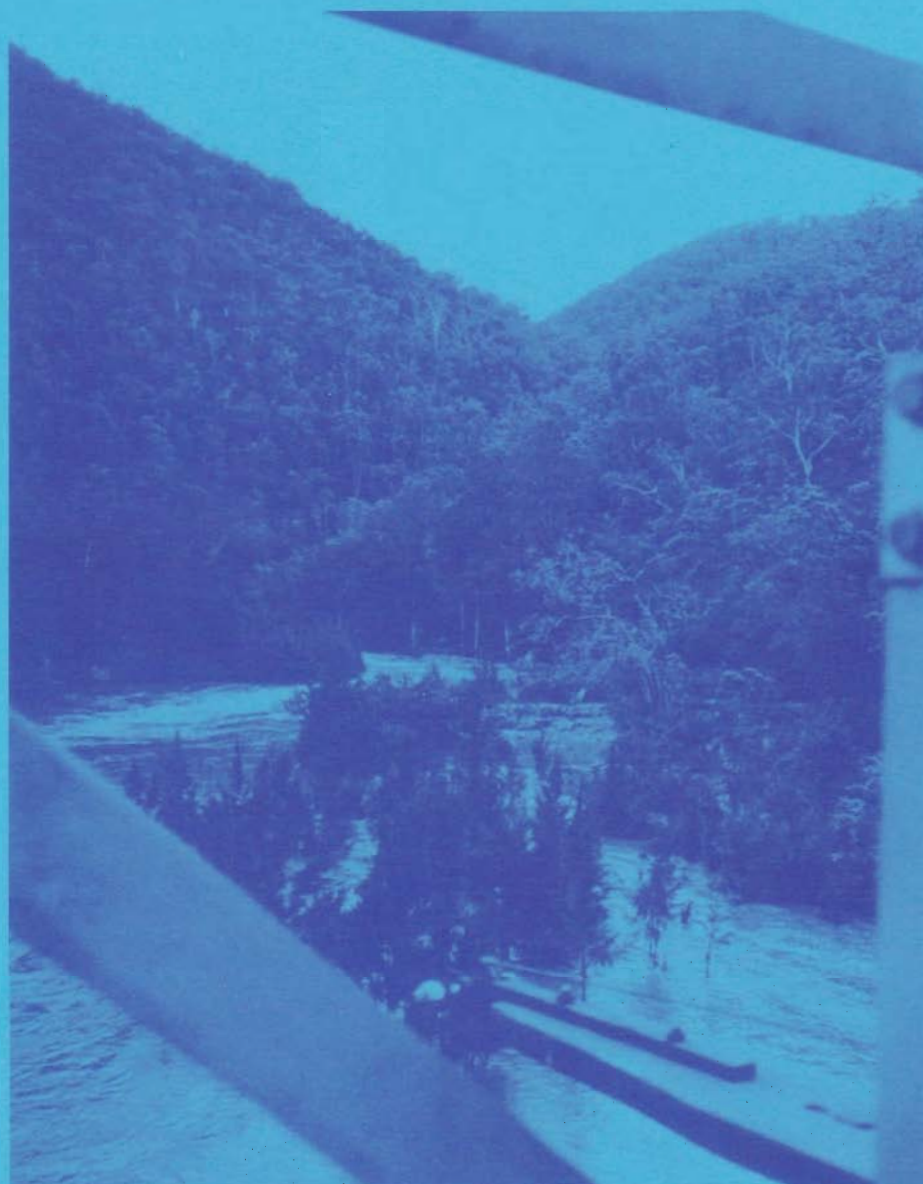


AUSTRALIAN HYDROGRAPHERS ASSOCIATION

Australian Hydrographer



Flood gauging from the cableway, Cox's River at Kelpie Point

Photo. © R. M. Clayton



November 2002
Volume 6, Number 9

EDITORIAL

Welcome to the November, 2002 edition of our quarterly Journal.

In this issue are a couple of papers from the conference. Nothing new there BUT these two papers are asking us and our fellow professionals to contribute to the ongoing development of studies and discussion of nationally relevant issues.

Tony Ladson's submission in regards to the development of an Australian Handbook of Stream Roughness Coefficients is an ideal example of how the years of data now stored away in our archives can be put to good use and further value adding of our product can be undertaken.

Most of us are aware of the decline, to various extents, in the use of the Australian River Station numbering system. Some of us are also experiencing the difficulties of exchanging data between data base systems when trying to map data into another data base that may already use your numbers. Imagine the same gauging station utilised by 2 or 3 authorities but it exists under three different station numbers (never mind the way site parameters and variables are described as well!!) Mike Matheson discusses these issues and in a way there must be some effort by us to attempt to resurrect the national numbering issue.

There has been progress on the continuing development of the new accredited training program for hydrographers. See more in Education and Training in this issue. I know of at least one organisation that is going through the development of a cadetship position at present so the availability of the completed course will be of great benefit and provide direction for the training of new hydrographers.

Mic.

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Australasian Hydrographer is the Journal of the **Australian Hydrographers' Association Incorporated**. The Journal is distributed quarterly to Members

Visit our **Web Site** at:

<http://www.austhydro.tascom.net>

to download a Membership application and to find contact details for your state representative.

Editorial and advertising enquiries should be directed to the association's **Publicity Officer**, Mic Clayton.

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This Journal is produced by the Australian Hydrographers' Association Incorporated

ISSN 0812-5090

The Web Site

The web site is in the process of being moved to a new site and details will soon be available as to it being operational in the next newsletter.

An expansion of the server storage is expected to be a benefit of this upgrade. It is expected that the new site will provide sufficient space to upload many of the papers presented at the conference and from future conferences.

The preliminary areas of the site are looking good and areas are still being populated with various information and links. Importantly there is a forum section that we hope you will use, to advance the evolution of the Association and to share professionally your hydrographic experiences with others.

Corporate Membership

Corporate Membership of AHA includes the following "benefits"

- Free full page ad in the quarterly Journal
- Free quarter page ad in the monthly newsletter (mainly due to space requirements)
- Free page and links on our web site.
- Use of our name in a manner of the form "All of our hydrographers are members of the AHA" when advertising/tendering etc.

