81	0.162		9201.273	823.539		
AW503504	ML	16/08/1995 13:50	1075.867	0.79	0.63	1.42	0.087		1527.731	93.600		
AW503504	CO	23/08/1995 14:20	534.015	0.7	0.62	1.32	0.082		704.900	43.789		
AW503504	CO	30/08/1995 13:00	546.764	0.36	0.63	0.99	0.083		541.297	45.381		
AW503504	CO	6/09/1995 12:40	406.588	0.07	0.66	0.73	0.053		296.809	21.549		
AW503504	CO	13/09/1995 13:10	337.942	0.02	0.52	0.54	0.035		182.488	11.828		
AW503504	CO	20/09/1995 14:20	330.851	0.01	0.5	0.51	0.035		168.734	11.580		
AW503504	MS	27/09/1995 15:30	834.886	0.32	0.65	0.97	0.072		809.839	60.112		
AW503504	CO	4/10/1995 12:40	427.084	0.33	0.75	1.08	0.066		461.250	28.188		
AW503504	CO	11/10/1995 12:30	335.087	0.32	0.62	0.94	0.07		314.982	23.456		
AW503504	CO	18/10/1995 16:00	250.667	0.3	0.64	0.94	0.058		235.627	14.539		
AW503504	CO	25/10/1995 14:25	233.240	0.21	0.56	0.77	0.053		179.595	12.362		
AW503504	CO	1/11/1995 12:50	158.215	0.26	0.68	0.94	0.042		148.722	6.645		
AW503504	CO	8/11/1995 14:00	141.752	0.12	0.5	0.62	0.035		87.886	4.961		
AW503504	CO	15/11/1995 13:40	119.618	0.09	0.41	0.5	0.037		59.809	4.426		
AW503504	CO	22/11/1995 13:45	50.288	0.04	0.52	0.56	0.029		28.161	1.458		
AW503504	CO	29/11/1995 16:05	26.503	0.01	0.48	0.49	0.03		12.987	0.795		
AW503504	CO	6/12/1995 14:20	8.550	0.01	0.67	0.68	0.046		5.814	0.393		
AW503504	CO	13/12/1995 13:50	4.801	0.01	0.72	0.73	0.044		3.504	0.211		
AW503504	CO	20/12/1995 16:05	4.049	0.01	0.6	0.61	0.034	85172	2.470	0.138		
AW503504	**CO**	**27/12/1995 14:05**	**3.592**	**0.01**	**0.61**	**0.62**	**0.046**	**83350**	**2.227**	**0.165**	**168116**	**25265**
AW503504	**CO**	**3/01/1996 13:45**	**2.081**	**0.02**	**0.59**	**0.61**	**0.037**		**1.269**	**0.077**		
AW503504	CO	10/01/1996 15:10	285.041	0.09	0.57	0.66	0.069		188.127	19.668		
AW503504	CO	17/01/1996 11:00	289.574	0.1	0.65	0.75	0.099		217.181	28.668		
AW503504	CO	24/01/1996 13:10	5.190	0.05	0.69	0.74	0.086		3.841	0.446		
AW503504	CO	31/01/1996 12:15	11.235	0.01	0.62	0.63	0.062		7.078	0.697		
AW503504	CO	6/02/1996 10:45	130.817	0.04	0.74	0.78	0.106		102.037	13.867		
AW503504	CO	14/02/1996 12:40	589.922	0.08	0.7	0.78	0.101		460.139	59.582		
AW503504	CO	21/02/1996 11:00	542.713	0.06	0.67	0.73	0.082		396.181	44.502		
AW503504	CO	28/02/1996 12:50	1083.964	0.05	0.61	0.66	0.082		715.416	88.885		
AW503504	CO	6/03/1996 15:34	1246.673	0.07	1.29	1.36	0.075		1695.475	93.500		
AW503504	CO	13/03/1996 17:19	1247.856	0.06	1.49	1.55	0.081		1934.177	101.076		
AW503504	CO	20/03/1996 10:50	1197.030	0.05	0.78	0.83	0.076		993.535	90.974		
AW503504	CO	27/03/1996 17:05	452.432	0.05	1.16	1.21	0.066		547.442	29.860		

STATION	COLI	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503504	MD	3/04/1996 18:15	6.478	0.01	0.6	0.61	0.066		3.951	0.428		
AW503504	MD	10/04/1996 11:00	5.258	0.01	0.63	0.64	0.063		3.365	0.331		
AW503504	CO	17/04/1996 12:50	781.546	0.02	0.52	0.54	0.047		422.035	36.733		
AW503504	CO	8/05/1996 16:00	2160.845	0.02	0.43	0.45	0.046		972.380	99.399		
AW503504	CO	15/05/1996 11:10	237.685	0.02	0.45	0.47	0.037		111.712	8.794		
AW503504	CO	22/05/1996 14:15	1203.959	0.04	0.57	0.61	0.06		734.415	72.238		
AW503504	CO	29/05/1996 15:45	827.046	0.07	0.89	0.96	0.072		793.964	59.547		
AW503504	CO	5/06/1996 0:00	750.176	0.11	0.61	0.72	0.087		540.127	65.265		
AW503504	CO	12/06/1996 14:15	917.318	0.3	0.58	0.88	0.094		807.240	86.228		
AW503504	CO	19/06/1996 14:25	982.500	0.25	0.86	1.11	0.148		1090.575	145.410		
AW503504	CO	26/06/1996 17:50	1695.829	0.67	1.28	1.95	0.284		3306.867	481.615		
AW503504	CO	3/07/1996 12:25	2619.138	1	1.98	2.98	0.396		7805.031	1037.179		
AW503504	CO	10/07/1996 11:55	2053.412	0.97	1.46	2.43	0.214		4989.791	439.430		
AW503504	CO	17/07/1996 11:35	1582.056	0.93	1.01	1.94	0.138		3069.189	218.324		
AW503504	CO	24/07/1996 14:30	6697.537	0.58	2.46	3.04	0.455		20360.512	3047.379		
AW503504	CO	31/07/1996 12:45	1296.035	0.86	0.93	1.79	0.104		2319.903	134.788		
AW503504	CO	6/08/1996 12:30	16330.560	0.449	2.8	3.249	0.59		53057.989	9635.030		
AW503504	CO	13/08/1996 9:30	6516.115	0.5	1.5	2	0.197		13032.230	1283.675		
AW503504	CO	20/08/1996 10:35	2801.200	0.491	1.26	1.751	0.144		4904.901	403.373		
AW503504	CO	28/08/1996 10:45	6861.312	0.378	1.63	2.008	0.269		13777.514	1845.693		
AW503504	CO	4/09/1996 11:50	1883.070	0.1	1.04	1.14	0.108		2146.700	203.372		
AW503504	CO	11/09/1996 15:30	788.450	0.332	0.77	1.102	0.077		868.872	60.711		
AW503504	CO	18/09/1996 8:30	1894.479	0.259	1.04	1.299	0.128		2460.928	242.493		
AW503504	CO	25/09/1996 10:25	1462.538	0.215	0.92	1.135	0.091		1659.981	133.091		
AW503504	CO	2/10/1996 10:40	17666.730	0.325	3.56	3.885	0.69		68635.246	12190.044		
AW503504	CO	9/10/1996 11:25	3186.900	0.361	1.17	1.531	0.146		4879.144	465.287		
AW503504	CO	16/10/1996 14:40	772.904	0.452	1	1.452	0.161		1122.257	124.438		
AW503504	CO	30/10/1996 13:10	762.862	0.105	0.76	0.865	0.052		659.875	39.669		
AW503504	CO	6/11/1996 11:15	213.910	0.064	0.73	0.794	0.042		169.844	8.984		
AW503504	CO	13/11/1996 14:50	152.971	0.011	0.59	0.601	0.044		91.935	6.731		
AW503504	CO	27/11/1996 13:35	829.188	0.027	0.64	0.667	0.086		553.069	71.310		
AW503504	CO	4/12/1996 10:15	690.6401	0.063	0.87	0.933	0.127		644.367	87.711		
AW503504	CO	11/12/1996 11:20	503.5813	0.055	0.71	0.765	0.126		385.240	63.451		
AW503504	CO	18/12/1996 9:30	427.0271	0.042	0.86	0.902	0.122	95949	385.178	52.097		
AW503504	**CO**	**26/12/1996 11:10**	**767.0290**	**0.049**	**0.71**	**0.759**	**0.136**	**95413**	582.175	104.316	**224610**	**33526**
AW503504	**CO**	**2/01/1997 9:45**	**671.5992**	**0.044**	**0.78**	**0.824**	**0.126**		**553.398**	**84.621**		
AW503504	CO	9/01/1997 11:30	581.5657	0.054	0.64	0.694	0.106		403.607	61.646		
AW503504	CO	16/01/1997 9:35	424.1103	0.033	0.67	0.703	0.109		298.150	46.228		
AW503504	CO	23/01/1997 14:00	376.5960	0.088	1.06	1.148	0.119		432.332	44.815		
AW503504	CO	30/01/1997 11:20	422.6714	0.091	0.93	1.021	0.113		431.547	47.762		
AW503504	CO	6/02/1997 10:10	421.0953	0.099	0.82	0.919	0.095		386.987	40.004		
AW503504	CO	12/02/1997 9:45	604.9746	0.126	0.93	1.056	0.092		638.853	55.658		
AW503504	CO	19/02/1997 7:45	784.2938	0.113	0.64	0.753	0.090		590.573	70.586		
AW503504	CO	26/02/1997 8:30	808.8017	0.132	0.79	0.922	0.105		745.715	84.924		
AW503504	CO	5/03/1997 11:25	870.7360	0.214	0.72	0.934	0.123		813.267	107.101		
AW503504	CO	12/03/1997 11:35	500.9384	0.227	0.67	0.897	0.115		449.342	57.608		
AW503504	CO	19/03/1997 13:25	450.8166	0.135	0.68	0.815	0.095		367.416	42.828		
AW503504	CO	26/03/1997 8:00	385.9114	0.158	0.67	0.828	0.091		319.535	35.118		
AW503504	CO	2/04/1997 9:00	401.7462	0.268	0.63	0.898	0.123		360.768	49.415		
AW503504	CO	9/04/1997 9:45	411.9131	0.329	0.73	1.059	0.146		436.216	60.139		
AW503504	CO	16/04/1997 12:35	151.6825	0.305	0.87	1.175	0.152		178.227	23.056		
AW503504	CO	23/04/1997 12:10	5.7296	0.183	0.76	0.943	0.112		5.403	0.642		
AW503504	CO	28/04/1997 14:25	3.5115	0.0025	0.85	0.8525	0.100		2.994	0.351		
AW503504	CO	6/05/1997 9:30	15.1390	0.094	0.71	0.804	0.102		12.172	1.544		
AW503504	CO	14/05/1997 13:10	44.9861	0.010	0.88	0.89	0.094		40.038	4.229		
AW503504	CO	20/05/1997 14:10	33.4383	0.006	0.74	0.746	0.081		24.945	2.709		
AW503504	CO	28/05/1997 12:20	115.3653	0.019	0.64	0.659	0.084		76.026	9.691		
AW503504	CO	1/07/1997 11:30	838.6817	0.014	0.58	0.594	0.069		498.177	57.869		
AW503504	CO	8/07/1997 10:25	955.8536	0.205	0.9	1.105	0.145		1056.218	138.599		
AW503504	CO	15/07/1997 9:10	1138.0970	0.229	0.71	0.939	0.17		1068.673	193.476		
AW503504	CO	22/07/1997 10:35	1457.6280	0.292	0.77	1.062	0.166		1548.001	241.966		
AW503504	CO	30/07/1997 13:05	1582.0620	0.225	0.75	0.975	0.18		1542.510	284.771		
AW503504	CO	6/08/1997 10:55	561.0320	0.215	0.78	0.995	0.17		558.227	95.375		
AW503504	CO	13/08/1997 11:00	3956.9580	0.934	1.74	2.674	0.369		10580.906	1460.118		
AW503504	CO	20/08/1997 13:45	1210.9850	0.989	0.94	1.929	0.138		2335.990	167.116		
AW503504	CO	27/08/1997 11:10	2410.5280	0.308	0.66	0.968	0.14		2333.391	337.474		
AW503504	CO	3/09/1997 10:50	3163.9030	0.271	0.88	1.151	0.138		3641.652	436.619		
AW503504	CO	10/09/1997 11:58	4395.9020	0.394	1.05	1.444	0.142		6347.682	624.218		
AW503504	CO	17/09/1997 14:50	2078.0890	0.41	0.86	1.27	0.118		2639.173	245.215		
AW503504	CO	24/09/1997 13:30	1775.2910	0.221	0.83	1.051	0.108		1865.831	191.731		
AW503504	CO	1/10/1997 14:00	1200.8440	0.106	0.84	0.946	0.1		1135.998	120.084		
AW503504	CO	8/10/1997 11:20	1381.8310	0.041	0.57	0.611	0.085		844.299	117.456		
AW503504	CO	15/10/1997 13:25	1458.7620	0.033	0.66	0.693	0.102		1010.922	148.794		
AW503504	CO	22/10/1997 12:20	1320.6630	0.036	0.71	0.746	0.124		985.215	163.762		
AW503504	CO	29/10/1997 11:20	1139.3550	0.045	0.73	0.775	0.134		883.000	152.674		
AW503504	CO	5/11/1997 14:00	2981.8500	0.387	1.35	1.737	0.244		5179.473	727.571		
AW503504	CO	12/11/1997 8:35	1544.7600	0.107	0.66	0.767	0.154		1184.831	237.893		
AW503504	CO	19/11/1997 12:55	1616.5330	0.12	0.8	0.92	0.148		1487.210	239.247		
AW503504	CO	26/11/1997 6:40	1446.071	0.122	0.8	0.922	0.142		1333.277	205.342		
AW503504	CO	4/12/1997 16:34	1703.161	0.129	1.64	1.769	0.13		3012.892	221.411		
AW503504	CO	10/12/1997 11:45	906.590	0.23	0.72	0.95	0.136		861.261	123.296		
AW503504	CO	17/12/1997 11:20	1099.738	0.165	0.71	0.875	0.127		962.271	139.667		
AW503504	CO	24/12/1997 8:35	1059.276	0.18	0.72	0.9	0.121	53491	953.348	128.172		
AW503504	**CO**	**31/12/1997 7:45**	**1072.632**	**0.135**	**0.67**	**0.805**	**0.114**	**53945**	**863.469**	**122.280**	**64281**	**8253**

STATION	COLL	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503504	**CO**	**7/01/1998 10:40**	**1089.786**	**0.113**	**0.74**	**0.853**	**0.109**		**929.587**	**118.787**		
AW503504	CO	14/01/1998 14:10	1166.887	0.129	0.85	0.979	0.107		1142.382	124.857		
AW503504	CO	22/01/1998 10:00	1261.818	0.137	0.66	0.797	0.105		1005.669	132.491		
AW503504	CO	28/01/1998 10:00	1019.962	0.158	0.6	0.758	0.115		773.131	117.296		
AW503504	CO	4/02/1998 10:45	1042.243	0.18	0.76	0.94	0.121		979.708	126.111		
AW503504	CO	11/02/1998 10:15	1386.909	0.194	0.92	1.114	0.143		1545.017	198.328		
AW503504	CO	18/02/1998 9:25	1427.889	0.208	0.65	0.858	0.148		1225.129	211.328		
AW503504	CO	25/02/1998 6:00	1810.789	0.244	0.73	0.974	0.165		1763.708	298.780		
AW503504	CO	4/03/1998 9:00	1796.610	0.25	0.86	1.11	0.164		1994.237	294.644		
AW503504	CO	11/03/1998 9:40	1923.045	0.301	0.81	1.111	0.185		2136.503	355.763		
AW503504	CO	25/03/1998 8:00	4189.851	0.302	0.86	1.162	0.196		4868.607	821.211		
AW503504	CO	1/04/1998 9:00	2286.253	0.32	0.83	1.15	0.235		2629.191	537.269		
AW503504	CO	8/04/1998 9:00	1712.204	0.326	0.69	1.016	0.217		1739.599	371.548		
AW503504	CO	15/04/1998 10:00	1468.222	0.328	0.96	1.288	0.244		1891.070	358.246		
AW503504	CO	16/04/1998 12:25	218.878	0.303	0.91	1.213	0.2		265.499	43.776		
AW503504	CO	22/04/1998 13:50	1587.616	0.406	1.03	1.436	0.34		2279.817	539.789		
AW503504	CO	29/04/1998 10:05	1538.003	0.406	0.97	1.376	0.243		2116.292	373.735		
AW503504	CO	6/05/1998 8:50	906.785	0.313	0.77	1.083	0.215		982.048	194.959		
AW503504	CO	13/05/1998 10:55	63.656	0.209	0.8	1.009	0.198		64.229	12.604		
AW503504	CO	20/05/1998 9:50	44.294	0.125	0.88	1.005	0.188		44.516	8.327		
AW503504	CO	27/05/1998 10:15	149.382	0.032	0.69	0.722	0.119		107.854	17.777		
AW503504	CO	3/06/1998 9:50	70.095	0.044	0.76	0.804	0.077		56.356	5.397		
AW503504	CO	10/06/1998 14:00	297.742	0.338	0.69	1.028	0.095		306.079	28.286		
AW503504	CO	17/06/1998 15:20	862.098	0.853	0.95	1.803	0.175		1554.362	150.867		
AW503504	CO	24/06/1998 14:40	1686.380	0.532	0.84	1.372	0.185		2313.713	311.980		
AW503504	CO	1/07/1998 13:30	973.362	0.588	0.7	1.288	0.133		1253.690	129.457		
AW503504	CO	8/07/1998 10:00	1316.488	0.669	1.52	2.189	0.301		2881.792	396.263		
AW503504	CO	15/07/1998 9:50	1011.333	0.782	1.09	1.872	0.142		1893.215	143.609		
AW503504	CO	22/07/1998 10:05	417.127	0.771	0.77	1.541	0.061		642.793	25.445		
AW503504	CO	28/07/1998 10:30	2116.666	0.429	0.84	1.269	0.15		2686.049	317.500		
AW503504	CO	28/07/1998 10:45	76.154	0.436	3.62	4.056	0.818		308.879	62.294		
AW503504	CO	5/08/1998 10:45	6496.537	0.848	1.55	2.398	0.244		15578.696	1585.155		
AW503504	CO	12/08/1998 11:47	927.732	0.797	0.87	1.667	0.087		1546.528	80.713		
AW503504	CO	19/08/1998 10:00	1158.364	0.467	0.66	1.127	0.092		1305.476	106.569		
AW503504	CO	26/08/1998 14:55	2561.699	0.37	1.03	1.4	0.156		3586.379	399.625		
AW503504	CO	2/09/1998 9:10	2072.009	0.34	0.92	1.26	0.127		2610.731	263.145		
AW503504	CO	9/09/1998 10:15	1815.555	0.154	0.6	0.754	0.13		1368.928	236.022		
AW503504	CO	16/09/1998 9:00	1612.725	0.099	0.63	0.729	0.126		1175.677	203.203		
AW503504	CO	23/09/1998 12:55	1934.335	0.145	0.84	0.985	0.164		1905.320	317.231		
AW503504	CO	30/09/1998 10:05	2253.103	0.293	1.14	1.433	0.183		3228.697	412.318		
AW503504	CO	4/11/1998 8:45	9007.031	0.262	1.01	1.272	0.332		11456.943	2990.334		
AW503504	CO	11/11/1998 8:15	1370.265	0.167	1.2	1.367	0.347		1873.152	475.482		
AW503504	CO	18/11/1998 14:45	1380.779	0.177	1.03	1.207	0.297		1666.600	410.091		
AW503504	CO	25/11/1998 8:00	1040.911	0.123	1.61	1.733	0.304		1803.899	316.437		
AW503504	CO	2/12/1998 8:10	1166.890	0.156	1.1	1.256	0.315		1465.614	367.570		
AW503504	CO	9/12/1998 9:00	920.909	0.187	1.32	1.507	0.362		1387.810	333.369		
AW503504	CO	16/12/1998 15:29	947.613	0.14	1.16	1.3	0.317		1231.896	300.393		
AW503504	CO	23/12/1998 7:00	655.604	0.208	1.06	1.268	0.294	74820	831.306	192.748		
AW503504	**CO**	**30/12/1998 8:10**	**548.191**	**0.082**	**0.81**	**0.892**	**0.194**	**74789**	**488.986**	**106.349**	**98893**	**15925**
AW503504	**CO**	**6/01/1999 8:15**	**1070.000**	**0.132**	**0.98**	**1.112**	**0.207**		**1189.840**	**221.490**		
AW503504	CO	13/01/1999 7:35	1215.000	0.141	0.83	0.971	0.18		1179.765	218.700		
AW503504	CO	20/01/1999 8:05	1192.000	0.166	0.88	1.046	0.191		1246.832	227.672		
AW503504	CO	27/01/1999 7:55	1179.000	0.175	0.93	1.105	0.173		1302.795	203.967		
AW503504	CO	3/02/1999 9:00	1724.212	0.189	0.97	1.159	0.173		1998.362	298.289		
AW503504	CO	10/02/1999 7:45	2114.903	0.168	0.84	1.008	0.161		2131.822	340.499		
AW503504	CO	17/02/1999 8:00	2187.003	0.168	0.92	1.088	0.163		2379.459	356.481		
AW503504	CO	24/02/1999 7:50	2243.924	0.187	0.89	1.077	0.153		2416.706	343.320		
AW503504	CO	3/03/1999 8:25	2206.315	0.074	0.86	0.934	0.151		2060.698	333.154		
AW503504	CO	10/03/1999 8:35	1969.230	0.133	0.9	1.033	0.176		2034.215	346.584		
AW503504	CO	17/03/1999 9:00	1857.908	0.217	0.84	1.057	0.183		1963.809	339.997		
AW503504	CO	24/03/1999 8:15	1977.823	0.2	0.86	1.06	0.177		2096.492	350.075		
AW503504	CO	31/03/1999 7:00	1354.778	0.203	0.85	1.053	0.163		1426.581	220.829		
AW503504	CO	7/04/1999 9:40	1045.224	0.167	0.82	0.987	0.151		1031.636	157.829		
AW503504	CO	14/04/1999 9:58	561.019	0.119	0.91	1.029	0.146		577.288	81.909		
AW503504	CO	21/04/1999 9:15	1042.155	0.081	0.72	0.801	0.134		834.766	139.649		
AW503504	CO	28/04/1999 8:20	1057.169	0.075	0.8	0.875	0.145		925.023	153.290		
Max				1.65	3.62	4.1	0.818					
Min				0.0025	0.28	0.31	0.00006					
Mean				0.24702	0.81997	1.06699	0.13344					
Median				0.14	0.73	0.899	0.1135					
SD				0.28195	0.42486	0.59653	0.10151					
AW503506 Echunga Creek upstream of Mt Bold Reservoir												
WQ#3207												
AW503506	CO	18/08/1988 15:20	NA									
AW503506	MD	30/09/1988 14:00	1314.839	0.01	0.65	0.66	0.033		867.794	43.390		
AW503506	MD	12/10/1988 12:20	30.243	0.01	0.65	0.66	0.033		19.960	0.998		
AW503506	**MD**	**15/12/1988 11:10**	**47.525**	**0.01**	**0.42**	**0.43**	**0.04**		**20.436**	**1.901**		
AW503506	**MD**	**5/01/1989 14:15**	**1.706**	**0.01**	**0.14**	**0.15**	**0.009**		**0.256**	**0.015**		
AW503506	MD	20/02/1989 15:00	3.541	0.01	0.44	0.45	0.016		1.593	0.057		
AW503506	MD	9/03/1989 13:30	1.158	0.01	0.41	0.42	0.029		0.486	0.034		
AW503506	MD	22/03/1989 11:15	0.888	0.04	0.13	0.17	0.02		0.151	0.018		

STATION	COLI	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503506	MD	5/04/1989 12:30	0.956	0.01	0.26	0.27	0.021		0.258	0.020		
AW503506	MD	14/04/1989 15:00	0.632	0.01	0.13	0.14	0.024		0.088	0.015		
AW503506	MD	28/04/1989 14:00	1.010	0.01	0.22	0.23	0.023		0.232	0.023		
AW503506	MD	11/05/1989 13:15	3.520	0.26	0.68	0.94	0.054		3.309	0.190		
AW503506	MD	26/05/1989 12:00	4.129	0.04	0.39	0.43	0.014		1.775	0.058		
AW503506	CO	12/07/1989 12:15	350.000	0.2	1.1	1.3	0.095		455.000	33.250		
AW503506	CO	3/08/1989 12:00	787.000	0.2	0.87	1.07	0.095		842.090	74.765		
AW503506	MD	8/08/1989 14:20	244.777	0.15	1.21	1.36	0.14		332.896	34.269		
AW503506	MD	12/09/1989 12:58	1613.971	0.2	1.44	1.64	0.24		2646.912	387.353		
AW503506	CO	21/09/1989 13:55	218.170	0.08	1.11	1.19	0.11		259.622	23.999		
AW503506	CO	4/10/1989 12:18	92.547	0.01	0.78	0.79	0.034		73.112	3.147		
AW503506	MD	17/10/1989 15:30	103.832	0.02	0.86	0.88	0.039		91.372	4.049		
AW503506	CO	7/11/1989 10:25	54.223	0.01	0.61	0.62	0.025		33.618	1.356		
AW503506	MD	16/11/1989 14:00	17.595	0.01	0.67	0.68	0.024		11.964	0.422		
AW503506	MD	1/12/1989 15:00	26.238	0.02	0.83	0.85	0.062	3415	22.303	1.627		
AW503506	**MD**	**18/12/1989 11:50**	**14.909**	**0.05**	**0.63**	**0.68**	**0.053**	**3541**	**10.138**	**0.790**	**4787**	**565**
AW503506	**MD**	**10/01/1990 12:00**	**1.671**	**0.01**	**0.3**	**0.31**	**0.045**		**0.518**	**0.075**		
AW503506	MD	8/02/1990 11:30	2.070	0.01	0.29	0.3	0.035		0.621	0.072		
AW503506	MD	26/02/1990 12:45	1.352	0.01	0.32	0.33	0.042		0.446	0.057		
AW503506	MD	15/03/1990 10:00	1.204	0.05	0.24	0.29	0.034		0.349	0.041		
AW503506	MD	2/04/1990 14:40	1.339	0.01	0.14	0.15	0.033		0.201	0.044		
AW503506	MD	11/04/1990 12:30	0.553	0.01	0.24	0.25	0.018		0.138	0.010		
AW503506	CO	3/05/1990 12:40	1.571	0.01	0.24	0.25	0.03		0.393	0.047		
AW503506	MD	25/05/1990 14:40	1.680	0.01	0.23	0.24	0.008		0.403	0.013		
AW503506	MD	21/06/1990 11:15	7.955	0.01	0.37	0.38	0.024		3.023	0.191		
AW503506	CO	19/07/1990 13:55	695.749	0.22	1.58	1.8	0.077		1252.347	53.573		
AW503506	CO	31/07/1990 15:25	256.247	0.18	1.04	1.22	0.076		312.621	19.475		
AW503506	CO	19/09/1990 15:20	1436.181	0.07	0.98	1.05	0.057		1507.990	81.862		
AW503506	CO	10/10/1990 12:05	91.686	0.01	0.56	0.57	0.02		52.261	1.834		
AW503506	CO	1/11/1990 10:11	118.086	0.02	0.17	0.19	0.029	2643	22.436	3.424		
AW503506	**CO**	**6/12/1990 12:00**	**17.633**	**0.02**	**0.38**	**0.4**	**0.027**	**2635**	**7.053**	**0.476**	**3161**	**161**
AW503506	**MD**	**15/01/1991 21:40**	**10.992**	**0.03**	**0.28**	**0.31**	**0.018**		**3.408**	**0.198**		
AW503506	MD	22/02/1991 9:20	2.735	0.01	0.21	0.22	0.036		0.602	0.098		
AW503506	MD	4/04/1991 13:55	3.131	0.01	0.29	0.3	0.027		0.939	0.085		
AW503506	CO	19/06/1991 2:36	11.870	0.02	0.41	0.43	0.01		5.104	0.119		
AW503506	MD	18/07/1991 14:24	241.120	0.19	0.73	0.92	0.039		221.831	9.404		
AW503506	CO	20/08/1991 12:00	236.500	0.17	1.35	1.52	0.082		359.480	19.393		
AW503506	CO	17/09/1991 12:00	1053.000	0.44	1.99	2.43	0.19	2469	2558.790	200.070		
			910.000	0.2	1	**1.2**	0.2	**2469**	1092.000	182.000	**4242**	**411**
AW503506	*MS*	*18/02/1992 12:43*	*924.000*	*0.03*	*0.52*	**0.55**	*0.019*					
			126.000	0.02	0.35	0.37	0.02		46.620	2.520		
AW503506	ML	1/04/1992 11:23	3.838	0.01	0.17	0.18	0.023		0.691	0.088		
AW503506	CO	29/04/1992 14:45	2.198	0.1	0.25	0.35	0.069		0.769	0.152		
AW503506	CO	28/05/1992 15:00	26.597	0.07	0.58	0.65	0.066		17.288	1.755		
AW503506	CO	23/06/1992 13:40	105.889	0.06	0.98	1.04	0.069		110.124	7.306		
AW503506	CO	22/07/1992 11:40	353.619	0.4	2.54	2.94	0.402		1039.641	142.155		
AW503506	MS	18/08/1992 12:25	780.853	0.16	1.33	1.49	0.142		1163.471	110.881		
AW503506	CO	18/08/1992 12:48	0.343	0.19	1.95	2.14	0.283		0.733	0.097		
AW503506	CO	22/09/1992 12:31	4241.086	0.39	1.48	1.87	0.338		7930.831	1433.487		
AW503506	CO	24/11/1992 9:56	2381.871	0.15	1.28	1.43	0.184	9081	3406.076	438.264		
AW503506	**CO**	**21/12/1992 14:54**	**1059.050**	**0.23**	**2.13**	**2.36**	**0.408**	**9081**	**2499.358**	**432.092**	**16216**	**2569**
AW503506	**CO**	**20/01/1993 10:42**	**150.000**	**0.45**	**1.66**	**2.11**	**0.262**		**316.500**	**39.300**		
AW503506	CO	23/02/1993 9:42	11.500	0.03	0.72	0.75	0.04		8.625	0.460		
AW503506	CO	23/03/1993 16:25	2.494	0.02	0.43	0.45	0.069		1.122	0.172		
AW503506	CO	28/04/1993 11:55	2.780	0.02	0.17	0.19	0.036		0.528	0.100		
AW503506	CO	25/05/1993 11:32	2.421	0.01	0.24	0.25	0.031		0.605	0.075		
AW503506	CO	22/06/1993 10:14	28.947	0.01	0.38	0.39	0.012		11.289	0.347		
AW503506	MS	27/07/1993 10:15	590.550	0.1	0.65	0.75	0.046		442.912	27.165		
AW503506	CO	29/09/1993 11:16	455.643	0.1	1.19	1.29	0.101		587.779	46.020		
AW503506	CO	6/10/1993 11:40	76.189	0.03	0.1	0.13	0.051		9.905	3.886		
AW503506	CO	14/10/1993 14:40	28.716	0.02	0.81	0.83	0.047		23.834	1.350		
AW503506	CO	20/10/1993 9:23	31.488	0.01	0.7	0.71	0.044		22.357	1.385		
AW503506	CO	27/10/1993 8:34	19.497	0.01	0.84	0.85	0.025		16.572	0.487		
AW503506	CO	3/11/1993 11:15	19.051	0.01	0.85	0.86	0.017		16.384	0.324		
AW503506	CO	11/11/1993 10:25	16.088	0.01	0.62	0.63	0.021		10.136	0.338		
AW503506	CO	17/11/1993 13:48	4.401	0.01	0.4	0.41	0.02		1.804	0.088		
AW503506	CO	24/11/1993 8:50	6.628	0.02	0.51	0.53	0.018		3.513	0.119		
AW503506	CO	1/12/1993 7:00	2.298	0.01	0.45	0.46	0.015		1.057	0.034		
AW503506	CO	8/12/1993 13:38	0.660	0.01	0.28	0.29	0.012		0.191	0.008		
AW503506	CO	15/12/1993 11:20	27.376	0.35	1.33	1.68	0.194	1364	45.992	5.311		
AW503506	**CO**	**21/12/1993 10:10**	**6.248**	**0.04**	**0.88**	**0.92**	**0.056**	**1483**	**5.748**	**0.350**	**1527**	**127**
AW503506	**CO**	**13/01/1994 10:25**	**42.599**	**0.01**	**0.84**	**0.85**	**0.06**		**36.209**	**2.556**		
AW503506	CO	19/01/1994 13:10	1.800	0.01	0.57	0.58	0.044		1.044	0.079		
AW503506	CO	27/01/1994 12:40	1.471	0.01	0.39	0.4	0.013		0.589	0.019		
AW503506	CO	3/02/1994 8:50	0.578	0.01	0.3	0.31	0.035		0.179	0.020		
AW503506	CO	9/02/1994 12:05	0.498	0.01	0.19	0.2	0.038		0.100	0.019		
AW503506	CO	16/02/1994 12:00	0.581	0.01	0.18	0.19	0.047		0.110	0.027		
AW503506	CO	24/02/1994 11:00	0.629	0.01	0.36	0.37	0.044		0.233	0.028		
AW503506	CO	2/03/1994 11:40	0.464	0.01	0.16	0.17	0.043		0.079	0.020		
AW503506	CO	9/03/1994 11:55	0.527	0.01	0.13	0.14	0.029		0.074	0.015		
AW503506	CO	16/03/1994 11:00	0.537	0.01	0.13	0.14	0.031		0.075	0.017		
AW503506	CO	23/03/1994 13:35	0.532	0.01	0.14	0.15	0.032		0.080	0.017		
AW503506	CO	30/03/1994 14:10	0.519	0.01	0.16	0.17	0.028		0.088	0.015		
AW503506	CO	6/04/1994 10:55	0.545	0.01	0.22	0.23	0.031		0.125	0.017		

