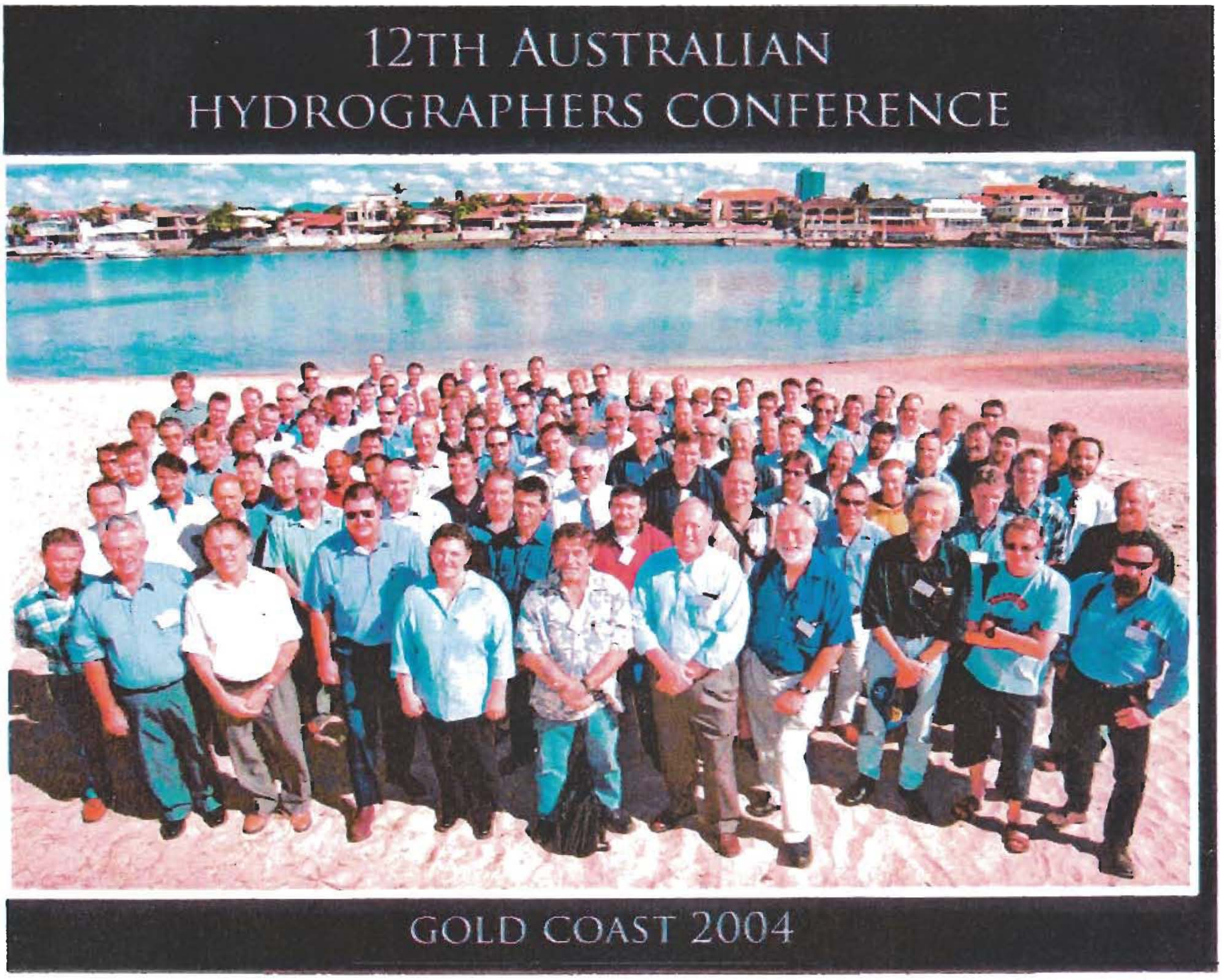
AUSTRALIAN HYDROGRAPHERS ASSOCIATION

Australasian Hydrographer



August – November, 2004

The **Australasian Hydrographer is the Journal of the Australian Hydrographers' Association Incorporated. ISSN 0812-5090**

THIS ISSUE

EDITORIAL

A successful 12th Australian Hydrographic Conference has now passed. The Conference ran in conjunction with the annual Hydstra Users Group and was attended by over 120 people from all states of Australia as well as New Zealand and Papua New Guinea representatives, and supplier/trade representatives from Europe and the United States. Congratulations to Ray Alford and Paul Martin (of Queensland Natural Resources Mines and Energy) for organising this very successful event.

The Annual General meeting was also held at the time of the conference and the minutes from it are contained in this Journal for your information.

Speaking of meetings, the Committee of your Association held a national Committee meeting recently in Canberra, as a follow on from the AGM.

Thanks to Mick Whiting from the Western Australian side for showing the enthusiasm and determination that is always welcome in the Association through his 'one night stand' at Bill Steen's place when he arrived in Canberra on Saturday morning and flew out again Sunday morning to partake in the meeting. Thanks is also passed on to John Skinner for organising meeting facilities at the Ecowise Offices in Canberra for this meeting. A summary of this meeting is included in this Journal.

National Water Week is fast approaching. Or is it? I went for a search on the web and found information was looking a bit scarce this year compared to previous years. Has it been overshadowed by the election. Don't really know but if your'e organisation is involved in activities this year please send us information so we can share with others.

On your mailing label you will note a month and date is now included which indicates the expiry date of your membership. This is in response to members being unsure as to where their membership is up to. It is also asked that members advise us of changed circumstances (addresses, emails etc) so that we can maintain accurate member details.

As usual articles are always welcome for the Journal, so get those hands on the key board and share your wisdom.

Mic Clayton, Publicity Officer

The **Australasian Hydrographer** is the Journal of the **Australian Hydrographers' Association Incorporated**. The Journal is distributed quarterly to Members. **ISSN 0812-5090**

Visit our **Web Site** at: **http://www.aha.net.au**
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.

e - mail publicist@aha.net.au , or
PO Box 843, COOMA, NSW, 2630.

Australian Hydrographers Association

24th Annual General Meeting

Gold Coast

July 27, 2004

Convened

Attendees:

Chair: Graham Armstrong
Secretary: Scott Walker
Treasurer: Max Hayes
Publicity Officer: Mic Clayton
AHA Members: Matthew Hamilton, Andrew Kaar, Anthony Skinner, Dennis Burt, Jim Tilley, Bill Steen, Faye Edden, Tony Polchleb, Garry Newton, David Williams, Gary Willis, Allan Russ, Rod Dew, Andrew Skinner, Don Alexander, Ray Alford, Mark Hopper, Paul Webb, Roman Oliver, Mark Pickles, Brian Chester, Rod Masters, Brian Keech,, Tom Gerdei, Graham Parsons, Simon Cruikschank, Luke Bloedel, Con Peshkoff, Michael Whiting, Jacquie Bellhouse.
Visitors:Ken Klaasen, Michael Connor, , Jason Whitwell, Darren Thompson, Charlie Thurgood

Member Apologies:

Michael Lysaght, John Skinner, Alex Springall, John Dawson.

Minutes From Last Meeting:

Minutes from the 23rd AGM read by Scott Walker.
Moved for Acceptance – Bill Steen
Seconded – Jim Tilley
Accepted.

Chair Persons Report for 2003-04(Graham Armstrong): (Minuted Precis)

Graham expressed a concern that there appeared to be a continuing trend in the value and resultant quality of measurement work – people with economic degrees rather than engineering/science degrees were in charge of organisations.

To raise the profile we need to be lobbying and raising the importance of good measuring science for decisions in water resources by addressing Ministers and Water Authorities**.**

We need to state what we do in the 'terms' of the day, phrases such as 'benefits to the community'. Graham asked the State Reps to advise the best contacts within each state for addressing our concerns to.

Moved For Acceptance – Bill Steen
Seconded – Jim Tilley
Accepted

Responses to Chairmans report:

- Bill Steen – work from within the organisations. Graham disagreed slightly saying this was important but we needed to also work from the top down.
- Dave Williams – Emphasise in the correspondence risk management and the importance of having good science in measuring and achieving confident data quality. Should we do a TV commercial!?
- Graham A – we should utilise the space we have in the *Water* magazine better.
- Simon Cruikschank – Work on getting a piece about hydrographers/hydrography in something like the Australian magazine. A few years ago there was an article about hydrography as a career in the employment sections of the Australian.

Secretary's Report 2003-04 (Scott Walker):

Well I have had the secretary job for a anther year and I am still enjoying the privilege.

The web site has cracked 500 hits in 18 months that's about 1 a day so I'm happy with that.

I have had some correspondence from mainly symposium / conference organisers around Australia.

This year I have not approached AWA to renew our arrangement because we got a free year out of them but with extra members we need to get them on the mailing list and we might incur an increased fee for the ***WATER*** magazine but this is yet to be tested . We were offered ½ a page every issue and presently this has not been utilised at all this year.

Most correspondence to and from the secretary's desk is via e-mail. Copies of e-mails are available upon request.

The Future:

2005 will see the AHA focusing on raising the profile of the industry. With the spotlight on the delicate state of the nation's water resources we need to cash in on this window of opportunity.

I have also been looking into some kind of association with the Australian Hydrographic Society. These people are in a similar position to us and there are a lot us cross over areas of interest.

Hope I can still be of service to the association over the next year.