The committee is currently looking at other aspects of improving the 'benefits' of corporate membership and this shall be publicised and discussed once the committee has discussed the merits and ramifications of a number of issues and after input from members.

HUG Gossip

In their latest newsletter Hydstra has outlined progress of the new entity and soon Time Studio and Hydsys will both be badged as

Hydstra to reflect the eventual 'one-ness' of the two softwares. All of us, in Australia at least are greatly affected by Hydstra developments so it is important that we make our views, both individually and at a corporate level known to them in regards as to what our industry requires of their products and services.

This month Hydstra held a Telemetry and Modelling Seminar in Sydney. At the Telemetry component of the seminar on the first day, Sydney Water presented information and ideas as to how its Star Trak remote data collection system was performing. Telstra presented information in regards to its involvement in the reborn Iridium satellite network and the progress it was making in regards to improving its friendliness in regards to data collection from remote hydrometric installations, but did receive some aggressive questioning from the floor in regards to the performance (or lack of!) of its CDMA network. Needless to say all were assured that the network was continually being refined and improved!

For more information on this seminar component and the modelling component head for the Hydstra web site at www.hydstra.com.au

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Contributions to the Journal and Newsletter

Member contributions to the Journal and newsletters are most welcome. You are the Association and hence it is helpful if you provide input into it.

Advertisers could also assist by providing TIF images or similar of their ads - while PDF format is handy it means cut and paste has to be done - literally!

Photographs are also welcome for the cover of the newsletter - final use of a submitted photo will depend on how well the image transposes onto the cover of the Journal, so the clearer the better.

Contribution deadlines are currently as follows:

December/January 2003	11/01/03
February (Q) 2003	07/02/03
March/April 2003	11/04/03
May (Q) 2003	09/05/03
June/July 2003	11/07/03
August (Q) 2003	08/08/03
September/October 2003	11/10/03

Tell the world how good you are by submitting your life story to '20 Questions with.....'. You won't win a million dollars answering the questions, even though they aren't that hard, but it will enable our peers, both young and old to get to know each other a bit better than we have in the past.

AHA and AWA

A trial of affiliated membership, for 2003 at this stage, with the Australian Water Association has finally been nipped out between our Association and AWA. At the time of going to press some loose ends were being tidied up but it appears that all should proceed as planned for the trial to commence at the start of 2003.

This has been mooted for some time as a way of lifting the profile of our Association and the work of its members around Australia.

The Association will be entitled to a half page of 'editorial' in the AWA Journal Water and

AHA members will be entitled to submit papers for publication in the magazine as well, subject to usual editorial scrutiny by the AWA team.

Only current financial members of AHA will receive the publication *Water*, as well as mail outs and flyers in regards to AWA activities and events.

The AHA Committee will review the trail affiliation towards the end of next year.

Wanted

Wanted to buy:

Second hand current meter and counter (mini).

Contact: Dennis Burt,
Ph: Home 0249921179
Work 0249921749
Fax 0249922007.

28th International Hydrology and Water Resources Symposium, November, 2003.

Wollongong, Australia

The organising committee of this symposium have approached our Association to have a 'presence' at this symposium. What form this will take has yet to be discussed but the Association would like to encourage members to consider attending this event, even to consider submitting a paper for presentation at the symposium. The closing date for submission of abstracts for consideration by the symposium panel is December 20, 2002.

The symposium will be covering a number of themes and more information is available from their web site at www.hwrs2003.org.au.

AN AUSTRALIAN HANDBOOK OF STREAM ROUGHNESS COEFFICIENTS: HOW HYDROGRAPHERS CAN HELP

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(Presented at the 11th Australian
Hydrographic Conference, July 2002)

Abstract

Stream roughness is a critical parameter for open channel flow calculations and has an important influence on hydrographic and engineering practice. In many cases the selection of an appropriate stream roughness coefficient, such as Manning's n , is required, but often this is not

straightforward. In other countries, particularly New Zealand and the United States, roughness coefficients have been collected for broad classes of streams, different types of vegetation and specific flow conditions. Pictorial guides or empirical equations, provide a firm basis for estimating these roughness coefficients. In some cases these guides are applicable to Australian conditions, but there are also many Australian streams that are not well covered by existing handbooks. It is also recognised that improved techniques to estimate roughness coefficients have the potential to provide benefit to those working in the area of hydraulics, including hydrographers, and to reduce costs to society.

It is now proposed to develop an Australian Handbook of Stream Roughness Coefficients. This will build on existing guides, and equations, and test their applicability through a series of case studies. Information collected by hydrographers will be a vital part of this effort. Roughness calculations can be made at any site where there are measurements of discharge, water surface slope and cross section dimensions. Any contributions of these data would be valuable and we invite hydrographers to collaborate in this project. Results from this work would also be available for use by hydrographers.

Key Words: Roughness, Australia, flow resistance, Manning's n

Introduction

Stream roughness is a critical parameter for open channel flow calculations and has an important influence on hydrographic and engineering practice including:

- Extrapolating rating curves for discharge estimation;
- Estimating stream discharge from measurements of cross sectional area and water surface slope;
- Establishing design flood levels;
- Designing stream rehabilitation works;
- Designing appropriate meander patterns and grades for restored channels; and
- Estimating stream velocity to guide the selection or revegetation works.

Generally some estimate of roughness is required for these tasks and this is usually based on handbooks and/or experience. The problem is that little guidance specific to Australian conditions exists, and in many cases suggested roughness values are inappropriate. For example roughness values from the literature are reported as being too low for use in flood studies (Cottman, 1984) while values from published guidelines were found to be much higher those determined from measurements of roughness in some urban streams (Daniell and Fitzgerald, 1983).

Inaccurate estimation of stream roughness has important economic consequences. If chosen roughness values are too high, stream velocities may be underestimated which, for example, could result in underestimation of discharge, or under design of erosion control works. Similarly, flood levels could be set too high, unnecessarily restricting development.

If roughness estimates are too low, water surface levels may be underestimated and velocities over estimated. This could result in over estimation of

discharge, under estimation of flood levels and over design and unnecessary expense associated with construction of rock chutes or other erosion control works.