STATION	COLL	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503506	CO	13/04/1994 11:10	0.543	0.01	0.09	0.1	0.036		0.054	0.020		
AW503506	CO	20/04/1994 13:00	0.546	0.01	0.2	0.21	0.029		0.115	0.016		
AW503506	CO	28/04/1994 14:45	0.612	0.01	0.1	0.11	0.02		0.067	0.012		
AW503506	CO	4/05/1994 15:50	0.469	0.01	0.16	0.17	0.04		0.080	0.019		
AW503506	CO	11/05/1994 13:30	0.542	0.01	0.16	0.17	0.017		0.092	0.009		
AW503506	CO	18/05/1994 10:45	0.560	0.01	0.14	0.15	0.03		0.084	0.017		
AW503506	CO	24/05/1994 10:30	0.506	0.01	0.07	0.08	0.023		0.040	0.012		
AW503506	CO	1/06/1994 14:45	0.978	0.01	0.06	0.07	0.024		0.068	0.023		
AW503506	CO	7/06/1994 22:26	10.788	0.37	0.84	1.21	0.121		13.053	1.305		
AW503506	CO	8/06/1994 14:20	2.583	0.37	0.84	1.21	0.121		3.126	0.313		
AW503506	CO	15/06/1994 9:30	6.735	0.3	0.61	0.91	0.059		6.129	0.397		
AW503506	CO	22/06/1994 9:45	8.914	0.01	0.41	0.42	0.036		3.744	0.321		
AW503506	CO	29/06/1994 14:40	107.016	0.41	1.84	2.25	0.297		240.787	31.784		
AW503506	CO	6/07/1994 10:10	14.822	0.16	0.66	0.82	0.056		12.154	0.830		
AW503506	CO	13/07/1994 14:10	12.950	0.03	0.48	0.51	0.031		6.605	0.401		
AW503506	CO	20/07/1994 14:40	13.572	0.02	0.48	0.5	0.026		6.786	0.353		
AW503506	CO	27/07/1994 14:30	9.196	0.01	0.42	0.43	0.013		3.954	0.120		
AW503506	CO	3/08/1994 12:30	37.262	0.04	0.74	0.78	0.04		29.064	1.490		
AW503506	CO	10/08/1994 10:30	18.946	0.01	0.55	0.56	0.02		10.610	0.379		
AW503506	CO	17/08/1994 12:50	31.275	0.01	0.63	0.64	0.08		20.016	2.502		
AW503506	CO	24/08/1994 11:50	16.314	0.01	0.49	0.5	0.044		8.157	0.718		
AW503506	CO	31/08/1994 10:50	12.005	0.01	0.42	0.43	0.019		5.162	0.228		
AW503506	CO	7/09/1994 13:25	20.496	0.01	0.44	0.45	0.023		9.223	0.471		
AW503506	CO	14/09/1994 10:50	18.035	0.01	0.49	0.5	0.021		9.017	0.379		
AW503506	CO	21/09/1994 12:20	13.421	0.01	0.44	0.45	0.02		6.039	0.268		
AW503506	CO	28/09/1994 11:25	8.817	0.01	0.4	0.41	0.021		3.615	0.185		
AW503506	CO	5/10/1994 12:25	61.309	0.04	1.05	1.09	0.087		66.827	5.334		
AW503506	CO	12/10/1994 13:22	47.657	0.02	1.11	1.13	0.054		53.852	2.573		
AW503506	CO	19/10/1994 13:10	10.519	0.01	0.6	0.61	0.063		6.417	0.663		
AW503506	CO	26/10/1994 10:20	6.204	0.01	0.62	0.63	0.026		3.908	0.161		
AW503506	CO	2/11/1994 13:05	14.278	0.01	0.6	0.61	0.038		8.710	0.543		
AW503506	CO	9/11/1994 9:40	41.147	0.01	0.83	0.84	0.042		34.563	1.728		
AW503506	CO	16/11/1994 10:15	11.377	0.01	0.74	0.75	0.03		8.533	0.341		
AW503506	CO	23/11/1994 10:45	5.150	0.01	0.65	0.66	0.028		3.399	0.144		
AW503506	CO	30/11/1994 10:12	2.693	0.02	0.47	0.49	0.025		1.320	0.067		
AW503506	CO	7/12/1994 10:10	0.918	0.01	0.34	0.35	0.024		0.321	0.022		
AW503506	CO	14/12/1994 9:45	0.614	0.01	0.29	0.3	0.019		0.184	0.012		
AW503506	CO	21/12/1994 9:40	0.564	0.03	0.31	0.34	0.034	641	0.192	0.019		
AW503506	**CO**	**28/12/1994 9:15**	**0.546**	**0.01**	**0.22**	**0.23**	**0.029**	**622**	**0.126**	**0.016**	**625**	**57**
AW503506	**CO**	**4/01/1995 10:00**	**0.561**	**0.01**	**0.23**	**0.24**	**0.038**		**0.135**	**0.021**		
AW503506	CO	11/01/1995 9:30	0.521	0.01	0.14	0.15	0.035		0.078	0.018		
AW503506	CO	18/01/1995 9:04	0.545	0.01	0.23	0.24	0.036		0.131	0.020		
AW503506	CO	25/01/1995 9:12	0.519	0.01	0.16	0.17	0.041		0.088	0.021		
AW503506	CO	1/02/1995 9:00	0.549	0.01	0.32	0.33	0.054		0.181	0.030		
AW503506	CO	8/02/1995 9:38	0.530	0.01	0.17	0.18	0.042		0.095	0.022		
AW503506	CO	15/02/1995 9:05	0.533	0.01	0.15	0.16	0.032		0.085	0.017		
AW503506	CO	22/02/1995 9:40	0.563	0.01	0.25	0.26	0.029		0.146	0.016		
AW503506	CO	1/03/1995 9:05	0.537	0.01	0.22	0.23	0.035		0.123	0.019		
AW503506	CO	8/03/1995 9:15	0.507	0.01	0.12	0.13	0.039		0.066	0.020		
AW503506	CO	15/03/1995 9:00	0.483	0.01	0.05	0.06	0.093		0.029	0.045		
AW503506	CO	21/03/1995 9:05	0.407	0.01	0.09	0.1	0.018		0.041	0.007		
AW503506	CO	29/03/1995 10:07	0.566	0.01	0.13	0.14	0.03		0.079	0.017		
AW503506	CO	5/04/1995 10:15	0.521	0.01	0.14	0.15	0.027		0.078	0.014		
AW503506	CO	11/04/1995 12:44	0.468	0.01	0.17	0.18	0.014		0.084	0.007		
AW503506	CO	19/04/1995 10:06	0.609	0.01	0.19	0.2	0.013		0.122	0.008		
AW503506	CO	26/04/1995 10:10	0.552	0.01	0.14	0.15	0.015		0.083	0.008		
AW503506	CO	3/05/1995 10:14	0.637	0.01	0.16	0.17	0.02		0.108	0.013		
AW503506	CO	10/05/1995 10:08	0.614	0.01	0.18	0.19	0.019		0.117	0.012		
AW503506	CO	17/05/1995 10:45	0.654	0.01	0.2	0.21	0.022		0.137	0.014		
AW503506	CO	23/05/1995 12:30	0.505	0.02	0.11	0.13	0.013		0.066	0.007		
AW503506	CO	30/05/1995 13:10	14.074	0.33	0.83	1.16	0.084		16.325	1.182		
AW503506	CO	6/06/1995 10:15	3.227	0.07	0.42	0.49	0.034		1.581	0.110		
AW503506	CO	14/06/1995 13:40	112.049	0.4	1.23	1.63	0.094		182.639	10.533		
AW503506	CO	21/06/1995 13:25	26.322	0.16	0.72	0.88	0.04		23.164	1.053		
AW503506	CO	28/06/1995 13:14	35.946	0.07	0.83	0.9	0.049		32.351	1.761		
AW503506	CO	5/07/1995 16:30	243.865	0.28	1.72	2	0.17		487.729	41.457		
AW503506	CO	11/07/1995 14:25	37.101	0.23	1	1.23	0.073		45.635	2.708		
AW503506	CO	18/07/1995 14:23	679.672	0.32	2.58	2.9	0.403		1971.049	273.908		
AW503506	CO	25/07/1995 14:30	1911.816	0.28	2.02	2.3	0.402		4397.177	768.550		
AW503506	CO	2/08/1995 15:00	1168.321	0.26	1.6	1.86	0.331		2173.077	386.714		
AW503506	CO	8/08/1995 14:15	348.893	0.3	1.36	1.66	0.272		579.162	94.899		
AW503506	CO	15/08/1995 15:00	85.382	0.29	0.96	1.25	0.154		106.727	13.149		
AW503506	CO	22/08/1995 10:40	31.591	0.13	0.72	0.85	0.08		26.853	2.527		
AW503506	CO	29/08/1995 13:50	32.684	0.06	0.69	0.75	0.061		24.513	1.994		
AW503506	CO	5/09/1995 16:20	26.926	0.01	0.74	0.75	0.039		20.194	1.050		
AW503506	CO	12/09/1995 13:30	21.557	0.04	0.52	0.56	0.018		12.072	0.388		
AW503506	CO	19/09/1995 9:05	18.371	0.01	0.53	0.54	0.021		9.920	0.386		
AW503506	CO	26/09/1995 14:25	183.521	0.38	1.9	2.28	0.381		418.428	69.922		
AW503506	CO	4/10/1995 11:20	39.872	0.03	0.68	0.71	0.061		28.309	2.432		
AW503506	CO	4/10/1995 14:10	0.576	0.01	0.66	0.67	0.046		0.386	0.026		
AW503506	CO	10/10/1995 13:50	17.552	0.01	0.66	0.67	0.035		11.760	0.614		
AW503506	CO	17/10/1995 14:30	12.682	0.02	0.79	0.81	0.025		10.272	0.317		
AW503506	CO	24/10/1995 14:10	18.259	0.02	0.75	0.77	0.045		14.059	0.822		
AW503506	CO	31/10/1995 14:50	15.084	0.01	0.84	0.85	0.023		12.822	0.347		

STATION	COLL	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503506	CO	7/11/1995 13:10	10.484	0.02	0.48	0.5	0.022		5.242	0.231		
AW503506	CO	14/11/1995 15:05	6.559	0.01	0.5	0.51	0.015		3.345	0.098		
AW503506	CO	21/11/1995 13:45	1.390	0.01	0.37	0.38	0.009		0.528	0.013		
AW503506	CO	28/11/1995 14:55	0.686	0.01	0.56	0.57	0.008		0.391	0.005		
AW503506	CO	5/12/1995 13:15	0.549	0.01	0.29	0.3	0.01		0.165	0.005		
AW503506	CO	12/12/1995 14:20	0.535	0.01	0.44	0.45	0.015		0.241	0.008		
AW503506	CO	19/12/1995 10:45	0.519	0.01	0.14	0.15	0.008	5112	0.078	0.004		
AW503506	**CO**	**26/12/1995 12:30**	**0.516**	**0.01**	**0.14**	**0.15**	**0.01**	**5118**	**0.077**	**0.005**	**10618**	**1678**
AW503506	**CO**	**2/01/1996 15:00**	**0.522**	**0.02**	**0.29**	**0.31**	**0.01**		**0.162**	**0.005**		
AW503506	CO	9/01/1996 15:15	0.522	0.01	0.13	0.14	0.012		0.073	0.006		
AW503506	CO	16/01/1996 10:35	0.479	0.01	0.27	0.28	0.015		0.134	0.007		
AW503506	CO	23/01/1996 11:05	0.463	0.03	0.28	0.31	0.017		0.144	0.008		
AW503506	CO	6/02/1996 12:20	1.101	0.02	1.12	1.14	0.058		1.255	0.064		
AW503506	CO	13/02/1996 12:50	0.499	0.01	0.49	0.5	0.026		0.250	0.013		
AW503506	CO	20/02/1996 12:20	0.495	0.02	0.24	0.26	0.017		0.129	0.008		
AW503506	CO	27/02/1996 13:20	0.495	0.03	0.51	0.54	0.027		0.268	0.013		
AW503506	CO	5/03/1996 13:40	0.453	0.03	0.93	0.96	0.026		0.435	0.012		
AW503506	CO	12/03/1996 12:50	0.451	0.01	0.72	0.73	0.027		0.329	0.012		
AW503506	CO	19/03/1996 14:20	0.499	0.01	0.31	0.32	0.029		0.160	0.014		
AW503506	CO	26/03/1996 15:00	0.490	0.01	0.47	0.48	0.023		0.235	0.011		
AW503506	CO	2/04/1996 14:05	0.482	0.01	0.41	0.42	0.022		0.203	0.011		
AW503506	CO	9/04/1996 12:50	0.497	0.01	0.37	0.38	0.024		0.189	0.012		
AW503506	CO	16/04/1996 13:00	0.529	0.01	0.26	0.27	0.017		0.143	0.009		
AW503506	CO	23/04/1996 14:10	0.526	0.01	0.26	0.27	0.014		0.142	0.007		
AW503506	MD	1/05/1996 11:40	0.613	0.01	0.16	0.17	0.015		0.104	0.009		
AW503506	CO	7/05/1996 11:00	0.462	0.01	0.19	0.2	0.014		0.092	0.006		
AW503506	CO	24/07/1996 16:55	893.100	0.2	2.27	2.47	0.287		2205.957	256.320		
AW503506	CO	31/07/1996 15:45	65.429	0.134	1.18	1.314	0.094		85.974	6.150		
AW503506	CO	6/08/1996 14:43	2024.000	0.187	2.38	2.567	0.324		5195.608	655.776		
AW503506	CO	13/08/1996 12:50	456.348	0.297	1.74	2.037	0.254		929.581	115.912		
AW503506	CO	20/08/1996 12:25	214.500	0.196	1.62	1.816	0.181		389.532	38.825		
AW503506	CO	28/08/1996 12:00	319.627	0.175	1.67	1.845	0.237		589.712	75.752		
AW503506	CO	4/09/1996 13:40	101.567	0.143	1.2	1.343	0.152		136.405	15.438		
AW503506	CO	11/09/1996 16:50	39.600	0.009	0.88	0.889	0.052		35.204	2.059		
AW503506	CO	18/09/1996 10:00	122.468	0.063	1.22	1.283	0.128		157.127	15.676		
AW503506	CO	25/09/1996 11:55	89.126	0.013	1.17	1.183	0.085		105.436	7.576		
AW503506	CO	2/10/1996 14:45	1175.812	0.215	4.7	4.915	0.95		5779.116	1117.021		
AW503506	CO	16/10/1996 17:00	212.500	0.079	0.89	0.969	0.062		205.913	13.175		
AW503506	CO	30/10/1996 14:50	25.866	0.01	0.61	0.62	0.019		16.037	0.491		
AW503506	CO	6/11/1996 13:10	5.683	0.007	0.8	0.807	0.018		4.587	0.102		
AW503506	CO	13/11/1996 16:05	3.653	0.006	0.48	0.486	0.015		1.775	0.055		
AW503506	CO	27/11/1996 14:55	3.702	0.005	0.48	0.485	0.01		1.795	0.037		
AW503506	CO	4/12/1996 12:30	0.5680	0.010	0.26	0.27	0.009		0.153	0.005		
AW503506	CO	11/12/1996 12:35	0.5880	0.0025	0.30	0.3025	0.012		0.178	0.007		
AW503506	CO	18/12/1996 11:55	0.5308	0.0025	0.46	0.4625	0.012	5764	0.245	0.006		
AW503506	**CO**	**26/12/1996 12:35**	**0.6000**	**0.0025**	**0.38**	**0.3825**	**0.008**	**5765**	**0.230**	**0.005**	**15845**	**2321**
AW503506	**CO**	**2/01/1997 11:00**	**0.4952**	**0.0025**	**0.42**	**0.4225**	**0.012**		**0.209**	**0.006**		
AW503506	CO	9/01/1997 8:47	0.4861	0.0025	0.17	0.1725	0.013		0.084	0.006		
AW503506	CO	16/01/1997 7:55	0.4932	0.0025	0.36	0.3625	0.026		0.179	0.013		
AW503506	CO	23/01/1997 15:25	0.5156	0.0025	0.32	0.3225	0.028		0.166	0.014		
AW503506	CO	30/01/1997 9:30	0.4715	0.0025	0.72	0.7225	0.029		0.341	0.014		
AW503506	CO	6/02/1997 11:20	0.4876	0.010	0.53	0.54	0.027		0.263	0.013		
AW503506	CO	12/02/1997 12:10	0.4003	0.0025	1.49	1.4925	0.044		0.597	0.018		
AW503506	CO	19/02/1997 8:55	0.4301	0.0025	0.44	0.4425	0.023		0.190	0.010		
AW503506	CO	26/02/1997 7:20	0.4621	0.0025	0.47	0.4725	0.029		0.218	0.013		
AW503506	CO	5/03/1997 16:00	0.4788	0.0025	0.17	0.1725	0.017		0.083	0.008		
AW503506	CO	12/03/1997 13:00	0.4100	0.007	0.57	0.577	0.025		0.237	0.010		
AW503506	CO	19/03/1997 14:35	0.4396	0.008	0.46	0.468	0.013		0.206	0.006		
AW503506	CO	26/03/1997 9:20	0.4409	0.008	0.41	0.418	0.014		0.184	0.006		
AW503506	CO	2/04/1997 10:10	0.4584	0.0025	0.38	0.3825	0.012		0.175	0.006		
AW503506	CO	9/04/1997 10:50	0.4669	0.0025	0.32	0.3225	0.027		0.151	0.013		
AW503506	CO	16/04/1997 14:00	0.4584	0.006	0.43	0.436	0.016		0.200	0.007		
AW503506	CO	24/04/1997 14:15	0.5064	0.0025	0.31	0.3125	0.015		0.158	0.008		
AW503506	CO	28/04/1997 12:40	0.2546	0.0025	0.17	0.1725	0.020		0.044	0.005		
AW503506	CO	6/05/1997 7:35	0.5024	0.0025	0.23	0.2325	0.018		0.117	0.009		
AW503506	CO	14/05/1997 14:15	0.6074	0.0025	0.54	0.5425	0.021		0.330	0.013		
AW503506	CO	20/05/1997 15:25	0.4461	0.008	0.93	0.938	0.023		0.418	0.010		
AW503506	CO	28/05/1997 13:25	0.6194	0.008	0.35	0.358	0.022		0.222	0.014		
AW503506	CO	1/07/1997 12:40	11.5247	0.024	0.55	0.574	0.02		6.615	0.230		
AW503506	CO	8/07/1997 12:15	3.5640	0.009	0.76	0.769	0.02		2.741	0.071		
AW503506	CO	15/07/1997 8:00	5.2412	0.0025	0.38	0.3825	0.018		2.005	0.094		
AW503506	CO	22/07/1997 12:00	25.7639	0.057	0.67	0.727	0.036		18.730	0.928		
AW503506	CO	30/07/1997 14:10	12.4206	0.0025	0.7	0.7025	0.024		8.725	0.298		
AW503506	CO	6/08/1997 9:35	6.2773	0.0025	0.48	0.4825	0.024		3.029	0.151		
AW503506	CO	13/08/1997 12:35	307.8862	0.627	3.12	3.747	0.51		1153.650	157.022		
AW503506	CO	20/08/1997 14:45	53.7076	0.177	1.09	1.267	0.061		68.048	3.276		
AW503506	CO	27/08/1997 12:40	42.2836	0.028	0.8	0.828	0.036		35.011	1.522		
AW503506	CO	3/09/1997 12:15	192.0108	0.115	1.86	1.975	0.127		379.221	24.385		
AW503506	CO	10/09/1997 13:15	211.3574	0.096	1.79	1.886	0.104		398.620	21.981		
AW503506	CO	17/09/1997 16:00	56.3880	0.057	1.25	1.307	0.053		73.699	2.989		
AW503506	CO	24/09/1997 14:50	51.1592	0.022	1.24	1.262	0.06		64.563	3.070		
AW503506	CO	1/10/1997 15:15	15.3244	0.006	1.01	1.016	0.026		15.570	0.398		
AW503506	CO	8/10/1997 12:55	9.0046	0.008	0.78	0.788	0.017		7.096	0.153		
AW503506	CO	15/10/1997 14:40	6.5130	0.0025	0.83	0.8325	0.01		5.422	0.065		

STATION	COLl	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503506	CO	21/10/1997 11:00	3.6749	0.007	0.51	0.517	0.016		1.900	0.059		
AW503506	CO	29/10/1997 13:25	3.3832	0.0025	0.84	0.8425	0.025		2.850	0.085		
AW503506	CO	5/11/1997 15:10	225.6457	0.306	2.95	3.256	0.464		734.702	104.700		
AW503506	CO	12/11/1997 9:35	8.7928	0.012	0.73	0.742	0.029		6.524	0.255		
AW503506	CO	19/11/1997 13:55	7.8864	0.015	0.89	0.905	0.027		7.137	0.213		
AW503506	CO	26/11/1997 8:00	2.618	0.012	0.64	0.652	0.024		1.707	0.063		
AW503506	CO	4/12/1997 16:34	0.706	0.011	0.76	0.771	0.018		0.544	0.013		
AW503506	CO	10/12/1997 14:00	0.459	0.016	0.29	0.306	0.015		0.141	0.007		
AW503506	CO	17/12/1997 12:45	0.504	0.005	0.31	0.315	0.02		0.159	0.010		
AW503506	CO	24/12/1997 6:15	0.492	0.006	0.23	0.236	0.01	1274	0.116	0.005		
AW503506	**CO**	**31/12/1997 6:30**	**0.474**	**0.007**	**0.62**	**0.627**	**0.014**	**1275**	**0.297**	**0.007**	**3004**	**322**
AW503506	**CO**	**7/01/1998 8:10**	**0.459**	**0.01**	**0.19**	**0.2**	**0.016**		**0.092**	**0.007**		
AW503506	CO	15/01/1998 7:55	0.506	0.005	0.24	0.245	0.021		0.124	0.011		
AW503506	CO	21/01/1998 13:05	0.379	0.005	0.19	0.195	0.016		0.074	0.006		
AW503506	CO	28/01/1998 11:25	0.426	0.005	0.29	0.295	0.029		0.126	0.012		
AW503506	CO	4/02/1998 12:05	0.435	0.006	0.29	0.296	0.017		0.129	0.007		
AW503506	CO	11/02/1998 6:00	0.410	0.005	0.24	0.245	0.017		0.100	0.007		
AW503506	CO	16/02/1998 11:20	0.312	0.01	0.16	0.17	0.026		0.053	0.008		
AW503506	CO	25/02/1998 7:10	0.528	0.01	0.16	0.17	0.021		0.090	0.011		
AW503506	CO	4/03/1998 15:15	0.417	0.005	0.13	0.135	0.016		0.056	0.007		
AW503506	CO	11/03/1998 7:50	0.397	0.005	0.13	0.135	0.01		0.054	0.004		
AW503506	CO	16/03/1998 13:35	0.314	0.005	0.13	0.135	0.01		0.042	0.003		
AW503506	CO	25/03/1998 9:00	0.515	0.005	0.12	0.125	0.013		0.064	0.007		
AW503506	CO	1/04/1998 9:00	0.430	0.005	0.13	0.135	0.006		0.058	0.003		
AW503506	CO	8/04/1998 9:00	0.429	0.005	0.11	0.115	0.01		0.049	0.004		
AW503506	CO	15/04/1998 8:30	0.536	0.005	0.47	0.475	0.033		0.255	0.018		
AW503506	CO	22/04/1998 15:00	0.661	0.005	0.41	0.415	0.036		0.274	0.024		
AW503506	CO	29/04/1998 8:20	0.568	0.005	0.34	0.345	0.036		0.196	0.020		
AW503506	CO	6/05/1998 7:40	0.536	0.005	0.38	0.385	0.015		0.206	0.008		
AW503506	CO	13/05/1998 9:20	0.546	0.011	0.59	0.601	0.026		0.328	0.014		
AW503506	CO	20/05/1998 8:45	0.554	0.005	0.42	0.425	0.023		0.236	0.013		
AW503506	CO	27/05/1998 9:05	1.154	0.005	0.3	0.305	0.021		0.352	0.024		
AW503506	CO	3/06/1998 8:20	1.321	0.007	0.25	0.257	0.015		0.340	0.020		
AW503506	CO	10/06/1998 15:05	8.260	0.007	0.38	0.387	0.021		3.197	0.173		
AW503506	CO	17/06/1998 11:34	28.366	0.22	0.77	0.99	0.082		28.082	2.326		
AW503506	CO	24/06/1998 15:50	52.537	0.125	0.88	1.005	0.087		52.800	4.571		
AW503506	CO	1/07/1998 14:35	32.592	0.085	0.89	0.975	0.044		31.777	1.434		
AW503506	CO	8/07/1998 8:20	117.508	0.343	2.3	2.643	0.328		310.575	38.543		
AW503506	CO	15/07/1998 8:40	89.594	0.266	1.49	1.756	0.142		157.327	12.722		
AW503506	CO	22/07/1998 9:00	32.126	0.119	0.75	0.869	0.032		27.917	1.028		
AW503506	CO	29/07/1998 9:40	332.139	0.277	2.54	2.817	0.433		935.635	143.816		
AW503506	CO	5/08/1998 9:35	113.076	0.218	1.08	1.298	0.108		146.773	12.212		
AW503506	CO	12/08/1998 8:35	48.716	0.057	0.8	0.857	0.043		41.749	2.095		
AW503506	CO	19/08/1998 8:25	37.240	0.015	0.78	0.795	0.034		29.606	1.266		
AW503506	CO	26/08/1998 16:25	178.112	0.11	1.54	1.65	0.132		293.885	23.511		
AW503506	CO	2/09/1998 7:30	56.347	0.105	1.19	1.295	0.099		72.970	5.578		
AW503506	CO	9/09/1998 9:00	36.702	0.005	0.79	0.795	0.038		29.178	1.395		
AW503506	CO	16/09/1998 7:55	20.297	0.005	0.65	0.655	0.02		13.294	0.406		
AW503506	CO	24/09/1998 10:23	215.739	0.251	2.4	2.651	0.383		571.923	82.628		
AW503506	CO	30/09/1998 8:45	64.363	0.123	1.47	1.593	0.147		102.531	9.461		
AW503506	CO	4/11/1998 8:25	143.908	0.008	0.44	0.448	0.02		64.471	2.878		
AW503506	CO	11/11/1998 7:45	3.738	0.009	0.49	0.499	0.03		1.865	0.112		
AW503506	CO	18/11/1998 7:40	10.725	0.006	0.44	0.446	0.02		4.783	0.214		
AW503506	CO	25/11/1998 7:30	2.250	0.005	0.58	0.585	0.017		1.316	0.038		
AW503506	CO	2/12/1998 7:50	0.811	0.005	0.52	0.525	0.023		0.426	0.019		
AW503506	CO	9/12/1998 8:25	0.569	0.007	0.47	0.477	0.068		0.271	0.039		
AW503506	CO	16/12/1998 7:35	0.536	0.008	1.33	1.338	0.009		0.717	0.005		
AW503506	CO	23/12/1998 6:40	0.518	0.012	0.89	0.902	0.012	1639	0.467	0.006		
AW503506	**CO**	**30/12/1998 6:15**	**0.491**	**0.007**	**0.57**	**0.577**	**0.011**	**1639**	**0.284**	**0.005**	**2927**	**347**
AW503506	**CO**	**6/01/1999 7:55**	**0.475**	**0.006**	**0.62**	**0.626**	**0.016**		**0.297**	**0.008**		
AW503506	CO	13/01/1999 7:15	0.468	0.005	0.34	0.345	0.026		0.161	0.012		
AW503506	CO	20/01/1999 7:40	0.446	0.005	0.36	0.365	0.021		0.163	0.009		
AW503506	CO	27/01/1999 7:25	0.444	0.008	0.28	0.288	0.021		0.128	0.009		
AW503506	CO	3/02/1999 8:20	0.454	0.008	0.37	0.378	0.028		0.172	0.013		
AW503506	CO	10/02/1999 7:20	0.446	0.009	0.32	0.329	0.029		0.147	0.013		
AW503506	CO	17/02/1999 7:35	0.461	0.005	0.31	0.315	0.037		0.145	0.017		
AW503506	CO	24/02/1999 7:25	0.460	0.005	0.27	0.275	0.02		0.126	0.009		
AW503506	CO	3/03/1999 7:55	0.427	0.005	0.17	0.175	0.021		0.075	0.009		
AW503506	CO	10/03/1999 8:10	0.457	0.005	0.46	0.465	0.028		0.213	0.013		
AW503506	CO	17/03/1999 7:35	0.458	0.005	0.23	0.235	0.022		0.108	0.010		
AW503506	CO	24/03/1999 7:45	0.531	0.005	0.29	0.295	0.027		0.157	0.014		
AW503506	CO	31/03/1999 7:20	0.513	0.005	0.18	0.185	0.02		0.095	0.010		
AW503506	CO	7/04/1999 9:10	0.523	0.005	0.31	0.315	0.023		0.165	0.012		
AW503506	CO	14/04/1999 9:04	0.510	0.005	0.18	0.185	0.018		0.094	0.009		
AW503506	CO	21/04/1999 8:45	0.515	0.005	0.22	0.225	0.014		0.116	0.007		
AW503506	CO	28/04/1999 7:40	0.517	0.005	0.2	0.205	0.021		0.106	0.011		
Max				0.627	4.7	4.915	0.95					
Min				0.0025	0.05	0.06	0.006					
Mean				0.05613	0.64269	0.69881	0.0605					
Median				0.01	0.47	0.48	0.028					
SD				0.10038	0.57782	0.65518	0.09698					

