

AUSTRALIAN HYDROGRAPHERS ASSOCIATION

Australasian Hydrographer



May, 2004

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EDITORIAL

Things are proceeding full steam ahead with preparations for our Associations 12th Australian Hydrographic Conference, to be held in late July, well in hand. In this issue Ray has provided us with an outline as to the schedule (as it stands to date) as well as a HYDSTRA/Kisters agenda for the Friday.

Our cover shows some of the equipment being offered by companies such as Nortek, Sontek and RD Instruments in the ADCP arena. ADCP technology has been around for some years having developed for oceanographic and estuarine studies (large scale water movement studies) but in the late nineties has started appearing as a possible alternative gauging method, mainly in very large rivers in flood, or on streams where standard boat gauging methods might be considered unsafe. The US, where a lot of work and investigation into this newer technology has occurred to date, continually compare ADCP's against the benchmark of fixed point gauging methods (fans/cup meters) or ratings derived by these methods! Given that many of our authorities and businesses have developed business quality assurance systems based on the existing ISO standards, and ADCP methods don't currently fit currently within the standard, the issue needs serious consideration from a range of angles. The forum at the conference should be an ideal start to constructive discussion and direction on this emerging technology.

Our West Australian group have provided a couple of articles for this issue, thanks for your contribution.

A paper from Jim Tilley and friends also appears in this issue, while it deals with flashy urban streams, the

concepts could quite equally be utilised in flashy non urban streams.

To those able to make the conference, I hope to catch up with you there. A report on proceedings and the Annual General Meeting will appear in the next issue of the Journal.

Mic Clayton

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Visit our **Web Site** at: <http://www.aha.net.au> to download a Membership application and to find contact details for your state representative.

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The views expressed in this publication are those of its contributors and do not necessarily represent those of the Australian Hydrographers Association Inc or its office bearers.

NEWS

Snowy Hydro Precipitation Enhancement Research Project

What is Snowy Hydro proposing?

The proposal is to conduct a five year research project of winter cloud seeding to assess the feasibility of increasing snow precipitation in the Snowy Mountains. The method of cloud seeding to be used in the trial is silver iodide (as the seeding agent) and indium sesquioxide (as a tracer) dispensed from ground based aerosol generators. Trace chemistry and a statistical design will be used to evaluate the effectiveness of snow enhancement.

Previous detailed studies have shown that post frontal winter cloud systems passing over the Snowy Mountains have an abundance of supercooled liquid water (SLW) and water vapour suitable for the production of ice-phase precipitation (snow). When silver iodide particles seed these clouds they can nucleate new ice particle embryos, which grow naturally to form snowflakes. Hence, the objective of the cloud seeding is to create snow from post-frontal clouds that might otherwise dissipate.

The target area for the project is within the Kosciusko National Park (KNP) and includes alpine regions where snowfall precipitation is highest in winter. The target area, which excludes the Wilderness Areas, is part of the major catchment area of the Snowy Mountains Hydro-electric Scheme.

The expected average annual increase in snowpack as a result of the cloud seeding project is approximately 10%, resulting in an average annual increase in water yield of 70 GL.

(Source - Snowy Hydro Web Site)

MEMBERSHIP RENEWALS

Many are now falling due. Application for renewal form can be found towards the back of this journal as well as at our website at www.aha.net.au.

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Phone 0064 3 544 3414

AHA 12th Australian Hydrographer's Conference Gold Coast 27th - 30th July 2004

July is fast approaching which will be the time to pack up and head to the Gold Coast for the 12 Annual Hydrographers Association Conference. It is not too late to register so don't forget.

The agenda for the event is printed in this issue. We have an interesting variety of topics for the papers with something for everyone. The workshop session about ADCP's will provide a forum for discussion about this new technology. There will also be a Streampro on display for those who haven't seen the latest in low flow doppler technology.

The Hydsys Users Group meeting looks like being well attended with more participants favouring the meeting over the field trip. Maybe the appearance of representatives from Kisters AG has swayed the decision. In any case, the field trippers will spare a thought for the hard working HUGgers as they enjoy their scenic tour of our hinterland stations.

I look forward to seeing you there.

Ray Alford, Convenor

Official Agenda (as of May)

<p>Hosted by: Department Natural Resources, Mines and Energy Major Sponsors: Hydrological Services; Underwater Video Systems Venue: Tarcoola conference facility, 4th floor, ANA Hotel, Surfers Paradise</p>	<p>Steve Bird Tyco Pumped Water Quality monitoring</p>
<p>Tuesday 27th July 1230-1530 Trade delegates given access to function area to set up display booths. 1530 - 1800 Registrations 1600 - 1800 Welcome Reception 1800-1930 Australian Hydrographer's Association Annual General Meeting</p>	<p>1130-1200 Technical Paper Luke Bloedel/Aaron Corbett Dept Natural Resources, Mines & Energy Low Flow Doppler Measurement using Streampro ADCP</p> <p>1200-1230 Technical Paper Scott May Dept Natural Resources, Mines & Energy Near Real Time data capture using SMS telemetry</p> <p>1230-1245 Official Conference Photograph</p>
<p>Wednesday 28th July Session 1 - Opening and Keynote addresses 0830-0900 Registrations 0900-0930 Opening Address 0930-1000 Keynote address 1000-1030 General Address 1030-1100 Morning Tea</p> <p>Session 2 - Papers of General Interest 1100-1130 Technical Paper</p>	<p>1245-1345 Lunch</p> <p>Session 3 - Gold Sponsor Presentations 1345-1415 Technical Presentation Underwater Video Systems</p> <p>1415-1445 Technical Presentation Hydrological Services</p> <p>1445-1515 Afternoon Tea</p>

		1200-1230	Technical Paper Tony Spandler Hydro Tasmania Wind Farms
Session 4 - Workshop			
1515 - 1715	Workshop session concerning ADCP experiences	1230-1300	Technical Paper TBA
1900-2300	Conference dinner and entertainment	1300 - 1400	Lunch
Thursday 29th July		Session 6 - Papers of General Interest	
Session 5 - Papers of General Interest		1400-1430	Technical Paper Geoff Carlin CSIRO Land and Water Remote Portable Water Quality Monitoring on a budget
0900-0930	Technical Paper Charlie Thurgood Hydrological Instrumentation in Papua New Guinea 1950-2004	1430-1500	Technical Paper Scott Walker Sydney Water Sydney Water Demand Management Strategy
0930-1000	Technical Paper Anthony Polchleb Sydney Water Structural Change within the Sydney Water Board	1500-1530	Afternoon Tea
1000-1030	Technical Paper Simon Cruickshank Dept. Infrastructure Planning & Environment Bathymetric Survey using household appliances	Session 7	Final papers and close
1030 - 1100	Morning Tea	1530-1600	Technical Paper Ray Alford Dept Natural Resources, Mines & Energy Discrepancies between Observed and Recorded Water Levels at Yangtze River gauging stations.
Session 6 - Data Processing and General Interest		1600-1630	Technical Paper TBA
1100-1130	Technical Paper Michael Natschke Kisters AG Integration of WISKI as national hydrological Information System in England and Wales	1630-1700	Summary and Conclusion
1130-1200	Technical Paper Brian Chester Dept Environment WA Increasing Certainty in Discharge Calculations	Friday 30th July	
		0830	Depart Hotel Bus tour of Rocklea Centre and field sites (Details TBA)
		0900-1700 (optional)	Hydstra Users Group Meeting
			Alternate HUG / Field Trip