Improving stream roughness estimates would increase the accuracy of discharge and velocity calculations and provide benefits to hydrographic and engineering practice and to society. These expected benefits led Land and Water Australia, the National Rivers Consortium, and the Cooperative Research Centre for Catchment Hydrology to fund the development of an Australian Handbook of Stream Roughness Coefficients. Ladson et al. (2002) provide additional information on the project.

Approach to this project

The total budget for this project is modest and it is recognised that a large, illustrated catalogue of rivers and roughness estimates is not possible using the available funds. Making a comprehensive guide would probably cost around an order of magnitude more than our budget if data had to be collected and collated specifically for the project. Instead, an approach is proposed that will build on existing guides as well as take advantage of work being done by others. It is thought that the bulk of the data required by this project is already routinely collected by hydrographers, consultants and departmental agencies, when they complete their normal activities, and we expect that additional requirements will be minor. Also there will be much existing data that simply needs to be collected and collated.

The project goals are to:

- Develop an analytical framework to guide the collection and collation of field measurements of stream roughness coefficients, and associated photographic information.
- Engage the support of State/Territory agency staff, other waterway managers and consulting company personnel with the required technical skills, to participate in collecting field data whenever conditions allow.

We plan to collate the data collected during the two year project, and prepare a web-based publication on the determination of roughness coefficients that will assist hydrographers, waterway managers, catchment groups and others in performing hydraulic calculations and

preparing river restoration and management plans.

It is proposed that the project will consist of the following steps.

1. Review the flow resistance literature particularly the theory and recent developments (much of this work is now complete).
2. Review existing guides to roughness estimation and comment on their applicability to Australian conditions.
3. Convince agencies and companies working on Australian streams to become involved in the project and to provide data for analysis.
4. Undertake some case studies of Australian streams to identify the applicability of existing guides and empirical equations.
5. Identify the types of Australian streams that are not covered by these existing guides. The project will then focus on these streams.
6. Develop a database to store information on stream roughness.
7. Develop a protocol for measuring roughness to ensure that data of a suitable standard can be incorporated into the database.
8. Collect and input existing data that meets data quality standards, into the database. For instance we plan to seek permission to incorporate data collected as part of the ACADS work of the early 1980's that includes 10 case studies and 51 photographs plus 4 other studies (Duncan et al. 1984).
9. Develop a web-based repository (including safeguards to ensure the security of existing data and the quality of added data) so that others can add data on stream roughness collected as part of their projects e.g. consultants doing flood studies and agencies undertaking stream gauging.
10. Collate the data as it comes in over the life of the project.
11. Collect and "publish" data at the end of the project. This could be web-based publishing rather than hardcopy.

Making use of existing guides

There are a large number of existing guides to stream roughness estimation and it is important that they are considered in this project and used where appropriate. The simplest of these guides (e.g. Chow, 1959) provide tabulated descriptions of stream channels, and flow conditions, with suggested roughness coefficients such as a Manning's n value.

More sophisticated guides include pictorial examples and descriptions (e.g. Barnes, 1967). Match your stream with the picture and you have an estimate of the roughness coefficient. Often these guides will only provide one roughness value and it is assumed this will be constant for a range of discharges.

In reality it is known that roughness usually varies with flow and the best guides deal with this explicitly by including roughness estimates for a range of discharges, see for example, the guide to roughness estimation in New Zealand streams by Hicks and Mason (1998). In a related project, a method is proposed to estimate changes in roughness with stage (Stewardson and Anderson, 2002).

There are also procedures that enable discharge to be calculated without reference to a flow resistance parameter, for example Dingman and Sharma (1997) provide the following empirical equation based on data from the US (Barnes 1967) and New Zealand (Hicks and Mason, 1998).

$$Q = 1.564A^{1.173} R^{0.400} S^{-0.0543 \log_{10} S} \quad (1)$$

Where Q is discharge (m^3/s), A is area (m^2), R is hydraulic radius (m), S is the water surface slope. They propose that this equation is appropriate for a wide range of channel sizes ($0.41 m^2 \leq A \leq 8520 m^2$) and slopes ($0.00001 \leq S \leq 0.0418$) where the Froude number $F > 0.2$ and $Q > 3$.

Equation 1 is similar in form to the Manning equation:

$$Q = \frac{AR^{\frac{2}{3}} S^{\frac{1}{2}}}{n} \quad (2)$$

Where, n , Manning's n , is a commonly used stream roughness parameter.

Equation 1 and 2 suggests that n can be expressed as a function of A , R and S . That is:

$$n = 0.639A^{-0.173} R^{0.267} S^{0.5+0.0543 \log_{10} S} \quad (3)$$

which may be a useful first estimate for n although many Australian streams will differ from the dataset used by Dingman and Sharma (1997): not necessarily in the values of slope and area but in the features that contribute resistance i.e. vegetation and woody debris compared to gravel bed material. We will test the applicability of the Dingman and Sharma (1997) relationship.

There are also a range of other similar relationships that are reviewed by Duncan and Smart (1999). Some of these depend on one or more of the hydraulic parameters, namely area, hydraulic radius and slope, while others include boundary resistance through some function of the bed material properties. The use of these relationships for Australian conditions will be explored further in this project.

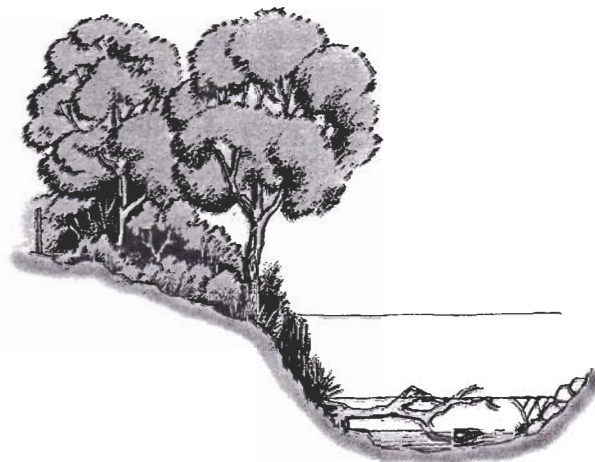
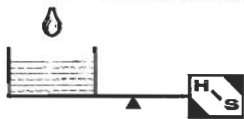