STATION	COLI	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503507 Lenswood Creek, Lenswood												
WQ#3208												
AW503507	CO	15/11/1994 12:10	NA									
AW503507	CO	22/11/1994 12:10	17.987	0.01	0.25	0.26	0.024		4.677	0.432		
AW503507	CO	29/11/1994 12:45	12.543	0.01	0.39	0.4	0.024		5.017	0.301		
AW503507	CO	6/12/1994 9:00	6.176	0.01	0.84	0.85	0.023		5.250	0.142		
AW503507	CO	13/12/1994 9:30	2.609	0.01	1.23	1.24	0.021		3.236	0.055		
AW503507	CO	20/12/1994 7:20	0.792	0.01	0.6	0.61	0.041		0.483	0.032		
AW503507	**CO**	**27/12/1994 9:55**	**0.792**	**0.02**	**0.42**	**0.44**	**0.049**		**0.348**	**0.039**		
AW503507	**CO**	**3/01/1995 7:10**	**0.401**	**0.01**	**0.32**	**0.33**	**0.034**		**0.132**	**0.014**		
AW503507	CO	18/04/1995 14:59	0.070	0.01	4	4.01	0.29		0.280	0.020		
AW503507	CO	25/04/1995 11:50	0.562	0.01	0.9	0.91	0.08		0.511	0.045		
AW503507	CO	3/05/1995 14:15	5.181	0.08	0.95	1.03	0.12		5.336	0.622		
AW503507	CO	9/05/1995 0:00	2.731	0.04	0.34	0.38	0.04		1.038	0.109		
AW503507	CO	16/05/1995 14:15	3.416	0.01	0.5	0.51	0.069		1.742	0.236		
AW503507	CO	23/05/1995 11:30	2.114	0.01	0.75	0.76	0.084		1.607	0.178		
AW503507	CO	30/05/1995 15:15	33.995	0.95	0.72	1.67	0.12		56.772	4.079		
AW503507	CO	6/06/1995 12:53	4.840	0.1	0.27	0.37	0.028		1.791	0.136		
AW503507	CO	13/06/1995 15:35	102.504	2.55	0.97	3.52	0.138		360.815	14.146		
AW503507	CO	20/06/1995 12:45	25.140	1.23	0.43	1.66	0.024		41.732	0.603		
AW503507	CO	27/06/1995 13:10	16.103	0.56	0.29	0.85	0.029		13.688	0.467		
AW503507	CO	4/07/1995 15:15	370.447	2.2	2.48	4.68	0.444		1733.694	164.479		
AW503507	CO	12/07/1995 12:18	288.316	1.67	1.21	2.88	0.207		830.349	59.681		
AW503507	CO	19/07/1995 11:40	697.940	1.72	0.69	2.41	0.072		1682.035	50.252		
AW503507	CO	26/07/1995 10:55	1212.068	1.11	1.46	2.57	0.281		3115.015	340.591		
AW503507	CO	2/08/1995 10:25	674.986	1.04	0.67	1.71	0.111		1154.226	74.923		
AW503507	CO	9/08/1995 11:25	449.135	1.04	0.55	1.59	0.045		714.124	20.211		
AW503507	CO	16/08/1995 11:30	99.644	0.83	0.28	1.11	0.019		110.605	1.893		
AW503507	CO	23/08/1995 11:50	43.673	0.55	0.22	0.77	0.013		33.628	0.568		
AW503507	CO	30/08/1995 11:20	38.029	0.34	0.27	0.61	0.018		23.198	0.685		
AW503507	CO	6/09/1995 11:20	33.422	0.25	0.28	0.53	0.02		17.714	0.668		
AW503507	CO	13/09/1995 11:05	27.559	0.13	0.2	0.33	0.018		9.094	0.496		
AW503507	CO	20/09/1995 11:35	23.539	0.05	0.25	0.3	0.018		7.062	0.424		
AW503507	CO	27/09/1995 11:40	35.278	0.26	0.69	0.95	0.053		33.514	1.870		
AW503507	CO	4/10/1995 10:50	26.611	0.1	0.39	0.49	0.015		13.039	0.399		
AW503507	CO	11/10/1995 10:50	24.313	0.09	0.38	0.47	0.017		11.427	0.413		
AW503507	CO	18/10/1995 14:25	21.372	0.08	0.24	0.32	0.018		6.839	0.385		
AW503507	CO	25/10/1995 12:30	16.779	0.07	0.39	0.46	0.02		7.718	0.336		
AW503507	CO	1/11/1995 11:00	13.570	0.02	0.58	0.6	0.012		8.142	0.163		
AW503507	CO	8/11/1995 12:30	14.252	0.05	0.42	0.47	0.018		6.699	0.257		
AW503507	CO	15/11/1995 11:00	10.122	0.04	0.24	0.28	0.015		2.834	0.152		
AW503507	CO	22/11/1995 10:50	7.787	0.02	0.23	0.25	0.015		1.947	0.117		
AW503507	CO	29/11/1995 14:35	3.773	0.01	0.28	0.29	0.015		1.094	0.057		
AW503507	CO	6/12/1995 12:35	2.138	0.01	0.36	0.37	0.021		0.791	0.045		
AW503507	CO	13/12/1995 12:15	1.779	0.01	0.38	0.39	0.019		0.694	0.034		
AW503507	CO	20/12/1995 14:15	1.225	0.01	0.52	0.53	0.024	4335	0.649	0.029		
AW503507	**CO**	**27/12/1995 12:15**	**0.760**	**0.01**	**0.33**	**0.34**	**0.022**	**4336**	**0.258**	**0.017**	**10012**	**740**
AW503507	**CO**	**3/01/1996 12:05**	**1.235**	**0.01**	**0.53**	**0.54**	**0.019**		**0.667**	**0.023**		
AW503507	CO	10/01/1996 12:40	0.852	0.01	0.53	0.54	0.057		0.460	0.049		
AW503507	CO	24/01/1996 11:30	0.665	0.01	0.82	0.83	0.092		0.552	0.061		
AW503507	CO	14/02/1996 11:15	4.019	0.01	0.98	0.99	0.08		3.978	0.321		
AW503507	CO	20/03/1996 12:55	4.020	0.6	2.12	2.72	0.257		10.934	1.033		
AW503507	CO	27/03/1996 15:43	0.563	0.02	1.66	1.68	0.126		0.946	0.071		
AW503507	CO	3/04/1996 17:05	0.419	0.02	0.77	0.79	0.111		0.331	0.047		
AW503507	CO	10/04/1996 13:25	0.758	0.01	0.72	0.73	0.091		0.553	0.069		
AW503507	CO	17/04/1996 10:50	1.768	0.02	0.65	0.67	0.064		1.185	0.113		
AW503507	CO	24/04/1996 11:00	1.118	0.05	0.4	0.45	0.041		0.503	0.046		
AW503507	CO	1/05/1996 13:40	2.850	0.06	1.08	1.14	0.036		3.249	0.103		
AW503507	CO	8/05/1996 14:30	1.142	0.01	0.39	0.4	0.026		0.457	0.030		
AW503507	CO	15/05/1996 12:20	2.384	0.01	0.35	0.36	0.025		0.858	0.060		
AW503507	CO	22/05/1996 12:20	1.627	0.01	0.48	0.49	0.028		0.797	0.046		
AW503507	CO	29/05/1996 14:30	2.499	0.01	0.48	0.49	0.021		1.225	0.052		
AW503507	CO	5/06/1996 13:45	12.535	0.33	0.76	1.09	0.064		13.664	0.802		
AW503507	CO	12/06/1996 12:10	10.540	0.22	0.55	0.77	0.03		8.116	0.316		
AW503507	CO	19/06/1996 12:45	45.062	1.5	1.24	2.74	0.168		123.470	7.570		
AW503507	CO	26/06/1996 16:15	80.799	1.4	1.53	2.93	0.215		236.742	17.372		
AW503507	CO	3/07/1996 11:00	235.576	2.3	1.47	3.77	0.154		888.122	36.279		
AW503507	CO	10/07/1996 10:25	210.221	1.6	0.68	2.28	0.064		479.304	13.454		
AW503507	CO	17/07/1996 12:50	184.964	1.15	0.58	1.73	0.045		319.987	8.323		
AW503507	CO	24/07/1996 12:15	509.568	1.14	1.12	2.26	0.154		1151.623	78.473		
AW503507	CO	31/07/1996 10:15	153.800	1.16	0.64	1.8	0.061		276.840	9.382		
AW503507	CO	6/08/1996 10:50	1116.600	0.86	1.73	2.59	0.326		2891.994	364.012		
AW503507	CO	13/08/1996 8:10	511.876	0.84	0.63	1.47	0.081		752.458	41.462		
AW503507	CO	20/08/1996 9:10	218.122	0.63	0.47	1.1	0.033		239.935	7.198		
AW503507	CO	28/08/1996 9:30	617.544	0.67	0.83	1.5	0.099		926.316	61.137		
AW503507	CO	4/09/1996 10:05	183.003	0.496	0.39	0.886	0.025		162.140	4.575		
AW503507	CO	11/09/1996 13:40	76.358	0.251	0.42	0.671	0.019		51.236	1.451		
AW503507	CO	18/09/1996 7:15	95.791	0.255	0.44	0.695	0.026		66.575	2.491		
AW503507	CO	25/09/1996 8:15	128.107	0.267	0.51	0.777	0.04		99.539	5.124		
AW503507	CO	9/10/1996 13:55	1436.400	0.618	0.4	1.018	0.03		1462.255	43.092		
AW503507	CO	16/10/1996 12:45	77.136	0.232	0.35	0.582	0.017		44.893	1.311		
AW503507	CO	22/10/1996 14:35	41.119	0.03	0.34	0.37	0.008		15.214	0.329		
AW503507	CO	30/10/1996 10:35	35.198	0.025	0.36	0.385	0.01		13.551	0.352		
AW503507	CO	13/11/1996 13:20	33.712	0.011	0.36	0.371	0.012		12.507	0.405		

STATION	COLI	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503507	CO	20/11/1996 10:05	9.460	0.028	0.2	0.228	0.013		2.157	0.123		
AW503507	CO	27/11/1996 10:45	7.149	0.015	0.35	0.365	0.012		2.610	0.086		
AW503507	CO	4/12/1996 8:05	4.7986	0.017	0.37	0.387	0.020		1.857	0.096		
AW503507	CO	11/12/1996 9:55	3.5550	0.114	3.43	3.544	0.397		12.599	1.411		
AW503507	CO	18/12/1996 7:35	2.0022	0.012	0.90	0.912	0.059	6069	1.826	0.118		
AW503507	**CO**	**26/12/1996 9:20**	**2.1105**	**0.009**	**0.83**	**0.839**	**0.055**	**6069**	**1.771**	**0.116**	**10286**	**709**
AW503507	**CO**	**2/01/1997 8:35**	**1.1094**	**0.0025**	**0.46**	**0.4625**	**0.022**		**0.513**	**0.024**		
AW503507	CO	9/01/1997 13:25	1.0882	0.0025	0.25	0.2525	0.016		0.275	0.017		
AW503507	CO	16/01/1997 10:40	0.4285	0.267	0.53	0.797	0.027		0.341	0.012		
AW503507	CO	23/01/1997 12:30	1.7560	0.020	0.48	0.5	0.040		0.878	0.070		
AW503507	CO	30/01/1997 12:55	0.7959	0.0025	0.79	0.7925	0.032		0.631	0.025		
AW503507	CO	6/02/1997 9:10	0.3954	0.015	1.40	1.415	0.040		0.559	0.016		
AW503507	CO	12/02/1997 7:00	1.4582	0.0025	0.81	0.8125	0.053		1.185	0.077		
AW503507	CO	19/02/1997 6:05	0.6310	0.021	0.62	0.641	0.032		0.404	0.020		
AW503507	CO	6/05/1997 11:25	3.2694	0.298	1.17	1.468	0.142		4.800	0.464		
AW503507	CO	14/05/1997 11:55	3.5261	0.019	1.01	1.029	0.043		3.628	0.152		
AW503507	CO	20/05/1997 12:45	2.7141	0.006	0.69	0.696	0.028		1.889	0.076		
AW503507	CO	28/05/1997 10:40	6.5863	0.168	0.59	0.758	0.064		4.992	0.422		
AW503507	CO	1/07/1997 10:25	29.5748	0.076	0.51	0.586	0.018		17.331	0.532		
AW503507	CO	8/07/1997 9:20	3.3370	0.011	0.34	0.351	0.018		1.171	0.060		
AW503507	CO	15/07/1997 10:25	5.0119	0.038	0.31	0.348	0.019		1.744	0.095		
AW503507	CO	30/07/1997 12:00	14.1561	0.057	1.07	1.127	0.058		15.954	0.821		
AW503507	CO	6/08/1997 13:05	3.2063	0.017	0.31	0.327	0.011		1.048	0.035		
AW503507	CO	12/08/1997 14:40	195.3742	2.78	2.12	4.9	0.35		957.334	68.381		
AW503507	CO	20/08/1997 11:45	68.0724	2.36	0.69	3.05	0.03		207.621	2.042		
AW503507	CO	27/08/1997 9:50	20.8711	0.881	0.35	1.231	0.021		25.692	0.438		
AW503507	CO	3/09/1997 9:35	119.7838	1.44	0.86	2.3	0.09		275.503	10.781		
AW503507	CO	10/09/1997 10:45	263.7010	1.48	0.87	2.35	0.088		619.697	23.206		
AW503507	CO	17/09/1997 13:45	121.0074	1.09	0.52	1.61	0.026		194.822	3.146		
AW503507	CO	24/09/1997 12:25	90.8135	0.846	0.85	1.696	0.076		154.020	6.902		
AW503507	CO	1/10/1997 11:30	42.3225	0.401	0.63	1.031	0.02		43.635	0.846		
AW503507	CO	8/10/1997 10:15	23.3491	0.144	0.28	0.424	0.011		9.900	0.257		
AW503507	CO	15/10/1997 11:25	12.6547	0.06	0.45	0.51	0.022		6.454	0.278		
AW503507	CO	22/10/1997 11:20	10.1442	0.044	0.49	0.534	0.015		5.417	0.152		
AW503507	CO	29/10/1997 9:10	5.8438	0.032	0.5	0.532	0.031		3.109	0.181		
AW503507	CO	31/10/1997 12:10	26.3624	0.73	1.44	2.17	0.261		57.206	6.881		
AW503507	CO	5/11/1997 12:25	56.4410	0.8	1.02	1.82	0.122		102.723	6.886		
AW503507	CO	12/11/1997 7:30	14.8000	0.065	0.32	0.385	0.016		5.698	0.237		
AW503507	CO	19/11/1997 12:00	17.5237	0.109	0.33	0.439	0.026		7.693	0.456		
AW503507	CO	26/11/1997 5:30	6.048	0.054	0.49	0.544	0.024		3.290	0.145		
AW503507	CO	3/12/1997 12:25	2.751	0.026	0.83	0.856	0.019		2.355	0.052		
AW503507	CO	10/12/1997 10:30	2.063	0.028	0.66	0.688	0.035		1.419	0.072		
AW503507	CO	17/12/1997 7:00	1.434	0.02	0.5	0.52	0.042		0.746	0.060		
AW503507	CO	24/12/1997 9:40	5.343	0.134	0.55	0.684	0.052	1185	3.655	0.278		
AW503507	**CO**	**31/12/1997 8:50**	**0.925**	**0.018**	**0.6**	**0.618**	**0.043**	**1187**	**0.571**	**0.040**	**2746**	**135**
AW503507	**CO**	**7/01/1998 13:10**	**0.613**	**0.011**	**0.75**	**0.761**	**0.048**		**0.467**	**0.029**		
AW503507	CO	14/01/1998 13:00	0.739	0.028	1.55	1.578	0.055		1.166	0.041		
AW503507	CO	21/01/1998 10:35	0.628	0.005	0.73	0.735	0.078		0.461	0.049		
AW503507	CO	28/01/1998 9:10	1.303	0.006	0.84	0.846	0.106		1.103	0.138		
AW503507	CO	4/02/1998 9:05	0.425	0.005	0.8	0.805	0.092		0.342	0.039		
AW503507	CO	11/02/1998 12:00	1.519	0.038	0.98	1.018	0.176		1.547	0.267		
AW503507	CO	18/02/1998 8:05	0.344	0.026	0.67	0.696	0.087		0.240	0.030		
AW503507	CO	15/04/1998 11:55	3.499	0.58	1.06	1.64	0.114		5.738	0.399		
AW503507	CO	22/04/1998 12:00	13.872	0.87	1.87	2.74	0.324		38.010	4.495		
AW503507	CO	29/04/1998 9:00	4.804	0.111	0.58	0.691	0.054		3.319	0.259		
AW503507	CO	6/05/1998 9:55	2.065	0.005	0.6	0.605	0.048		1.249	0.099		
AW503507	CO	13/05/1998 12:30	2.738	0.006	0.62	0.626	0.05		1.714	0.137		
AW503507	CO	20/05/1998 11:35	2.266	0.007	0.66	0.667	0.048		1.511	0.109		
AW503507	CO	27/05/1998 12:00	3.613	0.021	0.48	0.501	0.051		1.810	0.184		
AW503507	CO	3/06/1998 10:50	1.921	0.008	0.39	0.398	0.035		0.765	0.067		
AW503507	CO	10/06/1998 12:10	13.115	0.544	0.59	1.134	0.07		14.872	0.918		
AW503507	CO	17/06/1998 14:00	42.813	1.47	1.09	2.56	0.164		109.602	7.021		
AW503507	CO	24/06/1998 12:40	25.329	1.02	0.42	1.44	0.045		36.474	1.140		
AW503507	CO	1/07/1998 11:40	30.581	1.05	0.52	1.57	0.03		48.013	0.917		
AW503507	CO	8/07/1998 11:55	57.901	1.52	1.11	2.63	0.164		152.280	9.496		
AW503507	CO	15/07/1998 10:50	58.051	1.39	0.63	2.02	0.053		117.264	3.077		
AW503507	CO	22/07/1998 11:15	18.201	0.594	0.29	0.884	0.013		16.089	0.237		
AW503507	CO	29/07/1998 13:05	405.601	1.71	3.75	5.46	0.534		2214.583	216.591		
AW503507	CO	5/08/1998 12:15	285.731	1.56	0.63	2.19	0.064		625.750	18.287		
AW503507	CO	12/08/1998 11:10	81.612	0.31	0.44	0.75	0.022		61.209	1.795		
AW503507	CO	19/08/1998 11:20	57.334	0.864	0.38	1.244	0.021		71.323	1.204		
AW503507	CO	26/08/1998 13:25	125.587	0.869	0.56	1.429	0.037		179.464	4.647		
AW503507	CO	2/09/1998 10:30	70.408	0.812	0.38	1.192	0.017		83.926	1.197		
AW503507	CO	9/09/1998 12:00	21.953	0.443	0.31	0.753	0.02		16.531	0.439		
AW503507	CO	16/09/1998 10:15	27.029	0.246	0.26	0.506	0.013		13.676	0.351		
AW503507	CO	23/09/1998 11:00	64.488	0.635	2.65	3.285	0.487		211.843	31.406		
AW503507	CO	30/09/1998 11:50	123.825	0.684	0.49	1.174	0.041		145.371	5.077		
AW503507	CO	4/11/1998 10:15	219.394	0.051	0.35	0.401	0.016		87.977	3.510		
AW503507	CO	11/11/1998 10:25	9.577	0.167	0.42	0.587	0.026		5.622	0.249		
AW503507	CO	18/11/1998 10:00	12.728	0.124	0.25	0.374	0.018		4.760	0.229		
AW503507	CO	25/11/1998 10:10	5.560	0.019	0.29	0.309	0.013		1.718	0.072		
AW503507	CO	2/12/1998 11:10	2.599	0.024	0.31	0.334	0.03		0.868	0.078		
AW503507	CO	16/12/1998 8:55	3.551	0.025	0.31	0.335	0.034		1.190	0.121		
AW503507	CO	23/12/1998 9:10	1.240	0.033	0.34	0.373	0.03	1805	0.462	0.037		

STATION	COLI	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503507	**CO**	**30/12/1998 9:30**	**0.758**	**0.019**	**0.38**	**0.399**	**0.041**	**1805**	**0.303**	**0.031**	**4281**	**314**
AW503507	**CO**	**13/01/1999 9:50**	**0.797**	**0.005**	**0.7**	**0.705**	**0.104**		**0.562**	**0.083**		
AW503507	CO	24/03/1999 9:50	2.702	0.658	1.22	1.878	0.161		5.074	0.435		
AW503507	CO	31/03/1999 9:50	0.632	0.027	0.63	0.657	0.068		0.415	0.043		
AW503507	CO	7/04/1999 11:55	0.495	0.006	0.59	0.596	0.087		0.295	0.043		
AW503507	CO	14/04/1999 11:45	0.340	0.012	0.65	0.662	0.103		0.225	0.035		
AW503507	CO	21/04/1999 11:00	0.693	0.005	0.84	0.845	0.09		0.586	0.062		
AW503507	CO	28/04/1999 10:10	0.507	0.005	0.59	0.595	0.079		0.302	0.040		
Max				2.78	4	5.46	0.534					
Min				0.0025	0.2	0.228	0.008					
Mean				0.3906	0.71468	1.10528	0.07077					
Median				0.057	0.55	0.753	0.04					
SD				0.5869	0.58321	0.9593	0.08898					
AW503509 Aldgate Creek near Railway Station												
WQ#3210												
AW503509	CO	27/09/1994 12:30	NA									
AW503509	CO	4/10/1994 14:11	110.637	0.5	0.82	1.32	0.101		146.040	11.174		
AW503509	CO	11/10/1994 13:40	74.069	0.7	0.72	1.42	0.065		105.179	4.815		
AW503509	CO	18/10/1994 12:35	13.570	0.27	0.45	0.72	0.07		9.771	0.950		
AW503509	CO	25/10/1994 11:35	6.938	0.22	0.98	1.2	0.065		8.326	0.451		
AW503509	CO	1/11/1994 6:15	6.919	0.19	0.57	0.76	0.085		5.259	0.588		
AW503509	CO	8/11/1994 10:10	122.940	0.46	1.37	1.83	0.26		224.979	31.964		
AW503509	CO	15/11/1994 0:00	19.673	0.39	0.64	1.03	0.08		20.263	1.574		
AW503509	CO	15/11/1994 9:40	0.660	0.39	0.64	1.03	0.08		0.680	0.053		
AW503509	CO	22/11/1994 10:50	9.662	0.25	0.74	0.99	0.089		9.565	0.860		
AW503509	CO	29/11/1994 10:00	4.297	0.09	0.58	0.67	0.054		2.879	0.232		
AW503509	CO	6/12/1994 7:00	1.646	0.07	0.64	0.71	0.048		1.168	0.079		
AW503509	CO	13/12/1994 6:50	1.802	0.24	0.81	1.05	0.084		1.893	0.151		
AW503509	CO	20/12/1994 6:10	0.293	0.09	0.51	0.6	0.037		0.176	0.011		
AW503509	**CO**	**27/12/1994 8:25**	**0.358**	**0.17**	**1.07**	**1.24**	**0.056**		**0.444**	**0.020**		
AW503509	**CO**	**3/01/1995 5:40**	**0.002**	**0.04**	**0.44**	**0.48**	**0.023**		**0.001**	**0.000**		
AW503509	CO	17/01/1995 8:55	0.957	0.72	1.28	2	0.134		1.913	0.128		
AW503509	CO	31/01/1995 7:40	1.116	0.72	1.68	2.4	0.316		2.678	0.353		
AW503509	CO	7/02/1995 7:30	4.276	0.32	0.62	0.94	0.16		4.019	0.684		
AW503509	CO	14/02/1995 6:20	0.065	0.01	0.41	0.42	0.055		0.027	0.004		
AW503509	CO	11/04/1995 11:30	7.866	0.21	0.67	0.88	0.141		6.922	1.109		
AW503509	CO	18/04/1995 13:27	4.361	0.22	0.8	1.02	0.12		4.448	0.523		
AW503509	CO	25/04/1995 10:30	1.291	0.01	0.25	0.26	0.032		0.336	0.041		
AW503509	CO	3/05/1995 12:35	23.403	0.28	1.2	1.48	0.22		34.636	5.149		
AW503509	CO	4/05/1995 11:00	2.000	0.1	0.34	0.44	0.042		0.880	0.084		
AW503509	CO	9/05/1995 12:20	3.918	0.08	0.4	0.48	0.042		1.881	0.165		
AW503509	CO	16/05/1995 13:10	6.345	0.06	0.55	0.61	0.091		3.870	0.577		
AW503509	CO	23/05/1995 12:25	2.331	0.02	0.26	0.28	0.023		0.653	0.054		
AW503509	CO	30/05/1995 14:05	90.687	0.64	3.07	3.71	0.68		336.450	61.667		
AW503509	CO	1/06/1995 0:00	1.356	0.18	0.35	0.53	0.037		0.719	0.050		
AW503509	CO	6/06/1995 11:53	6.982	0.19	0.44	0.63	0.07		4.399	0.489		
AW503509	CO	13/06/1995 13:40	110.789	0.78	1.29	2.07	0.237		229.333	26.257		
AW503509	CO	20/06/1995 11:30	20.290	0.51	0.5	1.01	0.043		20.493	0.872		
AW503509	CO	27/06/1995 11:25	16.158	0.32	0.76	1.08	0.143		17.450	2.311		
AW503509	CO	4/07/1995 14:20	252.971	0.78	1.18	1.96	0.214		495.823	54.136		
AW503509	CO	12/07/1995 13:50	165.390	0.7	0.98	1.68	0.166		277.856	27.455		
AW503509	CO	19/07/1995 13:25	295.348	0.68	0.83	1.51	0.108		445.975	31.898		
AW503509	CO	26/07/1995 12:15	434.343	0.65	0.77	1.42	0.107		616.767	46.475		
AW503509	CO	27/07/1995 13:30	14.556	0.66	0.48	1.14	0.055		16.594	0.801		
AW503509	CO	2/08/1995 11:43	355.938	0.45	0.72	1.17	0.1		416.447	35.594		
AW503509	CO	9/08/1995 12:40	177.076	0.52	0.65	1.17	0.075		207.179	13.281		
AW503509	CO	16/08/1995 12:55	40.600	0.49	0.52	1.01	0.04		41.006	1.624		
AW503509	CO	23/08/1995 13:30	21.765	0.36	0.45	0.81	0.038		17.630	0.827		
AW503509	CO	30/08/1995 12:30	31.958	0.31	0.9	1.21	0.161		38.670	5.145		
AW503509	CO	6/09/1995 12:15	23.526	0.25	0.82	1.07	0.082		25.173	1.929		
AW503509	CO	13/09/1995 12:30	15.609	0.15	0.32	0.47	0.036		7.336	0.562		
AW503509	CO	20/09/1995 12:40	20.639	0.17	0.66	0.83	0.094		17.131	1.940		
AW503509	CO	27/09/1995 13:25	81.561	0.34	0.97	1.31	0.143		106.845	11.663		
AW503509	CO	4/10/1995 12:00	41.514	0.26	0.89	1.15	0.115		47.742	4.774		
AW503509	CO	11/10/1995 12:00	22.375	0.25	0.64	0.89	0.061		19.913	1.365		
AW503509	CO	18/10/1995 15:20	16.671	0.22	0.63	0.85	0.032		14.170	0.533		
AW503509	CO	25/10/1995 13:45	14.689	0.17	0.64	0.81	0.06		11.898	0.881		
AW503509	CO	1/11/1995 12:05	6.445	0.09	0.62	0.71	0.071		4.576	0.458		
AW503509	CO	8/11/1995 13:30	12.811	0.18	0.82	1	0.079		12.811	1.012		
AW503509	CO	15/11/1995 12:35	5.122	0.1	0.62	0.72	0.052		3.688	0.266		
AW503509	CO	22/11/1995 12:55	2.494	0.06	0.44	0.5	0.036		1.247	0.090		
AW503509	CO	29/11/1995 15:30	1.445	0.02	0.38	0.4	0.03		0.578	0.043		
AW503509	CO	6/12/1995 13:40	0.838	0.03	0.44	0.47	0.033		0.394	0.028		
AW503509	CO	13/12/1995 13:10	0.562	0.04	0.61	0.65	0.032		0.365	0.018		
AW503509	CO	20/12/1995 15:20	0.510	0.18	0.79	0.97	0.061	2366	0.495	0.031		
AW503509	**CO**	**27/12/1995 13:20**	**0.248**	**0.03**	**0.32**	**0.35**	**0.029**	**2361**	**0.087**	**0.007**	**3520**	**343**
AW503509	**CO**	**3/01/1996 13:00**	**7.548**	**0.42**	**1.36**	**1.78**	**0.385**		**13.436**	**2.906**		
AW503509	CO	10/01/1996 14:15	0.122	0.08	0.92	1	0.042		0.122	0.005		
AW503509	CO	24/01/1996 12:30	1.670	0.32	2.89	3.21	0.438		5.361	0.731		
AW503509	CO	31/01/1996 11:20	10.084	0.36	1.54	1.9	0.284		19.159	2.864		
AW503509	CO	14/02/1996 12:10	1.255	0.11	1.08	1.19	0.098		1.494	0.123		