HUG 2004 Agenda

- 8:30** **Registration**
Tea and coffee available
- 9:00** **Workshop Introduction [10 minutes]**
Bill Steen Hydstra Pty Ltd
- 9:10** **Introduction [40 minutes]**
Klaus Kisters, Kisters AG
Merger of Hydstra and Kisters
Future product portfolio
- 10:00** **What's New [60 minutes]**
Peter Heweston, Hydstra Pty Ltd
- 11:00** **----- Morning tea-----**
- 11:15** **SODA [90 minutes]**
Michael Natschke, Kisters AG
Telemetry and Scheduler – SODA Integration
Upgrade process for customers that have purchased the telemetry package
- 12:45** **----- Lunch-----**
- 13:45** **Technology Overview [45 minutes]**
Peter Heweston, Hydstra Pty Ltd
- 14:30** **TSM 2004 [60 minutes]**
Klaus Kisters, Kisters AG
- 15:30** **----- Afternoon tea-----**
- 15:40** **WISKI - WEB Module [40 minutes]**
Michael Natschke, Kisters AG
- 16:20** **TimeStudio What's New**
Peter Taylor
- 16:50** **WISKI TV**
Debbie Cockburn, Hydstra Pty Ltd
- 17:10** **Session End**



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28th - 30th July 2004
Gold Coast, ANA HOTEL

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SINGLE-DAY REGISTRATION \$275 **Nominate Day:** _____

Full Registration Delegates MUST Complete	
I will be attending the:	Field Trip <input type="checkbox"/> Hydstra Meeting <input type="checkbox"/>
<i>Please tick one box only.</i>	

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For further information, please contact:	
Ray Alford - Ray.Alford@nm.qld.gov.au	or Paul Martin - Paul.Martin@nm.qld.gov.au

Hydrography in the Pilbara, Western Australia

(Article provided by Greg May, Environment WA)

Roebourne Enhancement Scheme

The Shire of Roebourne has contracted the Water and Rivers Commission's North-West Region Karratha office to carry out a feasibility study to rehabilitate the Harding River Pools within the town of Roebourne.

The study is part of a \$3 million dollar project called 'The Roebourne Enhancement Scheme' and aims to improve the town with better services and infrastructure, increase cultural awareness and social values and offer a healthier and safer natural environment.

Roebourne (or Ieramagadu as known by the traditional owners) was first gazetted as a town in 1886. The Ngaluma people are the traditional inhabitants of Roebourne and the surrounding districts, however, they have close kinship and ceremonial ties with the Injibandi and Banjima people, many of whom now reside in Roebourne.

By the early 1900's Roebourne became the administrative and cultural centre of the Pilbara. The pastoral industry was booming and the town also served for the port of Point Samson, which was the third busiest port in the State (after Fremantle and Albany).

The Harding River (Ngurin) runs through Roebourne and is of great cultural significance to the Aboriginal people, and in general is a busy area for social activity. According to the Ngaluma and Injibandi Lore, the Warlu, a serpent of the Dreaming, is responsible for the creation of the river.



However, since the damming of the Harding river in 1984, its system has changed dramatically. Previously, the river sustained higher water levels in the pools near Roebourne but since the damming there has been a decrease in flows. Furthermore, years of litter build up has also created an unsightly foreshore and weeds such as date palms and parkinsonia have started to grow and have altered the riparian zone.



The main objective of the study is to investigate the feasibility of artificially supplementing the Harding River pools in Roebourne. The study will aim to identify water volume requirements, infrastructure requirements, environmental impacts and foreshore management options.

The vision is to create an area that will provide a social and cultural benefit to locals. It would also serve as an attraction to the many tourists that visit the town each year. With the pools as a focus it is also hoped that cultural heritage walkways, picnic areas and public amenities will be built to further enhance the area.

The project draws on staff expertise from several areas such as hydrography, water allocation and waterways management. It is therefore a great team project that has a community focus. It also raises the profile of the department by contributing to a regionally significant project which involves some sixteen agencies.

Still in its early stages, staff are carrying out field measurements such as measuring pool capacity, foreshore surveys and investigating possible water supplies. The feasibility study is due to be completed by the end of March.

PS.

As luck (the weather) has it Cyclone Monty decided that the Harding dam, upstream of Roebourne, needed a top up, sufficient to produce massive overflows. Roebourne now has a much larger swimming hole than planned, at least temporarily.



Harding Dam Spillway March 2004



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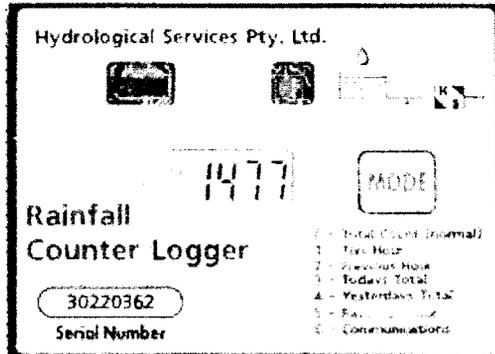
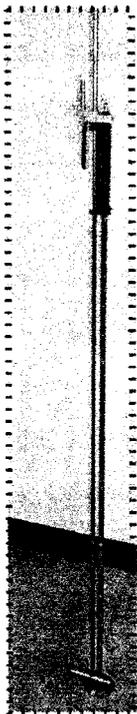
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DEVELOPMENT OF A STAGE-DISCHARGE RELATIONSHIP FOR THE RAPIDLY VARYING FLOWS IN URBAN STREAMS

JH Tilley, School of Civil and Environmental Engineering,
The University of New South Wales
A Coates, Civil Solutions

A Wojcik, School of Civil and Environmental Engineering,
The University of New South Wales

I Abustan, Department of Civil Engineering, University of Science, Malaysia

JE Ball, Water Research Laboratory, School of Civil and
Environmental Engineering, The University of New South Wales

ABSTRACT

It is now recognised that stream water quality is a major issue both in the urban environment and the rural environment. However, the determination of water quality within an urban drainage system and hence the impact of the stormwater on the receiving water depends on an accurate assessment of water quantity. A major source of error in the determination of the quantity of water passing a point is the rating curve used for conversion of the monitored flow depth to a discharge. In many cases, these rating curves are derived from field measurements with the time required to gauge the stream or stormwater channel during a flood event having a significant influence on the reliability of the rating curve. The standard stream gauging method uses a simple average of the gauge heights at the start and end of the time period over which measurements across the entire section are taken. Past experience with this method and current recommendations within the ISO standard suggests that this method should be applied with confidence only to the steady gradually varying flow situations that are associated usually with large streams and rivers.

When standard approaches are applied to the flash floods that occur in urban environments, the significant fluctuations in level that can occur means that a

simple averaging of the gauge heights does not reflect the flow conditions existing at the instant in time when a particular sub-section measurement was obtained. An alternative method for use in these circumstances involves the monitoring of the gauge height for each sub-section at the instant the sub-section measurement is obtained. Presented in this paper is an outline of an alternative method. Also presented in the paper is a discussion of its application for the gauging of rapidly varying discharges in streams within an urban drainage system.