Figure 1 – Vegetation provides flow resistance in many Australian Streams (Tubman and Price, 1999)

Adopting Manning's n as a roughness parameter

Manning's n is just one approach to roughness parameterisation and is not without its detractors. Problems with the use of n have been well documented but it is widely used in Australia and is likely to remain an important part of professional practice in the future. Therefore, we proposed to base the guide to stream roughness on Manning's n for the following reasons:



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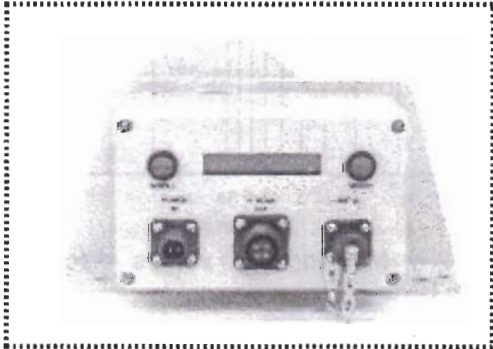
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linearity and Temperature
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- Several existing guides use Manning's n , so information from these guides can be easily compared to the outcomes of this project;
- The Manning's equation is in common usage by Australian engineers;
- Other friction factors such as Chezy (C) and Darcy-Weisbach (f) can be calculated from n with little difficulty provided the hydraulic radius is measured; and
- The variation of n with discharge can be explicitly allowed for by including, in the handbook, n values for a range of discharges.

In some cases there would be advantages to using absolute surface roughness or relative roughness as the basis for estimating Manning's n . Data collected during this project will be used to explore the economy of these alternate approaches.

Possible sources of data – the role of hydrographers

A critical requirement of this project is to obtain a wide range of data sets for Australian streams. This data will be used to test the applicability of existing guides and empirical equations and to develop case studies that we can share with others.

We anticipate that a key source of data will be information that is collected routinely by hydrographers. In particular we are interested in information from flow gauges where there are also measurements of water surface slope. We know of four sites in Victoria where slope and discharge estimates have been made routinely:

- Acheron River at Taggerty;
- Merriman's Creek at Stradbroke West;
- Tambo River at Ramrod Creek; and
- Mitta Mitta River at Hinnomunjie Bridge

At these gauges, cross sections have been surveyed at the rated sites and up and downstream, and gauge boards placed at all the cross sections. This means that water surface slope can be measured whenever water level observations or ratings are made. Water surface slope is required to back calculate reach resistance. Data from these sites has been kindly

provided by Thiess Environmental Services Pty Ltd.

This type of data is particularly useful for our project because: 1) we can test a range of empirical equations that have been suggested to explain flow resistance and identify the most appropriate for use under Australian conditions; 2) with further information (see appendix 1), or a site visit, we can isolate the effect of vegetation, large woody debris, and boundary roughness on flow resistance and through modelling, predict their importance at ungauged sites; and 3) we can include these sites as case studies on the project web site and so provide guidance for others.

We are keen to find others sites in Australia where there are similar observations and would welcome any collaborators.

Acheron River at Taggerty: A case study

We have undertaken preliminary analysis of the data from the Acheron River at Taggerty. This is a gravel bed stream in north east Victoria. Gauge heights were measured at three cross sections and these readings provides water surface slopes for 11 discharges. We have calculated the Manning's n values that correspond to these discharges as shown in Figure 2. At discharges higher than $20 \text{ m}^3/\text{s}$ there is reasonably constant n value with perhaps a slight decrease with discharge as would generally be expected and which is consistent with many streams measured by Hicks and Mason (1998). At low discharges n seems to be highly variable.

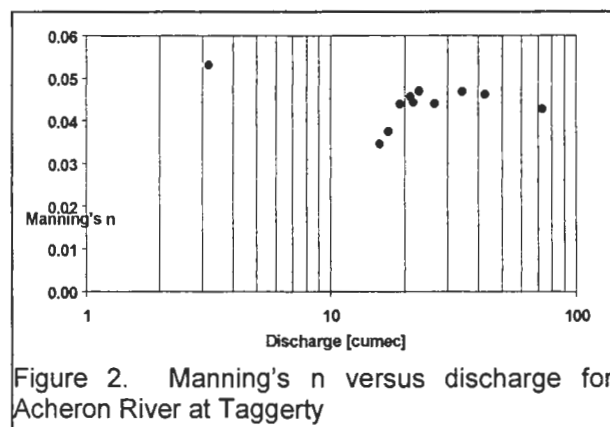


Figure 2. Manning's n versus discharge for Acheron River at Taggerty

We also calculated the n value as predicted by Dingman and Sharma (1997), equation 3 (see Figure 3). All the values lie below the 1 to 1 line suggesting that the Dingman and Sharma approach underestimates the actual Manning's n .

We have also tested other empirical approaches none of which have been found to provide good predictions but are continuing our analysis using the other sites for which we have data. If none of the existing empirical approaches prove to be useful we propose to develop new equations that describe the rivers where we have data, or at least describe the results as a series of case studies to guide others.

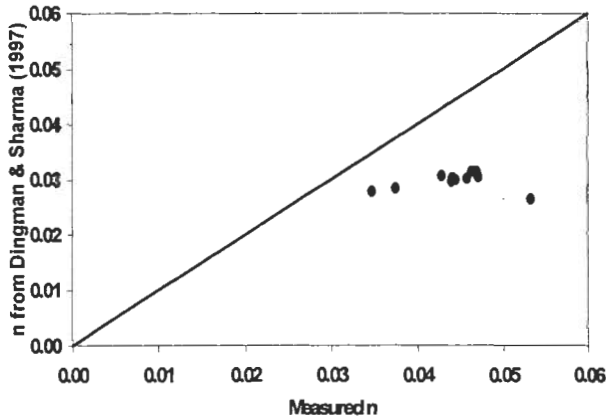


Figure 3. Measured n versus n estimated from the Dingman and Sharma (1997) equation

Other sources of data

We are also exploring other sources of data besides information from the stream gauging network.

First, there are existing datasets that have been collected to describe stream roughness characteristics of Australian streams in particular areas. This work has often been undertaken by agencies with waterway management or floodplain management responsibilities. We plan to seek permission to incorporate this data into the current project. As a minimum we will develop a web page that provides a reference list and links to existing data and guides where these are available on the internet and a good reference list for guides that aren't.