STATION	COLI	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503509	CO	20/03/1996 10:20	14.310	0.3	2.17	2.47	0.339		35.346	4.851		
AW503509	CO	10/04/1996 11:30	1.638	0.05	0.85	0.9	0.084		1.474	0.138		
AW503509	CO	17/04/1996 12:00	4.834	0.11	1.17	1.28	0.155		6.188	0.749		
AW503509	CO	24/04/1996 10:00	1.655	0.03	0.41	0.44	0.038		0.728	0.063		
AW503509	CO	1/05/1996 12:40	13.951	0.08	0.92	1	0.161		13.951	2.246		
AW503509	CO	8/05/1996 15:30	1.329	0.06	0.83	0.89	0.042		1.183	0.056		
AW503509	CO	15/05/1996 10:35	3.675	0.01	0.61	0.62	0.091		2.278	0.334		
AW503509	CO	22/05/1996 13:45	3.504	0.06	0.66	0.72	0.099		2.523	0.347		
AW503509	CO	29/05/1996 15:20	4.098	0.03	0.48	0.51	0.043		2.090	0.176		
AW503509	CO	5/06/1996 16:00	38.717	0.25	1.64	1.89	0.322		73.175	12.467		
AW503509	CO	12/06/1996 13:20	24.671	0.29	1.34	1.63	0.12		40.214	2.961		
AW503509	CO	19/06/1996 13:45	53.290	0.35	0.93	1.28	0.162		68.212	8.633		
AW503509	CO	26/06/1996 17:25	94.406	0.61	0.76	1.37	0.089		129.336	8.402		
AW503509	CO	3/07/1996 11:55	108.246	0.66	0.6	1.26	0.049		136.390	5.304		
AW503509	CO	10/07/1996 0:00	120.678	0.59	1.03	1.62	0.13		195.499	15.688		
AW503509	CO	17/07/1996 12:05	122.611	0.48	0.86	1.34	0.117		164.299	14.345		
AW503509	CO	24/07/1996 14:00	230.001	0.52	1.07	1.59	0.148		365.702	34.040		
AW503509	CO	31/07/1996 11:50	80.974	0.391	0.88	1.271	0.119		102.919	9.636		
AW503509	CO	6/08/1996 11:55	484.467	0.445	1.79	2.235	0.382		1082.783	185.066		
AW503509	CO	6/08/1996 11:55	0.000	0.445	1.79	2.235	0.382		0.000	0.000		
AW503509	CO	13/08/1996 8:50	149.161	0.45	0.7	1.15	0.081		171.535	12.082		
AW503509	CO	20/08/1996 10:10	109.817	0.344	0.94	1.284	0.116		141.005	12.739		
AW503509	CO	28/08/1996 10:20	254.979	0.358	0.92	1.278	0.139		325.864	35.442		
AW503509	CO	4/09/1996 11:10	74.528	0.205	0.66	0.865	0.063		64.467	4.695		
AW503509	CO	11/09/1996 14:55	38.411	0.241	0.6	0.841	0.048		32.304	1.844		
AW503509	CO	18/09/1996 8:05	84.117	0.232	0.8	1.032	0.128		86.808	10.767		
AW503509	CO	25/09/1996 9:50	80.634	0.193	0.99	1.183	0.144		95.391	11.611		
AW503509	CO	2/10/1996 10:00	501.214	0.349	1.49	1.839	0.28		921.732	140.340		
AW503509	CO	9/10/1996 12:50	100.264	0.343	0.59	0.933	0.061		93.547	6.116		
AW503509	CO	16/10/1996 13:55	37.410	0.262	0.63	0.892	0.065		33.369	2.432		
AW503509	CO	22/10/1996 10:20	17.589	0.194	0.63	0.824	0.059		14.493	1.038		
AW503509	CO	30/10/1996 11:45	15.049	0.173	0.63	0.803	0.049		12.084	0.737		
AW503509	CO	6/11/1996 10:45	8.594	0.112	0.68	0.792	0.041		6.806	0.352		
AW503509	CO	27/11/1996 12:50	14.555	0.094	0.7	0.794	0.039		11.557	0.568		
AW503509	CO	4/12/1996 9:30	1.9956	0.051	0.46	0.511	0.034		1.020	0.068		
AW503509	CO	11/12/1996 11:00	7.2181	0.379	1.64	2.019	0.332		14.573	2.396		
AW503509	CO	18/12/1996 8:30	0.5773	0.051	0.62	0.671	0.042	2919	0.387	0.024		
AW503509	**CO**	**26/12/1996 10:40**	**0.5120**	**0.052**	**0.51**	**0.562**	**0.034**	**2924**	**0.288**	**0.017**	**4491**	**555**
AW503509	**CO**	**2/01/1997 9:20**	**0.1997**	**0.023**	**0.74**	**0.763**	**0.037**		**0.152**	**0.007**		
AW503509	CO	16/01/1997 10:00	0.1485	0.223	1.62	1.843	0.131		0.274	0.019		
AW503509	CO	23/01/1997 13:35	5.9182	0.394	1.42	1.814	0.274		10.736	1.622		
AW503509	CO	30/01/1997 12:10	0.1137	0.027	1.50	1.527	0.064		0.174	0.007		
AW503509	CO	12/02/1997 8:50	8.8944	0.410	6.40	6.81	1.63		60.571	14.498		
AW503509	CO	6/05/1997 10:15	4.7573	0.071	1.36	1.431	0.220		6.808	1.047		
AW503509	CO	14/05/1997 12:50	6.4467	0.112	0.92	1.032	0.133		6.653	0.857		
AW503509	CO	20/05/1997 13:40	6.6425	0.196	2.03	2.226	0.386		14.786	2.564		
AW503509	CO	28/05/1997 12:00	26.6069	0.237	1.36	1.597	0.272		42.491	7.237		
AW503509	CO	1/07/1997 11:05	74.4784	0.075	0.45	0.525	0.027		39.101	2.011		
AW503509	CO	8/07/1997 10:05	2.8810	0.066	0.48	0.546	0.028		1.573	0.081		
AW503509	CO	15/07/1997 9:40	26.5225	0.225	0.99	1.215	0.178		32.225	4.721		
AW503509	CO	22/07/1997 10:15	19.5888	0.327	0.61	0.937	0.063		18.355	1.234		
AW503509	CO	30/07/1997 12:45	18.1488	0.186	0.98	1.166	0.115		21.162	2.087		
AW503509	CO	6/08/1997 11:35	6.3134	0.127	0.61	0.737	0.08		4.653	0.505		
AW503509	CO	12/08/1997 16:00	267.6354	0.781	1.52	2.301	0.289		615.829	77.347		
AW503509	CO	20/08/1997 13:10	53.2921	0.666	0.65	1.316	0.056		70.132	2.984		
AW503509	CO	27/08/1997 10:50	50.2188	0.329	0.66	0.989	0.08		49.666	4.018		
AW503509	CO	3/09/1997 10:20	138.4968	0.401	1.02	1.421	0.11		196.804	15.235		
AW503509	CO	10/09/1997 11:35	150.0139	0.397	0.95	1.347	0.096		202.069	14.401		
AW503509	CO	17/09/1997 14:30	76.9807	0.342	0.82	1.162	0.087		89.452	6.697		
AW503509	CO	24/09/1997 13:10	50.7945	0.23	1.23	1.46	0.182		74.160	9.245		
AW503509	CO	1/10/1997 12:10	23.5429	0.153	0.67	0.823	0.054		19.376	1.271		
AW503509	CO	8/10/1997 11:00	12.3491	0.084	0.52	0.604	0.046		7.459	0.568		
AW503509	CO	15/10/1997 12:50	8.1851	0.059	0.58	0.639	0.037		5.230	0.303		
AW503509	CO	22/10/1997 12:00	6.9045	0.073	0.59	0.663	0.045		4.578	0.311		
AW503509	CO	29/10/1997 9:55	4.5094	0.079	0.75	0.829	0.073		3.738	0.329		
AW503509	CO	31/10/1997 13:05	81.8132	0.319	1.62	1.939	0.323		158.636	26.426		
AW503509	CO	5/11/1997 13:15	65.9821	0.466	0.94	1.406	0.138		92.771	9.106		
AW503509	CO	12/11/1997 8:20	8.2093	0.114	0.49	0.604	0.046		4.958	0.378		
AW503509	CO	19/11/1997 12:35	21.2747	0.169	1.4	1.569	0.259		33.380	5.510		
AW503509	CO	26/11/1997 6:15	2.846	0.09	0.68	0.77	0.05		2.191	0.142		
AW503509	CO	3/12/1997 13:05	0.692	0.104	0.79	0.894	0.049		0.619	0.034		
AW503509	CO	10/12/1997 11:15	3.471	0.082	1.09	1.172	0.143		4.068	0.496		
AW503509	CO	17/12/1997 9:25	0.507	0.143	0.57	0.713	0.044	1242	0.361	0.022		
AW503509	**CO**	**24/12/1997 8:55**	**6.676**	**0.157**	**1.44**	**1.597**	**0.216**	**1242**	**10.662**	**1.442**	**1906**	**215**
AW503509	**CO**	**1/01/1998 10:45**	**0.504**	**0.048**	**0.76**	**0.808**	**0.072**		**0.407**	**0.036**		
AW503509	CO	11/02/1998 10:45	3.068	0.26	3.72	3.98	0.696		12.211	2.135		
AW503509	CO	15/04/1998 14:04	27.719	0.292	1	1.292	0.162		35.813	4.490		
AW503509	CO	22/04/1998 13:15	55.943	0.316	2.05	2.366	0.377		132.360	21.090		
AW503509	CO	29/04/1998 10:50	26.469	0.204	1.04	1.244	0.129		32.927	3.414		
AW503509	CO	6/05/1998 9:15	3.447	0.034	0.81	0.844	0.062		2.910	0.214		
AW503509	CO	13/05/1998 11:30	1.782	0.047	0.6	0.647	0.03		1.153	0.053		
AW503509	CO	20/05/1998 10:35	7.317	0.101	1.2	1.301	0.173		9.520	1.266		
AW503509	CO	27/05/1998 10:55	15.657	0.091	0.74	0.831	0.096		13.011	1.503		
AW503509	CO	3/06/1998 10:10	2.721	0.068	0.56	0.628	0.029		1.709	0.079		

STATION	COLL	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503509	CO	10/06/1998 13:35	37.575	0.282	1.03	1.312	0.243		49.298	9.131		
AW503509	CO	17/06/1998 14:50	65.721	0.363	1.07	1.433	0.175		94.178	11.501		
AW503509	CO	24/06/1998 13:25	83.354	0.424	0.82	1.244	0.112		103.692	9.336		
AW503509	CO	1/07/1998 13:00	35.880	0.422	0.66	1.082	0.065		38.822	2.332		
AW503509	CO	9/07/1998 11:45	89.543	0.405	1.32	1.725	0.208		154.461	18.625		
AW503509	CO	15/07/1998 10:10	22.935	0.422	1.02	1.442	0.134		33.072	3.073		
AW503509	CO	22/07/1998 10:25	25.659	0.277	0.76	1.037	0.087		26.608	2.232		
AW503509	CO	29/07/1998 12:15	155.815	0.508	1.26	1.768	0.205		275.481	31.942		
AW503509	CO	5/08/1998 11:20	136.158	0.54	0.8	1.34	0.098		182.451	13.343		
AW503509	CO	12/08/1998 16:30	41.520	0.425	0.61	1.035	0.054		42.974	2.242		
AW503509	CO	19/08/1998 10:25	40.928	0.303	0.59	0.893	0.065		36.549	2.660		
AW503509	CO	26/08/1998 14:30	95.250	0.291	0.98	1.271	0.128		121.062	12.192		
AW503509	CO	2/09/1998 9:50	30.248	0.342	0.62	0.962	0.05		29.099	1.512		
AW503509	CO	9/09/1998 10:40	21.879	0.195	0.55	0.745	0.055		16.300	1.203		
AW503509	CO	16/09/1998 9:25	29.688	0.142	0.73	0.872	0.113		25.888	3.355		
AW503509	CO	23/09/1998 12:00	97.992	0.344	1.88	2.224	0.338		217.935	33.121		
AW503509	CO	4/11/1998 9:25	240.117	0.11	0.36	0.47	0.041		112.855	9.845		
AW503509	CO	11/11/1998 9:20	22.763	0.267	1.05	1.317	0.197		29.979	4.484		
AW503509	CO	18/11/1998 9:00	14.358	0.174	0.57	0.744	0.072		10.682	1.034		
AW503509	CO	25/11/1998 9:00	3.180	0.064	0.43	0.494	0.04		1.571	0.127		
AW503509	CO	2/12/1998 10:25	3.778	0.223	0.78	1.003	0.118		3.789	0.446		
AW503509	CO	9/12/1998 9:35	0.447	0.065	0.41	0.475	0.071		0.212	0.032		
AW503509	CO	16/12/1998 8:20	0.457	0.061	0.44	0.501	0.038		0.229	0.017		
AW503509	CO	23/12/1998 8:25	5.777	0.386	0.88	1.266	0.164	1445	7.314	0.947		
AW503509	**CO**	**30/12/1998 15:51**	**0.229**	**0.077**	**0.46**	**0.537**	**0.039**	**1446**	**0.123**	**0.009**	**1857**	**209**
AW503509	**CO**	**13/01/1999 8:45**	**2.380**	**0.315**	**1.22**	**1.535**	**0.214**		**3.653**	**0.509**		
AW503509	CO	10/03/1999 9:05	0.511	1.03	1.98	3.01	0.208		1.538	0.106		
AW503509	CO	24/03/1999 8:45	23.595	0.456	1.3	1.756	0.218		41.432	5.144		
AW503509	CO	31/03/1999 9:10	4.650	0.098	0.54	0.638	0.07		2.967	0.325		
AW503509	CO	7/04/1999 11:10	0.976	0.028	0.41	0.438	0.023		0.427	0.022		
AW503509	CO	21/04/1999 9:50	2.561	0.018	1.25	1.268	0.202		3.248	0.517		
AW503509	CO	28/04/1999 9:05	0.501	0.137	0.33	0.467	0.024		0.234	0.012		
Max				1.03	6.4	6.81	1.63					
Min				0.01	0.25	0.26	0.023					
Mean				0.26136	0.92127	1.18263	0.13107					
Median				0.223	0.76	1.032	0.085					
SD				0.19954	0.64398	0.73234	0.15622					
AW503526 Cox Creek, Uraidla												
WQ#3227												
AW503526	CO	18/10/1994 15:50	NA									
AW503526	CO	25/10/1994 12:30	11.964	5.9	0.72	6.62	0.206		79.201	2.465		
AW503526	CO	1/11/1994 7:30	9.849	5.5	1	6.5	0.6		64.020	5.910		
AW503526	CO	8/11/1994 11:25	87.258	7.3	3.8	11.1	2.69		968.560	234.723		
AW503526	CO	15/11/1994 11:20	28.275	6.55	1.14	7.69	0.354		217.435	10.009		
AW503526	CO	22/11/1994 11:20	12.333	6.2	1.37	7.57	0.428		93.360	5.278		
AW503526	CO	29/11/1994 11:45	7.094	7.2	1.35	8.55	0.643		60.655	4.562		
AW503526	CO	6/12/1994 7:35	4.243	7.7	2.19	9.89	1.7		41.964	7.213		
AW503526	CO	13/12/1994 8:10	3.567	8.5	2.35	10.85	2.22		38.700	7.918		
AW503526	CO	20/12/1994 6:45	2.699	9	1.94	10.94	1.9		29.532	5.129		
AW503526	**CO**	**27/12/1994 9:00**	**1.981**	**7.4**	**2.13**	**9.53**	**1.73**		**18.881**	**3.428**		
AW503526	**CO**	**3/01/1995 6:20**	**1.430**	**6.4**	**1.48**	**7.88**	**1.13**		**11.265**	**1.615**		
AW503526	CO	10/01/1995 6:50	1.203	5.9	1.53	7.43	0.7		8.939	0.842		
AW503526	CO	17/01/1995 9:20	2.044	5.6	4.7	10.3	4.44		21.052	9.075		
AW503526	CO	24/01/1995 6:30	0.991	4.9	0.79	5.69	0.754		5.640	0.747		
AW503526	CO	31/01/1995 8:10	3.768	3.8	10.4	14.2	10.6		53.503	39.939		
AW503526	CO	7/02/1995 8:40	2.607	2.9	4.74	7.64	5.66		19.918	14.756		
AW503526	CO	14/02/1995 6:40	1.543	5.5	2.05	7.55	1.41		11.650	2.176		
AW503526	CO	21/02/1995 11:00	1.823	4.9	2.62	7.52	2.58		13.706	4.702		
AW503526	CO	28/02/1995 10:12	1.346	4.6	3.4	8	1.28		10.769	1.723		
AW503526	CO	7/03/1995 10:20	0.958	3.7	1.3	5	0.909		4.788	0.870		
AW503526	CO	14/03/1995 10:50	0.863	3.3	0.24	3.54	1.77		3.055	1.527		
AW503526	CO	21/03/1995 10:40	0.723	3.3	8.67	11.97	1.09		8.658	0.788		
AW503526	CO	28/03/1995 11:35	0.696	4	1.4	5.4	0.6		3.757	0.417		
AW503526	CO	4/04/1995 11:45	0.828	2.69	1.17	3.86	0.48		3.195	0.397		
AW503526	CO	11/04/1995 12:05	2.999	3.6	2.12	5.72	2.49		17.153	7.467		
AW503526	CO	18/04/1995 14:08	2.746	2.9	3.6	6.5	2.95		17.849	8.101		
AW503526	CO	25/04/1995 10:55	2.673	2.7	0.2	2.9	0.28		7.752	0.748		
AW503526	CO	3/05/1995 13:25	13.062	5.9	5.6	11.5	4.55		150.213	59.432		
AW503526	CO	9/05/1995 12:45	7.699	9.1	0.7	9.8	0.24		75.446	1.848		
AW503526	CO	16/05/1995 13:47	9.246	4	1	5	0.67		46.232	6.195		
AW503526	CO	23/05/1995 12:45	7.346	3.8	0.29	4.09	0.149		30.046	1.095		
AW503526	CO	30/05/1995 14:40	48.617	10.5	5.28	15.78	4.76		767.173	231.416		
AW503526	CO	6/06/1995 12:20	13.063	7.1	0.62	7.72	0.45		100.850	5.879		
AW503526	CO	13/06/1995 14:30	78.433	8.5	7.95	16.45	5.21		1290.231	408.638		
AW503526	CO	20/06/1995 12:00	22.467	8.9	0.8	9.7	0.18		217.928	4.044		
AW503526	MS	27/06/1995 11:55	17.935	7.4	0.91	8.31	0.435		149.036	7.802		
AW503526	MS	28/06/1995 11:04	14.468	8.4	1.14	9.54	0.42		138.027	6.077		
AW503526	CO	4/07/1995 14:45	137.032	5.47	2.13	7.6	1.48		1041.442	202.807		
AW503526	CO	12/07/1995 13:05	84.917	7	0.53	7.53	0.126		639.425	10.700		
AW503526	CO	19/07/1995 12:30	180.447	4	1.92	5.92	1.06		1068.244	191.274		
AW503526	CO	26/07/1995 11:42	269.161	2.6	2.04	4.64	1.14		1248.905	306.843		

STATION	COLL	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503526	CO	2/08/1995 11:10	182.794	3.1	0.23	3.33	0.188		608.705	34.365		
AW503526	CO	9/08/1995 12:10	94.446	4	0.91	4.91	0.28		463.732	26.445		
AW503526	CO	16/08/1995 12:30	30.355	5.7	0.34	6.04	0.092		183.343	2.793		
AW503526	CO	23/08/1995 12:55	20.212	5.4	0.4	5.8	0.079		117.227	1.597		
AW503526	CO	30/08/1995 12:10	19.697	4.9	0.75	5.65	0.332		111.286	6.539		
AW503526	CO	6/09/1995 11:50	16.227	4.6	0.43	5.03	0.128		81.623	2.077		
AW503526	CO	13/09/1995 11:50	14.802	3.8	0.76	4.56	0.144		67.499	2.132		
AW503526	CO	20/09/1995 12:25	14.682	3.5	1.02	4.52	0.45		66.361	6.607		
AW503526	CO	27/09/1995 12:25	26.116	3.1	1.92	5.02	1.5		131.102	39.174		
AW503526	CO	4/10/1995 11:20	18.482	3.96	0.58	4.54	0.2		83.910	3.696		
AW503526	CO	11/10/1995 11:30	17.478	3.94	0.92	4.86	0.54		84.942	9.438		
AW503526	CO	18/10/1995 15:00	14.282	4.11	0.78	4.89	0.3		69.837	4.284		
AW503526	CO	25/10/1995 13:05	11.626	3.49	0.61	4.1	0.181		47.667	2.104		
AW503526	CO	1/11/1995 11:40	8.227	3.75	0.69	4.44	0.211		36.526	1.736		
AW503526	CO	8/11/1995 13:05	9.471	3.81	0.84	4.65	0.427		44.039	4.044		
AW503526	CO	15/11/1995 11:50	6.669	4.1	1.65	5.75	0.82		38.350	5.469		
AW503526	CO	22/11/1995 11:45	4.193	5.2	2.1	7.3	0.92		30.611	3.858		
AW503526	CO	29/11/1995 15:05	3.669	6.1	2.85	8.95	1.61		32.839	5.907		
AW503526	CO	6/12/1995 13:15	2.933	5.7	3.04	8.74	1.38		25.633	4.047		
AW503526	CO	13/12/1995 12:50	3.274	4.29	1.98	6.27	1.16		20.529	3.798		
AW503526	CO	20/12/1995 14:45	2.797	4.36	1.1	5.46	1.41	1464	15.274	3.944		
AW503526	**CO**	**27/12/1995 12:50**	**1.898**	**5.19**	**1.18**	**6.37**	**0.57**	**1457**	**12.092**	**1.082**	**9559**	**1715**
AW503526	**CO**	**3/01/1996 12:30**	**8.993**	**4.5**	**3.4**	**7.9**	**38.1**		**71.048**	**342.648**		
AW503526	CO	10/01/1996 13:30	2.338	5.08	1.58	6.66	1.22		15.574	2.853		
AW503526	CO	24/01/1996 12:05	4.812	3.6	5	8.6	5.5		41.382	26.465		
AW503526	CO	31/01/1996 10:30	7.467	4.03	5.1	9.13	5.28		68.176	39.427		
AW503526	CO	14/02/1996 11:45	3.907	3.4	1.8	5.2	1.28		20.317	5.001		
AW503526	CO	21/02/1996 10:05	1.831	5.09	3.83	8.92	2.76		16.329	5.052		
AW503526	CO	28/02/1996 11:58	1.417	6.9	3.22	10.12	3.2		14.335	4.533		
AW503526	CO	6/03/1996 13:22	1.329	4.1	2.65	6.75	0.975		8.969	1.295		
AW503526	CO	13/03/1996 15:48	1.338	3.8	2	5.8	0.91		7.761	1.218		
AW503526	CO	20/03/1996 11:30	8.035	4.8	7.5	12.3	1.07		98.826	8.597		
AW503526	CO	27/03/1996 16:15	1.295	4.91	1.6	6.51	0.63		8.433	0.816		
AW503526	CO	3/04/1996 17:30	1.216	4.4	1.1	5.5	0.72		6.687	0.875		
AW503526	CO	10/04/1996 12:40	1.667	3.4	0.66	4.06	0.43		6.768	0.717		
AW503526	CO	17/04/1996 11:35	3.096	2.93	6.6	9.53	2.79		29.502	8.637		
AW503526	CO	24/04/1996 10:25	2.515	2.48	0.42	2.9	0.252		7.293	0.634		
AW503526	CO	1/05/1996 13:10	6.613	3.7	1.44	5.14	0.67		33.988	4.430		
AW503526	CO	8/05/1996 15:00	4.242	2.89	0.4	3.29	0.2		13.957	0.848		
AW503526	CO	15/05/1996 11:50	4.900	2.25	0.46	2.71	0.265		13.280	1.299		
AW503526	CO	22/05/1996 13:20	5.986	1.73	0.5	2.23	0.266		13.349	1.592		
AW503526	CO	29/05/1996 14:55	6.895	2.26	1.67	3.93	0.81		27.096	5.585		
AW503526	CO	5/06/1996 15:00	18.548	5.44	3.4	8.84	2.19		163.960	40.619		
AW503526	CO	12/06/1996 12:45	24.444	9.5	1.7	11.2	1		273.774	24.444		
AW503526	CO	19/06/1996 13:20	43.077	6.9	3.33	10.23	2.09		440.675	90.030		
AW503526	CO	26/06/1996 16:50	92.250	6.53	3.45	9.98	2.11		920.650	194.646		
AW503526	CO	3/07/1996 0:00	104.462	5.4	2.2	7.6	1.69		793.913	176.541		
AW503526	CO	10/07/1996 11:00	116.026	4.36	2.2	6.56	1.21		761.133	140.392		
AW503526	CO	17/07/1996 12:25	83.660	4.4	1.3	5.7	0.56		476.865	46.850		
AW503526	CO	24/07/1996 13:35	151.521	3	2.28	5.28	1.1		800.029	166.673		
AW503526	CO	31/07/1996 11:05	53.311	4.05	1.8	5.85	0.96		311.870	51.179		
AW503526	CO	6/08/1996 11:25	287.060	2	3	5	1.68		1435.299	482.260		
AW503526	CO	13/08/1996 8:30	101.884	3.25	1.16	4.41	0.437		449.307	44.523		
AW503526	CO	21/08/1996 0:00	68.194	3.95	1.3	5.25	0.66		358.019	45.008		
AW503526	CO	21/08/1996 12:20	3.644	3.95	1.3	5.25	0.66		19.132	2.405		
AW503526	CO	28/08/1996 10:00	152.803	2.32	1.2	3.52	0.69		537.866	105.434		
AW503526	CO	4/09/1996 10:45	43.600	4.4	0.67	5.07	0.156		221.053	6.802		
AW503526	CO	11/09/1996 14:10	26.433	4.61	0.66	5.27	0.329		139.301	8.696		
AW503526	CO	25/09/1996 9:00	80.849	3.46	1.9	5.36	1.04		433.351	84.083		
AW503526	CO	9/10/1996 13:20	284.280	3.37	0.59	3.96	0.134		1125.748	38.093		
AW503526	CO	16/10/1996 13:30	26.463	4.22	0.87	5.09	0.34		134.697	8.997		
AW503526	CO	22/10/1996 10:45	16.689	3.83	0.78	4.61	0.284		76.935	4.740		
AW503526	CO	30/10/1996 11:10	15.223	4.24	0.95	5.19	0.444		79.007	6.759		
AW503526	CO	6/11/1996 10:20	9.177	4.26	0.76	5.02	0.354		46.066	3.248		
AW503526	CO	13/11/1996 13:50	6.759	3.81	0.89	4.7	0.392		31.766	2.649		
AW503526	CO	27/11/1996 12:20	8.045	5.8	1.5	7.3	0.84		58.725	6.757		
AW503526	CO	4/12/1996 8:40	3.2502	4.70	1.50	6.2	0.950		20.151	3.088		
AW503526	CO	11/12/1996 10:40	4.4508	4.43	4.20	8.63	3.90		38.411	17.358		
AW503526	CO	18/12/1996 8:10	2.5177	5.65	2.00	7.65	1.47	1907	19.260	3.701		
AW503526	**CO**	**26/12/1996 10:20**	**4.7733**	**4.50**	**1.45**	**5.95**	**0.850**	**1913**	**28.401**	**4.057**	**10718**	**2273**
AW503526	**CO**	**2/01/1997 9:00**	**3.4228**	**3.06**	**1.63**	**4.69**	**0.87**		**16.053**	**2.978**		
AW503526	CO	9/01/1997 12:45	3.1121	3.65	1.22	4.87	0.72		15.156	2.241		
AW503526	CO	16/01/1997 10:20	2.2332	3.71	6.00	9.71	6.90		21.684	15.409		
AW503526	CO	23/01/1997 13:10	3.7294	2.77	6.20	8.97	7.70		33.453	28.716		
AW503526	CO	30/01/1997 12:30	1.9442	2.90	1.50	4.4	0.83		8.554	1.614		
AW503526	CO	6/02/1997 9:35	1.9810	3.49	1.70	5.19	1.01		10.282	2.001		
AW503526	CO	12/02/1997 8:05	4.0542	3.53	5.60	9.13	4.65		37.015	18.852		
AW503526	CO	19/02/1997 7:00	1.6175	2.39	0.90	3.29	0.63		5.322	1.019		
AW503526	CO	26/02/1997 9:00	1.8739	3.54	1.40	4.94	0.67		9.257	1.256		
AW503526	CO	5/03/1997 10:50	2.0649	3.26	0.84	4.1	0.63		8.466	1.301		
AW503526	CO	12/03/1997 10:25	1.8938	4.03	1.12	5.15	0.61		9.753	1.155		
AW503526	CO	19/03/1997 12:45	2.0268	2.96	1.40	4.36	1.12		8.837	2.270		
AW503526	CO	26/03/1997 7:20	1.4317	2.71	0.68	3.39	0.393		4.853	0.563		
AW503526	CO	2/04/1997 8:20	1.9436	2.39	1.40	3.79	1.28		7.366	2.488		