1 INTRODUCTION

As a result of the perceived importance of urban drainage systems for management of urban water quantity and quality, managers of urban drainage systems are requiring information about the quality and quantity response of their systems to storm events. This information about water quantity and quality within an urban environment can be obtained through monitoring of both the water quantity and quality or through mathematical simulations using catchment modelling systems. While mathematical simulation is necessary whenever the potential impact of changes within the catchment are needed, monitoring programs are necessary to provide essential information for the calibration, validation and implementation of catchment modelling systems as well as for the collation of information pertaining to existing water quantity and quality conditions at a particular location.

The collection of hydrologic data involves many activities; Chow et al. (1988) present one sequence of the activities involved in the collection of hydrologic data. These activities, as illustrated in Figure 1, include

- Sensing - this step involves the use of sensors that react to hydrological phenomena. It should be noted that sensors may be direct, where the sensors measures the phenomena itself, or indirect, where the sensor measures a parameter directly related to the phenomena. An example of a sensor undertaking a direct measurement is the mercury in a thermometer while an example of a sensor undertaking an indirect measurement is an ultrasonic velocity probe.
- Recording - this step is used to record the sensed phenomena or parameter. For example, the depth of water in a channel may be recorded, historically, on paper charts, or, as is the more

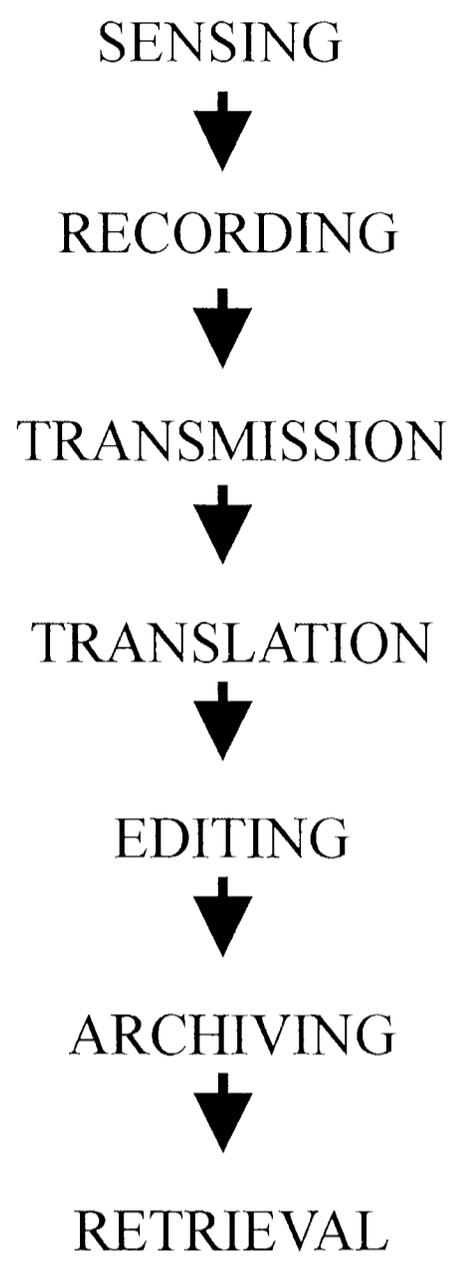


Figure 1 - Activities in Monitoring Hydrological Phenomena

common case now, electronically.

- Translation - this step involves the conversion of the field record to the stored format. This may be as simple as the downloading of the electronically stored data or it may involve the transformation of the parameter recorded in the field into the desired phenomena.

Of particular concern herein is the determination of the transformation from the monitored water level into the recorded discharge. This transformation commonly is obtained from a stage-discharge relationship developed from field measurements of the stage and discharge using a technique referred to as the velocity-area method and described by Rantz et al. (1982) and presented in ISO1070-1973. With this technique, the discharge is derived from the sum of the products of stream velocity, flow depth, and distance between observation verticals. This technique is explained best with reference to Figure 2; in this figure, the solid lines represent the observation verticals while the broken lines represent the division between adjacent cross section segments. The average velocity within a cross section segment is determined from one or more velocity observations along the observation vertical. This average velocity, together with a knowledge of the flow area of the cross section segment, is transformed into the discharge through that segment of the cross section. Summation of the segmental discharges then results in the total discharge through the cross section. Each application of the velocity-area method results in one data point for the desired stage-discharge relationship and the development of the full relationship requires many applications of the velocity-area method.

The monitoring of the quantity and quality of flows in small rapidly responding catchments has been a recognised problem for many years (see, for example, Pilgrim and Cornish, 1975). Many of these problems are associated with estimation of the flowrate rather than determination of water quality parameters. Since estimation of the flowrate is essential for reliable determination of the contaminant mass flux, problems with determination of the flowrate at a site propagate into the estimation of the contaminant mass flux.

A major problem associated with determination of the stage-discharge relationship for channels draining small catchments is the rapid response time of the catchments and the very rapid variations in stage. The Powells Creek Stormwater Channel is monitored by a gauging station installed and operated by the School of Civil and Environmental Engineering, UNSW. This gauging station is typical of the gauging stations installed on small rapidly responding

catchments. At this gauging station in 1982 an increase in stage approaching 13 metres per hour was recorded with the cross section average flow velocity in excess of 6ms^{-1} during this period.. Rapid changes in stage of this magnitude preclude the usual approach for considering changes in stage during the application of the velocity-area method; this usual approach is the arithmetic averaging of the stage at the start and end of the measurements.

Presented herein is a variation on the velocity-area method which has been developed to overcome some of the difficulties associated with development of the transformation of stage to discharge for channels draining small urban catchments. To validate the method, it has been applied at monitoring sites operated by the School of Civil and Environmental Engineering, UNSW with one of these applications described herein.

2 VELOCITY-AREA METHOD

The velocity-area method for the determination of discharge for a given stage level is the classical method of stream gauging and, consequently, the most commonly used method of stream gauging. It consists of observation of stream velocity, flow depth and distance across the channel between observation points. The discharge is derived from the sum of the product of mean velocity, depth and distance between observation verticals.

For application of the velocity-area method at a gauging site, the cross section is divided into a number of subsections. In order to describe the variations in cross section and the horizontal velocity variation completely, an infinite number of subsections would be required. However, this is not practical and consequently a finite number of subsections is used. An example of the subdivision of a cross section into a number of subsections is shown in Figure 2. These subsections are defined usually on the basis of equal section width, equal segments of flow, or on the basis of the bed profile with the choice being made on the basis of the flow conditions, the geometry of the cross section and the width of the total section. Within each subsection, the average velocity of the flow is determined from one or more measurements.