Second we would like to invite consultants and agencies to contribute information on roughness coefficients that they have established as part of hydraulic investigations such as flood studies. Although we understand that some companies may wish to guard the exact details of many projects closely, we hope they may be prepared to provide the equivalent of a 'worked example' where they have high confidence in the results. Along with the n values we would also require

supporting information such as location, discharge, information on roughness elements such as vegetation, and photographs. It is also important to have information on the computer program that was used as part of calibration since n is, to some extent, model dependent (ACADS, 1982). Where data is measured in reaches containing multiple controls, or with significant variation in local properties, the energy slope will provide an accurate measurement of the energy loss for a reach. However, there will be significant variation in the local values of roughness and so care must be taken in describing the reach so that this variation is evident to the user.

We have begun collecting information about some existing flood studies including some excellent examples from an earlier workshop on stream roughness (ACADS, 1982; Duncan et al., 1984).

A third source of flow resistance data would be from specific research studies that include measurement of flow resistance as part of the method (for example, see Gordon, 1996).

A preliminary data list

The information recorded in existing handbooks, particularly Hicks and Mason (1998), was used as a template for generating a list of data that we would like to collect about each site where there are stream roughness estimates. Some enhancements were suggested following our literature review. The desired information includes the following.

- Photographs should be taken for each measured discharge, cross referenced with the discharge magnitude and the time and date of the measurement (providing important information on season).
- An description of the bed material including size grading of gravel and sand-bed streams or a description of the bed surface for other streams.
- Quantitative data regarding the properties and distribution of riparian vegetation and LWD should be recorded. (A measurement scheme of limited complexity will be recommended).
- The complete hydraulic geometry measured for each cross-section should be provided as an appendix to the main data.

A recommended data list is present in Appendix 1, including a comparison with the information provided in existing handbooks. We acknowledge that all this information may not be available, particularly for past projects.

Conclusion

Stream roughness is an important consideration in many areas of hydrographic practice, hydraulic analysis and design, but the selection of parameters to describe flow resistance in Australia streams remains difficult. Improved techniques to estimate roughness coefficients have the potential to provide benefit to those working in the area of hydraulics, and to reduce costs to society.

A way forward is to develop an Australian Handbook of Stream Roughness Coefficients. This would build on the extensive work that has been undertaken both nationally and internationally by bringing together existing guides and empirical equations, testing their applicability in a range of conditions, and developing new approaches where necessary.

Hydrographic data will be a key part of this endeavour. Any situation where there are measurements of discharge, water surface slope and channel cross sections will allow calculation of roughness coefficients. With additional information, as listed in Appendix 1, we can undertake a complete analysis of contributions to flow resistance. We plan to use this data in a series of case studies that will inform users of the roughness of Australian streams; to identify those streams that are adequately covered by existing guides and those where additional work is required. We also hope to engage hydrographers, consultants, and researchers in collecting additional data in key areas. There are also existing data that we plan to make more accessible.

An Australian guide to stream roughness coefficients will only be successful if there is support from the industry and individuals to supply and use the information. If you would like more information, know of data that should be included in the project, or have data to contribute please visit the project web site or contact the authors. www.civag.unimelb.edu.au/~arlads/roughness.htm

Acknowledgements

This project has received assistance from George Mallory, John Fenton, Bob Keller, Rex Candy and Erwin Weinmann, which is gratefully

acknowledged. Funding is being provided by Land and Water Australia as part of the National Rivers Consortium and the Cooperative Research Centre for Catchment Hydrology. We thank Phil Price for his vision in initiating this project.

The assistance of Michael Briggs and Barbara Dworakowski from Thiess Environmental Services Pty Ltd in providing discharges, cross-sections and water surface slope data for selected Victorian streams is gratefully acknowledged.

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Tony Ladson is a project leader in the stream restoration program of the Cooperative Research Centre for Catchment Hydrology and has over 15 years experience in river management. He has worked on practical stream restoration issues with Catchment Management Authorities, water allocation to the environment, adaptive management and project evaluation. He completed a PhD in 2000 that developed, and examined, a multi-component indicator of river health. Current projects include the development of an Australian Handbook of Stream Roughness Coefficients, work on rehabilitation of urban streams and scour of stream restoration works.

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Brett Anderson received a first class honours degree in Aerospace Engineering and Business Administration from the Royal Melbourne Institute of Technology in 1996. He worked in both the automotive and aerospace industries as a practicing engineer before returning to study in the year 2000. He is currently based at the University of Melbourne and is completing a PhD in the field of Environmental Engineering with the support of the CRC for Catchment Hydrology. His research

is examining whether the condition of riparian vegetation influences catchment-scale flood characteristics.

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SHAKERS AND MOVERS

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Andrew Kaar - Sydney Water to Ecowise

Appendix 1 - Preliminary data list compared with existing products

Suggested Data	Chow (1959)	Barnes (1967)	Hicks and Mason (1998)
<i>Reach Information</i>			
Map reference			
Catchment area			
Period of record			
Mean annual flood			
Mean flow			
<i>Summary Information</i>			
Cross-sections			
Manning's n			
Channel description			
Bed surface material	Qualitative	Qualitative	
<i>Riparian Vegetation Survey</i>			
Height			
Density			
Dominant Species			
Lateral zoning (location)			
Longitudinal extent			
<i>Large Woody Debris Audit</i>			
Density			
Geometry of accumulations			
Lateral zoning			
<i>Hydraulic Record</i>			
Discharge			
Water surface slope			
Friction slope			
Area			
Net reach expansion			
Hydraulic radius			
Mean velocity			
Manning n			
Chezy C			
Error			
<i>Plots and Pictures</i>			
Grain size of bed material			
Manning n vs. Discharge			
Chezy vs. R/d ₅₀			
Plan view of reach			
Cross section plots			
Reach photographs			

Bureau of Meteorology



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- **National catalogue of rainfall station**
- **National evapotranspiration maps**

The Bureau of Meteorology's Hydrology Program would like to thank the Hydrographic and data management groups in all States and Territory water agencies for their support over the years. Data and information have been provided for many projects, including:

- **Gobal Runoff Data Centre sponsored by WMO**
- **UNESCO Asian Pacific Friend Project**
- **Stream Gauging Information, Australia**
- **Flood warning system development and operation**
- **Rainman Streamflow Project**

AUSTRALIAN RIVER STATION NUMBERING SYSTEM

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1. Introduction

The Australian Water Resources Council (AWRC) introduced the national station numbering system in the 1960s. During the 1990s and, partially as a consequence of the upheaval in the water industry caused by the COAG water reform process, adherence to the numbering system has declined. For example, stations in Division III Tasmania are now identified according to a unique local numbering system. The major agencies in the other States and Territories still use forms of the AWRC system however the practices of the smaller water agencies in these States and Territories are unknown. The changes in the water industry and the decline in the use of the numbering system have resulted in a number of problems associated with the management of the surface water network and the exchange, transfer and use of the data collected.