Sincerely

Scott Walker
AHA Secretary
27/07/04

Moved for Acceptance – Bill Steen
Seconded – Jim Tilley
Accepted

Treasurers Report (Max Hayes):

AUSTRALIAN HYDROGRAPHERS ASSOCIATION
INCORPORATED
STATEMENT OF RECEIPTS AND EXPENDITURE
01/01/03 TO 31/12/03

<u>RECEIPTS</u>

Subscriptions	$6.690.00
Interest	$65.56

Total Income	**$6.755.56**

<u>Expenditure</u>

Newsletter Expenses	$2.853.60
State Govt. Tax BAD	$12.50
Bank Charges	$286.00
Air Fares A.G.M. Hobart	$571.56
Web Site	$200.00

Total Expenditure	**$3.923.66**

Bank of Melbourne Account No. 033-259 13-0104

Opening Balance: 1 January 2003 $27.137.01

Income:	$6.755.56	
		$33.892.57
Expenditure	$3.923.66	

Closing Balance December 31, 2003		**$29.968.91**

Reconcillation :

Closing Balance,December 31, 2003 (as per statement)	$29.968.91
Plus receipts not credited :	$0.00
Less unpresented cheques	$0.00

Closing Balance, December 31. 2003: $29.968.91

Moved for Acceptance – Tony Polchleb
Seconded – Faye Edden
Accepted

Publicity Officers Report (Mic Clayton):

Publications over the last year have seen Journals published:
August 2003, 24 pages
November 2003, 20 pages
February 2004, 20 pages
May 2004, 32 pages

Newsletters were prepared for
June/July, 2004

Besides members receiving Journals, copies of the Journal continue to be forwarded to the State Library of New South Wales for archiving. Courtesy copies continue to be forwarded to the New Zealand Hydrological Society for their information.

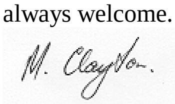
Membership reviews continuously occur to assess mailouts of newsletters and Journals lists, via hard copy and via email. Membership renewal reminders have taken various forms via the newsletters and Journal. Reminders to a handful of 'just lapsed' memberships occurred in late May/early June.

In the last 12 months Western Australia has forwarded a number of items for the Journal as well as TAFE in regards to the Hydrography Course and the Bureau in regards to availability of Hydrological data across Australia. These contributions are greatly appreciated - how about other organisations and states joining in and contributing a bit more!

Over the last 12 months, besides preparing the Journals and newsletters, a number of job ads were forwarded to members via email lists. This year saw 14 job ads passed on to members over the last twelve months as well as published on the AHA web site. The jobs were submitted by employers and by net surfing.

Some may say "but I haven't seen the ads" - well I can only simply apologise for that but stress that the main problem appears to be people forgetting to advise us of changes in their membership details so we can get information that is up to date. BUT a visit to the web site at www.aha.net.au will get you access to the more recent position advertisements!

As always I am always open to submissions for the newsletter. While conferences give me a good supply of articles they are not endless! Photos for the cover are always welcome.



27/7/04

Publicity Officer
Australian Hydrographers Association Inc.
Moved for Acceptance – Andrew Skinner
Seconded – Bill Steen
Accepted

State/Regional Reports

New Zealand – Martin Doyle

The watery stuff in New Zealand
Hydrography appears quite buoyant in New Zealand at present. Hydrological Science at a national level is carried out by NIWA, and regional by Councils. NIWA competes for central Government science funding against other science groups. After some cuts over the years, it seems that nationally, the science is assured of ongoing funding.

At the regional level, Hydrographic work appears to be mostly gaining funding as more and more national responsibilities are being handing off to Regional Councils to fund through local rates. Two massive floods this year in the Manawatu and Bay of Plenty have ensured that hydrographic work, and flood warning in particular, has been kept to the front of politician's minds. Water allocation issues are also very topical in all areas, and Central Government has increased funding through the Ministry of Environment to help in these areas.

Several gatherings of New Zealand Hydrographers have occurred in recent times. Council staff gathered in Masterton for several days, including a one day workshop on the topic of continuous water quality monitoring. The New Zealand Hydrological Society held its annual conference in Taupo last November, which also had an excellent turnout of scientists, engineers and hydrographers. Another workshop was held on the topic of irrigation water metering, which poses Councils some challenges in terms of getting large quantities of data back, and dealing with compliance issues.

On that topic, it seems to me that workshops are an excellent means of bringing our group together, and AHA could have a role in promoting a workshop on a relevant topic in the year that its doesn't hold its conference. For instance, the ADCP topic could be explored in more depth at a later date, along with other measuring technologies.

Finally, let me finish with a photo of some South Island Hydrography to cool you all down as you sit there in that humid West Island, Gold Coast air…….

Martin Doyle

Western Australia:
Michael Whiting: Hydrography activity fairly busy. The region had supplied some articles for the Journal over thye last 12 months

Queensland:
Ray Alford – Ray advised that things were busy in the Sunshine State and particularly busy with the organisation of the Conference

General Business:
Matters for discussion from AHA.net.au

- Raising awareness of industry.
- A relation with the Australasian Hydrographic Society.
- Corporate Membership

General Business & Matters arising from the floor
Time and date of nextAGM including election of Committee.
The date of the next meeting was not confirmed at this AGM but it is expected that this will coincide with the 2005 Kisters/Hydstra User Group Meeting. As a result it will be expected that this will occur in either Canberra or Hobart.
The next AGM will also coincide with the end of the current term of the committee and a resultant election will take place.

General Business from the floor:

- *Tony Polchleb* – look into a possible affiliation with similar organisations such as Australian Hydrographic Society (ocean cousins)

- *Michael Whiting* – felt there was a need to review Corporate Membership. Action – review at next Committee Meeting
- *Scott Walker* – Raised proposal to investigate Life Membership and membership protocols. Action – Review at next Committee Meeting.
- *Mic Clayton* – Constitution requires some housekeeping. Action:Committee to review Constitution and prepare as appropriate proposals regarding the Constitution.
- *Ray Alford* – Who will host next Workshop?
- While no firm volunteers, Dave Williams (NT) and Mic Clayton (NSW) advised that they would investigate options.
- *Jim Tilley* gave a vote of congratulations to Scott Walker and Mic Clayton in regards to the work they had undertaken in the previous 12 months and believed that the following conference would set up many discussion points amongst hydrographers in Australia.

Meeting Closed: 19:40

MEMBERSHIP RENEWALS

Many are now falling due or may be overdue. Some of you may have recently received a reminder notice. The Committee asks to be kept up to date about your details and renewing your membership of the Association promptly is one way of achieving this. An 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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Bathymetric Survey Using Household Appliances

Simon Cruickshank

Dept Infrastructure Planning and Environment

(Water Resources)

Presentation made at the 12th Australian Hydrographic Conference, 2004

Surveying with Household appliances ? This should be good !

Actually this title is a little misleading as not all the equipment I will be referring to can be found under the kitchen sink. In fact probably not any of it. However what I am attempting to demonstrate is a fast and accurate method to undertake bathymetry without purchasing expensive or complex instrumentation . There is even half a chance that you will have half this gear already in your storerooms.

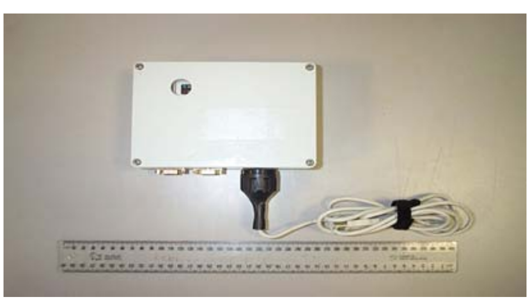
For many years we have been using various methods to determine the volumes of billabongs and the like for various clients, and have used a range of equipment to do so. Earlier efforts used torch style depth sounders and rangefinder binoculars, but there had to be an easier way.

Then we used ADCP's but there had to be a cheaper way.

Effectively all we needed was a depth sounder and a GPS and some software to plot it all up with. However we discovered some problems when we tried to interface the location data with the depth data. The post survey data manipulation was painful and time consuming.

My colleague Dave Williams was playing on the net one day and came up with a solution. If we could interface a GPS with a depth sounder then we could have all the data coming in on one line and therefore it would be easier to manage and interpret.

Multiplexer



What we came up with is a multiplexer which is basically a black box that takes the NMEA string from the GPS and interfaces it with the NMEA string from the Depth sounder and outputs it via a USB port. This Multiplexer was purchased from a marine supplier and cost about $600.

And other household appliances?

We use the Garmin GPS's such as this one. These are a fairly basic unit costing about $300 and the Depth Sounder is actually a fish finder again only costing about $300.

The only thing to bare in mind is the pinging frequency of the sounder, most basic units ping every 4 seconds but you will get better resolution and possibly faster trawling speeds with a unit capable of 1 sec ping rates.

Add a 12v battery a laptop and a boat and that's the hardware covered.

Where the Fugawi ?

Now all we need is some software to tie the whole lot together. A comms emulator like hyperterminal will do it but we already had a product called Fugawi.

Just digressing a little, one of the greatest physical challenges to top end Hydrographers, other than getting eaten, bogged, running out of beer or getting stuck at the wrong end of a 8m tide is finding our way back to some of the sites.