STATION	COLl	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503526	CO	9/04/1997 9:15	1.7773	1.61	0.61	2.22	0.271		3.946	0.482		
AW503526	CO	16/04/1997 12:00	1.7384	1.80	0.71	2.51	0.239		4.363	0.415		
AW503526	CO	23/04/1997 11:35	1.7028	1.75	1.00	2.75	0.220		4.683	0.375		
AW503526	CO	30/04/1997 10:50	1.5894	1.80	0.70	2.5	0.194		3.973	0.308		
AW503526	CO	6/05/1997 10:35	2.9440	1.92	1.24	3.16	0.675		9.303	1.987		
AW503526	CO	14/05/1997 12:25	3.6929	1.98	0.46	2.44	0.196		9.011	0.724		
AW503526	CO	20/05/1997 13:25	4.4422	1.94	1.93	3.87	1.26		17.191	5.597		
AW503526	CO	28/05/1997 11:45	9.3016	3.04	2.38	5.42	2.05		50.415	19.068		
AW503526	CO	1/07/1997 10:50	57.4196	4.33	0.38	4.71	0.104		270.446	5.972		
AW503526	CO	8/07/1997 9:45	8.4305	3.73	0.52	4.25	0.105		35.830	0.885		
AW503526	CO	15/07/1997 10:00	12.9418	3.53	1.11	4.64	0.493		60.050	6.380		
AW503526	CO	22/07/1997 10:00	17.5745	6.46	2	8.46	1.4		148.680	24.604		
AW503526	CO	30/07/1997 12:30	15.7769	5.2	1.04	6.24	0.386		98.448	6.090		
AW503526	CO	6/08/1997 12:35	11.9868	4.32	1.1	5.42	0.636		64.968	7.624		
AW503526	CO	12/08/1997 15:25	126.4353	5.4	4.1	9.5	2.55		1201.135	322.410		
AW503526	CO	20/08/1997 12:25	48.0288	6.6	1.14	7.74	0.369		371.743	17.723		
AW503526	CO	27/08/1997 10:15	34.6546	5.96	0.57	6.53	0.118		226.295	4.089		
AW503526	CO	3/09/1997 10:00	84.4645	3.78	2.05	5.83	0.95		492.428	80.241		
AW503526	CO	10/09/1997 11:20	90.2031	4.23	1.54	5.77	0.526		520.472	47.447		
AW503526	CO	17/09/1997 14:10	49.5586	4.28	1.22	5.5	0.322		272.573	15.958		
AW503526	CO	24/09/1997 12:57	29.7408	4.56	0.96	5.52	0.265		164.169	7.881		
AW503526	CO	1/10/1997 11:55	19.3402	4.42	0.51	4.93	0.102		95.347	1.973		
AW503526	CO	8/10/1997 10:45	12.7701	4.02	0.47	4.49	0.103		57.338	1.315		
AW503526	CO	15/10/1997 12:10	8.8122	3.34	0.52	3.86	0.175		34.015	1.542		
AW503526	CO	22/10/1997 11:40	7.7776	2.97	0.66	3.63	0.176		28.233	1.369		
AW503526	CO	29/10/1997 9:40	5.0577	4.83	0.93	5.76	0.425		29.132	2.150		
AW503526	CO	31/10/1997 12:45	24.7651	6.9	8.31	15.21	5.86		376.678	145.124		
AW503526	CO	5/11/1997 12:50	35.3925	6.84	2.03	8.87	1.13		313.931	39.993		
AW503526	CO	12/11/1997 8:05	10.0968	8.02	1.17	9.19	0.34		92.789	3.433		
AW503526	CO	19/11/1997 12:20	14.3419	4.79	3.21	8	3.5		114.735	50.197		
AW503526	CO	26/11/1997 5:55	5.230	8.6	2.6	11.2	1.84		58.580	9.624		
AW503526	CO	4/12/1997 16:34	4.140	8	1.8	9.8	1.19		40.571	4.926		
AW503526	CO	10/12/1997 11:00	2.632	6.6	2.47	9.07	1.88		23.870	4.948		
AW503526	CO	17/12/1997 8:30	2.919	6.24	1.32	7.56	1.16		22.064	3.386		
AW503526	CO	24/12/1997 9:15	3.880	5.73	4.42	10.15	3.16	805	39.385	12.262		
AW503526	**CO**	**31/12/1997 8:25**	**2.292**	**5.7**	**1.44**	**7.14**	**1.04**	**807**	**16.368**	**2.384**	**5569**	**943**
AW503526	**CO**	**7/01/1998 12:40**	**2.147**	**4.27**	**1.28**	**5.55**	**0.99**		**11.917**	**2.126**		
AW503526	CO	14/01/1998 13:40	2.060	3.13	1.68	4.81	0.82		9.908	1.689		
AW503526	CO	21/01/1998 11:00	1.807	3.98	1.11	5.09	0.74		9.200	1.338		
AW503526	CO	28/01/1998 9:35	1.596	3.12	1.16	4.28	0.72		6.833	1.149		
AW503526	CO	4/02/1998 10:15	1.566	4.12	1.36	5.48	0.668		8.583	1.046		
AW503526	CO	11/02/1998 11:10	4.599	4.26	15.8	20.06	7.3		92.253	33.572		
AW503526	CO	18/02/1998 8:35	1.634	3.3	0.97	4.27	0.863		6.979	1.410		
AW503526	CO	25/02/1998 5:35	1.471	5.42	2.4	7.82	2.28		11.504	3.354		
AW503526	CO	4/03/1998 9:00	1.741	5.12	1.65	6.77	1.16		11.784	2.019		
AW503526	CO	11/03/1998 14:30	1.996	5.78	2.6	8.38	2.34		16.725	4.670		
AW503526	CO	25/03/1998 10:00	3.283	4.18	1.22	5.4	0.972		17.728	3.191		
AW503526	CO	1/04/1998 10:00	1.486	4.29	3.96	8.25	1.16		12.263	1.724		
AW503526	CO	8/04/1998 10:00	1.274	2.52	0.8	3.32	0.48		4.228	0.611		
AW503526	CO	15/04/1998 11:05	16.644	10.9	5.05	15.95	4.62		265.470	76.895		
AW503526	CO	16/04/1998 10:50	0.339	4.25	1.6	5.85	1.33		1.986	0.451		
AW503526	CO	22/04/1998 12:55	32.024	9.4	13	22.4	10.2		717.340	326.646		
AW503526	CO	29/04/1998 9:30	13.068	8.05	1.11	9.16	0.72		119.698	9.409		
AW503526	CO	29/04/1998 11:30	0.058	9.41	2.65	12.06	3.6		0.695	0.208		
AW503526	CO	13/05/1998 11:50	9.473	5.79	0.78	6.57	0.49		62.238	4.642		
AW503526	CO	20/05/1998 11:00	6.560	3.71	1.7	5.41	0.985		35.492	6.462		
AW503526	CO	27/05/1998 11:10	8.788	3.67	1.45	5.12	2.54		44.994	22.321		
AW503526	CO	3/06/1998 10:25	6.633	3.68	0.57	4.25	0.402		28.188	2.666		
AW503526	CO	10/06/1998 14:15	19.900	5.65	3	8.65	2.6		172.136	51.740		
AW503526	CO	17/06/1998 14:30	40.809	7.25	3.1	10.35	2.39		422.375	97.534		
AW503526	CO	24/06/1998 13:10	40.530	7.33	1.66	8.99	0.838		364.361	33.964		
AW503526	CO	1/07/1998 12:25	30.119	8.22	0.79	9.01	0.292		271.372	8.795		
AW503526	CO	8/07/1998 11:25	37.742	6.44	2.7	9.14	1.78		344.961	67.181		
AW503526	CO	15/07/1998 10:30	32.385	6.48	1.07	7.55	0.412		244.510	13.343		
AW503526	CO	22/07/1998 10:50	23.140	5.15	0.99	6.14	0.433		142.080	10.020		
AW503526	CO	29/07/1998 12:35	118.150	3.54	3.4	6.94	2.4		819.959	283.559		
AW503526	CO	5/08/1998 11:40	105.537	4.29	1.41	5.7	0.732		601.559	77.253		
AW503526	CO	12/08/1998 10:45	31.211	5.8	0.62	6.42	0.13		200.374	4.057		
AW503526	CO	19/08/1998 10:55	33.110	5.49	0.74	6.23	0.213		206.275	7.052		
AW503526	CO	26/08/1998 14:15	66.802	4.11	2.01	6.12	1.14		408.827	76.154		
AW503526	CO	2/09/1998 10:05	30.360	5.29	0.55	5.84	0.113		177.305	3.431		
AW503526	CO	9/09/1998 11:20	19.567	4.78	0.45	5.23	0.121		102.334	2.368		
AW503526	CO	16/09/1998 9:50	23.537	3.89	1.04	4.93	0.391		116.040	9.203		
AW503526	CO	23/09/1998 11:30	30.545	4.13	1.72	5.85	1.04		178.687	31.767		
AW503526	CO	30/09/1998 10:50	35.982	4.66	1.41	6.07	0.694		218.410	24.971		
AW503526	CO	4/11/1998 9:40	117.316	5.07	0.98	6.05	0		709.764	0.000		
AW503526	CO	11/11/1998 9:45	10.388	9.73	4.3	14.03	2.64		145.738	27.423		
AW503526	CO	18/11/1998 9:25	11.003	16.4	0.69	17.09	0.454		188.034	4.995		
AW503526	CO	25/11/1998 9:00	4.730	7.4	2.22	9.62	1.78		45.503	8.419		
AW503526	CO	2/12/1998 10:40	3.875	7.7	2.86	10.56	1.72		40.920	6.665		
AW503526	CO	9/12/1998 11:15	3.361	8.12	2.24	10.36	1.4		34.824	4.706		
AW503526	CO	16/12/1998 8:30	3.173	7.64	2.95	10.59	2.37		33.601	7.520		
AW503526	CO	23/12/1998 8:40	2.454	6.49	2.4	8.89	1.68	999	21.818	4.123		
AW503526	**CO**	**30/12/1998 9:10**	**2.602**	**5.77**	**2.28**	**8.05**	**1.66**	**999**	**20.948**	**4.320**	**7729**	**1378**

STATION	COLI	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW503526	**CO**	**6/01/1999 9:00**	**2.669**	**4.08**	**2.62**	**6.7**	**2.01**		**17.882**	**5.365**		
AW503526	CO	13/01/1999 9:20	2.421	5.8	4.75	10.55	4.77		25.542	11.548		
AW503526	CO	20/01/1999 9:25	1.417	5.16	2.76	7.92	1.9		11.223	2.692		
AW503526	CO	27/01/1999 9:20	1.387	5.44	1.98	7.42	1.6		10.292	2.219		
AW503526	CO	3/02/1999 10:30	1.168	4.4	2.15	6.55	1.45		7.653	1.694		
AW503526	CO	10/02/1999 8:25	1.278	5.6	1.74	7.34	1.18		9.382	1.508		
AW503526	CO	17/02/1999 9:00	1.255	7.08	1.5	8.58	1.2		10.765	1.506		
AW503526	CO	24/02/1999 8:20	1.052	5.8	2	7.8	1.45		8.205	1.525		
AW503526	CO	3/03/1999 9:30	0.862	8.67	3.14	11.81	1.52		10.180	1.310		
AW503526	CO	10/03/1999 9:25	1.854	9.42	4.48	13.9	3.28		25.765	6.080		
AW503526	CO	17/03/1999 8:40	0.981		3	3	1.85		2.944	1.816		
AW503526	CO	24/03/1999 14:58	9.787	10.7	11.3	22	8.46		215.307	82.796		
AW503526	CO	31/03/1999 9:25	1.364	7.1	1.06	8.16	0.466		11.130	0.636		
AW503526	CO	7/04/1999 12:33	1.111	4.29	1.1	5.39	0.322		5.989	0.358		
AW503526	CO	14/04/1999 11:08	0.847	7.93	1.36	9.29	0.61		7.870	0.517		
AW503526	CO	21/04/1999 10:10	1.272	4.75	1.54	6.29	0.74		7.999	0.941		
AW503526	CO	28/04/1999 9:30	1.389	2.95	0.63	3.58	0.324		4.972	0.450		
Max				16.4	15.8	22.4	38.1					
Min				1.61	0.2	2.22	0					
Mean				4.98329	2.09053	7.05177	1.56014					
Median				4.4	1.45	6.215	0.8565					
SD				2.06572	2.08753	3.25796	2.96304					
AW504525 Kersbrook Creek upstream of Milbrook Reservoir												
WQ#3326												
AW504525	CO	30/04/1992 14:40	NA									
AW504525	CO	26/05/1992 14:29	7.497	0.01	0.53	0.54	0.029		4.049	0.217		
AW504525	CO	24/06/1992 14:23	32.986	0.28	1.02	1.3	0.081		42.881	2.672		
AW504525	CO	22/07/1992 13:59	221.620	0.34	1.77	2.11	0.153		467.618	33.908		
AW504525	CO	19/08/1992 12:16	664.041	0.6	1.41	2.01	0.125		1334.723	83.005		
AW504525	CO	30/08/1992 23:17	679.543	0.33	1.29	1.62	0.119		1100.860	80.866		
AW504525	CO	23/09/1992 16:06	2198.264	0.16	1.08	1.24	0.069		2725.847	151.680		
AW504525	CO	10/10/1992 20:38	1407.794	0.25	0.99	1.24	0.096		1745.665	135.148		
AW504525	CO	28/10/1992 15:40	442.987	0.09	0.7	0.79	0.047		349.960	20.820		
AW504525	CO	20/11/1992 23:43	230.852	0.39	1.78	2.17	0.238		500.948	54.943		
AW504525	CO	25/11/1992 12:20	183.372	0.21	1.53	1.74	0.098		319.068	17.970		
AW504525	CO	19/12/1992 15:30	239.471	0.22	2.57	2.79	0.333		668.123	79.744		
AW504525	**CO**	**22/12/1992 10:14**	**156.827**	**0.22**	**1.44**	**1.66**	**0.101**		**260.333**	**15.840**		
AW504525	**CO**	**20/01/1993 16:03**	**57.740**	**0.24**	**0.98**	**1.22**	**0.05**		**70.443**	**2.887**		
AW504525	CO	27/01/1993 5:00	5.234	0.06	1.02	1.08	0.04		5.652	0.209		
AW504525	CO	24/02/1993 15:22	3.366	0.01	0.96	0.97	0.051		3.265	0.172		
AW504525	CO	1/04/1993 16:00	3.497	0.01	0.96	0.97	0.051		3.392	0.178		
AW504525	CO	29/04/1993 14:25	0.158	0.04	0.6	0.64	0.023		0.101	0.004		
AW504525	CO	26/05/1993 12:05	4.076	0.05	0.8	0.85	0.04		3.465	0.163		
AW504525	CO	1/07/1993 12:55	26.622	0.21	0.74	0.95	0.041		25.290	1.091		
AW504525	CO	28/07/1993 12:55	84.728	1.04	1.14	2.18	0.095		184.707	8.049		
AW504525	CO	9/08/1993 12:00	52.296	0.44	0.82	1.26	0.03		65.893	1.569		
AW504525	CO	24/08/1993 10:38	144.645	0.39	0.86	1.25	0.036		180.807	5.207		
AW504525	CO	1/09/1993 18:50	26.476	0.43	0.76	1.19	0.03		31.507	0.794		
AW504525	CO	22/09/1993 17:09	210.004	0.32	1.45	1.77	0.093		371.707	19.530		
AW504525	CO	3/10/1993 12:05	115.894	0.32	1.45	1.77	0.093		205.132	10.778		
AW504525	CO	6/10/1993 17:10	27.057	0.32	1.45	1.77	0.093		47.891	2.516		
AW504525	CO	27/10/1993 12:55	129.087	0.18	1.06	1.24	0.037		160.068	4.776		
AW504525	CO	3/11/1993 15:30	14.552	0.15	0.81	0.96	0.025		13.969	0.364		
AW504525	CO	10/11/1993 12:05	12.668	0.08	0.62	0.7	0.038		8.867	0.481		
AW504525	CO	17/11/1993 11:27	3.733	0.04	0.56	0.6	0.027		2.240	0.101		
AW504525	CO	24/11/1993 9:40	2.626	0.04	0.7	0.74	0.026		1.943	0.068		
AW504525	CO	1/12/1993 10:22	1.017	0.03	0.51	0.54	0.014		0.549	0.014		
AW504525	CO	8/12/1993 9:40	0.515	0.01	0.6	0.61	0.022		0.314	0.011		
AW504525	CO	15/12/1993 7:50	0.638	0.02	0.62	0.64	0.028	879	0.409	0.018		
AW504525	**CO**	**21/12/1993 7:40**	**0.251**	**0.02**	**0.61**	**0.63**	**0.035**	**927**	**0.158**	**0.009**	**1388**	**59**
AW504525	**CO**	**12/01/1994 13:35**	**9.186**	**0.17**	**0.99**	**1.16**	**0.063**		**10.656**	**0.579**		
AW504525	CO	19/01/1994 10:20	0.313	0.02	0.53	0.55	0.039		0.172	0.012		
AW504525	CO	27/01/1994 9:30	0.120	0.03	0.6	0.63	0.072		0.076	0.009		
AW504525	CO	16/02/1994 8:35	0.326	0.01	0.81	0.82	0.049		0.267	0.016		
AW504525	CO	23/02/1994 14:10	0.048	0.03	0.64	0.67	0.024		0.032	0.001		
AW504525	CO	8/06/1994 10:50	0.568	0.5	0.9	1.4	0.119		0.795	0.068		
AW504525	CO	15/06/1994 12:30	0.414	0.17	0.58	0.75	0.051		0.310	0.021		
AW504525	CO	22/06/1994 12:55	2.696	0.02	0.48	0.5	0.037		1.348	0.100		
AW504525	CO	29/06/1994 12:20	43.734	3.66	1.67	5.33	0.118		233.104	5.161		
AW504525	CO	6/07/1994 14:45	3.906	1.91	0.8	2.71	0.039		10.585	0.152		
AW504525	CO	13/07/1994 11:50	4.319	0.27	0.52	0.79	0.026		3.412	0.112		
AW504525	CO	20/07/1994 11:00	4.527	0.16	0.56	0.72	0.035		3.259	0.158		
AW504525	CO	27/07/1994 10:50	2.475	0.12	0.47	0.59	0.031		1.460	0.077		
AW504525	CO	3/08/1994 9:00	38.270	1.48	1.69	3.17	0.102		121.315	3.904		
AW504525	CO	10/08/1994 8:00	22.289	0.55	0.96	1.51	0.034		33.656	0.758		
AW504525	CO	17/08/1994 8:00	31.619	0.81	1.2	2.01	0.053		63.554	1.676		
AW504525	CO	24/08/1994 8:05	11.089	0.33	0.63	0.96	0.018		10.645	0.200		
AW504525	CO	31/08/1994 8:05	5.178	0.17	0.62	0.79	0.037		4.090	0.192		
AW504525	CO	7/09/1994 9:15	3.351	0.15	0.47	0.62	0.019		2.078	0.064		
AW504525	CO	14/09/1994 8:10	2.671	0.12	0.41	0.53	0.018		1.416	0.048		
AW504525	CO	21/09/1994 8:30	2.140	0.05	0.42	0.47	0.02		1.006	0.043		

STATION	COLI	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW504525	CO	28/09/1994 8:36	1.669	0.05	0.48	0.53	0.023		0.885	0.038		
AW504525	CO	5/10/1994 9:38	21.167	0.72	1.1	1.82	0.083		38.525	1.757		
AW504525	CO	12/10/1994 8:35	25.854	0.37	1.04	1.41	0.046		36.454	1.189		
AW504525	CO	19/10/1994 7:55	3.881	0.06	0.75	0.81	0.021		3.143	0.081		
AW504525	CO	26/10/1994 8:05	1.861	0.06	0.52	0.58	0.024		1.079	0.045		
AW504525	CO	2/11/1994 9:25	5.239	0.38	0.93	1.31	0.06		6.863	0.314		
AW504525	CO	9/11/1994 8:42	19.646	0.19	0.93	1.12	0.054		22.003	1.061		
AW504525	CO	16/11/1994 0:00	5.855	0.04	0.82	0.86	0.036		5.035	0.211		
AW504525	CO	23/11/1994 7:45	2.065	0.02	0.9	0.92	0.033		1.900	0.068		
AW504525	CO	30/11/1994 7:08	1.027	0.02	0.6	0.62	0.025		0.637	0.026		
AW504525	CO	7/12/1994 7:16	0.173	0.04	0.57	0.61	0.033	276	0.106	0.006		
AW504525	**CO**	**14/12/1994 7:05**	**0.054**	**0.12**	**0.65**	**0.77**	**0.026**	**278**	**0.042**	**0.001**	**620**	**18**
AW504525	CO	30/05/1995 8:15	0.943	0.92	1.1	2.02	0.105		1.905	0.099		
AW504525	CO	6/06/1995 8:05	0.018	0.21	0.69	0.9	0.06		0.016	0.001		
AW504525	CO	14/06/1995 9:00	28.799	0.14	0.67	0.81	0.049		23.328	1.411		
AW504525	CO	21/06/1995 8:00	2.080	0.07	0.58	0.65	0.027		1.352	0.056		
AW504525	MS	28/06/1995 8:10	3.914	0.66	1	1.66	0.062		6.497	0.243		
AW504525	MS	5/07/1995 8:15	116.443	1.9	1.28	3.18	0.062		370.288	7.219		
AW504525	MS	12/07/1995 10:30	106.986	0.68	1.74	2.42	0.13		258.907	13.908		
AW504525	CO	19/07/1995 9:47	506.073	0.83	1.88	2.71	0.125		1371.456	63.259		
AW504525	CO	26/07/1995 9:20	933.776	0.58	2.34	2.92	0.334		2726.626	311.881		
AW504525	CO	2/08/1995 7:45	585.986	0.5	1.47	1.97	0.096		1154.393	56.255		
AW504525	CO	9/08/1995 10:05	413.661	0.45	1.26	1.71	0.074		707.360	30.611		
AW504525	CO	16/08/1995 9:40	66.348	0.67	0.86	1.53	0.034		101.513	2.256		
AW504525	CO	23/08/1995 10:30	26.623	0.42	0.76	1.18	0.027		31.415	0.719		
AW504525	CO	30/08/1995 9:00	17.784	0.23	0.66	0.89	0.031		15.828	0.551		
AW504525	CO	6/09/1995 10:10	21.774	0.2	1.07	1.27	0.04		27.653	0.871		
AW504525	CO	13/09/1995 0:00	14.718	0.14	0.62	0.76	0.02		11.186	0.294		
AW504525	CO	20/09/1995 10:05	11.934	0.15	0.7	0.85	0.025		10.144	0.298		
AW504525	CO	27/09/1995 10:30	11.256	0.16	0.76	0.92	0.027		10.356	0.304		
AW504525	CO	4/10/1995 9:45	8.988	0.13	0.66	0.79	0.025		7.101	0.225		
AW504525	CO	11/10/1995 9:45	8.317	0.11	0.7	0.81	0.023		6.737	0.191		
AW504525	CO	18/10/1995 13:30	3.774	0.06	0.51	0.57	0.018		2.151	0.068		
AW504525	CO	25/10/1995 11:30	1.834	0.03	0.73	0.76	0.02		1.394	0.037		
AW504525	CO	1/11/1995 9:45	1.898	0.01	0.97	0.98	0.015		1.860	0.028		
AW504525	CO	8/11/1995 10:30	1.251	0.01	0.45	0.46	0.01		0.575	0.013		
AW504525	CO	15/11/1995 9:30	0.644	0.01	0.56	0.57	0.008		0.367	0.005		
AW504525	CO	22/11/1995 9:30	0.288	0.01	0.44	0.45	0.007		0.130	0.002		
AW504525	CO	29/11/1995 9:15	0.150	0.01	0.49	0.5	0.008		0.075	0.001		
AW504525	CO	6/12/1995 10:30	0.050	0.01	0.66	0.67	0.016	2896	0.033	0.001		
AW504525	**CO**	**13/12/1995 8:45**	**0.005**	**0.01**	**0.71**	**0.72**	**0.016**	**2896**	**0.003**	**0.000**	**6851**	**491**
AW504525	MD	5/06/1996 11:25	1.885	0.74	1.42	2.16	0.148		4.072	0.279		
AW504525	CO	12/06/1996 10:25	1.578	0.07	0.98	1.05	0.054		1.657	0.085		
AW504525	CO	19/06/1996 11:20	14.583	0.58	2.27	2.85	0.288		41.560	4.200		
AW504525	CO	26/06/1996 15:25	47.025	0.56	1.77	2.33	0.156		109.568	7.336		
AW504525	CO	17/07/1996 13:55	613.468	0.89	1.68	2.57	0.104		1576.613	63.801		
AW504525	CO	24/07/1996 10:35	555.879	0.63	1.99	2.62	0.178		1456.402	98.946		
AW504525	CO	6/08/1996 9:40	820.484	0.378	1.8	2.178	0.153		1787.013	125.534		
AW504525	CO	13/08/1996 7:10	358.470	0.386	1.48	1.866	0.109		668.905	39.073		
AW504525	CO	20/08/1996 7:15	150.528	0.336	1.4	1.736	0.074		261.317	11.139		
AW504525	CO	28/08/1996 7:45	510.696	0.224	1.57	1.794	0.124		916.188	63.326		
AW504525	CO	4/09/1996 9:10	143.890	0.207	1.18	1.387	0.071		199.575	10.216		
AW504525	CO	11/09/1996 12:40	60.593	0.134	1.36	1.494	0.064		90.525	3.878		
AW504525	CO	18/09/1996 6:24	81.233	0.139	1.32	1.459	0.083		118.520	6.742		
AW504525	CO	25/09/1996 6:40	119.063	0.137	1.46	1.597	0.089		190.143	10.597		
AW504525	CO	9/10/1996 14:55	1036.899	0.265	1.26	1.525	0.097		1581.271	100.579		
AW504525	CO	16/10/1996 11:05	41.781	0.114	1.07	1.184	0.03		49.469	1.253		
AW504525	CO	16/10/1996 11:40	0.105	0.166	0.86	1.026	0.038		0.107	0.004		
AW504525	CO	20/11/1996 11:00	34.824	0.006	0.5	0.506	0.017		17.621	0.592		
AW504525	CO	5/12/1996 0:00	0.8784	0.0025	0.54	0.5425	0.014		0.477	0.012		
AW504525	CO	11/12/1996 8:50	0.7981	0.011	0.80	0.811	0.036	4594	0.647	0.029		
AW504525	**CO**	**18/12/1996 5:45**	**0.0398**	**0.006**	**0.95**	**0.956**	**0.020**	**4595**	**0.038**	**0.001**	**9072**	**548**
AW504525	**CO**	**12/08/1997 11:20**	**61.2542**	**1.22**	**1.91**	**3.13**	**0.192**		**191.726**	**11.761**		
AW504525	CO	20/08/1997 9:25	19.4406	1.78	1.37	3.15	0.056		61.238	1.089		
AW504525	CO	27/08/1997 9:00	8.8032	0.521	0.75	1.271	0.027		11.189	0.238		
AW504525	CO	3/09/1997 8:35	98.3430	0.626	2.42	3.046	0.235		299.553	23.111		
AW504525	CO	10/09/1997 9:10	158.2555	0.559	2.18	2.739	0.13		433.462	20.573		
AW504525	CO	17/09/1997 13:05	79.8406	0.433	1.82	2.253	0.139		179.881	11.098		
AW504525	CO	24/09/1997 8:10	49.0794	0.26	1.51	1.77	0.078		86.871	3.828		
AW504525	CO	1/10/1997 9:55	20.0226	0.119	1.32	1.439	0.042		28.813	0.841		
AW504525	CO	8/10/1997 9:15	5.4635	0.077	0.86	0.937	0.033		5.119	0.180		
AW504525	CO	15/10/1997 8:40	2.2022	0.045	0.74	0.785	0.03		1.729	0.066		
AW504525	CO	22/10/1997 9:20	1.5484	0.021	1.03	1.051	0.023		1.627	0.036		
AW504525	CO	29/10/1997 7:50	0.9546	0.015	0.75	0.765	0.025		0.730	0.024		
AW504525	CO	31/10/1997 11:20	36.8515	0.34	2.25	2.59	0.362		95.445	13.340		
AW504525	CO	5/11/1997 9:10	73.7215	0.293	1.61	1.903	0.167		140.292	12.311		
AW504525	CO	12/11/1997 6:45	5.2912	0.07	0.91	0.98	0.035		5.185	0.185		
AW504525	CO	19/11/1997 11:00	3.6084	0.059	0.71	0.769	0.035		2.775	0.126		
AW504525	CO	26/11/1997 4:55	0.843	0.01	0.9	0.91	0.045		0.767	0.038		
AW504525	CO	4/12/1997 16:34	0.125	0.009	0.95	0.959	0.048		0.120	0.006		
AW504525	CO	10/12/1997 6:10	0.282	0.008	0.8	0.808	0.041	627	0.228	0.012		
AW504525	**CO**	**24/12/1997 10:30**	**1.227**	**0.124**	**1.01**	**1.134**	**0.049**	**627**	**1.391**	**0.060**	**1548**	**99**
AW504525	CO	22/04/1998 10:00	3.654	0.82	1.94	**2.76**	0.217		10.084	0.793		
AW504525	CO	29/04/1998 13:20	2.271	0.1	1.16	1.26	0.081		2.862	0.184		