The purpose of this paper is to describe the AWRC numbering system, to present what is known about current practices and to raise a number of questions about the future of the numbering system. It is hoped this will prompt discussion that will result in an acceptable process for resolving the problems that have been identified.

2. AWRC Numbering System

The following description of the AWRC national numbering system is based on information included in the 6th Edition of Stream Gauging Information, Australia published in 1984 and the unofficial 7th

Edition published by the Bureau of Meteorology in 1990.

The original numbering system consisted of six digit station identifiers. For stations within drainage divisions I to IX, the first digit describes the drainage division and the second and third digits identify the river basin within the division. For stations within divisions X, XI and XII, the first two digits identify the drainage division by 00, 01 and 02 respectively, with the third digit identifying the river basin. The remaining three digits identified the station within the river basin, allowing up to 1000 stations in each basin.

Each organisation operating surface water stations was allocated a block of these numbers to be assigned as required by that organisation. The blocks were allocated in such a way as to ensure that, where multiple organisations operated in the same river basin, each surface water station would have a unique identifier. For example, the Bureau of Meteorology was allocated the block 900-999 to be used nationally, the NSW Water Resources Commission (now DLWC) was allocated the block 001-199 to be used in NSW basins and, as there was no overlap in area of responsibility, Melbourne Metropolitan Board of Works was allocated 100-199 to be used in Victoria. The most recent known description of the allocation of the blocks of numbers is contained in Table 1 of the 6th Edition of Stream Gauging Information, Australia. This has been reproduced as Table 1 in Annex 1.

Subsequent to the publication of the 6th Edition a decision was made to expand the numbering system from six digits to seven digits. While the exact details are a little hazy, the change was required to increase the number of station identifiers available per basin so that other station types such as water

quality and sediment sampling could be accommodated. The seven digit number was achieved by inserting a new digit between the 3rd and 4th digits of the existing 6 digit number. The last four digits of the seven digit number are then used by each organisation to identify the station within the river basin using the following preferred criteria:

1. The numbers 0000 to 0999 are retained for "traditional" gauging station sites.
2. The remaining numbers 1000 to 9999 can be divided into groupings to identify specialist stations including partial flow, water quality only or sediment only. Such groupings are left to each State/Territory.

The introduction of the seven digit numbering system was not mandatory and, as can be seen from an examination of the latest web version of Stream Gauging Australia (www.bom.gov.au/hydro/wr), there is a mixture of six and seven digit numbers (excluding the alpha characters added to the numerical sequence by some organisations).

Other criteria to be satisfied by both six and seven digit systems are:

1. Each site is to be identified by a unique number:
2. The numbering system is not to include meteorological stations. They are identified by a separate Bureau of Meteorology numbering system. (This criterion may not have been strictly applied.)

To be eligible for inclusion into the national gauging station numbering system, a station must meet the following criteria:

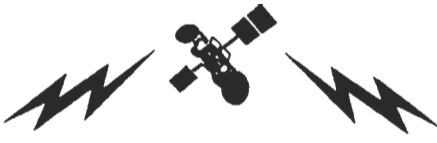
1. It must satisfy the definition of a surface water station i.e. a place on a defined watercourse, natural lake or reservoir, where data are collected on a recurring basis involving either the measurement of streamflow characteristics, streamflow quality, suspended sediment load or water quality;
2. The data are collated in a systematic manner;
3. The data are archived in a retrievable form;
4. The station is operated by a recognised gauging authority;
5. If the station is on an artificial channel;
 - The data collected provide information on surface water diverted from or returning to a natural stream channel system; or
 - The data collected provide information on surface water that is the runoff from a defined catchment area.

Additional information that may be of interest to some readers is provided in Annex 1. This information provides more detail about the allocation of the number blocks and the "rules" for changing station numbers.

3. Current status of the numbering system

The following description is based on information gained over the past two to three years during the development of the web based version of Stream Gauging Information, Australia (www.bom.gov.au/hydro/wr). It is incomplete as not all organisations operating surface water stations have been contacted or have provided station information (that is another story) however it provides a reasonable snapshot of the current situation.