Access

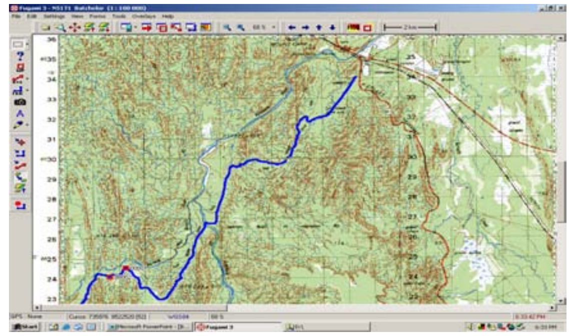
Access can be a major challenge when a track looks like this at the end of the wet season

Before a burn off finding a bore cap in 3m spear grass can be a might tricky if you don't have good access notes.

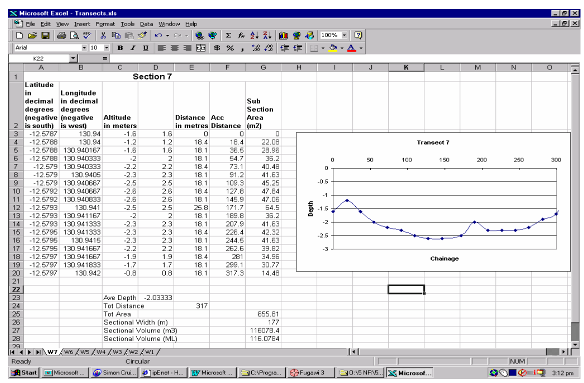
Are you sure we are still on the track ?

Fugawi uses BSB maps to provide topographical features wich interface with the GPS location.
Fugawi allows you to mark access tracks on the map as you drive along so the next time you need to visit or if you need to send another member of staff that has never been to the site, they have no excuse for getting lost. Useful information like locked gates and photos of intersections etc can all be added to the waypoint track.

According to Fugawi we are !!



This software costs about $160 and a 1:100,000 map is about $3 to $10 depending on how many you buy.
So add this to our hardware costs, for a total of $1400 we can start our survey.



	A	B	C	D	E	F	G
1	Section 7						
2	Latitude in decimal degrees (negative is south)	Longitude in decimal degrees (negative is west)	Altitude in meters		Distance in metres	Acc Distance	Sub Section Area (m2)
3	-12.5787	130.94	-1.6	1.6	0	0	0
4	-12.5788	130.94	-1.2	1.2	18.4	18.4	22.08
5	-12.5788	130.940167	-1.6	1.6	18.1	36.5	28.96
6	-12.5788	130.940333	-2	2	18.1	54.7	36.2
7	-12.579	130.940333	-2.2	2.2	18.4	73.1	40.48
8	-12.579	130.9405	-2.3	2.3	18.1	91.2	41.63
9	-12.579	130.940667	-2.5	2.5	18.1	109.3	45.25
10	-12.5792	130.940667	-2.6	2.6	18.4	127.8	47.84
11	-12.5792	130.940833	-2.6	2.6	18.1	145.9	47.06
12	-12.5793	130.941	-2.5	2.5	25.8	171.7	64.5
13	-12.5793	130.941167	-2	2	18.1	189.8	36.2
14	-12.5793	130.941333	-2.3	2.3	18.1	207.9	41.63
15	-12.5795	130.941333	-2.3	2.3	18.4	226.4	42.32
16	-12.5795	130.9415	-2.3	2.3	18.1	244.5	41.63
17	-12.5795	130.941667	-2.2	2.2	18.1	262.6	39.82
18	-12.5797	130.941667	-1.9	1.9	18.4	281	34.96
19	-12.5797	130.941833	-1.7	1.7	18.1	299.1	30.77
20	-12.5797	130.942	-0.8	0.8	18.1	317.3	14.48
21							
22							
23			Ave Depth	-2.03333			
24			Tot Distance		317		
25			Tot Area				655.81
26			Sectional Width (m)				177
27			Sectional Volume (m3)				116078.4
28			Sectional Volume (ML)				116.0784

Supplier Web Sites
www.shipmodul.com - multiplexer
www.fugawi.com - software

A Conference Review (Part 1)

Mic Clayton

The 12th National Australian Hydrographic Conference was held on the Gold Coast on July 28 and 29, 2004. It was organised by the Queensland Department of Natural Resources Mines and Energy (NRME), and primary sponsors were NRME, Hydrological Services and Underwater Video Systems.

The venue was the ANA Hotel only a block from Surfers beaches and the busy world that is surfers Paradise.

Over 110 delegates attended from around Australia, and overseas including Papua New Guinea, New Zealand, United States and Germany.

The conference opened on the morning of the 28th with the Queensland Minister for Natural Resources, Mines and Energy, the Hon Stephen Robinson presenting the opening address. His address highlighted the recent agreement that arose from the COAG meeting on nationwide water reform, and that while he was a critic of the National Water Initiative, he admitted that successive governments had had problems with managing the upper reaches of the Darling.

He discussed how there had been a process of community consultation in these areas that highlighted that while there were up to 100 years of record at some monitoring points what was worrying that overall there was a marked lack of data to support catchment management decisions by the government (a familiar theme recurring yet again!) and it was this lack of data that was giving credence to decisions when challenged through the courts and other avenues. As a result a multimillion dollar program to improve water data collection in Queensland, use better science in decision processes and ensure that essential stream data and information gathering networks was currently underway. He ended his address by thanking hydrographers past and present in their commitment to the collection of the data and information that would be essential to the management of Queensland's, and Australia's water resources.

Keith Barratt from Western Australia gave the Keynote Address of the Conference and he reviewed water assessment in Western Australia and Australia, in particular about the formation of the Australian Water Resources Council (AWRC) in 1963, followed in 1964/65 Commonwealth grants to the states for the development of water resource Measurement networks around Australia. He noted that after the grants money evaporated in the late 70's short sightedness by state government economic rationalists began a process of closing gauging networks, not understanding the value of long term monitoring. The idea of short term study sights became vogue but this approach is ineffective and probably unscientific as hydrological changes are often gradual and not noticeable until many years of data are collected. He highlighted the current re-establishment of gauging networks around the catchments of Perth where logging had impacts on catchment yield and groundwater available for Perths water supply. He then went on to highlight the impact of regrowth forestry in Perth catchments, but also highlighted that recognising these trends could only have resulted from long term continuous monitoring of the hydrological area to be managed. Such changes would not have been recognised in short term studies.

Keith then commented about being involved in the first Hydrographic Workshop in 1978, and as we moved into the 1980's Australian hydrographers were recognised internationally as operating at worlds best practice but was concerned that this standard was being eroded by various causes that had been slowly occurring over the last decade or so.

His closing view was that we must ensure that the wisdom, knowledge and experience that we have must not be lost to future generations.

Dave Williams gave a paper on a study he is involved in investigations into the Daly River Tidal Bore, an inrushing tide wave that occurs regularly and the impacts and effects of the erosive powers it brings with it. An interesting issue raised was that while digital data recording is good it can miss important data. Unless the parameter to be measured is understood and equipment configured to the requirements of the project, possibly erroneous assumptions and deductions might be made from the collected data, basically by virtue of not recording the appropriate data. And to think that this was discovered when the digital data was compared against an old analogue chart recorder, giving better data resolution!

Aaron Corbett and Luke Bloedell gave a presentation on their short experience with a newly acquired Stream Pro ADCP, purchased by the Rocklea facility for evaluation. Having only played with it in the few weeks prior to the conference they were still learning about its limitations and as such advised that in their opinion at that stage of their experience the technology was in early days and saw the need for more evolution. The observations they were presenting were based on a limited experience (particularly as they were trying to measure flows that were similar to many areas in the east – drought flows!).

- A lot of estimation of flows at the surface and above the bed occurs

- Experienced large discrepancies at slower velocities
- They had not identified any time savings over traditional wading gauging methods
- At this stage it appears that such technology may be better suited to flow ranges where wading was unsafe due to depth and velocities but too shallow for effective boat gaugings.

After lunch the delegates convened down by the Nerang River for the Conference Photo and then were given simple demonstrations of the Stream Pro and Sontek ADCP. Many delegates had not encountered the equipment previously – it was estimated that less than 20% of delegates had been exposed let alone used this type of equipment. Unfortunately the Nerang in this location is tidal and was not in motion during the demos, so we were basically given demonstrations of the depth sounding tools of the equipment. It did get everyone swapping ideas and thoughts and the continuation of the workshop back at the venue saw commencement of collation of experiences and recommendations which should be available at a later date from the convenors.

Bill Barratt from Hydrological Services regaled us with his recent trade trip to Sweden and the problems with ice and snow. Heated float wells that look like Swiss cuckoo clocks are all the go! He then moved on to cover the development of gas purge systems and problems that can be encountered with some systems including an issue called Latitude Error for such systems where the latitudinal locational of a site can also affect the precision of sensors. That is on top of altitude, water temperature, height of sensor above the the orifice and so on. You thought it was hard enough to get someone to read a gauge board accurately!

The second day saw presentations by Simon Cruikshank (NT), Alex Springall (ex DLWC), Charlie Thurgood (NZ), Brian Chester (WA), Tony Spandler Hydro Tas), Michael Sievers (Qld NRME), Scott Walker (Sydney Water), Stephen Bird (Tyco), Ken Klaasen (Qld NRME), Andrew Skinner (MEA), Hening Huang (RDI), Chris Ward (Sontek), Geoff Carlin (CSIRO) and Parker-Gordon-Drake (Qld NRME). These presentations will be précised in the next Journal.