STATION	COLL	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg
AW504525	CO	28/05/1998 9:00	0.202	0.005	1.08	1.085	0.053		0.219	0.011		
AW504525	CO	10/06/1998 11:05	9.249	0.405	0.96	1.365	0.17		12.625	1.572		
AW504525	CO	17/06/1998 9:05	11.324	0.277	0.98	1.257	0.105		14.234	1.189		
AW504525	CO	24/06/1998 11:55	8.269	0.375	0.91	1.285	0.063		10.626	0.521		
AW504525	CO	1/07/1998 7:40	10.415	0.53	0.93	1.46	0.049		15.205	0.510		
AW504525	CO	8/07/1998 14:35	17.452	0.631	1.64	2.271	0.127		39.633	2.216		
AW504525	CO	15/07/1998 12:45	28.695	0.863	1.93	2.793	0.162		80.146	4.649		
AW504525	CO	22/07/1998 11:50	7.570	0.615	0.71	1.325	0.018		10.030	0.136		
AW504525	CO	29/07/1998 15:15	360.552	0.5	2.21	2.71	0.342		977.096	123.309		
AW504525	CO	5/08/1998 13:05	227.130	0.661	1.34	2.001	0.087		454.487	19.760		
AW504525	CO	12/08/1998 13:15	56.791	0.643	1.09	1.733	0.049		98.418	2.783		
AW504525	CO	19/08/1998 12:30	45.113	0.373	0.79	1.163	0.027		52.467	1.218		
AW504525	CO	26/08/1998 10:15	140.579	0.303	1.56	1.863	0.094		261.898	13.214		
AW504525	CO	2/09/1998 11:00	55.005	0.289	1.27	1.559	0.049		85.753	2.695		
AW504525	CO	8/09/1998 9:50	20.838	0.211	0.81	1.021	0.039		21.275	0.813		
AW504525	CO	16/09/1998 11:15	24.680	0.217	0.84	1.057	0.031		26.087	0.765		
AW504525	CO	23/09/1998 6:55	59.289	0.251	1.85	2.101	0.184		124.567	10.909		
AW504525	CO	4/11/1998 12:20	299.614	0.007	0.52	0.527	0.015		157.896	4.494		
AW504525	CO	11/11/1998 11:25	4.322	0.029	0.7	0.729	0.025		3.150	0.108		
AW504525	CO	18/11/1998 12:35	4.382	0.027	0.58	0.607	0.025		2.660	0.110		
AW504525	CO	25/11/1998 12:30	2.124	0.007	0.65	0.657	0.019		1.395	0.040		
AW504525	CO	2/12/1998 13:10	0.935	0.005	0.61	0.615	0.022	1400	0.575	0.021		
AW504525	CO	9/12/1998 12:50	0.162	0.005	0.71	**0.715**	0.017	**1401**	0.116	0.003	**2464**	**192**
Max				3.66	2.57	5.33	0.362					
Min				0.0025	0.41	0.45	0.007					
Mean				0.30908	1.03669	1.34576	0.06919					
Median				0.17	0.91	1.134	0.042					
SD				0.4345	0.48289	0.78106	0.06712					

APPENDIX 3

Worksheets for calculation of Nutrient Loads in water pumped from the River Murray.

	Pumped into Millbrook from Mannum								Pumped into Mt_Bold from Murray Bridge							
	Volume		Concentration		Monthly Load		Annual Load		Volume		Concentration		MonthlyLoad		Annual Load	
	Monthly	Annual	TN	TP	TN	TP	TN	TP	Monthly	Annual	TN	TP	TN	TP	TN	TP
Month	ML	ML	mg/L	mg/L	kg	kg	kg	kg	ML	ML	mg/L	mg/L	kg	kg	kg	kg
31/01/1988	304		0.92	0.094	279.68	28.576			3041		0.92	0.108	2797.72	328.428		
29/02/1988	509		0.86	0.062	437.74	31.558			2662		0.98	0.105	2608.76	279.51		
31/03/1988	156		0.65	0.069	101.4	10.764			0		0.53	0.065	0	0		
30/04/1988	575		0.81	0.061	465.75	35.075			2439		1.09	0.117	2658.51	285.363		
31/05/1988	841		0.77	0.074	647.57	62.234			1113		0.73	0.078	812.49	86.814		
30/06/1988	0		0.62	0.057	0	0			0		1.12	0.107	0	0		
31/07/1988	39		0.99	0.211	38.61	8.229			0		0.95	0.172	0	0		
31/08/1988	0		1.06	0.195	0	0			0		1.09	0.21	0	0		
30/09/1988	0		0.85	0.198	0	0			0		1.14	0.205	0	0		
31/10/1988	0		1.08	0.15	0	0			0		1.12	0.113	0	0		
30/11/1988	0		0.99	0.149	0	0			709		0.84	0.149	595.56	105.641		
31/12/1988	372	**2796**	0.88	0.147	327.36	54.684	**2298**	**231**	3260	**13224**	1.38	0.392	4498.8	1277.92	**13972**	**2364**
31/01/1989	67		0.77	0.147	51.59	9.849			2557		0.74	0.147	1892.18	375.879		
28/02/1989	48		1.08	0.111	51.84	5.328			1405		0.77	0.102	1081.85	143.31		
31/03/1989	115		0.61	0.13	70.15	14.95			1898		0.95	0.194	1803.1	368.212		
30/04/1989	742		0.8	0.18	593.6	133.56			2007		0.83	0.16	1665.81	321.12		
31/05/1989	0		1.1	0.244	0	0			1606		0.7	0.122	1124.2	195.932		
30/06/1989	272		0.82	0.145	223.04	39.44			0		0.9	0.153	0	0		
31/07/1989	0		1.2	0.338	0	0			0		0.91	0.198	0	0		
31/08/1989	0		1.14	0.192	0	0			0		1.22	0.188	0	0		
30/09/1989	0		1.06	0.195	0	0			0		0.84	0.163	0	0		
31/10/1989	0		1.04	0.226	0	0			0		1.04	0.218	0	0		
30/11/1989	451		1.4	0.192	631.4	86.592			1665		1.08	0.182	1798.2	303.03		
31/12/1989	0	**1695**	0.67	0.103	0	0	**1622**	**290**	962	**12100**	0.69	0.101	663.78	97.162	**10029**	**1805**
31/01/1990	96		1.05	0.122	100.8	11.712			1972		1.47	0.148	2898.84	291.856		
28/02/1990	512		0.68	0.064	348.16	32.768			3765		0.64	0.064	2409.6	240.96		
31/03/1990	2335		0.76	0.082	1774.6	191.47			2161		0.73	0.074	1577.53	159.914		
30/04/1990	5701		0.79	0.12	4503.79	684.12			0		0.58	0.052	0	0		
31/05/1990	387		0.82	0.153	317.34	59.211			1899		0.87	0.163	1652.13	309.537		
30/06/1990	0		0.68	0.228	0	0			2187		1.27	0.471	2777.49	1030.077		
31/07/1990	1628		0.84	0.177	1367.52	288.156			0		1.67	0.163	0	0		
31/08/1990	1002		0.97	0.203	971.94	203.406			0		1.64	0.233	0	0		
30/09/1990	0		1.18	0.219	0	0			1076		1.14	0.226	1226.64	243.176		
31/10/1990	0		1.47	0.261	0	0			1305		1.22	0.28	1592.1	365.4		
30/11/1990	0		1.04	0.208	0	0			4621		1.15	0.211	5314.15	975.031		
31/12/1990	4275	**15936**	1.36	0.19	5814	812.25	**15198**	**2283**	7402	**26388**	1.12	0.159	8290.24	1176.918	**27739**	**4793**
31/01/1991	655		1.69	0.135	1106.95	88.425			6758		0.95	0.146	6420.1	986.668		
28/02/1991	4578		0.9	0.084	4120.2	384.552			4450		0.97	0.071	4316.5	315.95		
31/03/1991	5867		1.01	0.091	5925.67	533.897			4104		1.27	0.106	5212.08	435.024		
30/04/1991	3917		1.7	0.171	6658.9	669.807			0		0.84	0.109	0	0		
31/05/1991	154		0.86	0.136	132.44	20.944			66		0.85	0.095	56.1	6.27		

	Pumped into Millbrook from Mannum								Pumped into Mt_Bold from Murray Bridge							
	Volume		Concentration		Monthly Load		Annual Load		Volume		Concentration		MonthlyLoad		Annual Load	
	Monthly	Annual	TN	TP	TN	TP	TN	TP	Monthly	Annual	TN	TP	TN	TP	TN	TP
Month	ML	ML	mg/L	mg/L	kg	kg	kg	kg	ML	ML	mg/L	mg/L	kg	kg	kg	kg
30/06/1991	0		1.24	0.128	0	0			2009		0.73	0.147	1466.57	295.323		
31/07/1991	2432		0.93	0.104	2261.76	252.928			3069		0.99	0.102	3038.31	313.038		
31/08/1991	4311		0.72	0.124	3103.92	534.564			3645		0.74	0.091	2697.3	331.695		
30/09/1991	971		1.08	0.145	1048.68	140.795			2081		1.21	0.12	2518.01	249.72		
31/10/1991	0		1.78	0.156	0	0			40		1.28	0.148	51.2	5.92		
30/11/1991	1067		1.05	0.14	1120.35	149.38			3249		1.36	0.127	4418.64	412.623		
31/12/1991	5417	**29369**	0.7	0.155	3791.9	839.635	**29271**	**3615**	4010	**33481**	0.62	0.149	2486.2	597.49	**32681**	**3950**
31/01/1992	565		0.92	0.125	519.8	70.625			3691		0.64	0.123	2362.24	453.993		
29/02/1992	2713		1.14	0.104	3092.82	282.152			2745		0.82	0.114	2250.9	312.93		
31/03/1992	748		1.05	0.118	785.4	88.264			0		1.07	0.107	0	0		
30/04/1992	52		0.58	0.115	30.16	5.98			0		0.61	0.132	0	0		
31/05/1992	0		0.62	0.078	0	0			0		0.66	0.095	0	0		
30/06/1992	33		0.66	0.07	21.78	2.31			0		0.74	0.085	0	0		
31/07/1992	0		0.68	0.075	0	0			0		0.67	0.084	0	0		
31/08/1992	838		0.57	0.07	477.66	58.66			1657		0.95	0.081	1574.15	134.217		
30/09/1992	6		0.59	0.07	3.54	0.42			0		0.62	0.066	0	0		
31/10/1992	48		0.8	0.11	38.4	5.28			0		1.39	0.141	0	0		
30/11/1992	38		1.03	0.146	39.14	5.548			0		1.08	0.151	0	0		
31/12/1992	0	**5041**	1.26	0.13	0	0	**5009**	**519**	0	**8093**	1.11	0.179	0	0	**6187**	**901**
31/01/1993	2200		0.85	0.14	1870	308			0		1.01	0.183	0	0		
28/02/1993	2929		0.78	0.108	2284.62	316.332			0		0.86	0.109	0	0		
31/03/1993	137		0.89	0.08	121.93	10.96			0		0.86	0.08	0	0		
30/04/1993	58		0.72	0.074	41.76	4.292			0		0.83	0.079	0	0		
31/05/1993	0		0.6	0.055	0	0			0		0.48	0.054	0	0		
30/06/1993	0		0.46	0.063	0	0			0		0.97	0.087	0	0		
31/07/1993	0		0.71	0.062	0	0			20		0.47	0.045	9.4	0.9		
31/08/1993	1265		0.49	0.079	619.85	99.935			0		0.61	0.092	0	0		
30/09/1993	2620		0.7	0.101	1834	264.62			2557		1.3	0.152	3324.1	388.664		
31/10/1993	3475		0.91	0.122	3162.25	423.95			5606		0.77	0.126	4316.62	706.356		
30/11/1993	4350		1.4	0.248	6090	1078.8			5436		1.57	0.199	8534.52	1081.764		
31/12/1993	3474	**20508**	1.13	0.143	3925.62	496.782	**19950**	**3004**	6037	**19656**	0.98	0.156	5916.26	941.772	**22101**	**3119**
31/01/1994	2083		1.05	0.095	2187.15	197.885			5962		1.04	0.096	6200.48	572.352		
28/02/1994	2868		0.71	0.058	2036.28	166.344			5152		0.86	0.083	4430.72	427.616		
31/03/1994	2577		0.61	0.08	1571.97	206.16			6871		0.6	0.076	4122.6	522.196		
30/04/1994	2382		0.57	0.067	1357.74	159.594			7362		0.61	0.082	4490.82	603.684		
31/05/1994	1964		0.68	0.071	1335.52	139.444			5198		0.53	0.067	2754.94	348.266		
30/06/1994	407		0.47	0.056	191.29	22.792			2036		0.42	0.052	855.12	105.872		
31/07/1994	0		0.43	0.051	0	0			1954		0.4	0.039	781.6	76.206		
31/08/1994	1234		0.77	0.041	950.18	50.594			4951		0.48	0.055	2376.48	272.305		
30/09/1994	2718		0.43	0.06	1168.74	163.08			8850		0.38	0.065	3363	575.25		
31/10/1994	2651		0.49	0.054	1298.99	143.154			9621		0.46	0.08	4425.66	769.68		

	Pumped into Millbrook from Mannum								Pumped into Mt_Bold from Murray Bridge							
	Volume		Concentration		Monthly Load		Annual Load		Volume		Concentration		MonthlyLoad		Annual Load	
	Monthly	Annual	TN	TP	TN	TP	TN	TP	Monthly	Annual	TN	TP	TN	TP	TN	TP
Month	**ML**	**ML**	**mg/L**	**mg/L**	**kg**	**kg**	**kg**	**kg**	**ML**	**ML**	**mg/L**	**mg/L**	**kg**	**kg**	**kg**	**kg**
30/11/1994	2540		0.58	0.062	1473.2	157.48			7247		0.43	0.062	3116.21	449.314		
31/12/1994	1471	**22895**	0.72	0.106	1059.12	155.926	**14630**	**1562**	6773	**71977**	0.53	0.087	3589.69	589.251	**40507**	**5312**
31/01/1995	2277		0.61	0.084	1388.97	191.268			7683		0.56	0.093	4302.48	714.519		
28/02/1995	6187		0.42	0.062	2598.54	383.594			6925		0.43	0.077	2977.75	533.225		
31/03/1995	4794		0.73	0.071	3499.62	340.374			5693		0.53	0.053	3017.29	301.729		
30/04/1995	1752		0.59	0.043	1033.68	75.336			2732		0.53	0.051	1447.96	139.332		
31/05/1995	2011		0.62	0.066	1246.82	132.726			6		0.5	0.049	3	0.294		
30/06/1995	776		0.7	0.092	543.2	71.392			4		0.48	0.043	1.92	0.172		
Jul-95	858		0.66	0.077	566.28	66.066			440		0.78	0.1	343.2	44		
Aug-95	0		0.91	0.127	0	0			0		0.88	0.137	0	0		
Sep-95	0		0.94	0.139	0	0			1		1.03	0.138	1.03	0.138		
Oct-95	0		1.03	0.161	0	0			0		0.95	0.154	0	0		
Nov-95	0		1.08	0.148	0	0			0		1.06	0.158	0	0		
Dec-95	0	**18655**	0.79	0.098	0	0	**10877**	**1261**	0	**23484**	1.31	0.146	0	0	**12095**	**1733**
Jan-96	0		1.48	0.479	0	0			649		0.73	0.096	473.77	62.304		
Feb-96	232		1.09	0.249	252.88	57.768			2828		0.78	0.103	2205.84	291.284		
Mar-96	327		0.69	0.056	225.63	18.312			4181		0.63	0.059	2634.03	246.679		
Apr-96	2161		0.62	0.056	1339.82	121.016			2442		0.7	0.117	1709.4	285.714		
May-96	1168		0.71	0.07	829.28	81.76			3091		0.65	0.064	2009.15	197.824		
Jun-96	0		0.7	0.105	0	0			2340		0.72	0.118	1684.8	276.12		
Jul-96	0		0.75	0.099	0	0			0		0.99	0.239	0	0		
Aug-96	0		1.17	0.205	0	0			0		1.09	0.204	0	0		
Sep-96	0		1.2	0.175	0	0			0		1.17	0.156	0	0		
Oct-96	0		0.97	0.148	0	0			0		1.3	0.23	0	0		
Nov-96	0		0.89	0.14	0	0			987		0.84	0.138	829.08	136.206		
Dec-96	170	**4058**	1.17	0.206	198.9	35.02	**2847**	**314**	2473	**18991**	0.95	0.129	2349.35	319.017	**13895**	**1815**
Jan-97	2019		0.97	0.116	1958.43	234.204			1886		0.86	0.116	1621.96	218.776		
Feb-97	3402		1.03	0.109	3504.06	370.818			2844		0.82	0.096	2332.08	273.024		
Mar-97	2821		1.2	0.196	3385.2	552.916			2281		1.17	0.095	2668.77	216.695		
Apr-97	755		0.91	0.173	687.05	130.615			569		0.94	0.216	534.86	122.904		
May-97	500		0.79	0.162	395	81			1		0.88	0.159	0.88	0.159		
Jun-97	0		0.77	0.167	0	0			306		0.78	0.183	238.68	55.998		
Jul-97	2759		0.72	0.172	1986.48	474.548			136		0.88	0.192	119.68	26.112		
Aug-97	3971		0.63	0.111	2501.73	440.781			73		0.97	0.286	70.81	20.878		
Sep-97	4325		0.97	0.339	4195.25	1466.175			138		0.56	0.102	77.28	14.076		
Oct-97	4110		0.75	0.125	3082.5	513.75			621		0.65	0.123	403.65	76.383		
Nov-97	4022		0.54	0.098	2171.88	394.156			189		1.03	0.156	194.67	29.484		
Dec-97	1770	**30454**	0.6	0.1	1062	177	**24930**	**4836**	237	**9281**	1	0.15	237	35.55	**8500**	**1090**
Jan-98	1130		0.88	0.13	994.4	146.9			30		0.88	0.13	26.4	3.9		
Feb-98	2090		0.88	0.13	1839.2	271.7			0		0.88	0.13	0	0		
Mar-98	140		0.88	0.13	123.2	18.2			0		0.88	0.13	0	0		

	Pumped into Millbrook from Mannum								Pumped into Mt_Bold from Murray Bridge							
	Volume		Concentration		Monthly Load		Annual Load		Volume		Concentration		MonthlyLoad		Annual Load	
	Monthly	Annual	TN	TP	TN	TP	TN	TP	Monthly	Annual	TN	TP	TN	TP	TN	TP
Month	ML	ML	mg/L	mg/L	kg	kg	kg	kg	ML	ML	mg/L	mg/L	kg	kg	kg	kg
Apr-98	0		0.88	0.13	0	0			0		0.88	0.13	0	0		
May-98	140		0.88	0.13	123.2	18.2			1		0.88	0.13	0.88	0.13		
Jun-98	871		0.88	0.13	766.48	113.23			0		0.88	0.13	0	0		
Jul-98	768		0.88	0.13	675.84	99.84			0		0.88	0.13	0	0		
Aug-98	1521		0.88	0.13	1338.48	197.73			0		0.88	0.13	0	0		
Sep-98	5229		0.88	0.13	4601.52	679.77			0		0.88	0.13	0	0		
Oct-98	6670		0.88	0.13	5869.6	867.1			0		0.88	0.13	0	0		
Nov-98	6502		0.88	0.13	5721.76	845.26			0		0.88	0.13	0	0		
Dec-98	4110	**29171**	0.88	0.13	3616.8	534.3	**25670**	**3792**	0	**31**	0.88	0.13	0	0	**27**	**4**
Mean			0.88	0.13							0.88	0.13				

APPENDIX 4

Worksheets for estimation of Pumping Losses in the Onkaparinga River

Onkaparinga Pumped and Gauged Flows

All volumes in ML

Month	Pumped Volume monthly	annual	Houlgrave Weir gauged monthly	annual	Possible Pumped Loss + only		Flow in adjacent catchments
Jan-89	2557		2134.0		16.5	16.5	0
Feb-89	1405		1038.0		26.1	26.1	0
Mar-89	1898		1723.0		9.2	9.2	0
Apr-89	2007		1948.0		2.9	2.9	0
May-89	1606		2416.0				1
Jun-89	0		3823.0				1
Jul-89	0		10978.0				1
Aug-89	0		18570.0				1
Sep-89	0		11448.0				1
Oct-89	0		3674.0				1
Nov-89	1665		2949.0				1
Dec-89	962	**12100**	1567.0	62268			**1**
Jan-90	1972		2186.0				1
Feb-90	3765		3503.0		7.0	7.0	0
Mar-90	2161		2406.0			-11.3	0
Apr-90	0		43.6				0
May-90	1899		1915.0			-0.8	0
Jun-90	2187		4447.0				1
Jul-90	0		11376.0				1
Aug-90	0		19457.0				1
Sep-90	1076		5902.0				1
Oct-90	1305		3898.0				1
Nov-90	4621		5458.0			-18.1	0
Dec-90	7402	**26388**	8386.0	68978		**-13**	**0**
Jan-91	6758		6865.0			-1.6	0
Feb-91	4450		4547.0			-2.2	0
Mar-91	4104		4210.0			-2.6	0
Apr-91	0		82.0				0
May-91	66		195.0				0
Jun-91	2009		3655.0				1
Jul-91	3069		8653.0				1
Aug-91	3645		21618.0				1
Sep-91	2081		28405.0				1
Oct-91	40		1519.0				1
Nov-91	3249		3853.0				1
Dec-91	4010	**33481**	4179.0	87781		**-4**	**0**
Jan-92	3691		3858.0			-4.5	0
Feb-92	2745		2730.0		0.5	0.5	0
Mar-92	0		156.0				0
Apr-92	0		191.0				0
May-92	0		751.0				1
Jun-92	0		2908.0				1
Jul-92	0		5755.0				1
Aug-92	1657		35472.0				1
Sep-92	0		37703.0				1
Oct-92	0		19035.0				1
Nov-92	0		6405.0				1
Dec-92	0	**8093**	16742.0	131706			**1**
Jan-93	0		1070.0				1
Feb-93	0		142.0				1
Mar-93	0		305.0				1
Apr-93	0		113.0				0
May-93	0		472.0				1
Jun-93	0		1263.0				1
Jul-93	20		3981.0				1
Aug-93	0		3358.0				1
Sep-93	2557		5787.0				1
Oct-93	5606		8185.0				1
Nov-93	5436		6103.0				1
Dec-93	6037	**19656**	6778.0	37557		**-12**	**0**
Jan-94	5962		7098.0				1

Month	Pumped Volume monthly	annual	Houlgrave Weir gauged monthly	annual	Possible Pumped Loss + only		Flow in adjacent catchments
Feb-94	5152		5393.0			-4.7	0
Mar-94	6871		6985.0			-1.7	0
Apr-94	7362		7392.0			-0.4	0
May-94	5198		5351.0			-2.9	0
Jun-94	2036		4015.0				1
Jul-94	1954		3098.0				1
Aug-94	4951		6666.0				1
Sep-94	8850		9717.0				1
Oct-94	9621		12211.0				1
Nov-94	7247		8589.0				1
Dec-94	6773	**71977**	6788.0	83303			**1**
Jan-95	7683		7607.0		1.0	1.0	0
Feb-95	6925		6894.0		0.4	0.4	0
Mar-95	5693		5608.0		1.5	1.5	0
Apr-95	2732		2880.0			-5.4	0
May-95	6		876.0				1
Jun-95	4		3371.0				1
Jul-95	440		43950.0				1
Aug-95	0		10389.0				1
Sep-95	1		2010.0				1
Oct-95	0		1218.0				1
Nov-95	0		350.0				1
Dec-95	0	**23484**	20.0	85173			**0**
Jan-96	649		592.0		8.8	8.8	0
Feb-96	2828		2603.0		8.0	8.0	0
Mar-96	4181		3893.0		6.9	6.9	0
Apr-96	2442		2417.0		1.0	1.0	0
May-96	3091		3030.0		2.0	2.0	0
Jun-96	2340		6251.0				0
Jul-96	0		12666.0				1
Aug-96	0		33146.0				1
Sep-96	0		19388.0				1
Oct-96	0		7887.0				1
Nov-96	987		1489.0				0
Dec-96	2473	**18991**	2587.0	95949		**-5**	**0**
Jan-97	1886		2025.0			-7.4	0
Feb-97	2844		2850.0			-0.2	0
Mar-97	2281		2207.0		3.2	3.2	0
Apr-97	569		654.0			-14.9	0
May-97	1		269.0				1
Jun-97	306		731.0				1
Jul-97	136		5461.0				1
Aug-97	73		9530.0				1
Sep-97	138		10837.0				1
Oct-97	621		6775.0				1
Nov-97	189		7211.0				1
Dec-97	237	**9281**	4942.0	53492			**1**
Jan-98	*30*		*4853.0*				0
Feb-98	0		6187.0				0
Mar-98	0		9148.0				0
Apr-98	0		6807.0				1
May-98	1		1053.0				1
Jun-98	0		3800.0				1
Jul-98	0		9695.0				1
Aug-98	0		8192.0				1
Sep-98	0		8040.0				1
Oct-98	0		8226.0				1
Nov-98	0		5485.0				1
Dec-98	0	**31**	3335.0	74821			**0**
Mean					6.3	-0.5	

APPENDIX 5

Worksheets for analysis of composite data for Millbrook Intake including corrections for overflow of Gumaracha Weir.