From a knowledge of the subsection areas (or width and average depth) and the average flow velocity in each subsection, the total discharge past the gauging site can be computed as

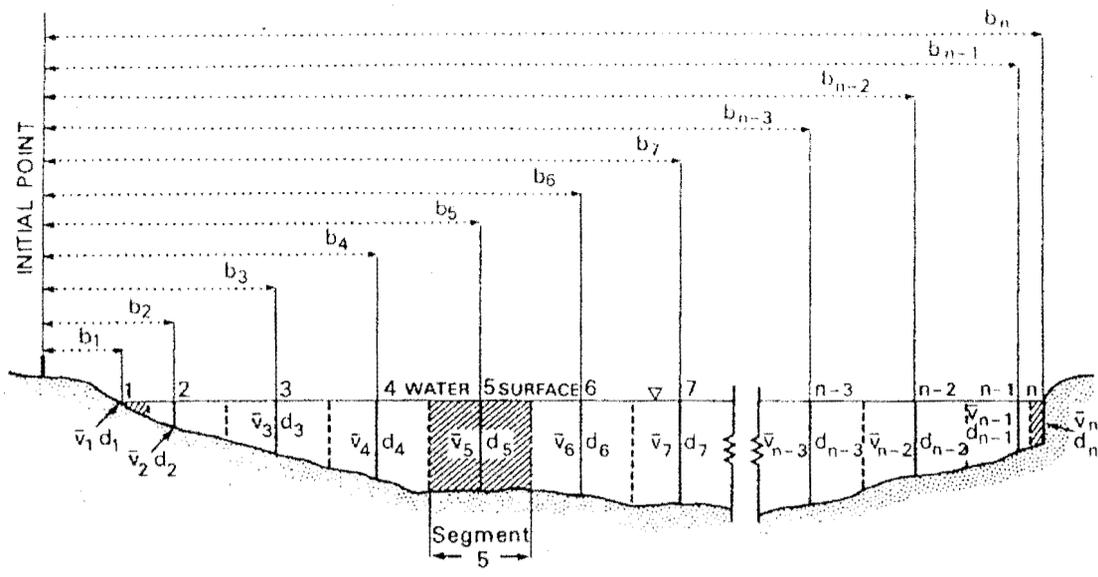


Figure 2 - Velocity Area Method

Scott Technical Instruments (Advertisement)

(Letter received march 2003)

Re: Glogger Repairs SN# 030165

Dear Owen,

Enclosed is the Moree Hydro Data team's Gauging Logger (Gavin). The black electrical terminal was broken in the line of duty whilst conducting a boat gauging.

The unit still appears to be functioning correctly, but is definitely no longer a sealed unit any more.

With the Glogger we have consistently cut down our work times in the field.

We hope that the necessary repairs do not take too long, as Gav now an invaluable third member of our team (see enclosed photo). We are finding it very hard to adjust to manually booking gaugings again after becoming used to the ease of using the glogger.

Please do repairs then fax me an invoice and I will send a purchase order over for that amount.

Yours sincerely



Simon Morse
Hydrographic Assistant,
Resource Information Unit
NSW Department of Land and Water Conservation



*Gav resting after a hard day
in the field. Mungindi Hotel/Motel.*

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$$Q = \sum_{i=1}^n v_i d_i w_i \quad (1)$$

where v_i is the average flow velocity in subsection i , d_i is the average depth of subsection i , and w_i is the width of subsection i . Where the water surface elevation changes during the gauging, a common approach to determination of the stage appropriate for the computed discharge is to average the stage at the start and the end of the gauging. However, for development of an accurate relationship between stage and discharge, Herschy (1985) recommends that this approach be used only when the change in stage is less than 50mm. In other words, this approach is suitable only for slowly varying flow conditions which are not the case for small rapidly responding catchments.

Repeated application of the velocity area-method results in development of the required transformation from the monitored stage to the desired flow rate. The ultimate result of these applications of the velocity-area method is a transformation analogous to that shown in Figure 3.

3 CONTINUOUS GAUGING METHOD

The continuous gauging method proposed herein is a variation on the standard velocity-area method. As such the method is not a replacement for the velocity-area method but rather is an enhancement of the existing method developed for fast responding catchments but suitable also for application in situations where the standard velocity-area method currently is used. For gauging of catchments with rapid response times, the proposed method saves time and can produce an accurate estimate of the discharge at any instant in time. Additionally, any anomalies in the collected data can be readily identified through the data analysis stage of the method.

Shown in Figure 4 is a gauging site with four subsections. The dashed line in this figure indicates the water surface during a typical gauging. Measurements would be obtained continuously by sampling both the average velocity and the water depth at each sub-section from the left bank to the right bank. The most important aspect of the continuous gauging method is to minimise the measurement time and to continuously move from one subsection to another. There are a number of options for the continuity of measurements; some of these alternative schemes (with reference to Figure 4) for the measurement sequence are