Trade Displays were manned by:

Hydrological Services, Underwater Video Systems, Imbros, John Morris, Sontek/YSI, Aqualab, ES&S (Mindata), ETM Pacific, Campbell Scientific, NIWA/ Unidata, Davidson, Focus Systems and Hydstra (Kisters)

The third day of the conference saw a choice for delegates of the Hydstra User Group meeting or a field trip around south east Queensland NRME facilities. Surprisingly there was a great attendance at the HUG! Reports on these will occur at a later date.

The Conference dinner was a great success on the Wednesday night. During the proceedings a number of people involved in the industry were exposed as having retired or about to retire. These included Don Alexander (Qld), Keith Barrett (WA), Alex Springall (NSW) and Jim Tilley (NSW). The audience expressed their appreciation at the efforts these gents had made in their fields of experience over their years in a variety of capacities in the hydrographic industry and wished them well in their future endeavours. Don Alexander was presented with a ‘golden’ current meter by his juniors in the Queensland authorities.

As the night wore on many stories were relived as acquaintances were renewed. What was also notable about the evening was that there wasn’t only the yarn spinning and tales but also much fervent and serious discussion about hydrographic work, technologies, what people were doing and so on. It was great to see the willingness of people to share knowledge and experiences.

Thanks is to be given to Ray Alford and his small team of helpers that made the Conference the success it was. Special thanks to those who presented and attended the conference as well. Their professionalism augers well for the future. I believe that all who attended gained from the sharing of information and knowledge that such professional conferences provide us with.

Queenslander first to Complete Hydrography Certificate

Niel Harper, TAFE NSW, OTEN.

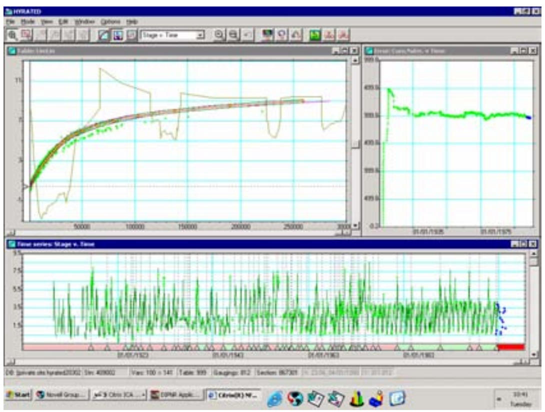
Congratulations to Arran Corbett of Queensland Department of Natural Resources and Mines who is the first student to complete the NSW TAFE Hydrography course by correspondence through OTEN. Arran achieved a distinction in all graded subjects he was required to complete.

The Hydrography Certificate IV was introduced by TAFE NSW in 2003, replacing the Water Resources Certificate. For information about the Hydrography Certificate IV and other Environmental Management courses available through OTEN contact neil.harper@tafensw.edu.au

Ratings – Black Art, Science or a Tool of the Capitalist Agribusiness Complex?

Alex Springall, DIPNR.
Presentation from 12th Australian Hydrographic Conference, 2004

The data I chose to review was from GS 409002 Murray River at Corowa.

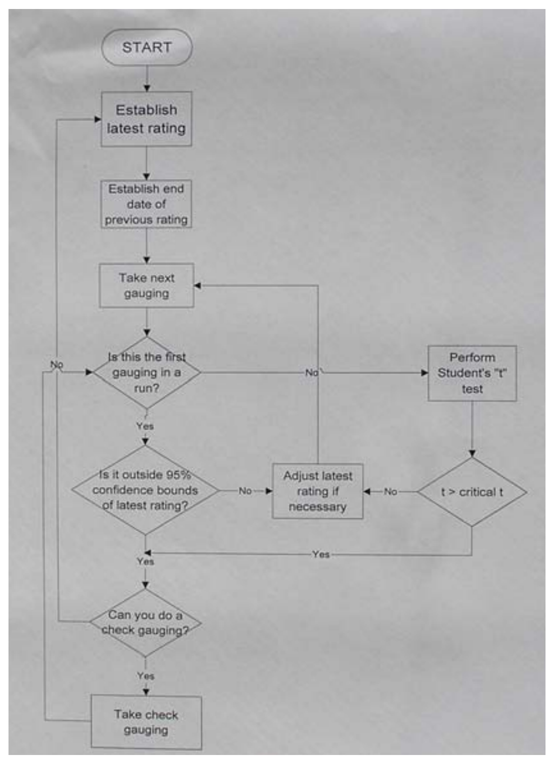


This station was established in 1894. According to the station history file it was discontinued in 1932 and re-established in 1939, but there is gauging and stage data for this period, so there seems to be a problem with the station history. Also, the early stage data is missing and probably, most of the gaugings.

Period	No. of Gaugings	Gaugings/ year	No. of Ratings - pre review	Gaugings per rating - pre review
Pre 1920	46	17.7	2	23.0
1920-1929	77	7.7	7	11.0
1930-1939	52	5.2	8	6.5
1940-1949	35	3.5	5	7.0
1950-1959	94	9.4	11	8.5
1960-1969	137	13.7	13	10.5
1970-1979	176	17.6	11	16.0
1980-1984	35	7	1	35.0
1985-1989	44	8.8	0	
1990--1994	40	8	1	40.0
1995-1999	43	8.6	2	21.5
2000-2003	33	7.5	1	33.0
	812	**9.3**	**62**	**13.1**

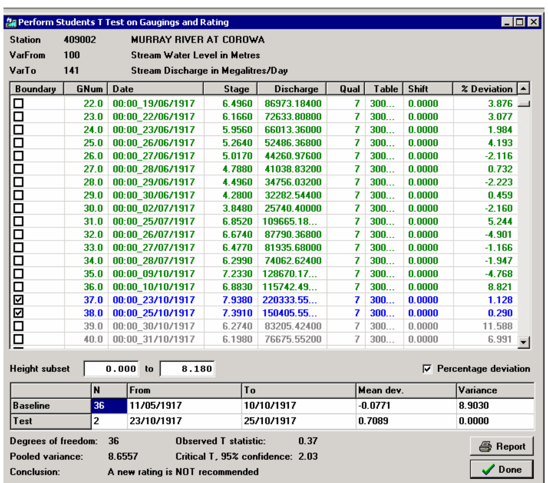
The old ratings were deleted and the following procedure was used to create a new set of ratings.

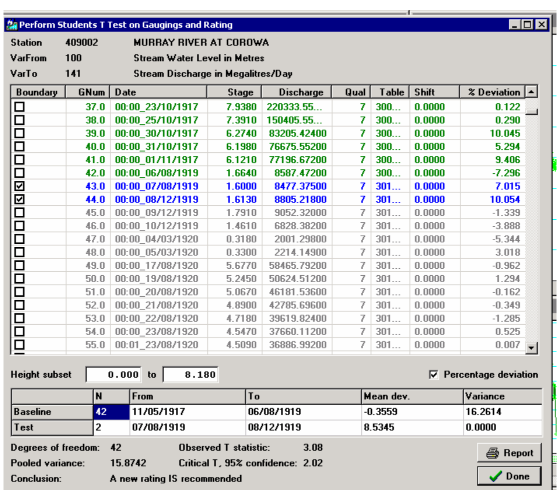
- An initial rating is created using the minimum number of gaugings possible – in this case about eight.
- As each subsequent gauging is taken, it is checked to see if it is within the 95% confidence bounds. If it is, there is no need to start a new table, but the current table is adjusted if necessary.
- If the gauging is outside the confidence bounds, the T test is applied. If it recommends a new table, a new rating is commenced, based on the latest gauging and the shape of the previous curve. If a new rating is not recommended, the current rating may be adjusted to take account of the latest gauging.
- As each new gauging is taken, the rating is reviewed and, if necessary, the rating is changed. The following flowchart shows the procedure.



I went through this procedure for the full period of record, and came up with some interesting results. Firstly, the number of ratings reduced from 62 to 35.

Period	No. of Gaugings	Gaugings /year	No. of Ratings - pre review	No. of Ratings post review	Gaugings per rating - pre review	Gaugings per rating - post review
Pre 1920	46	17.7	2	2	23.0	23.0
1920-1929	77	7.7	7	4	11.0	19.3
1930-1939	52	5.2	8	3	6.5	17.3
1940-1949	35	3.5	5	1	7.0	35.0
1950-1959	94	9.4	11	3	8.5	31.3
1960-1969	137	13.7	13	6	10.5	22.8
1970-1979	176	17.6	11	5	16.0	35.2
1980-1984	35	7	1	3	35.0	11.7
1985-1989	44	8.8	0	2		22.0
1990--1994	40	8	1	2	40.0	20.0
1995-1999	43	8.6	2	4	21.5	10.8
2000-2003	33	7.5	1	0	33.0	
	812	**9.3**	**62**	**35**	**13.1**	**23.2**

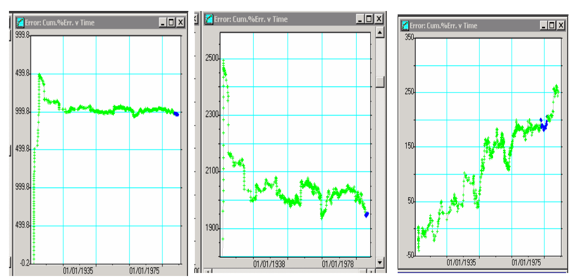




Just reducing the number of gaugings doesn't prove a thing. I could have put two ratings through all the gaugings. What is important is that the new ratings are better than the old ones.