Satelemetry

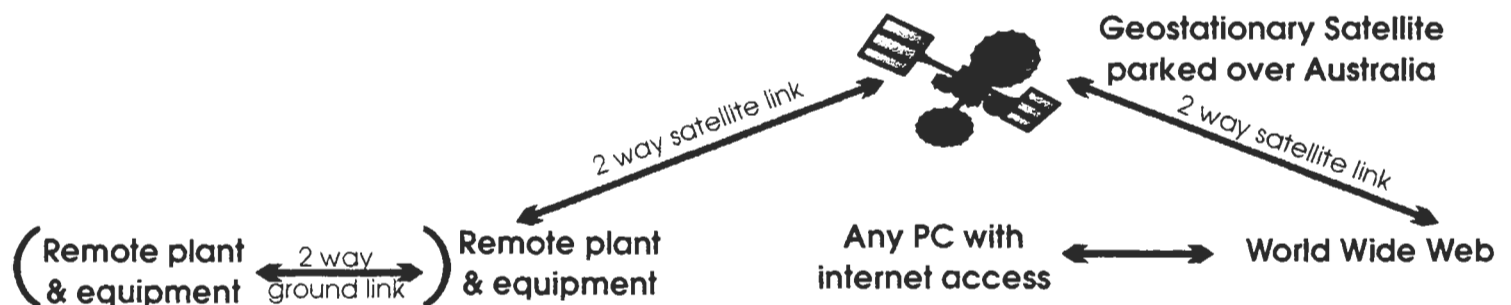


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Use of AWRC numbers

- The major water agencies in all states and territories except Tasmania are still using the numbering system, or variations of it.
- Tasmanian water agencies have adopted a unique numbering system that does not appear to have any links with the AWRC numbering system. Apparently the Tasmanian agencies are able to associate their stations with AWRC defined river basins if required.
- NSW Public Works and Services stations operated by Manly Hydraulics Laboratory appear to have alphabetic station identifiers. Where an AWRC number exists it is shown however many stations (new stations?) do not have an AWRC number assigned.
- NT Department of Infrastructure, Land, Planning and Environment appear to be the only agency widely using the 7 digit numbering sequence. NSW DLWC appear to have implemented 8 digit numbers for some stations due to a shortage of numbers in some river basins.
- Some water agencies have prefix or postfix alpha characters attached to the numeric station identifier. The prefix characters AW are used in South Australia and the character G is used in the Northern Territory. A number of agencies use postfix letters (A, B, C etc.) to identify changes in conditions (location and equipment??) at a station.

Allocation of numbers

- There does not appear to be any coordinated system of managing the allocation of numbers in any State or Territory. This is obviously not a problem where there is still only one agency operating the surface water network in the State/Territory.
- Many of the organisations that received an allocation of a block of numbers have

been broken up, absorbed or ceased to exist as a result of the water reform process. It is not known whether all the successor organisations make use of the original block of numbers.

- Where regional or river basin management authorities have been established, it is unknown whether these organisation make use of AWRC numbers or if there is any process for coordinating the allocation of station identifiers.

3. Problems

The break down of both the administration and the use of the national numbering system has already caused a number of problems and there is potential for other problems to occur over time. The problems identified so far are:

- Loss of the link between the station and the well known named and numbered river basins.
- Potential for duplicate numbers both within a basin and also between basins.
- Confusion between numbering systems resulting in data exchanged or transferred to an organisation being associated with the incorrect station. This could have serious implications in real time operations such as flood warning and reservoir operations.
- Confusion amongst data users who work with surface water data obtained from a number of different agencies. For example engineering consultants, researchers and National Land and Water Audit style of projects.
- Within some agencies using the national numbering system there is confusion about who is responsible for what. For example there have been a number of occasions where it was thought that the Bureau of Meteorology was responsible for the allocation of new station numbers.
- Confusion and discrepancies between station identifiers and digital river basin

boundaries and the process of updating one to reflect agreed changes in the other.

5. Questions

In order to address these problems a number of questions need to be raised. It is hoped that answers to these questions will help identify the best way to proceed.

- Is there value in maintaining a national numbering system? It is essential that this question be considered by all stakeholders: from managers of the networks to data users.
- If so then:
 - What other network and data management issues need to be considered in conjunction with reviewing the numbering system?
 - What form should the numbering system take?
 - How should the system be managed at the State/Territory/regional level so that there is sufficient local flexibility but national consistency is maintained?
 - What is the most effective way of managing the system at the national level?
 - What interim measures can be put in place to maintain the existing system while longer-term solutions are developed?

5. Request

That there be a concerted effort to promote discussion at all levels within the water industry about the national numbering system for surface water stations with a view to reaching consensus and developing and implementing solutions as soon as possible.

In addition, any feedback on details of current practices and procedures in individual water agencies (large and small) will be appreciated so that a more complete understanding of the current situation can be developed. Please forward any feedback to Mike Matheson at

the Bureau of Meteorology (email: m.matheson@bom.gov.au ph: 03-96694607). Information received will be collated and provided as input to any process that is established to address the national numbering system.

ANNEX 1

Below is a summary of (or excerpts taken from) a document which described the national numbering system for surface water data collecting stations as adopted by the Technical Committee on Surface Water (TCSW) of the Australian Water Resources Council in 1960.

INTRODUCTION

In the existing numbering system each station is allocated a six-digit number. For stations within divisions I to IX the first digit identifies the drainage basin and the second and third digits identify the river basin. For stations within division X, XI and XII the first two digits identify the drainage divisions by 00, 01 and 02 respectively with the third digit identifying the river basin. Blocks of numbers comprising the last three digits were allocated to each gauging organisation for the indexing of individual gauging stations.

A copy of the list of organisations that were allocated blocks of numbers is attached.

ALLOCATION OF NUMBERS

1. When the National Station Numbering System was introduced, blocks of numbers for each basin were given to various authorities for allocation to stations operated by those authorities. In some instances these authorities have used some of these numbers for allocation to stations operated by smaller authorities that did not receive an initial block of numbers. Also as a result of changes in the operating

authority for particular stations, station numbers now do not necessarily indicate which is the operating authority.

This is not considered to be a serious defect in the system. It is more important that once a station is issued with a number, that number should not be altered. The only value in reserving blocks of numbers is therefore to ensure that numbers are not duplicated. It is necessary however to review the present situation with regard to authorities, which should allocate numbers.

2. Stations must be operated by a competent authority and the decision as to which authorities are appropriate should rest with a limited number of water authorities.
3. It is therefore proposed that allocation be limited to authorities which have representation on TCSW (see attached list) and that numbers for stations operated by other authorities should be allocated by the major water authority in the appropriate state. Authorities represented on TCSW, other than the major water authorities, will retain the blocks of numbers originally allocated.

ALTERATION TO EXISTING NUMBERS

It is proposed that any changes in policy should only apply to the allocation of numbers to new stations, existing stations at present without any number or to stations which are relocated in the future.

All stations that are currently allocated a national number are to be reviewed by competent water authorities to determine if

that station meets the criteria for inclusion in the numbering system and should be retained. If that number is abandoned it should not be re-used.

In the case where stations have already been allocated more than one number, the first number allocated or the number allocated by the original operating authority should be retained. The number abandoned must not be re-used.