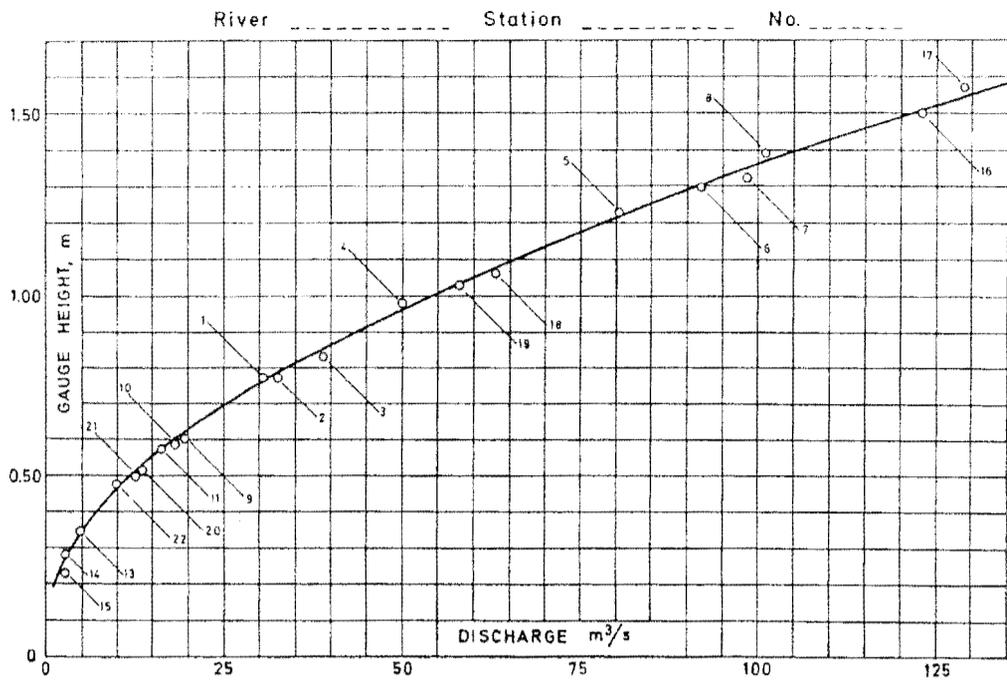


Figure 3 - Typical stage-discharge relationship

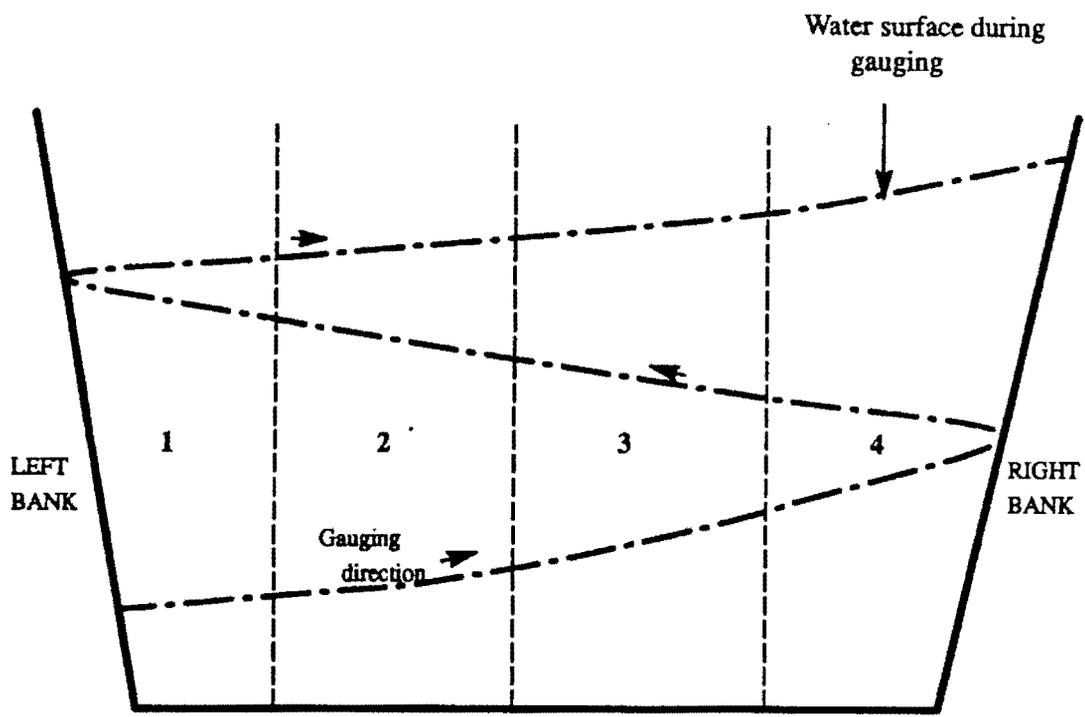


Figure 4 - Schematic cross section for application of continuous gauging method

- 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4
- 1 2 3 4 3 2 1 2 3 4 3 2 1 2 3 4
- 1 2 3 4 4 3 2 1 1 2 3 4 4 3 2 1

From a practical viewpoint of minimising total time while maximising the number of measurements, the second sequence is preferred but experience with the application of the continuous gauging methodology has not resulted in a distinct advantage of one measuring sequence over another.

For application of the continuous gauging method at a site it is necessary to collect the following data at each subsection

- Time of measurement,
- Subsection being sampled,
- Subsection average velocity at sample time, and
- Stage at sample time.

This data is similar to that collected during application of the velocity-area method with the only additional data being the time and stage at which an individual subsection measurement is made. From this data, time-series data containing the subsection average velocity and the subsection stage are obtained.

The subsequent analysis of this time-series data produces the individual subsection areas for each velocity measurement. The discharge in each of the subsections at the time of measurement can then be computed by

$$Q_i = v_i A_i \quad (2)$$

where v_i is the average velocity within subsection i , A_i is the subsection area at the time of the velocity measurement, and Q_i is the discharge in subsection i .

Using the time series of subsection discharges, stage-discharge relationships for each subsection



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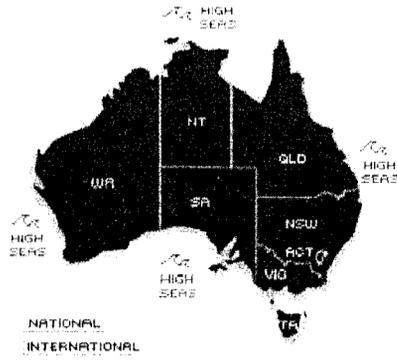
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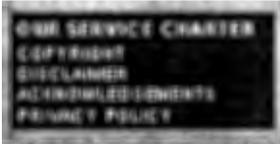
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can be developed. The desired stage-discharge relationship for the total section is then computed from the summation of the individual subsection discharges for a given gauge height.

From the above description, the continuous gauging method proposed herein is similar to the classical velocity area method with the major variation being that the subsection discharges are not combined after a single pass across the channel section. By summation of the subsection discharges during post-processing of the collected data the need to obtain an average gauge height is removed thus mitigating one of the major sources of error in the gauging of small urban catchments with rapidly changing stages.

The following description of the application of the continuous gauging method more completely describes the post-processing of the field data.

4 APPLICATION OF THE CONTINUOUS GAUGING METHOD

The School of Civil and Environmental Engineering at The University of New South Wales has been operating a gauging station on the Powells Creek Stormwater Channel since 1958. Initially this gauging station monitored only the quantity of flow but since the early 1990s has been modified to monitor water quality parameters as well. The catchment area draining to this gauging consists of 2.3km² of urban development; primarily residential housing of various densities with some commercial and educational land uses.

The stormwater channel at the gauging station is a concrete lined “U” shaped channel 2.5 metre deep by 3 metres wide. For purposes of application of the continuous gauging method, the cross section was arbitrarily divided into five (5) subsections as shown in Figure 5. Abustan (1998) found, when he applied the method to the Musgrave Avenue Stormwater Channel which is another gauging station operated by UNSW, that the number of subsections did not influence the stage-discharge relationship and, hence, the number of subsections should be selected on the basis of the cross section properties rather than a predefined number.

Shown in Figure ? is a time series of the gauge height at Powells Creek Stormwater Channel over a six-hour period during which 188 individual velocity observations were made using the continuous gauging method. Each data point shown in this figure indicates the time at which a