COLLMETH	CO = Composite																	
	AG = Automatic Grab sample																	
	MS = Manual grab taken from sampler intake																	
	MD = Manual Grab taken from stream																	
	ML = Manual Grab and left on site for period until next sample visit																	
Codes	NA	Not Available																
	NR	No Result																
	NP	Not Processed																
STATION	**COLL**	**ExcelDateTime Oracle Format**	**Volume since last Sample MegaLitres**	**Nox mg/L**	**TKN mg/L**	**Tot N mg/L**	**Tot P mg/L**	**Total Annual Flow ML**	**TN Load kg**	**TP Load kg**	**TN Annual Load kg**	**TP Annual Load kg**	**Gum_Weir Overflow ML**	**Gum_Weir Overflow Total ML**	**TN corrected kg**	**TP corrected kg**	**TN Annual corrected**	**TP Annual corrected**
AW504508 Milbrook Intake, Milbrook Reservoir																		
WQ#3309																		
AW504508	ML	24/02/1992 11:00	644.978						0	0					0.0	0.0		
AW504508	CO	11/03/1992 13:06	1178.316	0.15	0.83	0.98	0.14		1154.750	164.964					1154.750	164.964		
AW504508	CO	25/03/1992 14:04	13.848	0.74	0.5	1.24	0.064		17.171	0.886					17.171	0.886		
AW504508	CO	30/04/1992 12:55	99.424	0.69	0.63	1.32	0.12		131.239	11.931					131.239	11.931		
AW504508	CO	4/05/1992 12:00	6.483	0.2	0.97	1.17	0.092		7.585	0.596					7.585	0.596		
AW504508	CO	1/06/1992 12:00	33.109	0.01	0.78	0.79	0.06		26.156	1.987					26.156	1.987		
AW504508	CO	6/07/1992 12:00	358.351	0.3	1.42	1.72	0.243		616.363	87.079			202.8		965.179	136.360		
AW504508	CO	3/08/1992 12:00	782.330	0.26	0.87	1.13	0.157		884.033	122.826					884.033	122.826		
AW504508	MS	19/08/1992 10:50	2300.422	0.46	1.61	2.07	0.172		4761.874	395.673			556.0		5912.794	491.305		
AW504508	CO	30/08/1992 11:05	1954.697	0.38	1.92	2.3	0.28		4495.803	547.315			6639.1		19765.733	2406.263		
AW504508	CO	23/09/1992 13:20	3895.496	0.38	1.92	2.3	0.28		8959.641	1090.739			16248.0		46330.041	5640.179		
AW504508	CO	28/10/1992 13:30	4780.240	0.08	0.91	0.99	0.111		4732.438	530.607			8220.7		12870.931	1443.104		
AW504508	CO	25/11/1992 13:08	2073.499	0.37	1.87	2.24	0.27	21641	4644.638	559.845			356.2	67631	5442.526	656.019		
AW504508	**CO**	**22/12/1992 9:21**	**2732.911**	**0.34**	**3.01**	**3.35**	**0.632**	**20854**	**9155.252**	**1727.200**			**14554.3**	**46777**	**57912.157**	**10925.517**		
AW504508	**CO**	**20/01/1993 15:11**	**1816.328**	**0.32**	**1.34**	**1.66**	**0.188**		**3015.104**	**341.470**					**3015.104**	**341.470**		
AW504508	CO	24/02/1993 14:18	2568.467	0.09	0.92	1.01	0.13		2594.152	333.901					2594.152	333.901		
AW504508	CO	24/03/1993 14:13	512.140	0.13	0.59	0.72	0.116		368.741	59.408					368.741	59.408		
AW504508	CO	29/04/1993 13:32	67.482	0.29	0.52	0.81	0.055		54.661	3.712					54.661	3.712		
AW504508	CO	26/05/1993 9:35	121.612	0.22	0.77	0.99	0.089		120.395	10.823					120.395	10.823		
AW504508	CO	1/07/1993 10:54	85.990	0.14	0.67	0.81	0.072		69.652	6.191			191.6		224.848	19.986		
AW504508	MS	28/07/1993 11:52	492.944	0.19	0.78	0.97	0.146		478.156	71.970			615.1		1074.803	161.774		
AW504508	CO	24/08/1993 9:24	645.096	0.33	0.86	1.19	0.148		767.664	95.474					767.664	95.474		
AW504508	CO	22/09/1993 12:08	1398.743	0.32	1.64	1.96	0.218		2741.536	304.926					2741.536	304.926		
AW504508	CO	7/10/1993 11:10	450.873	0.27	1.1	1.37	0.134		617.696	60.417					617.696	60.417		
AW504508	CO	14/10/1993 10:10	115.889	0.26	0.88	1.14	0.12		132.113	13.907					132.113	13.907		
AW504508	CO	19/10/1993 9:13	398.941	0.13	0.9	1.03	0.175		410.909	69.815					410.909	69.815		
AW504508	CO	27/10/1993 13:30	794.863	0.09	1.17	1.26	0.161		1001.527	127.973					1001.527	127.973		
AW504508	CO	3/11/1993 15:55	877.066	0.06	1.37	1.43	0.169		1254.204	148.224					1254.204	148.224		
AW504508	CO	10/11/1993 12:45	938.277	0.07	1.42	1.49	0.255		1398.032	239.261					1398.032	239.261		
AW504508	CO	14/11/1993 6:14	308.102	0.09	0.92	1.01	0.144		311.183	44.367					311.183	44.367		
AW504508	CO	17/11/1993 11:48	267.268	0.09	0.92	1.01	0.144		269.941	38.487					269.941	38.487		
AW504508	MD	24/11/1993 10:42	668.143	0.04	1.18	1.22	0.194		815.134	129.620					815.134	129.620		
AW504508	MD	1/12/1993 11:15	764.541	0.04	1.24	1.28	0.195		978.612	149.085					978.612	149.085		
AW504508	MD	8/12/1993 10:26	1087.768	0.02	1.08	1.1	0.16		1196.545	174.043					1196.545	174.043		
AW504508	MD	15/12/1993 7:25	1082.499	0.02	1.09	1.11	0.177	15954	1201.574	191.602				17168	1201.574	191.602		

STATION	COLL	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg	Gum_Weir Overflow ML	Gum_Weir Overflow Total ML	TN corrected kg	TP corrected kg	TN Annual corrected	TP Annual corrected
AW504508	**CO**	**21/12/1993 7:05**	**898.366**	**0.03**	**1.12**	**1.15**	**0.185**	**16361**	**1033.121**	**166.198**	**20831**	**2781**		**807**	**1033.121**	**166.198**	**21582**	**2884**
AW504508	**CO**	**12/01/1994 12:50**	**399.714**	**0.03**	**1.14**	**1.17**	**0.096**		**467.666**	**38.373**					**467.666**	**38.373**		
AW504508	CO	19/01/1994 9:45	575.025	0.03	1.16	1.19	0.234		684.280	134.556					684.280	134.556		
AW504508	CO	27/01/1994 10:10	697.717	0.03	0.44	0.47	0.02		327.927	13.954					327.927	13.954		
AW504508	CO	3/02/1994 12:12	618.022	0.02	0.7	0.72	0.103		444.976	63.656					444.976	63.656		
AW504508	CO	9/02/1994 9:00	504.719	0.04	0.68	0.72	0.084		363.397	42.396					363.397	42.396		
AW504508	CO	16/02/1994 9:10	144.175	0.07	0.55	0.62	0.073		89.388	10.525			612.8		469.324	55.259		
AW504508	CO	23/02/1994 15:20	18.762	0.15	0.49	0.64	0.054		12.007	1.013			1142.9		743.463	62.730		
AW504508	MD	2/03/1994 7:23	10.950	0.21	0.38	0.59	0.047		6.460	0.515			1048.8		625.252	49.808		
AW504508	CO	9/03/1994 9:04	7.697	0.23	0.3	0.53	0.037		4.079	0.285			1100.8		587.503	41.014		
AW504508	CO	16/03/1994 8:40	6.338	0.24	0.27	0.51	0.042		3.232	0.266			1113.2		570.964	47.021		
AW504508	CO	23/03/1994 8:50	527.147	0.02	0.66	0.68	0.063		358.460	33.210			170.1		474.128	43.927		
AW504508	CO	30/03/1994 11:05	587.124	0.05	0.64	0.69	0.058		405.115	34.053					405.115	34.053		
AW504508	CO	6/04/1994 13:55	584.732	0.03	0.8	0.83	0.073		485.327	42.685					485.327	42.685		
AW504508	CO	13/04/1994 14:00	80.183	0.05	0.48	0.53	0.076		42.497	6.094			712.5		420.122	60.244		
AW504508	CO	20/04/1994 10:25	17.396	0.18	0.4	0.58	0.048		10.090	0.835			1064.1		627.268	51.912		
AW504508	CO	28/04/1994 11:40	301.055	0.03	0.55	0.58	0.079		174.612	23.783			773.2		623.068	84.866		
AW504508	CO	4/05/1994 11:30	525.311	0.03	0.52	0.55	0.075		288.921	39.398					288.921	39.398		
AW504508	CO	11/05/1994 11:10	599.590	0.02	0.5	0.52	0.06		311.787	35.975					311.787	35.975		
AW504508	CO	18/05/1994 15:25	614.701	0.03	0.41	0.44	0.062		270.468	38.111					270.468	38.111		
AW504508	CO	24/05/1994 12:55	360.895	0.04	0.6	0.64	0.109		230.973	39.338					230.973	39.338		
AW504508	CO	1/06/1994 12:50	405.615	0.05	0.54	0.59	1.03		239.313	417.783					239.313	417.783		
AW504508	CO	8/06/1994 11:10	356.031	0.06	0.53	0.59	0.108		210.059	38.451					210.059	38.451		
AW504508	CO	15/06/1994 13:20	88.345	0.37	0.94	1.31	0.294		115.732	25.973					115.732	25.973		
AW504508	CO	22/06/1994 13:15	57.371	0.36	0.63	0.99	0.172		56.797	9.868					56.797	9.868		
AW504508	CO	29/06/1994 12:45	443.087	0.82	1.46	2.28	0.347		1010.238	153.751					1010.238	153.751		
AW504508	CO	6/07/1994 15:15	113.231	1.69	1.38	3.07	0.291		347.619	32.950					347.619	32.950		
AW504508	CO	13/07/1994 12:00	45.144	0.8	1.14	1.94	0.218		87.579	9.841					87.579	9.841		
AW504508	CO	20/07/1994 10:20	51.036	0.24	0.78	1.02	0.168		52.057	8.574					52.057	8.574		
AW504508	CO	27/07/1994 11:10	12.762	0.34	0.71	1.05	0.181		13.400	2.310					13.400	2.310		
AW504508	CO	28/07/1994 11:52	1.453	0.16	0.74	0.9	0.113		1.307	0.164					1.307	0.164		
AW504508	MD	3/08/1994 9:27	8.501	0.24	0.6	0.84	0.103		7.141	0.876			0.0		7.158	0.878		
AW504508	MD	10/08/1994 8:20	9.090	0.16	0.63	0.79	0.086		7.181	0.782			506.6		407.395	44.349		
AW504508	CO	17/08/1994 8:20	403.677	0.08	0.84	0.92	0.203		371.383	81.946			16.4		386.471	85.276		
AW504508	CO	24/08/1994 8:30	357.852	0.05	0.56	0.61	0.086		218.290	30.775					218.290	30.775		
AW504508	CO	31/08/1994 8:35	489.058	0.02	0.61	0.63	0.074		308.107	36.190					308.107	36.190		
AW504508	CO	7/09/1994 8:25	659.269	0.03	0.49	0.52	0.072		342.820	47.467					342.820	47.467		
AW504508	CO	14/09/1994 8:30	887.304	0.04	0.45	0.49	0.068		434.779	60.337					434.779	60.337		
AW504508	CO	21/09/1994 8:50	910.325	0.03	0.53	0.56	0.076		509.782	69.185					509.782	69.185		
AW504508	CO	28/09/1994 8:56	1055.190	0.05	0.55	0.6	0.08		633.114	84.415					633.114	84.415		
AW504508	CO	5/10/1994 10:10	913.992	0.1	0.62	0.72	0.109		658.074	99.625					658.074	99.625		
AW504508	CO	12/10/1994 9:45	918.242	0.11	0.73	0.84	0.101		771.323	92.742					771.323	92.742		
AW504508	CO	19/10/1994 8:20	1072.401	0.05	0.62	0.67	0.075		718.509	80.430					718.509	80.430		
AW504508	MD	26/10/1994 7:45	1082.207	0.03	0.55	0.58	0.087		627.680	94.152					627.680	94.152		
AW504508	CO	2/11/1994 9:10	1060.817	0.04	0.65	0.69	0.083		731.964	88.048					731.964	88.048		
AW504508	CO	9/11/1994 7:10	1041.926	0.05	0.59	0.64	0.091		666.833	94.815					666.833	94.815		
AW504508	CO	16/11/1994 7:15	1006.634	0.01	0.75	0.76	0.121		765.042	121.803					765.042	121.803		

STATION	COLI	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg	Gum_Weir Overflow ML	Gum_Weir Overflow Total ML	TN corrected kg	TP corrected kg	TN Annual corrected	TP Annual corrected
AW504508	CO	23/11/1994 8:20	988.531	0.02	0.74	0.76	0.092		751.283	90.945					751.283	90.945		
AW504508	CO	30/11/1994 7:30	576.675	0.11	0.7	0.81	0.114		467.107	65.741					467.107	65.741		
AW504508	CO	7/12/1994 7:30	749.776	0.02	0.62	0.64	0.113		479.856	84.725					479.856	84.725		
AW504508	CO	14/12/1994 7:15	524.362	0.04	0.68	0.72	0.124		377.541	65.021					377.541	65.021		
AW504508	CO	21/12/1994 7:25	464.297	0.07	0.69	0.76	0.108	24284	352.866	50.144				32664	352.866	50.144		
AW504508	**CO**	**28/12/1994 12:00**	**466.891**	**0.05**	**0.5**	**0.55**	**0.108**	**24402**	**256.790**	**50.424**	**17573**	**2789**		**8261**	**256.790**	**50.424**	**22429**	**3256**
AW504508	**CO**	**4/01/1995 12:25**	**455.889**	**0.05**	**0.54**	**0.59**	**0.104**		**268.975**	**47.412**					**268.975**	**47.412**		
AW504508	CO	11/01/1995 14:15	559.817	0.05	0.55	0.6	0.088		335.890	49.264					335.890	49.264		
AW504508	CO	18/01/1995 7:05	584.385	0.07	0.66	0.73	0.073		426.601	42.660					426.601	42.660		
AW504508	CO	25/01/1995 7:04	900.805	0.05	0.53	0.58	0.074		522.467	66.660					522.467	66.660		
AW504508	CO	1/02/1995 7:00	955.198	0.06	0.74	0.8	0.074		764.158	70.685					764.158	70.685		
AW504508	CO	8/02/1995 7:05	1369.446	0.04	0.54	0.58	0.069		794.279	94.492					794.279	94.492		
AW504508	CO	15/02/1995 7:10	1618.611	0.04	0.44	0.48	0.076		776.933	123.014					776.933	123.014		
AW504508	CO	22/02/1995 7:18	1643.663	0.04	0.74	0.78	0.056		1282.057	92.045					1282.057	92.045		
AW504508	CO	1/03/1995 7:04	1623.051	0.04	0.59	0.63	0.065		1022.522	105.498					1022.522	105.498		
AW504508	CO	8/03/1995 7:05	1286.489	0.05	0.65	0.7	0.082		900.542	105.492					900.542	105.492		
AW504508	CO	15/03/1995 6:58	1215.144	0.04	0.62	0.66	0.059		801.995	71.693					801.995	71.693		
AW504508	CO	21/03/1995 6:56	822.467	0.03	0.5	0.53	0.056		435.908	46.058					435.908	46.058		
AW504508	CO	29/03/1995 8:12	1102.418	0.03	0.61	0.64	0.07		705.548	77.169					705.548	77.169		
AW504508	CO	5/04/1995 8:10	445.630	0.06	0.43	0.49	0.071		218.359	31.640					218.359	31.640		
AW504508	CO	11/04/1995 8:40	301.789	0.06	0.49	0.55	0.058		165.984	17.504					165.984	17.504		
AW504508	CO	19/04/1995 8:08	369.012	0.06	0.54	0.6	0.059		221.407	21.772					221.407	21.772		
AW504508	CO	26/04/1995 8:20	323.575	0.06	0.52	0.58	0.054		187.673	17.473					187.673	17.473		
AW504508	CO	3/05/1995 8:15	280.396	0.07	0.6	0.67	0.065		187.865	18.226					187.865	18.226		
AW504508	CO	10/05/1995 8:08	537.785	0.03	0.49	0.52	0.067		279.648	36.032					279.648	36.032		
AW504508	CO	16/05/1995 7:52	590.902	0.04	0.53	0.57	0.057		336.814	33.681					336.814	33.681		
AW504508	CO	23/05/1995 8:40	696.493	0.03	0.4	0.43	0.061		299.492	42.486					299.492	42.486		
AW504508	CO	30/05/1995 8:40	311.219	0.13	0.55	0.68	0.121		211.629	37.658					211.629	37.658		
AW504508	CO	6/06/1995 8:30	243.523	0.14	0.6	0.74	0.137		180.207	33.363					180.207	33.363		
AW504508	CO	14/06/1995 10:20	780.430	0.4	1.34	1.74	0.352		1357.948	274.711					1357.948	274.711		
AW504508	CO	21/06/1995 8:40	259.072	0.21	0.65	0.86	0.134		222.802	34.716					222.802	34.716		
AW504508	CO	28/06/1995 9:05	449.242	0.07	0.52	0.59	0.09		265.053	40.432					265.053	40.432		
AW504508	CO	5/07/1995 9:20	910.788	0.5	1.48	1.98	0.295		1803.360	268.682			11.1		1825.338	271.957		
AW504508	CO	12/07/1995 11:28	743.031	0.45	1.07	1.52	0.231		1129.408	171.640			93.4		1271.376	193.216		
AW504508	CO	19/07/1995 10:18	2313.987	0.89	2.42	3.31	0.356		7659.297	823.779			682.3		9917.710	1066.678		
AW504508	CO	26/07/1995 10:00	3109.821	0.87	2.46	3.33	0.358		10355.704	1113.316			7941.6		36801.232	3956.409		
AW504508	CO	2/08/1995 8:10	2973.381	0.68	1.96	2.64	0.22		7849.726	654.144			1192.4		10997.662	916.472		
AW504508	CO	9/08/1995 10:35	1219.220	0.71	1.81	2.52	0.185		3072.434	225.556			1008.0		5612.594	412.036		
AW504508	CO	16/08/1995 10:25	517.736	0.81	1.29	2.1	0.134		1087.245	69.377					1087.245	69.377		
AW504508	CO	23/08/1995 10:50	204.086	0.6	1.06	1.66	0.124		338.782	25.307					338.782	25.307		
AW504508	CO	30/08/1995 9:25	158.228	0.11	0.92	1.03	0.107		162.975	16.930					162.975	16.930		
AW504508	CO	6/09/1995 10:25	134.483	0.08	1.04	1.12	0.119		150.621	16.004					150.621	16.004		
AW504508	CO	13/09/1995 9:30	125.284	0.11	0.76	0.87	0.083		108.997	10.399					108.997	10.399		
AW504508	CO	20/09/1995 10:25	108.099	0.09	0.71	0.8	0.066		86.479	7.135					86.479	7.135		
AW504508	CO	27/09/1995 10:55	114.267	0.09	0.74	0.83	0.085		94.842	9.713					94.842	9.713		
AW504508	CO	4/10/1995 10:05	96.965	0.1	0.84	0.94	0.071		91.147	6.884					91.147	6.884		
AW504508	CO	11/10/1995 10:05	99.862	0.16	0.78	0.94	0.081		93.871	8.089					93.871	8.089		

STATION	COLI	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg	Gum_Weir Overflow ML	Gum_Weir Overflow Total ML	TN corrected kg	TP corrected kg	TN Annual corrected	TP Annual corrected
AW504508	CO	18/10/1995 10:10	69.174	0.24	0.64	0.88	0.073		60.873	5.050					60.873	5.050		
AW504508	CO	25/10/1995 11:45	51.556	0.12	0.81	0.93	0.07		47.947	3.609					47.947	3.609		
AW504508	CO	1/11/1995 10:10	19.421	0.2	0.63	0.83	0.056		16.120	1.088			211.4		191.582	12.926		
AW504508	CO	8/11/1995 10:15	16.990	0.25	0.71	0.96	0.083		16.310	1.410			642.3		632.918	54.721		
AW504508	CO	15/11/1995 9:50	68.760	0.1	0.85	0.95	0.128		65.322	8.801			365.8		412.832	55.624		
AW504508	CO	22/11/1995 10:00	254.687	0.13	1	1.13	0.152		287.796	38.712					287.796	38.712		
AW504508	CO	29/11/1995 9:00	146.315	0.14	1.04	1.18	0.137		172.652	20.045					172.652	20.045		
AW504508	CO	6/12/1995 10:50	30.186	0.22	0.73	0.95	0.099		28.677	2.988					28.677	2.988		
AW504508	CO	13/12/1995 8:35	23.449	0.24	0.79	1.03	0.063		24.152	1.477					24.152	1.477		
AW504508	CO	20/12/1995 9:45	16.741	0.34	0.52	0.86	0.052	33046	14.397	0.871				45415	14.397	0.871		
AW504508	**CO**	**27/12/1995 11:25**	**14.100**	**0.48**	**0.65**	**1.13**	**0.064**	**33267**	**15.933**	**0.902**	**48008**	**5144**		**12148**	**15.933**	**0.902**	**83703**	**8815**
AW504508	**CO**	**3/01/1996 11:15**	**7.895**	**0.62**	**0.71**	**1.33**	**0.078**		**10.501**	**0.616**					**10.501**	**0.616**		
AW504508	CO	24/01/1996 10:25	29.703	0.46	0.24	0.7	0.022		20.792	0.653					20.792	0.653		
AW504508	CO	14/02/1996 10:35	54.210	0.12	1	1.12	0.074		60.716	4.012			112.4		186.604	12.329		
AW504508	CO	28/02/1996 10:39	39.579	0.16	0.87	1.03	0.107		40.766	4.235					40.766	4.235		
AW504508	CO	6/03/1996 11:15	11.864	0.32	0.88	1.2	0.166		14.236	1.969			142.2		184.876	25.575		
AW504508	CO	13/03/1996 13:22	13.200	0.17	2.82	2.99	0.142		39.468	1.874			68.7		244.881	11.630		
AW504508	CO	20/03/1996 13:50	11.878	0.11	0.62	0.73	0.105		8.671	1.247			99.0		80.941	11.642		
AW504508	CO	27/03/1996 15:00	155.875	0.02	1.2	1.22	0.107		190.167	16.679			513.3		816.393	71.602		
AW504508	CO	3/04/1996 16:30	24.917	0.2	1.81	2.01	0.147		50.082	3.663			298.0		649.062	47.469		
AW504508	CO	10/04/1996 14:10	35.389	0.06	0.76	0.82	0.074		29.019	2.619			667.5		576.369	52.014		
AW504508	CO	17/04/1996 10:05	38.714	0.07	0.41	0.48	0.066		18.583	2.555			723.6		365.911	50.313		
AW504508	CO	24/04/1996 11:50	38.998	0.08	0.47	0.55	0.058		21.449	2.262			780.9		450.944	47.554		
AW504508	CO	1/05/1996 15:05	39.169	0.06	0.44	0.5	0.062		19.585	2.428			806.5		422.835	52.431		
AW504508	CO	15/05/1996 13:05	690.011	0.05	1.03	1.08	0.121		745.211	83.491			645.4		1442.243	161.585		
AW504508	CO	22/05/1996 11:25	199.929	0.07	0.76	0.83	0.101		165.941	20.193					165.941	20.193		
AW504508	CO	29/05/1996 12:50	23.748	0.45	1.32	1.77	0.123		42.034	2.921					42.034	2.921		
AW504508	CO	5/06/1996 11:00	40.600	0.59	1.02	1.61	0.16		65.366	6.496					65.366	6.496		
AW504508	CO	12/06/1996 11:20	47.217	0.48	1.04	1.52	0.168		71.769	7.932					71.769	7.932		
AW504508	CO	19/06/1996 11:50	105.156	0.59	1.22	1.81	0.262		190.332	27.551					190.332	27.551		
AW504508	CO	26/06/1996 15:40	393.968	0.61	2.32	2.93	0.468		1154.327	184.377			26.5		1231.972	196.779		
AW504508	CO	3/07/1996 10:05	1193.726	0.8	2.08	2.88	0.376		3437.931	448.841			454.5		4746.891	619.733		
AW504508	CO	17/07/1996 13:45	2013.631	0.79	1.71	2.5	0.218		5034.078	438.972			39.0		5131.578	447.474		
AW504508	CO	24/07/1996 11:15	2096.284	0.6	2	2.6	0.228		5450.338	477.953			3191.2		13747.458	1205.546		
AW504508	CO	6/08/1996 10:00	1839.300	0.388	2.24	2.628	0.261		4833.680	480.057			4370.5		16319.354	1620.758		
AW504508	CO	13/08/1996 7:25	932.293	0.5	1.74	2.24	0.178		2088.336	165.948			2967.4		8735.312	694.145		
AW504508	MS	20/08/1996 7:35	676.192	0.345	1.58	1.925	0.129		1301.669	87.229			110.3		1513.996	101.457		
AW504508	CO	28/08/1996 8:05	948.966	0.272	1.99	2.262	0.199		2146.560	188.844			3580.8		10246.330	901.423		
AW504508	CO	4/09/1996 8:50	745.397	0.34	1.6	1.94	0.14		1446.070	104.356			220.1		1873.064	135.170		
AW504508	CO	11/09/1996 13:00	517.351	0.145	1.46	1.605	0.131		830.349	67.773					830.349	67.773		
AW504508	CO	18/09/1996 6:40	553.437	0.151	1.58	1.731	0.154		957.999	85.229			481.3		1791.130	159.349		
AW504508	CO	25/09/1996 7:15	550.236	0.155	1.53	1.685	0.139		927.147	76.483			45.5		1003.815	82.807		
AW504508	CO	9/10/1996 14:30	1196.700	0.314	1.81	2.124	0.182		2541.791	217.799			10998.3		25902.180	2219.490		
AW504508	CO	16/10/1996 12:00	472.231	0.424	1.41	1.834	0.189		866.072	89.252					866.072	89.252		
AW504508	CO	24/10/1996 10:40	307.029	0.119	1.48	1.599	0.127		490.939	38.993					490.939	38.993		
AW504508	CO	20/11/1996 10:45	386.900	0.092	0.77	0.862	0.073		333.508	28.244					333.508	28.244		
AW504508	CO	4/12/1996 5:20	52.6311	0.147	1.40	1.547	0.186		81.420	9.789					81.420	9.789		

STATION	COLL	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg	Gum_Weir Overflow ML	Gum_Weir Overflow Total ML	TN corrected kg	TP corrected kg	TN Annual corrected	TP Annual corrected
AW504508	CO	11/12/1996 9:00	12.0129	0.377	0.80	1.177	0.056		14.139	0.673					14.139	0.673		
AW504508	CO	18/12/1996 6:00	5.4264	0.487	0.60	1.087	0.045	16508	5.898	0.244				47852	5.898	0.244		
AW504508	**CO**	**26/12/1996 7:55**	**7.4416**	**0.310**	**0.64**	**0.95**	**0.102**	**16509**	**7.070**	**0.759**	**35754**	**3385**		**31343**	**7.070**	**0.759**	**100901**	**9235**
AW504508	**CO**	**2/01/1997 7:40**	**5.3778**	**0.291**	**0.51**	**0.801**	**0.047**		**4.308**	**0.253**					**4.308**	**0.253**		
AW504508	CO	9/01/1997 15:00	6.6027	0.127	0.88	1.007	0.109		6.649	0.720					6.649	0.720		
AW504508	CO	16/01/1997 9:42	8.8428	0.699	1.08	1.779	0.106		15.731	0.937			532.17		962.462	57.347		
AW504508	CO	23/01/1997 9:25	10.3546	0.031	0.76	0.791	0.079		8.190	0.818			747.71		599.629	59.887		
AW504508	CO	30/01/1997 14:20	6.9342	0.382	0.87	1.252	0.065		8.682	0.451			902.74		1138.912	59.129		
AW504508	CO	6/02/1997 6:10	236.0302	0.044	1.03	1.074	0.136		253.496	32.100			684.83		989.004	125.237		
AW504508	CO	12/02/1997 5:35	627.9828	0.088	1.24	1.328	0.122		833.961	76.614					833.961	76.614		
AW504508	CO	19/02/1997 5:25	822.9762	0.090	0.78	0.87	0.108		715.989	88.881					715.989	88.881		
AW504508	CO	26/02/1997 10:10	736.9976	0.152	1.06	1.212	0.141		893.241	103.917					893.241	103.917		
AW504508	CO	5/03/1997 9:50	802.6186	0.067	0.74	0.807	0.115		647.713	92.301					647.713	92.301		
AW504508	CO	12/03/1997 8:25	807.1172	0.155	0.87	1.025	0.124		827.295	100.083					827.295	100.083		
AW504508	CO	19/03/1997 16:10	467.6341	0.261	1.00	1.261	0.172		589.687	80.433					589.687	80.433		
AW504508	CO	23/03/1997 6:25	212.9863	0.339	1.05	1.389	0.185		295.838	39.402					295.838	39.402		
AW504508	CO	2/04/1997 7:20	587.3022	0.230	0.95	1.18	0.186		693.017	109.238					693.017	109.238		
AW504508	CO	8/04/1997 8:10	240.2465	0.321	1.07	1.391	0.194		334.183	46.608					334.183	46.608		
AW504508	CO	16/04/1997 10:45	48.8011	0.348	1.23	1.578	0.135		77.008	6.588					77.008	6.588		
AW504508	CO	23/04/1997 6:45	13.1590	0.334	1.06	1.394	0.095		18.344	1.250					18.344	1.250		
AW504508	CO	30/04/1997 7:05	10.4312	0.172	0.59	0.762	0.068		7.949	0.709					7.949	0.709		
AW504508	CO	6/05/1997 12:10	7.1130	0.176	0.51	0.686	0.037		4.880	0.263					4.880	0.263		
AW504508	CO	14/05/1997 8:50	9.0325	0.224	0.45	0.674	0.038		6.088	0.343					6.088	0.343		
AW504508	CO	20/05/1997 12:00	5.7372	0.228	0.46	0.688	0.051		3.947	0.293					3.947	0.293		
AW504508	CO	28/05/1997 9:30	8.0735	0.156	0.74	0.896	0.050		7.234	0.404					7.234	0.404		
AW504508	CO	1/07/1997 9:15	44.5230	0.148	0.55	0.698	0.036		31.077	1.603			103.1		103.041	5.314		
AW504508	CO	8/07/1997 8:40	10.5441	0.114	0.8	0.914	0.038		9.637	0.401			211.66		203.095	8.444		
AW504508	CO	15/07/1997 11:30	10.1229	0.102	0.71	0.812	0.039		8.220	0.395			193.58		165.407	7.944		
AW504508	CO	22/07/1997 8:30	9.8608	0.132	0.54	0.672	0.039		6.626	0.385			250.18		174.747	10.142		
AW504508	CO	30/07/1997 9:05	11.7238	0.169	0.38	0.549	0.035		6.436	0.410			294.9		168.336	10.732		
AW504508	CO	6/08/1997 14:00	10.5768	0.14	0.34	0.48	0.032		5.077	0.338			340.81		168.666	11.244		
AW504508	CO	12/08/1997 12:00	1101.3820	0.596	1.75	2.346	0.459		2583.842	505.534			114.15		2851.638	557.929		
AW504508	CO	20/08/1997 10:10	810.7822	0.409	1.36	1.769	0.275		1434.274	222.965					1434.274	222.965		
AW504508	CO	27/08/1997 9:15	635.0099	0.06	0.7	0.76	0.129		482.608	81.916					482.608	81.916		
AW504508	CO	3/09/1997 8:50	926.0767	0.239	1.38	1.619	0.237		1499.318	219.480			104.84		1669.054	244.327		
AW504508	CO	10/09/1997 9:30	1278.7540	0.294	1.4	1.694	0.2		2166.209	255.751			82.19		2305.439	272.189		
AW504508	CO	17/09/1997 13:15	621.4779	0.215	1.13	1.345	0.153		835.888	95.086					835.888	95.086		
AW504508	CO	24/09/1997 8:25	523.8326	0.077	0.94	1.017	0.134		532.738	70.194					532.738	70.194		
AW504508	CO	1/10/1997 10:10	478.6719	0.043	0.85	0.893	0.106		427.454	50.739					427.454	50.739		
AW504508	CO	8/10/1997 9:35	655.0706	0.034	0.64	0.674	0.101		441.518	66.162					441.518	66.162		
AW504508	CO	15/10/1997 9:10	861.6496	0.034	0.8	0.834	0.146		718.616	125.801					718.616	125.801		
AW504508	CO	22/10/1997 9:30	776.5046	0.049	0.83	0.879	0.145		682.548	112.593					682.548	112.593		
AW504508	CO	29/10/1997 8:05	697.8416	0.059	0.75	0.809	0.154		564.554	107.468					564.554	107.468		
AW504508	CO	5/11/1997 9:00	927.1076	0.311	1.18	1.491	0.255		1382.317	236.412			346.68		1899.217	324.816		
AW504508	CO	12/11/1997 7:00	840.4606	0.069	0.66	0.729	0.14		612.696	117.664					612.696	117.664		
AW504508	CO	19/11/1997 11:10	1059.1930	0.068	0.84	0.908	0.116		961.747	122.866					961.747	122.866		
AW504508	CO	26/11/1997 4:45	980.465	0.069	0.82	0.889	0.132		871.633	129.421					871.633	129.421		