On the other hand, only 8 (13%) of the new set of ratings failed, but these only failed the last test or did not have sufficient gaugings to pass the runs test. Failing the last test indicates that there is unacceptable scatter in the gaugings. Bear in mind that what is acceptable or not is completely arbitrary. We could just as easily have set the test at 70% of gaugings within 8% of the rating, and passed the test. Taking more gaugings, or producing unjustified ratings, will not overcome this. Only improving the control, or the gauging section, or our methods will reduce the scatter.

If we compare the cumulative errors of the two sets of ratings we notice an interesting phenom
In about the first 7 years, the cumulative errors are about +2500%, then over the next 10 years the accumulated value is about –500%. Over the remaining time, the ratings showed a cumulative fall of about xx%. By comparison, the new set of ratings showed a cumulative increase over the full period, of XX%.



Since the ratings passed all the tests, I wondered why they indicated this balance. Examination showed that it was caused by a skewed distribution of the gaugings about the ratings. In particular, the main large deviations from the ratings were on the positive side. I didn't have time to investigate what caused this, or whether it was peculiar to this station or was a common phenomenon. If I were to speculate, I would suspect that it was caused by sub-surface angle flow at some sections, but that is pure speculation. It might just as well be caused by some bias in the way I draw my ratings.

What this investigation shows is that there is no justification for changing ratings on the basis of a percentage deviation only. The Student's T test provides an objective method of deciding whether a new rating is required.

Optimising data quality from environmental monitoring stations

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A big paper presented at the 11th Hydrographic Conference in Sydney, 2002.

ABSTRACT

A wide variety of electronic sensors are now used to continuously record environmental data. Sensor manufacturers specify the quality of data that can be expected from their instruments, provided calibration is maintained. However a sensor is usually one of a chain of hardware and software components comprising a measurement / recording system, each of which can contribute to uncertainty in the recorded data. The uncertainty in the recorded data attributable to the sensor performance may be a minor part of the overall uncertainty. An understanding of the potential for degradation of data at each of the components / stages allows the system to be designed to minimise degradation and enable confident interpretation of the data. The monitoring systems considered in this paper comprise discrete sensors and a data logger connected by cables, with examples from hydrometric, meteorological, and water quality stations. The elements of a system that contribute to uncertainty in recorded data are identified, and methods for minimising the uncertainty are described.

INTRODUCTION

There are several elements or stages in an environmental monitoring system that may contribute to the uncertainty in the recorded data. The errors at some stages are random in nature and can be statistically quantified. However significant systematic and spurious errors can be introduced at several stages, due to poor understanding of the issues involved, or inadequate maintenance programs. The existence and magnitude of these errors may be unknown to a person analysing and interpreting the recorded data, and result in erroneous conclusions. This paper identifies the elements of a monitoring system that contribute to uncertainty, and issues to be considered in order to minmise or eliminate systematic and spurious errors.

An understanding of the potential for degradation of data at each of the stages in a system allows the system to be designed to minimise degradation and enable confident interpretation of the data.

OVERVIEW

The establishment of an environmental monitoring station is the realisation of planning involving selection of appropriate sensors and a datalogger, and decisions such as where to site the sensors and how to mount them, and the quantities to record that will provide the desired information.

Figure 1 shows the sequence of stages in a monitoring system, consisting of discrete sensors and a datalogger connected by cables, that contribute to uncertainty in the recorded data.

Some of the stages are not present in monitoring instruments that combine one or more sensors and an integral logger in a single package. Some of the stages that are present in this type of instrument can be effectively ignored because errors in these stages are compensated for when the instrument is calibrated as a single entity.

THE STAGES IN A SENSING/RECORDING CHAIN THAT CONTRIBUTE TO DATA UNCERTAINTY

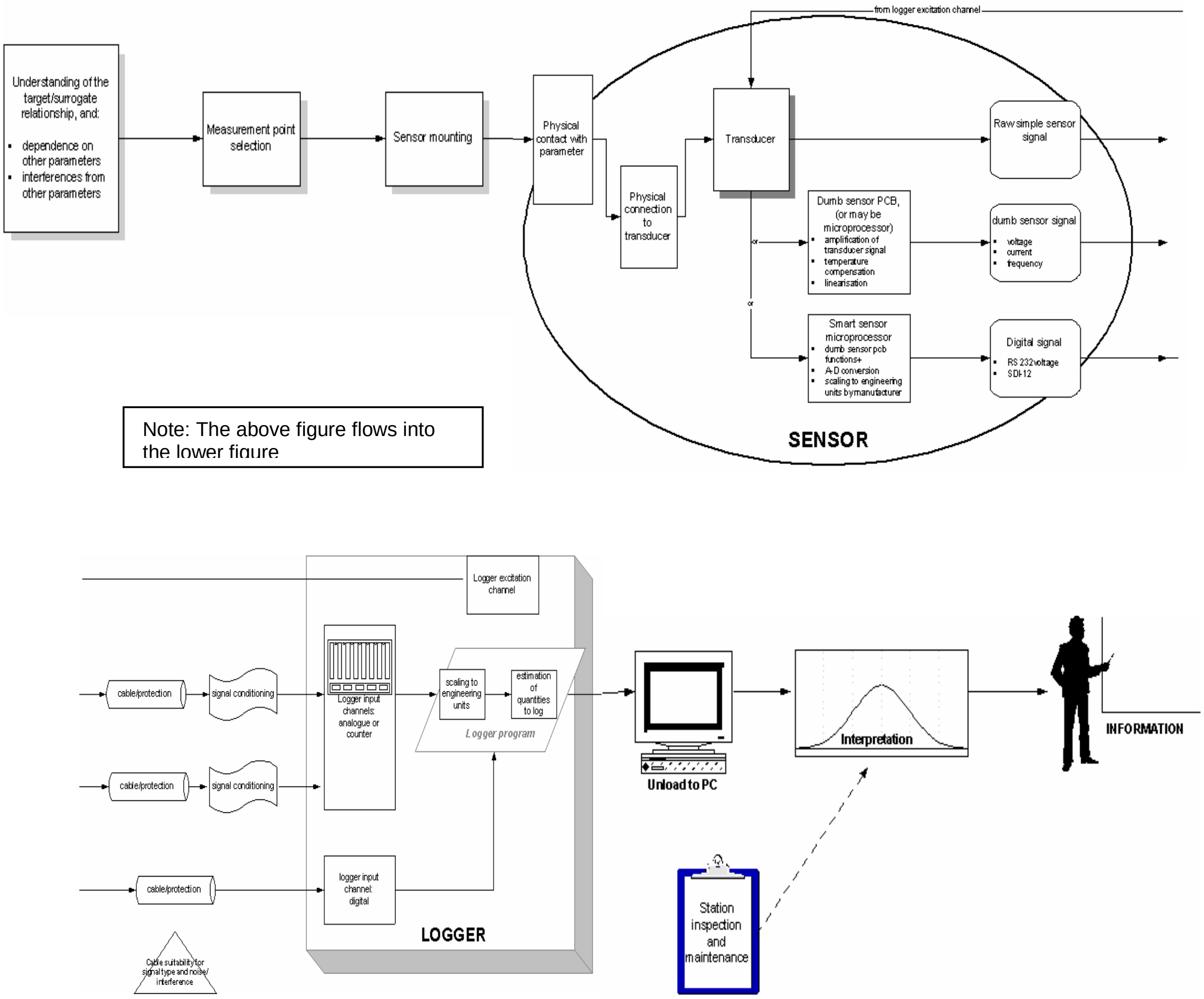
A wide variety of electronic sensors are now used to continuously record environmental data. A sensor is one of a chain of hardware and software components comprising a measurement/recording system, each of which can contribute to uncertainty in the recorded data. The uncertainty in the recorded data attributable to the sensor performance may be minor part of the overall uncertainty.

To optimise the value of information gained from recorded data the elements in the data integrity chain depicted in Figure 1 must be considered. Issues to be addressed are:

- an appropriate sensor must be used;
- the sensor range must match the expected range of the measured parameter;
- the sensor accuracy, resolution and sensitivity of the sensor must match the data quality requirements;
- the measurement point must be representative of the region of interest;
- the sensor and it's mounting method must be suitable for the deployment environment;
- the sensor must be known to be correctly calibrated;
- the sensor-logger cabling must be suitable;
- the sensor must be correctly interfaced to the datalogger;

- the logger channel specifications must be suitable;
- the sensor output must be correctly converted (scaled) to engineering units;
- the logger must be programmed to record the required meaningful quantities;
- an appropriate station inspection and maintenance programme must be designed.

FIGURE 1: Data Integrity Chain



The following sections discuss each of the data integrity chain elements depicted in Figure 1.

Target parameter-surrogate relationship

Some sensors measure their target parameters directly, for example temperature, windspeed and direction, and solar radiation sensors. Measurements of some target parameters such as water depth, suspended sediment concentration, salinity, and DO concentration are made indirectly, by measuring a related "surrogate" parameter. The surrogate parameters used in the preceding cases are pressure, turbidity, conductivity and oxygen partial pressure respectively.