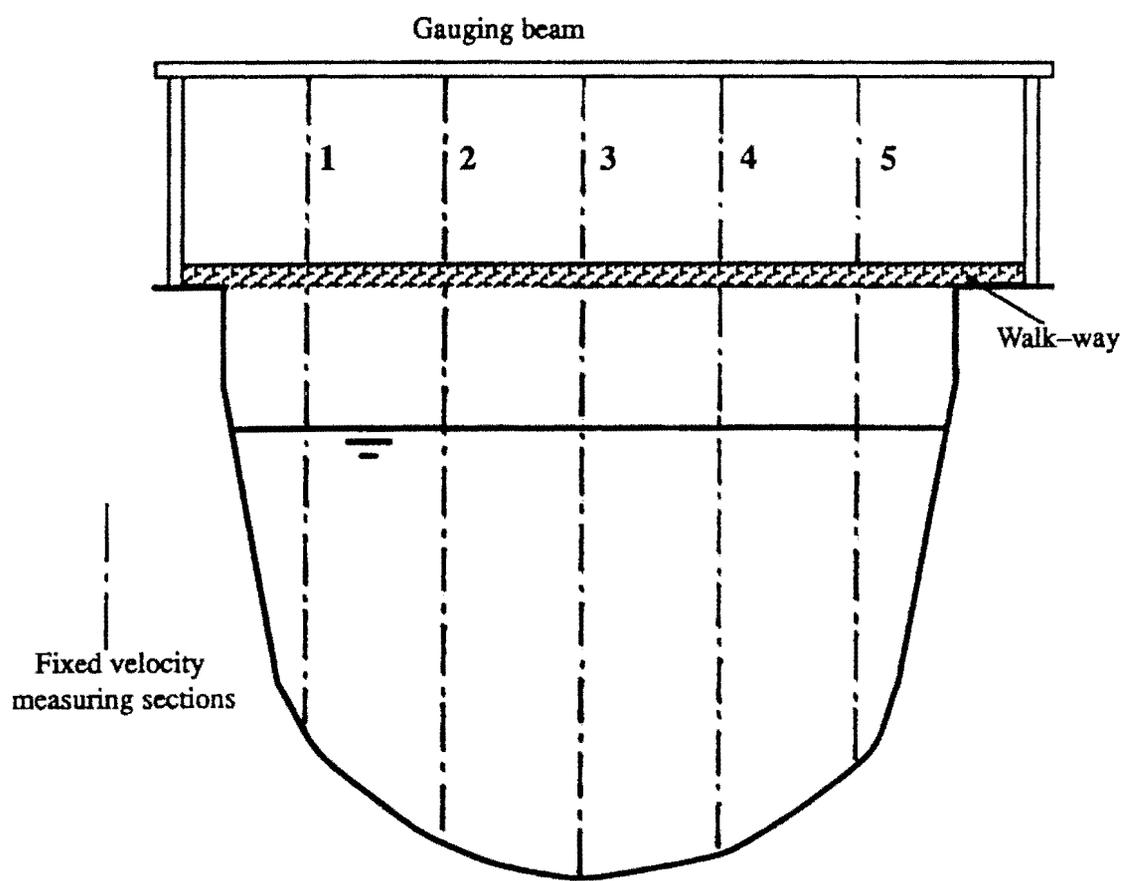


Figure 5 - Powells Creek Stormwater Channel

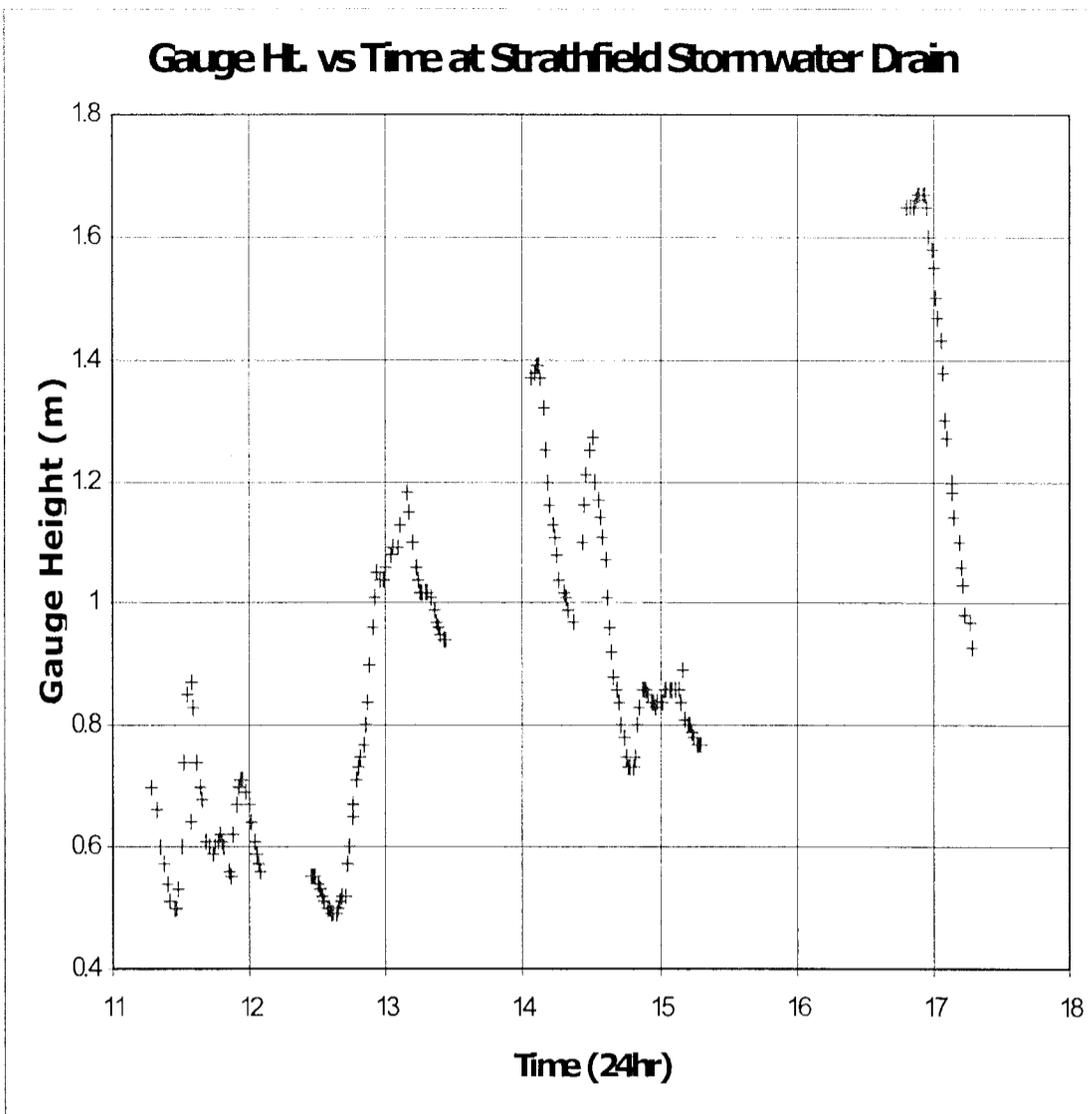
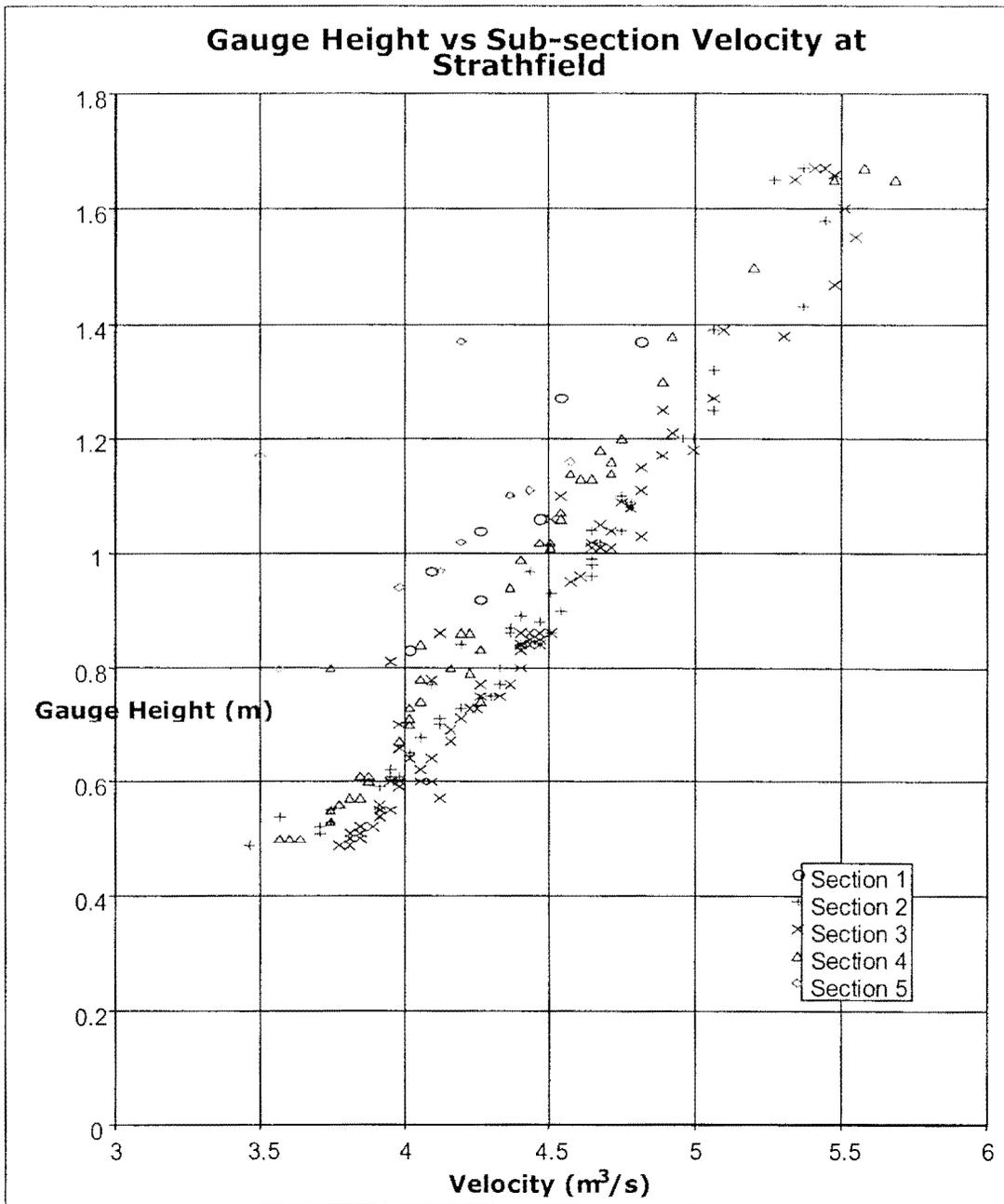