EXTENT OF CHANGE IN LOCATION REQUIRING A DIFFERENT NUMBER

1. The purpose of the station numbering system is to differentiate between "places" where measurements or samples are taken and ideally a new number should be allocated for each different place.
2. There are numerous instances of relocation of gauging stations or establishment of new stations close to existing or previously discontinued stations. The reasons for these changes or for new stations are various and include: changes in pool or control; bridge or other construction work; difficulties in access; location of gauge reader; etc. In many cases although significant change in the location may have occurred there is no significant change in the parameters being measured, while in other cases a very small change in location can result in very significant differences in some parameters. Therefore, although ideally it may be desirable to allocate a new number for each different place, there is only a need to allocate a new number when there is a need to differentiate.

3. Stream flow quantity, suspended sediment load and water quality are principally dependent upon the catchment upstream of the station. Flow characteristics (i.e. stage height and stream velocity) although dependent on the catchment are also dependent on the physical properties of the channel in the vicinity (both upstream and downstream) of the station itself. Changes in stream flow quantity, suspended sediment load or water quality due to a change in location of a station are therefore only significant if there is a significant change in the catchment (either in area or physical properties). Changes in stream flow characteristics although dependent upon the catchment can also result from changes in the physical properties of the channel and can therefore occur without any change in location of the station.
4. It is therefore proposed that new station numbers should only be allocated when there is either a significant distance between stations or if there is a significant change in the catchment. Changes in the physical properties of the channel in the vicinity of the station resulting from either a change in location or for any other reason are to be considered as another variable for which appropriate data must be recorded.
5. Stations are therefore only to be differentiated by allocation of different station numbers if:
- There is a significant distance between stations.
- As a guide it is suggested that the distance, which could be taken as significant, would be of the order of:
- 500 metres in mountainous country
 - 2 kilometres in undulating country
 - 5 kilometres in flat country
6. The new siting changes the location in relation to a tributary stream, an effluent, diversion or return flow, a regulating control structure, a water quality or environmental feature such as pollutant input.
7. The new siting arrangements result in significant differences in groundwater inflow or seepage losses.
8. The catchment area changes by more than 3%
6. In exceptional cases it may be desirable to allocate a different number for a station without change in location if a significant change is made to the catchment area by permanent diversion of a tributary stream. Different numbers should not be allocated as a result of changes in land use or stream regulation within a catchment.
7. As numbers are associated with a particular location if the station is taken over by a different operating authority the number of the station should not be changed. Similarly if the purpose of the station is changed the number should not be changed.

Table 1. ORGANISATIONS ALLOCATED SITE NUMBERS
(From Stream Gauging Information, Australia, Sixth edition, 1984)

	<u>Index Numbers Allocated</u>
Commonwealth	
C.S.I.R.O.	800 – 899
Bureau of Meteorology	900 – 999
Australian Capital Territory	
Dept. of Housing & Construction	700 – 799
New South Wales	
Water Resources Commission	001 – 199
Metropolitan Water, Sewerage & Drainage Board	200 – 299
University of New South Wales	300 – 349
Public Works Department	400 – 499
Snowy Mountains Hydro-Electric Authority	500 – 599
Victoria	
La Trobe Valley Water & Sewerage Board	001 – 099
Melbourne & Metropolitan Board of Works	100 – 149
Soil Conservation Authority	150 – 199
State Rivers & Water Supply Commission	200 – 399
State Electricity Commission	400 – 499
Queensland	
Queensland Water Resources Commission	001 – 599
Tasmania	
Hydro-Electric Commission	001 – 199
Rivers & Water Supply Commission	200 – 399
South Australia	
Engineering & Water Supply Department	500 – 699
Western Australia	
Public Works Department	011 – 649
Northern Territory	
Department of Transport & Works	001 – 299

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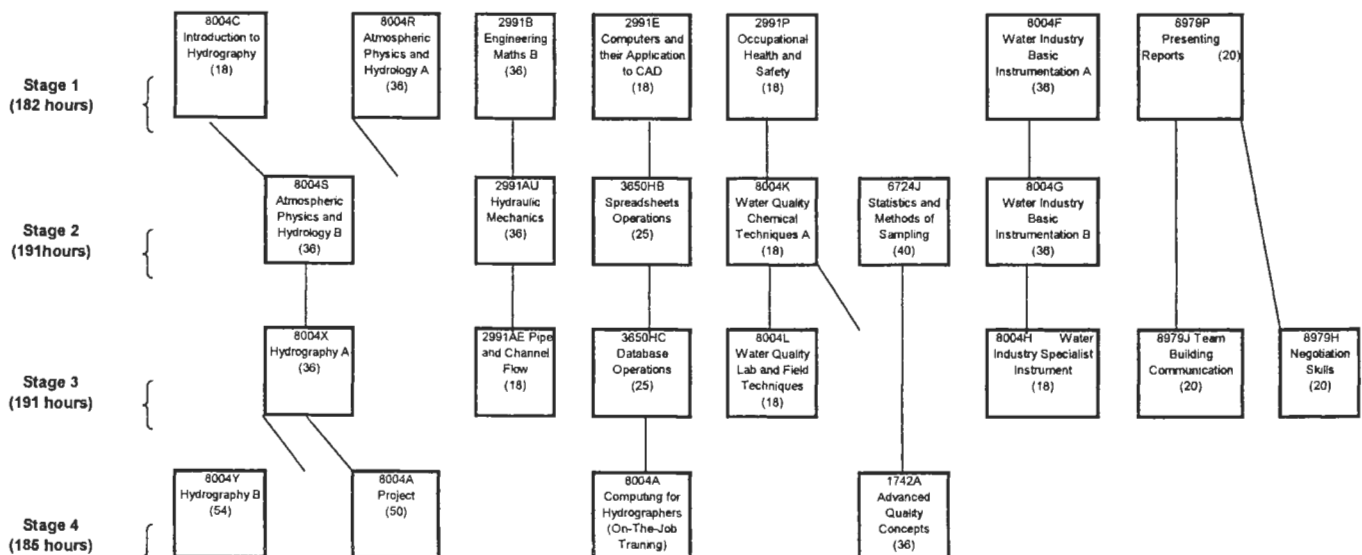
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I wish to receive my Quarterly Newsletter at my Home/Work Address.

Signed: _____

Date Received _____ **Member Number** _____