Indirect measurements can be subject to additional uncertainty due to dependence of the surrogate on a third parameter, especially temperature. For example, water pressure (the surrogate) varies with depth (the target), and also with density. Water density varies with temperature and its composition. Water has a maximum density of 1 gm/ml at 4°C. Its density decreases by only 0.013% as the temperature falls to 0°C, and by 0.43% as the temperature rises from 4 to 30°C. Assuming a density of 1 gm/ml at 30°C would result in an under-estimation of depth at rate of 4.3mm/m. The total dissolved solids concentrations for New Zealand freshwaters are generally low, and errors introduced by assuming pure water density will be small. Typical seawater densities range from 1.02 to 1.03 gm/ml. Failure to correct for seawater density will result in a 2 – 3 % over-estimation of depth, i.e. 20 – 30 mm/m.

The accuracy of depth data from pressure sensors could be improved by monitoring temperature and conductivity as well as pressure, and applying corrections for density changes due to temperature and salinity variations.

Sensors measuring a surrogate parameter often measure temperature as well, so that a temperature correction can be applied by the sensor pcb or by the datalogger.

Sometimes the relationship applied to correct for temperature involves an assumption. For example, the relationship used to "normalise" conductivity readings depends on the ionic composition of the solution.

The target parameter/surrogate relationship may be specific to, and have to be established for, each station. Common examples are flow/stage and suspended sediment concentration/turbidity relationships.

Calibration of the target parameter/surrogate parameter relationship may be necessary, particularly where the relationship is station-specific, or where it changes with time. At stations where stage is measured as a surrogate for flow, flow gaugings must be carried out to establish and maintain the stage/flow relationship. Similarly at stations where turbidity is measured as a surrogate for suspended sediment concentration, a program of water sampling is required so that the sediment concentration/turbidity relationship can be defined.

Measurement point selection

The measurement point must be representative of the measurand regime in the region of interest. Examples are:

Solar radiation and PAR sensors should be sited at points where they will not be subject to non-representative shading.

A raingauge should be sited at a point that is not atypically sheltered or exposed to wind.

Fresh water flowing into a bay may initially "float" in seawater and may take some time to mix with the sea water. Depending on the objective for monitoring, a conductivity sensor deployed in the bay would be mounted at a shallow or at a deep point.

To measure the concentration and load of a slug of pollutant released into a channel, a sensor must be located at a well fed point in the stream rather than in a poorly fed slack water region.

Wind speed and direction sensors must be mounted away from structures that will affect the flow and direction of wind. As a general rule, the airflow around a structure is disturbed to twice the height of the structure upwind, six times the height downwind, and up to twice the height of the structure above ground.

Turbidity sensors intended to measure concentrations of suspended material should be sited away from features that induce aeration of the water (water bubbles also scatter light).

SENSOR MOUNTING

Inappropriate mounting of sensors can introduce large errors. Sensor mounting design may need to take into account issues such as:

Provision for tying the sensor output to a station datum

Water level sensors must be set to agree with a level datum. Wind direction sensors must be oriented to give the output the signal corresponding to 0 degrees when the vane is pointing true north.

Interference due to the mounting hardware

Interference due to the mounting hardware itself or other local features must be minimised.

Toroidal conductivity sensors must be mounted so that the toroid is surrounded on all sides by water to a minimum distance. Mounting hardware or water boundaries within the inductive “view” of the sensor will cause anomalously low readings. The hole in the toroid in particular must be kept free from fouling or debris. Where appropriate, a screen may be used to trap debris away from the sensor.

Electrode type conductivity sensors will also under-read if significant fouling occurs on the electrodes or debris lodges in the space between the electrodes.

To minimise interference from ambient radiation, turbidity sensors use infrared frequency light, which is rapidly attenuated by water. Ambient infrared does not cause interference when a sensor is mounted at a depth greater than 200 mm. Sensors mounted horizontally in shallow water must be shielded from above.

The photo-diode transducers in turbidity sensors do exhibit a small response to visible light. Ideally the optical window of the sensor should point downwards from within a shielding tube. Exclusion of ambient light has the added benefit of reducing biofouling by plants. Biofouling of turbidity lenses is often controlled by wipers or pumps.

Raingauge catches are reduced by the action of wind on the gauge. The effect increases with height. For comparative purposes, in New Zealand raingauges are mounted so that the orifice height is a standard 500 mm above ground. The error due to wind can be eliminated by installing the gauge so that the orifice is at ground level and surrounded by an anti-splash grid. Aerodynamic raingauges, or wind shields such as Alter shields can be installed to reduce the error due to wind.

Temperature sensors deployed to measure ambient air temperature must be shielded to prevent the sensors being heated directly by the sun.

Water quality sensors deployed in small streams must be mounted so that the whole sensor body is always immersed. Water temperature transducers included in a sensor for temperature compensation purposes are often inside the sensor, and may be seriously fooled if part of the body is in the air and sometimes exposed to direct sunlight.

Mounting design to allow access to sensors during station inspections

Sensors should be mounted so that they can readily be checked during periodic station visits. Calibration checks are necessary at intervals which vary depending on the type of sensor. Checks for wear and tear that may affect sensor performance are necessary. Where sensors can be affected by fouling, the effect must be quantified and the sensor cleaned.

Meteorological station masts designed to be readily lowered can be used to allow periodic inspection of the sensors.

Water quality sensors can be mounted in vertical or sloping pipes so that they can be readily removed irrespective of the water level at the station at the time of the visit.

THE SENSOR ELEMENT THAT INTERFACES WITH THE MEASURAND

The transducer element for some sensors is effectively in direct contact with the measurand. Examples are solar radiation and temperature sensors. Temperature transducers may be potted inside probes whose thermal mass will present the mean of rapid, local fluctuations to the transducer.

Some sensors have a mechanical element that interfaces with the measurand and responds, usually by moving, to changes in the parameter magnitude. The mechanical response is translated to the transducer via a linkage or connection to the transducers.

CONNECTION OF THE INTERFACE ELEMENT TO THE TRANSDUCER

Table 1 lists interface elements and linkage elements for several types of sensor.

Transducers may interface with their measured parameter via mechanical and or fluid linkages, which may build inertia and/or additional uncertainty into the data.

TABLE 1: Sensors: Element in physical contact with parameters, and connection to transducer.

Parameter	Element interfacing with parameter	Connection to transducer	Transducer
Water level (shaft encoder)	float	wire or tape, tensioned with counterweight in pulley	photo-chopper or magnets/read switches or magnets/Hall effect sensor
Water level (submersible PT)	capacitive: ceramic disc	direct	capacitor electrodes
	piezo-resistive: diaphragm	direct	strain gauge
Water level (gas purge PT)	bubble line orifice	via gas line and diaphragm	strain gauge or resonating quartz crystal
Rain	orifice rim and tipping buckets	fulcrum/lever and magnet	reed switch
Wind speed	anemometer cups or propeller	rotating shaft	photo-chopper or generator or reed switch
Wind direction	wind vane	rotating shaft	potentiometer
Temperature	outer surface of probe	via probe mass	thermistor platinum resistor integrated circuit
Turbidity	infra red light	scattered light	photo-diode
Conductivity (toroidal)	excitation signal	inductive coupling field via conducting solution	receiver toroid
Dissolved oxygen	membrane	cell electrolyte	cell electrodes

STIL Flow Monitor and Logger

To manage increasing demand for limited water resources, consent authorities throughout New Zealand are introducing mandatory monitoring and logging of all water use – surface and groundwater.

STIL have developed a Flow Logger to meet the needs of both consent holders and consent authorities. The Flow Logger is compatible with standard water meters (contact closure) and typically operates in conjunction with the water meter mechanical total. The logger normally displays flow (l/sec or gal/sec according to setup), but can also display total, as a cross check against the mechanical meter.

The construction of the flow logger is particularly robust. All electronics are encased in solid epoxy resin and under normal use the battery has an operational life of 10 years.

The Flow Logger is equipped with a waterproof infrared port so PCs or PDAs with standard IRDA and Flow Logger software can be used to recover the store memory of up to 200,000 date and time stamped data points.

In addition to physical security, the logger is designed with software security. Anybody may download data from the logger, but only those in possession of a password (over 14 million possible combinations) can reset the logging or modify the configuration.

Data security extends to the recovered ASCII data file (csv), with the last line including a 3DES encrypted file check value. Any subsequent changes to the file text will invalidate the check value.

This arrangement allows consent holders to email data files to regional authorities (as a condition of their consent). The authorities can process the data, secure in the knowledge that it is valid.

The STIL Flow Logger is well established, with units installed in Canterbury, Otago, Hawkes Bay and Taranaki – mainly for water bore use.

Developing and testing is also well advanced for units with cellular telemetry, using GPRS and CDMA networks. This will ultimately provide users and authorities with near real time data. These cellular units are expected to be released for general distribution in Australia in early 2005.

STIL Gauging Logger – The standard for river gauging in Australia and New Zealand.

- **Measures Velocity Directly**
- Records and Stores Whole Gaugings
- **No Paper, Pencils, Calculators needed**
- **Improved Gauging Quality**
- **Instant Discharge Results**
- **Computer Software Included**
- **Operates with Reed Switch and Wiping Contact Meters.**
- **Direct Import to Hydsys and other TS Software.**

For more information: **www.scottech.net**

Email: info@scottech.net **ph +64 7 8470646** **fax +64 7 8470647**

Continued from page 18

Inertia or "dampening" where it occurs may be intentional and desirable, or undesirable.