Figure 6 - Time series of gauge height during gauging operation



velocity measurement was made. These velocity measurements can be related to the gauge height at the time of measurement and anomalous measurements readily identified. As shown in Figure 7, anomalous measurements were recorded at all subsections; these data points were those that were not consistent with the other measurements recorded at that subsection. One example of an anomalous data point is the velocity of 3.5ms^{-1} for a gauge height of nearly 1.2m; a more consistent measurement would result in a velocity of approximately 4.5ms^{-1} for the same gauge height as was recorded during the gauging exercise. These anomalous data were discarded and not used in the subsequent calculations of the stage discharge relationship.

Using the time series stage height data, the flow area for each velocity measurement was determined and used to calculate the subsection discharge for a given gauge height. This information suffices for the development of stage-discharge relationships for each subsection; shown in Figure 8 are the stage-discharge relationships developed for each subsection at the Powells Creek gauging station.

For the purposes of subsequent determination of the stage-discharge relationship for the full section, regression equations were fitted to each of these subsection relationships. The R^2 coefficient for these relationships, due to the initial checking of the field data, were high (the lowest value obtained was 0.998) and, therefore, were not considered to be a major source of potential error. Using these relationships, the discharge in each subsection of the channel for a given stage could be obtained and hence the total discharge determined by summation. The resultant stage-discharge relationship for the Powells Creek gauging station is shown in Figure 8 also.

5 CONCLUSIONS

Large streams and rivers, even in flood, generally do not exhibit rapid changes in stage and hence the classical velocity-area method suffices for development of the stage-discharge relationship necessary for transformation of the monitored stage to a flowrate. Smaller streams and particularly those in an urban environment, however, are characterised by rapid changes in stage. These rapid changes necessitate an alternative method for development of the desired stage-discharge relationship. One feasible method is the continuous gauging method which has been described herein. This method has been applied to the development of the stage-discharge

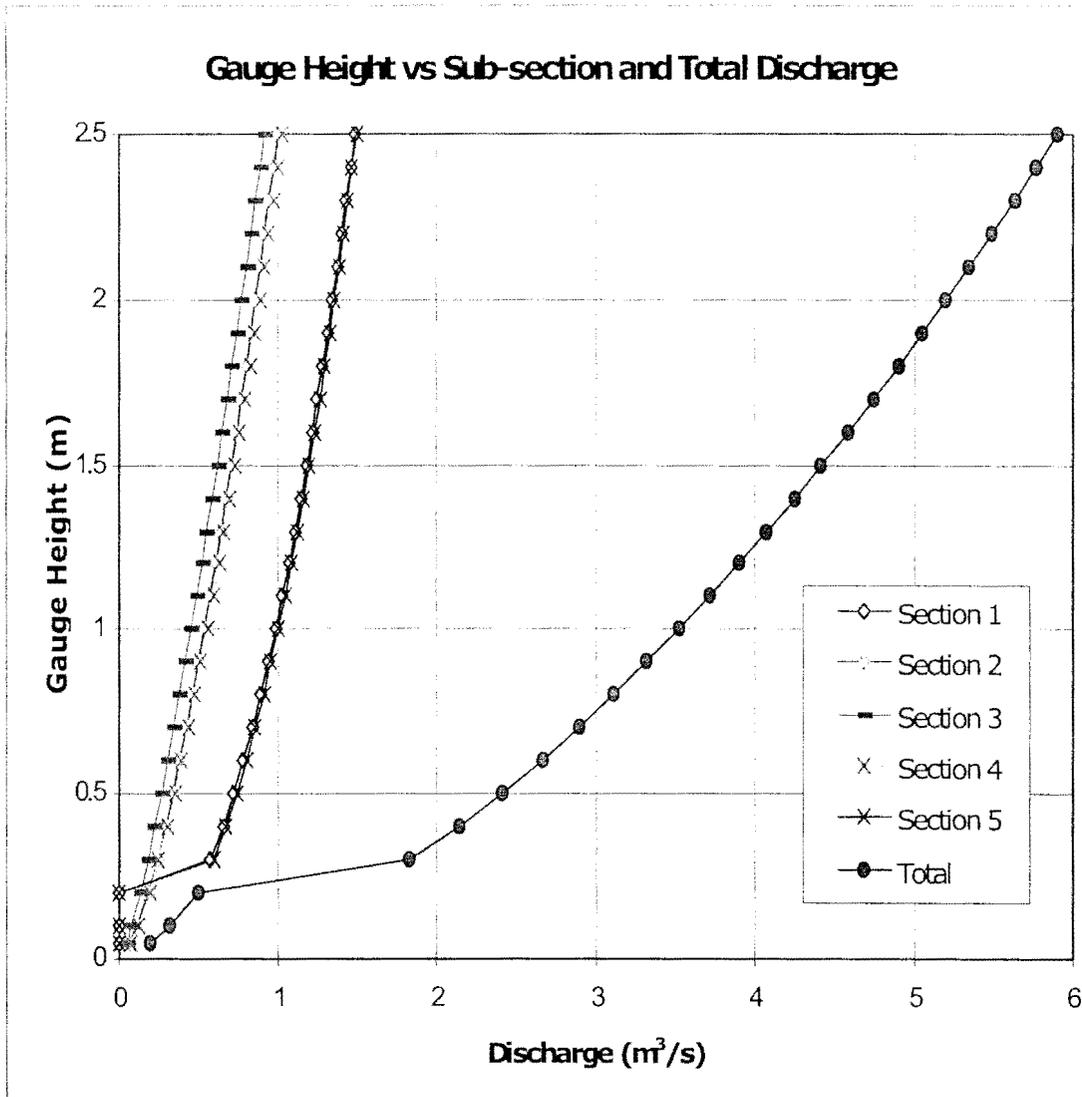


Figure 8 - Subsection and total section discharge against gauge height

relationship for the gauging station operated by UNSW located on the Powells creek Stormwater Channel. It was found that the stage-discharge relationship developed using this method was accurate and reliable.