STATION	COLI	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg	Gum_Weir Overflow ML	Gum_Weir Overflow Total ML	TN corrected kg	TP corrected kg	TN Annual corrected	TP Annual corrected
AW504508	CO	4/12/1997 16:34	1199.319	0.099	1.01	1.109	0.137		1330.045	164.307					1330.045	164.307		
AW504508	CO	10/12/1997 5:50	482.666	0.174	0.69	0.864	0.133		417.024	64.195					417.024	64.195		
AW504508	CO	17/12/1997 5:35	428.100	0.156	0.66	0.816	0.14		349.330	59.934					349.330	59.934		
AW504508	CO	24/12/1997 10:30	433.355	0.094	0.75	0.844	0.115	21517	365.751	49.836				26431	365.751	49.836		
AW504508	**CO**	**31/12/1997 9:35**	**23.898**	**0.326**	**1.47**	**1.796**	**0.115**	**21521**	**42.920**	**2.748**	**25024**	**3647**		**4910**	**42.920**	**2.748**	**30437**	**4147**
AW504508	**CO**	**7/01/1998 13:50**	**5.617**	**0.455**	**0.43**	**0.885**	**0.074**		**4.971**	**0.416**					**4.971**	**0.416**		
AW504508	CO	14/01/1998 11:10	4.986	0.65	0.44	1.09	0.073		5.435	0.364					5.435	0.364		
AW504508	CO	21/01/1998 10:00	4.800	0.52	0.92	1.44	0.082		6.913	0.394					6.913	0.394		
AW504508	CO	28/01/1998 8:40	5.968	0.234	0.97	1.204	0.107		7.185	0.639					7.185	0.639		
AW504508	CO	4/02/1998 8:30	9.019	0.164	0.94	1.104	0.113		9.957	1.019			114.8		136.697	13.992		
AW504508	CO	11/02/1998 11:45	216.508	0.058	0.8	0.858	0.12		185.764	25.981			382.8		514.206	71.917		
AW504508	CO	18/02/1998 7:10	488.013	0.084	0.64	0.724	0.118		353.322	57.586					353.322	57.586		
AW504508	CO	25/02/1998 4:35	392.697	0.094	0.95	1.044	0.195		409.975	76.576					409.975	76.576		
AW504508	CO	4/03/1998 9:45	369.600	0.218	1.18	1.398	0.213		516.701	78.725					516.701	78.725		
AW504508	CO	11/03/1998 15:15	15.717	0.22	1.88	2.1	0.167		33.006	2.625					33.006	2.625		
AW504508	CO	25/03/1998 9:45	16.962	0.181	0.68	0.861	0.077		14.604	1.306					14.604	1.306		
AW504508	CO	1/04/1998 9:45	7.367	0.214	0.69	0.904	0.065		6.659	0.479					6.659	0.479		
AW504508	CO	8/04/1998 9:30	6.159	0.186	0.98	1.166	0.074		7.181	0.456					7.181	0.456		
AW504508	CO	15/04/1998 13:15	5.833	0.202	0.74	0.942	0.064		5.495	0.373					5.495	0.373		
AW504508	CO	16/04/1998 6:50	0.594	0.22	0.7	0.92	0.091		0.546	0.054					0.546	0.054		
AW504508	CO	22/04/1998 10:15	5.504	0.193	0.64	0.833	0.06		4.585	0.330					4.585	0.330		
AW504508	CO	29/04/1998 13:55	7.831	0.146	0.59	0.736	0.054		5.764	0.423					5.764	0.423		
AW504508	CO	6/05/1998 13:10	7.160	0.151	0.6	0.751	0.051		5.377	0.365					5.377	0.365		
AW504508	CO	13/05/1998 13:10	8.393	0.155	0.71	0.865	0.041		7.260	0.344					7.260	0.344		
AW504508	CO	20/05/1998 13:30	9.263	0.191	0.6	0.791	0.05		7.327	0.463					7.327	0.463		
AW504508	CO	27/05/1998 12:55	6.706	0.304	0.4	0.704	0.062		4.721	0.416					4.721	0.416		
AW504508	CO	3/06/1998 15:15	8.909	0.273	0.64	0.913	0.047		8.134	0.419					8.134	0.419		
AW504508	CO	10/06/1998 11:20	10.413	0.238	0.43	0.668	0.056		6.956	0.583			225.5		157.590	13.211		
AW504508	CO	17/06/1998 9:20	236.344	0.167	1.07	1.237	0.25		292.357	59.086			107.1		424.840	85.861		
AW504508	CO	24/06/1998 12:05	58.425	0.163	1.2	1.363	0.182		79.633	10.633					79.633	10.633		
AW504508	CO	1/07/1998 8:20	60.219	0.164	0.91	1.074	0.132		64.675	7.949					64.675	7.949		
AW504508	CO	8/07/1998 14:20	109.510	0.255	1.33	1.585	0.243		173.573	26.611					173.573	26.611		
AW504508	CO	15/07/1998 12:55	139.428	0.464	1.24	1.704	0.262		237.585	36.530					237.585	36.530		
AW504508	CO	22/07/1998 12:05	46.295	0.211	0.8	1.011	0.121		46.804	5.602					46.804	5.602		
AW504508	CO	29/07/1998 16:05	725.330	0.564	1.64	2.204	0.411		1598.628	298.111			1633.9		5199.743	969.644		
AW504508	CO	5/08/1998 12:55	754.852	0.947	1.5	2.447	0.23		1847.122	173.616					1847.122	173.616		
AW504508	CO	12/08/1998 13:25	227.177	0.835	1.23	2.065	0.168		469.120	38.166					469.120	38.166		
AW504508	CO	19/08/1998 12:10	158.318	0.277	1.06	1.337	0.126		211.671	19.948					211.671	19.948		
AW504508	CO	26/08/1998 10:45	528.591	0.2	1.26	1.46	0.142		771.743	75.060					771.743	75.060		
AW504508	CO	2/09/1998 11:15	244.600	0.222	1.33	1.552	0.137		379.619	33.510					379.619	33.510		
AW504508	CO	8/09/1998 9:35	264.522	0.057	1.02	1.077	0.116		284.891	30.685					284.891	30.685		
AW504508	CO	16/09/1998 11:35	585.535	0.037	0.76	0.797	0.126		466.671	73.777					466.671	73.777		
AW504508	CO	17/09/1998 13:54	147.230	0.04	0.8	0.84	0.14		123.673	20.612					123.673	20.612		
AW504508	CO	23/09/1998 6:40	753.830	0.06	0.82	0.88	0.16		663.370	120.613					663.370	120.613		
AW504508	CO	30/09/1998 12:50	1302.436	0.153	1.15	1.303	0.204		1697.074	265.697					1697.074	265.697		
AW504508	CO	4/11/1998 12:30	4622.676	0.179	1.04	1.219	0.35		5635.042	1617.937			63.6		5712.570	1640.197		
AW504508	CO	11/11/1998 11:10	735.690	0.154	1.23	1.384	0.381		1018.195	280.298					1018.195	280.298		

STATION	COLI	ExcelDateTime Oracle Format	Volume since last Sample MegaLitres	Nox mg/L	TKN mg/L	Tot N mg/L	Tot P mg/L	Total Annual Flow ML	TN Load kg	TP Load kg	TN Annual Load kg	TP Annual Load kg	Gum_Weir Overflow ML	Gum_Weir Overflow Total ML	TN corrected kg	TP corrected kg	TN Annual corrected	TP Annual corrected
AW504508	CO	18/11/1998 12:10	839.621	0.119	1.09	1.209	0.328		1015.102	275.396					1015.102	275.396		
AW504508	CO	25/11/1998 12:00	798.300	0.091	1.1	1.191	0.312		950.775	249.070					950.775	249.070		
AW504508	CO	2/12/1998 12:55	747.107	0.089	1.16	1.249	0.308		933.136	230.109					933.136	230.109		
AW504508	CO	9/12/1998 12:40	773.856	0.076	1.28	1.356	0.298		1049.349	230.609					1049.349	230.609		
AW504508	CO	16/12/1998 12:05	638.447	0.083	1.17	1.253	0.292		799.974	186.427					799.974	186.427		
AW504508	CO	23/12/1998 9:45	672.366	0.163	1	1.163	0.264	18546	781.962	177.505				20940	781.962	177.505		
AW504508	**CO**	**30/12/1998 12:45**	**627.086**	**0.076**	**0.95**	**1.026**	**0.205**	**18412**	**643.390**	**128.553**	**23853**	**4922**		**2528**	**643.390**	**128.553**	**28270**	**5715**
AW504508	**CO**	**6/01/1999 11:20**	**771.000**	**0.057**	**1.09**	**1.147**	**0.189**		**884.337**	**145.719**					**884.337**	**145.719**		
AW504508	CO	13/01/1999 11:55	468.000	0.115	1.02	1.135	0.234		531.180	109.512					531.180	109.512		
AW504508	CO	20/01/1999 12:05	423.000	0.085	0.85	0.935	0.164		395.505	69.372					395.505	69.372		
AW504508	CO	27/01/1999 12:00	399.000	0.075	0.89	0.965	0.152		385.035	60.648					385.035	60.648		
AW504508	CO	3/02/1999 13:20	546.000	0.079	0.94	1.019	0.17		556.374	92.820					556.374	92.820		
AW504508	CO	10/02/1999 10:15	759.203	0.115	0.9	1.015	0.17		770.591	129.064					770.591	129.064		
AW504508	CO	17/02/1999 11:25	789.560	0.131	0.94	1.071	0.157		845.618	123.961					845.618	123.961		
AW504508	CO	24/02/1999 10:45	785.424	0.108	0.87	0.978	0.153		768.144	120.170					768.144	120.170		
AW504508	CO	3/03/1999 13:10	836.914	0.096	0.89	0.986	0.161		825.197	134.743					825.197	134.743		
AW504508	CO	10/03/1999 14:00	913.230	0.109	0.92	1.029	0.2		939.714	182.646					939.714	182.646		
AW504508	CO	17/03/1999 11:40	836.990	0.102	0.97	1.072	0.173		897.253	144.799					897.253	144.799		
AW504508	CO	24/03/1999 11:50	980.991	0.138	0.76	0.898	0.145		880.930	142.244					880.930	142.244		
AW504508	CO	31/03/1999 11:10	683.425	0.117	0.81	0.927	0.16		633.535	109.348					633.535	109.348		
AW504508	CO	7/04/1999 14:50	434.990	0.096	0.81	0.906	0.159		394.100	69.163					394.100	69.163		
AW504508	CO	14/04/1999 12:20	298.226	0.09	0.78	0.87	0.138		259.457	41.155					259.457	41.155		
AW504508	CO	21/04/1999 13:05	245.236	0.107	1.01	1.117	0.129		273.929	31.635					273.929	31.635		
AW504508	CO	28/04/1999 10:55	332.354	0.05	0.77	0.82	0.148		272.531	49.188					272.531	49.188		
Max				1.69	3.01	3.35	1.03											
Min				0.01	0.24	0.43	0.02											
Mean				0.20542	0.92543	1.13085	0.13966											
Median				0.14	0.81	0.978	0.12											
SD				0.21219	0.43797	0.56887	0.09969											

APPENDIX 6

Worksheets for estimation of Pumping Losses in the River Torrens

Torrens River Pumped and Gauged Flows

All volumes in ML

Month	Pumped Volume		Millbrook Intake gauged		Gumeracha Weir gauged		Total water into Gum_Weir	Possible Pumped Loss	Flow in adjacent catchments
	monthly	annual	monthly	annual	monthly	annual			
Jan-93	2200		1606.0		0.0		1606.0	**27.0**	1
Feb-93	2929		2364.0		0.0		2364.0	**19.3**	1
Mar-93	137		188.7		0.0		188.7		1
Apr-93	58		55.6		0.0		55.6	**4.2**	0
May-93	0		138.2		0.0		138.2		1
Jun-93	0		65.5		166.9		232.4		1
Jul-93	0		523.5		639.7		1163.2		1
Aug-93	1265		776.7		0.0		776.7	**38.6**	1
Sep-93	2620		1466.0		0.0		1466.0	**44.0**	1
Oct-93	3475		2003.0		0.0		2003.0	**42.4**	1
Nov-93	4350		3280.0		0.0		3280.0	**24.6**	1
Dec-93	3474	**20508**	**3484.0**	**15951**	**0.0**	**806.6**	3484.0		**0**
Jan-94	2083		1774.0		0.0		1774.0	**14.8**	1
Feb-94	2868		848.7		2607.0		3455.7		0
Mar-94	2577		1255.0		2585.0		3840.0		0
Apr-94	2382		1080.0		2550.0		3630.0		0
May-94	1964		2256.0		0.0		2256.0		0
Jun-94	407		1032.0		0.0		1032.0		1
Jul-94	0		167.8		0.0		167.8		1
Aug-94	1234		1304.0		523.1		1827.1		1
Sep-94	2718		3872.0		0.0		3872.0		1
Oct-94	2651		4432.0		0.0		4432.0		1
Nov-94	2540		3901.0		0.0		3901.0		1
Dec-94	1471	**22895**	2357.0	**24280**	**0.0**	**8265.1**	**2357**		**1**
Jan-95	2277		3190.0		0.0		3190.0		0
Feb-95	6187		6225.0		0.0		6225.0		0
Mar-95	4794		4676.0		0.0		4676.0	**2.5**	0
Apr-95	1752		1427.0		0.0		1427.0	**18.6**	0
May-95	2011		2255.0		0.0		2255.0		1
Jun-95	776		1945.0		0.0		1945.0		1
Jul-95	858		9186.0		9894.0		19080.0		1
Aug-95	0		2770.0		1026.0		3796.0		1
Sep-95	0		502.9		0.0		502.9		1
Oct-95	0		287.8		167.3		455.1		1
Nov-95	0		497.6		1052.0		1549.6		1
Dec-95	0	**18655**	**79.5**	**33042**	**0.0**	**12139.3**	**79.53**		**0**
Jan-96	0		43.0		0.0		43.0		0
Feb-96	232		86.0		112.4		198.4	**14.5**	0
Mar-96	327		205.0		874.9		1079.9		0
Apr-96	2161		159.0		3153.0		3312.0		0
May-96	1168		924.0		715.8		1639.8		0
Jun-96	0		1621.0		481.0		2102.0		0
Jul-96	0		5031.0		3393.0		8424.0		1
Aug-96	0		4053.0		11084.0		15137.0		1
Sep-96	0		2382.0		8571.0		10953.0		1
Oct-96	0		1698.0		2953.0		4651.0		1
Nov-96	0		268.0		0.0		268.0		0
Dec-96	170	**4058**	**37.0**	**16507**	**0.0**	**31338.1**	**37**	**78.2**	**0**
Jan-97	2019		35.0		2373.0		2408.0		0
Feb-97	3402		2716.0		494.3		3210.3	**5.6**	0
Mar-97	2821		2507.0		0.0		2507.0	**11.1**	0
Apr-97	755		390.0		0.0		390.0	**48.3**	0
May-97	500		33.0		0.0		33.0	**93.4**	1
Jun-97	0		40.0		95.4		135.4		1
Jul-97	2759		45.0		1019.0		1064.0	**61.4**	1
Aug-97	3971		3040.0		393.1		3433.1	**13.5**	1
Sep-97	4325		3317.0		186.8		3503.8	**19.0**	1
Oct-97	4110		3342.0		312.5		3654.5	**11.1**	1
Nov-97	4022		4128.0		35.0		4163.0		1
Dec-97	1770	**30454**	**1924.0**	**21517**	**0.0**	**4909.1**	**1924**		**1**
Jan-98	1130		24.0		0.0		24.0	**97.9**	0
Feb-98	2090		1320.0		497.6		1817.6	**13.0**	0
Mar-98	140		193.0		0.0		193.0		0
Apr-98	0		28.0		0.0		28.0		1
May-98	140		35.0		0.0		35.0	**75.0**	1

Month	Pumped Volume		Millbrook Intake gauged		Gumeracha Weir gauged		Total water into Gum_Weir	Possible Pumped Loss	Flow in adjacent catchments
	monthly	annual	monthly	annual	monthly	annual			
Jun-98	871		366.0		331.1		697.1	**20.0**	1
Jul-98	768		1385.0		1633.0		3018.0		1
Aug-98	1521		1530.0		0.0		1530.0		1
Sep-98	5229		3133.0		0.0		3133.0	**40.1**	1
Oct-98	6670		4243.0		63.6		4306.6	**35.4**	1
Nov-98	6502		3270.0		0.0		3270.0	**49.7**	1
Dec-98	4110	**29171**	**3019.0**	**18546**	**0.0**	**2525.3**	**3019**	**26.5**	**0**

APPENDIX 7

Percentage landuses in each of the monitored catchments as derived from the landuse data.

Percentage landuses in each of the monitored catchments

LU Code	Landuse	Aldgate %	Cox %	Echunga %	First %	Kersbrook %	Lenswood %	Scott %	Sixth %	GS504518 %	GS504549 %	GS504576 %	GS504580 %	GS504581 %	GS504582 %	GS504583 %	GS504901 %
100000	Urban - Adelaide Hills	60.56	9.49	1.45	2.22	1.52	0.15	0.26	0.78	6.76	17.85	20.49	6.61	0	0	3.3	7.69
100099	Urban - Adelaide Plains	0	0	0	0	0	0	0	0	0	21.61	0.91	27.2	61.54	67.5	43.99	3.88
111200	Rural Residential Accomadation	11.33	6.28	11.97	4.01	4.47	0.82	5.82	1.48	25.6	9.58	14.73	23.54	0	0	13.4	39.01
200000	Manufacturing	0	0	0	0	0	0	0	0.01	0	2.25	0.49	0.82	8.96	15.1	2.84	0.34
300000	Commerce	0	0	0	0	0	0	0	0	0	0	1.31	0.17	0.79	10.57	16.07	3.69	0
440000	Government Admin & Defence Services	0	0	0	0	0	0	0	0	0	0.79	0.51	1.62	1	0	2.46	1.41
451000	Education	3.99	0.63	0.91	0	0.04	0.04	0.12	0.03	0.19	2.48	2.46	4.73	9.57	0	3.17	0.06
460000	Cultural & Recreation Services	6.25	1.1	0.08	2.85	0	0.08	0.32	0.09	0.02	0.15	0.24	0	0	0	0	0
481400	Cemetery / Crematorium	0	0	0	0	0	0	0	0	0	0.39	0.07	0	0	0	0.43	0
510000	Livestock	8.55	20.27	35.22	1.25	37.75	24.67	35.1	24.59	20.61	13.58	21.05	5.46	0	0	2.76	9.34
512300	Dairy Cattle	0	0	11.48	0	4.15	2.33	3.18	0.48	1.22	0.21	0.32	0	0	0	0	0
513000	Horses	0	0.63	8.35	0	5.32	0.82	2.71	0.55	0.3	0.36	0.55	0	0	0	0	0
520000	Field Crops	0	0	0	0	0	0	0	0	1.26	0.22	0.34	3.39	0	0	1.85	0
520022	Field Crops - Irrigated	0	6.16	4.22	0	0	0.64	0	1.41	0	0	0	0	0	0	0	0
520025	Field Crops - Temporal	0	1.45	1.23	0	0	0	0	0.42	0	0	0	0	0	0	0	0
530000	Horticulture - Trees	0	6.25	0.02	0	3.95	44.38	1.95	13.58	2.59	0.85	1.32	0.1	0	0	0.05	0.17
541300	Vegetables - Brassicas	0	0	0	0	0	0	0	0.07	0	0	0	0	0	0	0	0
541900	Vegetables - other	0	19.99	1.47	0	1.05	0.09	0.13	0.61	0.04	0.01	0.01	0	0	0	0	0
543000	Vine Fruit	0	12.56	1.34	0	0	8.69	0.51	2.45	0.88	0.15	0.23	0	0	0	0	0
552000	Forest Plantation	0.24	0	3.19	0	8.19	1.48	0.29	3.05	0.18	0.08	0.12	0.08	0	0	0.05	0.14
579000	Improved Pasture	0	0	2.24	0	2.88	0	0.34	0.04	0	0	0	0	0	0	0	0
600000	Mining or Extractive Industry	0.23	0	0	0	0	0	0.09	0.1	0.18	0.14	0.22	0.58	0	0	0.29	0.99
710000	Protected Area	0	0.34	1.27	77.87	0	0	30.74	5.31	2.98	7.92	12.28	0.35	0	0	0.18	0.61
715000	Landscape/Seascape/Cons Rec Area	0	0	0	0	0	0	0	0	0	2.16	3.35	0	0	0	0	0
719000	Protected Area NEC	7.38	14.46	14.32	11.8	30.48	15.71	18.33	44.88	32.85	7.76	12.03	12.22	0	0	6.09	20.91
730000	Outdoor Recreation Area	1.31	0.4	1.12	0	0	0.09	0.1	0.07	0.27	3.15	1.94	0.88	2.74	0.49	6.01	0.28
790000	Mainly Native veg	0	0	0	0	0	0	0	0	3.8	5.82	5.44	10.77	0	0	7.86	14.7
814100	Airport / Airstrip	0	0	0	0	0	0	0	0	0	0	0	0.28	0.6	0	0.66	0
834100	Water Storage - Reservoir, Dam etc	0.17	0	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0
835900	Sewage Facility	0	0	0	0	0.19	0	0	0	0.05	0.01	0.01	0	0	0	0	0
836100	Rubbish Dump	0	0	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0
911000	Vacant land	0	0	0	0	0	0	0	0	0.2	1.18	0.72	0.59	5.02	0.85	0.93	0.48

APPENDIX 8

GIS Model – Technical Details.

GIS Model - Technical Details

The nutrient load model was based on the Grid model of the GIS program Arcinfo (v7.2.1). The models were written in Arc Macro Language (AML). Arcinfo was run on a DEC Alpha Unix-based workstation.

All AMLS include notes describing the function of the AML and the operating requirements. Also included are comments within the code to explain the actions of each stage of the process. The reader should refer to these notes for full details on the operation of the AMLS. Brief overviews are provided below.

All GIS data was stored in the EPA standard work area format. This has workspaces and directories for coverages (also used for grids), AMLS, data files, import and export data. Other workspaces and directories are provided but were not used in this project.

The nutrient load model was developed initially as an offshoot of another project (Pollution Risk Mapping). As a consequence, all data and AMLS for this project are co-located with the data and AMLS of that project. This provided advantages in the early stages of this project, as many datasets and AMLS were common to both projects. However, in the final version of the nutrient load model, there was very little that needed to be in common. Further, some aspects of the nutrient load model could benefit from a different structure that is not reliant on data from the co-located project. It is envisaged, therefore, that the data and AMLS for the two projects will be separated and located in separate work areas at some future time.

Note also, that the Barossa region was processed after the work for the Adelaide was complete and not all functions of the model were built into the AMLS to run on the workspace for the Barossa region.

There were three main stages associated with the nutrient load model. These were (a) data preparation; (b) creation of nutrient load datasets; and (c) nutrient load reporting. Each stage is described separately below.

Data Preparation

In order to minimise the data volume of each dataset and to divide the processing time of each stage into smaller, manageable periods, the study area was divided into catchments. Each catchment was provided with a workspace named as follows: CLARENDON; GORGE_WEIR; SPARA_RESV; NTH_ADELAIDE; and PATAWALONGA (for the Adelaide region) and NTH_PARA_NPI (for the Barossa Region). In addition, other workspaces were created to hold master datasets covering all or more of the whole study area. These workspaces were named MLR (for dataset covering the whole Mount Lofty Ranges); METRO (for datasets covering the metropolitan areas); and NPI and NPI_GEO (for datasets covering the NPI reporting area).

A master coverage of sub-catchments (named SUBCATS) was created in the NPI workspace. The arcs were obtained from several sources including the catchment coverage from the EPA map libraries; a sub-catchment coverage created in the South Central project; a historical coverage of gauging station sub-catchments; and some on-screen digitising over map-library contours.

This master sub-catchment coverage was used to create polygon coverages (named CATCH) of the catchment boundary of each catchment. These were placed in the respective catchment workspaces and were used to define the boundaries of all datasets for each catchment.

The macro MAKEDEM.AML was then used to create a DEM (Digital Elevation Model) for each catchment from map-library contours. The cell size of the DEM (and all subsequent grids) was set to 25m. In the final version of the nutrient load model, the DEM was used only to set the analysis environment for the Grid module of Arcinfo. However, the DEMs were required for the co-located project.

The macro MAKESTDDATA.AML was then used to create all the required datasets in each catchment workspace from master datasets. For the nutrient load model, the only datasets required are the mask grid, landuse grid, and the sub-catchment grid, although the macro is capable of generating several other datasets required by the co-located project.

A master grid of mean annual rainfall (named RAIN_MEANANN) was also required. This was created by first creating a grid of annual rainfall for each year using all available rain gauging stations with a reasonable record. Then, the mean of all the annual rainfall grids was created. This was placed in the MLR workspace. Areas with greater than 1000 mm of rainfall were identified as having a higher nutrient generation rate for intensive vegetable production (in the Piccadilly Valley).

A comma-delimited file (NP_RATES.CSV) was created that listed landuse codes and nutrient generation rates. This was placed in the project DATAFILES directory. The data for this file was created in a spreadsheet file (NP-Generation Rates.xls) on a PC and saved as a comma delimited file and transferred to the Unix workstation. The sources for the nutrient generation rates are described in another section. The landuse codes were based on the ANZLUC system as described in another section.

Creation of Nutrient Load Datasets

Grids of total nitrogen load and of total phosphorus load were created in each catchment workspace by the macro NP.AML. NP.AML was capable of creating one grid (either total nitrogen or total phosphorus) in one catchment. The macro NP-BOTH.AML was capable of calling NP.AML twice to create grids for each of total nitrogen and total phosphorus in one catchment. NP-NPI was capable of calling NP.AML twice (to create grids for each of total nitrogen and total phosphorus) for all the catchments used for NPI reporting for 1999.

The macro NP.AML operated by reading the nutrient generation rates from the file NP_RATES.CSV for each of the landuse codes listed in the file. These values were stored as a set of variables. Then, for each cell in the landuse grid, the landuse code was determined and multiplied by the nutrient generation rate for that landuse code. This value was then multiplied by the area of the cell in hectares, and the result (in units of kg/cell/y) was placed in the corresponding cell of the output nutrient load grid.

The macro NP.AML determined the total nutrient load for the whole catchment and reported the values to screen. This was useful during the calibration phase. NP.AML also determined the area of the catchment (by counting the number of cells in the MASK grid) and used this to calculate the nutrient load per hectare per year, and reported the result to screen.

Both the macro NP.AML and the nutrient generation rates file NP_RATES.CSV had columns for several sets of nutrient generation rates. Two of these were for total nitrogen and total phosphorus. The other columns were intended for uncertainty values, minimum and maximum values that were not used in the project to date.

The macro NP.AML produced nutrient load grids for diffuse sources as given by the landuse data and the nutrient generation rates. However, NP.AML was also capable of incorporating nutrient loads from point sources. Using dairy sheds as point sources was trialed and was operational.

However, for NPI reporting for 1999, it was decided to not include this source as the management practice for disposal of dairy shed effluent was not known for each dairy enterprise. The inclusion of other point sources (e.g. septic tanks) was allowed for but not implemented.

Nutrient Load Reporting

Once the nutrient load grids had been created, two macros (NPI-REPORT.AML and EPA-REPORT.AML) were used to total the nutrient loads for each of the sub-catchments defined for this project. The extent of each sub-catchment was determined from a grid of sub-catchments (SUBCATS-G) created in each catchment workspace with the macro MAKESTDDATA.AML during the data preparation stage. The macro NPI-REPORT.AML put the results in a text file (NPI_WATER.TXT) formatted according the Environment Australia Data Transfer Protocol. The macro EPA-REPORT.AML put the results into an INFO file that was joined to the PAT of a copy of the sub-catchment coverage (SUBCATS2). This was used for map display purposes.