Stilling wells at water level stations are used to provide average water levels, free of short period waves. The water level is "linked" to the shaft encoder "transducer" via a float, connecting wire, and counterweight system. For small diameter floats especially, the net weight of the float, and its level relative to the water level, varies through the water level range. The weight of the connecting wire is effectively added to the weight of the counterweight, and subtracted from the weight of the float, when the water level is high and a corresponding length of wire has been transferred to the counterweight side of the pulley. The reverse is true when the water level is low.

The accuracy with which shaft encoders can convert shaft rotation to water level depends on the accuracy of the pulley circumference.

The gas pressure at a "gas purge", above-water, water-level pressure sensor, is slightly greater at the sensor than at the submerged orifice. This positive offset at the sensor is greater for long, small bore tubes. Gas purge systems can "follow" decreasing water levels rapidly, but lag behind rising water levels. The extent of the lag depends on the bubble rate.

Inertia and friction in anemometer cups or propellers and in wind direction vanes determine the minimum magnitude of response and the ability to detect rapid fluctuations.

THE TRANSDUCER AND ITS SPECIFICATIONS

Some transducers need an excitation voltage from the sensor pcb on the datalogger. Transducers such as the piezo-resistive bridge in a pressure sensor, or the potentiometer in a WD sensor need an excitation voltage in order to present an output signal.

In many cases the accuracy of the transducer output depends on the accuracy of the excitation signal.

In some cases the transducer performance is temperature dependant, and its output signal must be compensated for temperature on the sensor pcb. This can be true for transducers that do require an excitation, and those that do not.

Temperature transducers utilise the known change in a transducer characteristic with temperature, to measure temperature. Thermistors and platinum resistance thermometers (PRTs) are simple temperature sensors whose resistance-change with temperature has been characterised.

Galvanic cells used as transducers for measuring dissolved oxygen concentration are unusual in that they locally reduce the magnitude of their measured parameter by consuming the oxygen. A variety of techniques are used to ensure that readings are representative of the water body, rather than a locally depleted region.

Quality specifications for simple sensors directly affect the quality of recorded data. Quality specification for dumb and smart sensors may be better than those for their transducer elements. The function of dumb and smart sensor circuit boards (pcbs) are described below.

The accuracy specification supplied for a sensor by the manufacturer should encompass the transducer and sensor's pcb performance. It doesn't quantify additional uncertainty introduced due to operations such as normalization of conductivity readings, or conversion of DO readings to PPM which are based on an assumed water composition.

Pressure sensors designed for water depth monitoring are often supplied with a calibration relating the sensor output to fresh water depth. The sensors will under-read depth when deployed in denser saline water. The manufacturer's specification for the accuracy of a sensor applies when the sensor is in a state of calibration. Many sensors are subject to calibration drift which is seldom reliably quantified by the manufacturers. The drift may be due to changes in characteristics of the transducer or of pcb components.

Drift in sensor output may be due to factors outside of the manufacturers control, such as biofouling (or other fouling) or wear and tear. Turbidity sensor readings may be affected by biofouling, which can be minimised by fitting a cleaning pump or wiper, or affected by lens scratching which can be minimised by careful mounting. Scratches on a nephelometer lens will cause the sensor to over-read. Anemometer bearing wear may cause a drift in calibration, requiring servicing.

Where sensor drift is an issue, subsequent data interpretation can be optimised by regular station inspections designed to lock the time-series to known references, and to record evidence of, and remove biofouling.

Datalogger programs can be designed to compensate for calibration drift, allowing the calibration to be software-adjusted, overcoming the need to remove the sensor for laboratory/workshop calibration adjustment.

Data resolution may be determined by the sensor or the datalogger. The resolution of rainfall data from a tipping bucket rain gauge is determined by the bucket size. It may be possible to improve the resolution of water-level data from a shaft encoder by fitting a pulley with a smaller circumference. The resolution of the datalogger's analog channels determines the resolution step size for readings from analog sensors.

The sensor selected must be capable of providing the information required from the recorded data. The nominal range for the sensor must encompass the lowest and highest parameter values expected. Data resolution will suffer if the sensor range is very large compared to the dynamic range of the parameter.

A sensor with high sensitivity will be selected where small changes in the parameter are of interest. For this reason thermistors are used to measure temperature profiles.

Sensor calibration must be confirmed at installation and at subsequent station visits.

THE SENSOR PCB

Sensor pcbs carryout functions which may include amplification of the transducer output, linearization of the sensor output, compensation for temperature dependence of a surrogate parameter, compensation for temperature dependence of the transducer performance, and for temperature dependence of pcb components, or generation of a current output signal.

The accuracy of the signal arriving at the datalogger depends on the accuracy of each of these steps.

In noisy environments a sensors that outputs a large signal (e.g.volts) will generally present a higher (more favourable) signal-to-noise ratio to the logger input, than a sensor that that outputs a small signal (e.g.millivolts). Amplified signals may also improve data resolution by using more of the span of a datalogger analog channel.

Many modern sensor pcbs include a microprocessor, which may apply algorithms for linearization and temperature compensation. In these cases the transducer output is digitized via an A/D converter, and the resolution of the ultimate sensor output will depend on the A/D resolution.

Some simple sensors such as thermistors and some pyranometers do not have associated electronic circuitry, and functions such as linearisation, where necessary, must be carried out on the datalogger, or subsequently on a PC.

Sensor microprocessors may be used to estimate quantities of interest from parameter measurements. The relationships used in estimating these quantities may involve assumptions. For optimum data quality it is advisable to ensure that the assumptions are valid.

For example, raw conductivity varies with ionic concentration, but also with temperature. Temperature compensated (to 25°C) conductivity is known as specific conductance or normalised conductivity. Instrument manufacturers usually apply a normalisation correction from within the range 1.8-2.0% per 1°C of difference from 25°C. The appropriate value depends on the ionic strength of the solution.

Raw dissolved oxygen (DO) sensor readings represent the partial pressure of DO expressed as percentage of saturation. The quantity of interest is usually DO concentration (ppm). The solubility of oxygen in water that is in equilibrium with air depends on the water temperature, salinity and atmospheric pressure. Most DO sensors do also measure temperature, but not salinity or barometric pressure. DO concentrations estimated on-board these sensors use assumed salinity and barometric pressure values.

Invalid assumptions can be corrected by the datalogger programme where actual values for the assumed quantities are known.

SENSOR SIGNALS

The properties of cables that affect data integrity, and methods for overcoming or mitigating problems are discussed in the following section.

The amplitude of an analog voltage signal measured at a datalogger channel decreases with sensor cable length due to the resistance of the cable conductors. In general, calculations should be carried out for any cable runs greater than 30m.

Current output sensors (0-20 or 4-20mA) are designed to generate the appropriate output current, irrespective of the resistance of the cable, up to the manufacturer's maximum loop resistance specification, and current output sensors may be used where long cables are required.

Frequency signals can also maintain their integrity over relatively long cables.

The specification for SDI-12 states that the maximum cable length for this digital signal is 60 m. Some SDI-12 devices may transmit over much longer distances. The maximum distance possible depends mainly on the ability of the electronic line drivers used in these devices.

Analog and frequency signals are more vulnerable to corruption by noise than digital signals.

SENSOR-LOGGER CABLES

Some loss in data quality may be attributed to, or be induced via, the cables used to connect sensors to dataloggers. Potential problems can be minimised by selecting suitable cables.

Sensor supply voltage may be reduced below the minimum required, and milli-volt or voltage signals attenuated with increasing cable resistance. Cable resistance varies with the type of conductor material, cross-sectional area, and cable length.

Digital signals are distorted by cable capacitance. Cable capacitance depends on the length and proximity of the conductors in a cable, and also on the type of dielectric material between the conductors (i.e. the type of plastic sheath around the wires).

Screened cables can be used to shield analog signals from electrostatic noise

Resistance and capacitance specifications for cables are provided by manufacturers.

Selecting the best cable for an application is a specialist task.

Radio links are available which can be used to connect sensors and dataloggers separated by distances up to several kilometres.

SENSOR-SIGNAL CONDITIONING AT DATALOGGER INPUT CHANNELS

"Voltage dividers", comprising a pair of resistors, are used when necessary to reduce the range of the sensor output voltage signal to match the range of the logger analog input channel. Two equal value resistors (usually 10K or 100K Ohms) are used for to halve the voltage . Any difference in the value of these two resistors, expressed as a percentage of the value, will lead to a corresponding error in the recorded data.

"Load resistors" at logger analog channels are used to convert sensor current signals to voltages. The value of the load resistance must be accurately known so that the sensor calibration relationship can be correctly applied. Any percentage difference between the actual and assumed load resistance value will lead to a corresponding error in the recorded data.

Resistive-capacitive (RC) filters are sometimes used at data logger counter channels to filter noise , for example switch bounce associated with switch closures. There is a time constant associated with an RC filter, which depends on the values of the resistor and capacitor used. The time constant corresponds to the period following a count, during which further counts will not be seen. Inappropriate filters will result in valid signals not being counted, or noise spikes being counted.

DATALOGGER INPUT CHANNEL PERFORMANCE

Analog channels are used to measure voltage or current output signals from a wide range of environmental sensors.

The resolution specified for an analog channel defines the step size of detectable parameter changes. The channel range for a "12-bit" channel is broken into 4096 (2^{12}) resolution steps. The channel range for a "16 bit" channel is broken into 65536 (2^{16}) resolution steps.