REFERENCES

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Chow, VT, Maidment, DR and Mays, LW, (1988), *Applied Hydrology*, M^cGraw-Hill Book Co.

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Pilgrim, DH and Cornish, DA, (1975), Difficulties in gauging small catchments - A case study, *Proc 1975 Hydrology Symposium*, Armidale, Australia, I.E.Aust. Nat. Conf. Pub. 75/3, pp 99-103.

Rantz, SE, **et al**, (1982), Measurement and computation of streamflow, Vol 1.: Measurement of stage and discharge, *Water Supply Paper 2175*, US Geological Survey, ????

TECHNOHEAD SPECIAL!!

(From the Sandgroper members. Much thanks again to Greg May in forwarding this article on to me! Ed)

WHAT IS AN LMU?

LMU is the term used by the Water and Rivers Commission, Western Australia to describe the combination of an autosampler and a Campbell data logger. An LMU (Load Measuring Unit) differs from the normal data logger stage initiated pump sampler installation, in that an LMU triggers on rate of change of the hydrograph whereas a traditional pump sampler installation will trigger at set stage heights. After the Campbell logger has been calibrated with a given site's hydrograph characteristics, specific areas on the hydrograph are targeted, which translates to more useful and relevant samples being taken.

The LMU consists of a Campbell Scientific data logger coupled to a Sigma or Epic pump sampler. The Campbell logger gets its level data from SDI enabled

equipment such as the Unidata, 6004 logger, or Microloggers via a system of communication called SDI-12. This avoids the need to have either separate transducers or dual-output shaft encoders. (Note: 6003 loggers do not support this function.) This simple system requires only two wires to be 'daisy-chained' from data logger to data logger or SDI enabled transducer as many times as required. The Campbell, which is always referred to as the master, requests the data it wants from whichever logger or transducer it has an interest. This reduces costs by avoiding duplication of transducers at the site. The Unidata logger continues its normal function as the primary data storage unit operating via Schemes.

So, the Campbell can ask a Mindata instrument for data about stage, a 4EC for data about conductivity and temperature, a Unidata logger for information about stage from a shaft encoder, D.O. probe, pH probe, pluviometer, etc. This is achieved with just two wires. Because of the need to use 6004 or Microloggers, telemetry, when fitted, must also be upgraded from the old Unidata landline sets. All other telemetry is OK.



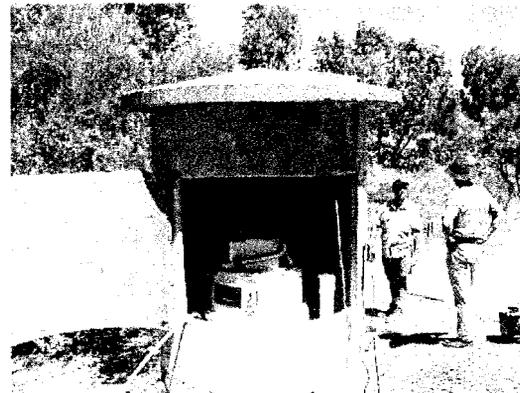
Dog Hill Station – General Layout



Float Well – After Instrument Changeover



Laying the Sampler Intake Line



Pump Sampler

LMU INSTALLATIONS

One of these systems has been set up at our training gauging station called Seaforth, located on the Canning River in Kelmscott. A second system went in during late February on the Peel Drain gauging station known as Dog Hill. The site was rebuilt in a day and involved installing the new LMU configuration as well as upgrading data loggers, telemetry etc. The work involved:

- removing all the old instrumentation and fitting a wall bracket to hold the new instrument housings in the float well;
- retrenching and fitting a new sample intake line to the pump sampler;
- fitting the pump sampler;
- converting the Water Resources Logger to a Micrologger running on schemes; and
- upgrading the telemetry to a Banksia landline.

More sites are planned with a further four systems currently being tested. It will be interesting to see how Dog Hill performs over the coming (hopefully) rainy winter. For further information please contact Paul Barton at the department's Hydrologic Technology Centre, Welshpool, Perth on (08) 9361 7323.

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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.

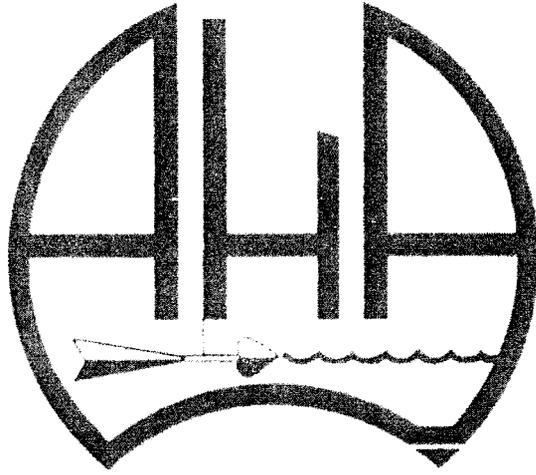
At present the Editor is limited to steam driven Word 6.0 so if you have a contribution could you please submit in that format.

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

I look forward to getting summaries of papers from the conference from those who have indicated that they are willing to provide them. Summaries of the summaries are also welcome as I can use them as a precursor in the newsletters for items appearing in the next Quarterly Journal.

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.

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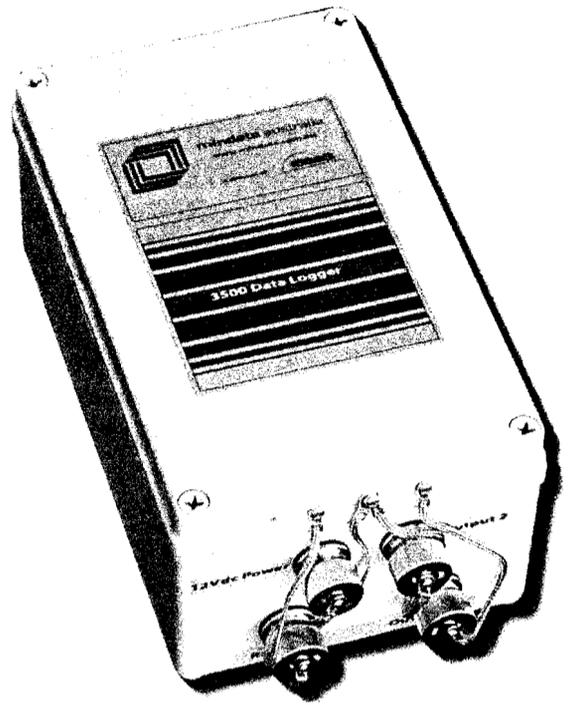
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A registration and welcoming function will be held from 4:30pm on the evening of the 27th of July. The Australian Hydrographic Association will hold a meeting following the function, and all members of the AHA are encouraged to attend. Following the presentation of papers, on Friday 30th July you will have the choice of attending the HYDSTRA users group meeting or touring the Hinterland (to see some gauging stations) and points of interest.

To Register, Contact a Conference Convener:

Ray Alford - Ray.Alford@nrm.qld.gov.au
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