The step size for data from a 20m range, 0-2.5v output pressure transducer, read by a 0-2.5v range analog channel will be 20,000/4096 mm (~5 mm) for a 12 bit channel, or 20,000/65536 mm(0.33 mm) for a 16 bit channel.

If the sensors voltage output range is less than the logger channel range, the number of resolution steps across the sensor's output will be proportionally less, and the size of the steps proportionally larger. Load resistors are used at datalogger terminals to convert a current signal to a voltage. A 125Ω resistor can be used to maximize the number of resolution steps for a 4-20 mA signal measured by a 0-2.5v channel. The voltage range corresponding to the 4-20mA current signal, via a 125Ω load, will be 0.5 – 2.5v, or 0.8 of the full channel range.

The step size for data from a 20m range, 4-20mA output pressure transducer read by a 12 bit, 0-2.5v range, analog channel via a 125Ω load will be 20,000/(4096*0.8)mm (~6 mm).

Analog channels can sample sensor signals very rapidly. The on-scan channel reading usually corresponds to the average of a number of rapid samples. Channels can often be configured for a short integration period (or a specified small number of samples), or a long integration period (or a larger number of samples). A long integration period can be used to "mean-out" high frequency noise in a signal. Where maximum or minimum values are of a "real" rapidly fluctuating signal are of interest, a short integration period can be used.

Datalogger analog channels can drift out of calibration. Error in the calibration of analog channels will be reflected in the data. The calibration can be adjusted.

Selectable analog channel ranges are available for some dataloggers. A low range of 5mV to +5mV, and a high range of –5v to +5v may be available with several intermediate ranges. The number of resolution steps specified for a channel is the same for each of the ranges, and so the step sizes are relatively small for the low ranges. Where several ranges are available, the lowest range that will accommodate the sensor output range is normally used, to minimize the size of the resolution steps.

DATALOGGER EXCITATION CHANNELS

Some sensors require a known regulated excitation voltage. Logger excitation channels provide fixed or programmable excitation voltages for sensors such as wind direction sensors or thermistors.

An error in the excitation voltage, expressed as a percentage, will cause the same error value, expressed as a percentage, in the sensor output.

THE DATALOGGER PROGRAM

Linear or non-linear relationships are used in the logger program to convert the raw voltage or frequency readings to engineering units. Manufacturers specify the parameter and output ranges for sensors, and supply equations relating output signal to parameter magnitude for non-linear sensors.

The datalogger programmer needs to correctly modify conversion relationships to take into account modification of the sensor output range by signal conditioning (voltage dividers and current loads). Scaling that assumes a 125Ω load resistor, when the resistor value is actually 124Ω will introduce a 0.8% error to the recorded readings.

Imperfections in the fit of relationships used will be represented in the recorded data. Some "linear" sensors do have characteristically curved calibration relationships. Where warranted, data quality may be improved by fitting a non-linear relationship to a multipoint calibration, for use in the datalogger program.

The logger program may be used to filter spikes from analog signals. "Real" noise in data, such as water waves may be "meaned out" by logging the average of frequent readings of a pressure sensor.

Water levels in stilling wells are meaned by the throttling effect of the static tube and therefore instantaneous encoder data will provide a true record of the mean water level.

Where information on waves is required, the frequency at which data is recorded must be sufficient to avoid the phenomenon known as aliasing.

The logging regime must be designed to capture the data required. Fixed interval logging may be appropriate for parameters that trend up and down slowly over time. Parameters that change intermittently may be best logged on an event basis. A mixture of fixed interval and event based logging may be appropriate where the background value of the parameter trends slowly, but occasional short-duration significant events occur. This method would be best where detail was required of occasional pollutant discharges into a stream.

The quantities logged must be chosen to allow the required information to be extracted from the data. Recorded wind data normally includes means and standard deviations and the maximum wind gust. Solar radiation means are more representative than instantaneous values, particularly on partly cloudy days.

A sensor signal read by a datalogger may contain error due to sensor calibration error, signal loss in the sensor cable, incorrect values for signal conditioning resistors, faulty logger channel calibration, or some combination of these. The logger program can be designed to provide a software-based, system calibration that adjusts for error in the perceived signal. Where appropriate this method can be applied at the time a station is installed, and at subsequent site visits.

STATION INSPECTIONS AND MAINTENANCE

Apparent faults in time series data may be due to:

- real, but unexpected behaviour of the measurand
- interference
- calibration drift
- fouling
- a faulty sensor

A program of station inspections can be designed to minimise the likelihood of problems and to identify, characterise and correct anomalies that do occur, so that the time series can be confidently interpreted.

The approach widely used at hydrometric stations in New Zealand can be adopted at stations monitoring other environmental parameters. At station inspection visits water level and rainfall sensor readings are routinely checked against reference gauges, and the logger time and the battery voltage are checked. Station inspection log sheets include fields for the respective readings and comments. Figure 2 is a water level station log sheet.

Similar inspection procedures can be designed for most parameters.

In some cases discrepancies identified between sensor readings and references can be corrected during a station visit. Fouling can be removed. The calibration of some sensors can be adjusted on-site. A stilling well static tube can be cleared. A source of interference may be eliminated. In other cases the source and magnitude of the discrepancy can be recorded to allow post-correction of the data. In some cases a damaged or faulty instrument or cable may need to be replaced.

Figure 3 is an inspection form for a conductivity sensor at a water quality station. Visible fouling prior to cleaning is noted. Sensor readings before and after cleaning are noted. An increased reading following cleaning indicates that fouling was affecting the sensor's performance. The sensor calibration is checked using two standards. Distilled water, or the dry sensor reading in air is used to check the zero point. A potassium chloride solution is used to check a high calibration point. The sensor calibration is adjusted if the sensor is found to be out of calibration.

Station visits must be scheduled at intervals that take into account station power requirements and expected battery life, the logging regime and expected "memory life", and instrument servicing requirements. Sensors subject to bio-fouling may have to be cleaned more frequently during summer months. Gas bottles need to be replaced periodically at gas-purge pressure sensor stations.

UNLOADING DATA TO PC

Data are occasionally corrupted during an unload. Unloaded data should be checked before leaving the station, to ensure that the dates and times for the first and last logs are as expected, and that the first few and last few recorded data values agree with noted reference readings.

DATA INTERPRETATION

Data interpretation is aided by good records from station inspections.

The quality of information derived from recorded data will depend on how well target parameter/surrogate parameter relationships are defined and understood.

The units and precision of recorded data must be clearly defined. There may be several common units for one parameter:

- DO is expressed as percent saturation or ppm.
- Conductivity data may be logged as raw or normalised readings with units of micro-siemens per centimetre or milli-siemens per meter.
- Windspeed data may be logged as metres per second, knots, or kilometres per hour.
- Data may be logged as tenths or hundredths of the normal unit, to increase precision.

RECORDER LOG SHEET

STATION: .... *at* ....
Data Start / Data End / Inspection..
DATAPAK/DATASET NO: In: .... Out: ....

Primary/ backup

INSTRUMENT No's.

....

....

....

TIME INFORMATION

DATE: .... Day No: ....
ACTUAL TIME: Standard: .... Daylight :..................
RECORDER TIME: ....

STAGE READINGS: Site No. ....

Offsets, etc.

EXTERNAL GAUGE:................................ *m* +............. *mm* ....
INTERNAL GAUGE: .... *m* + ... *mm* ....
RECORDED STAGE: .... *m*
RECORDER DISCREPANCY= .... mm
SENSOR/ENCODER: .... *m* ....
WATER TEMPERATURE: *measured:* .... °; *+/- correction* ....°C

RAINFALL: Site No: ....

CHECK GAUGE .... *mm* by dipstick.
.... *mm* by glass. *Emptied?* Yes/No
TIP COUNTER: .... *tips / 2 =................................ mm rainfall. ....*
MANUAL TIPS: Delete .... tips at ....NZST. ....

TELEMETRY: Comms. Test OK? Y / N ....

POWER SUPPLY

	Battery No.	Voltage:	Diode checked Y/N
	....	volts	load / no load / main / back-up
OUT			
	....	volts	load / no load / main / back-up
IN / CH			
Out/IN/CHECK			
	....	volts	indicated by logger / remote

REMARKS / Other Parameters: Logger Manual

...
Back-up rec "chart changed"? Y/N ....
Gauging completed ? Y/N Observer:..

FIELD SENSOR CHECK/ADJUSTMENT REPORT

Station: Lake Forsyth

Operated by: CRC

Date: 03-Feb-00

Technicians: SED

Logger Type CR10

Program Name: FORSYTH.DLD

Sensor Type: EC200

Sensor Serial #: EC2200

Range: 0-30000 uS/cm

SENSOR INSPECTION

Reading before cleaning: 5872

Reading after cleaning: 8767

Apperance: OK. Some minor buildup of scale

CALIBRATION CHECK / ADJUSTMENT

Refence used: Standardised KCL Solutions

BEFORE ADJUSTMENT

Reference value	0	25100			
mV Output	515	2118.4			
Logger Reading	81.4	25342			

Adjustment Implemented: Y

Old Slope: 15.754

New Slope: 15.654

Old Constant: -8031.6

New Constant: -8061.9

After Adjustment @ 14.54 degC

Reference value	0	25100	147R	130R	160R
mV Output	516.3	2114.7	1696.6	1857	1604.7
Logger Reading	20	25041	18497	21008	17059

Comments: Sensor calibrated well. I have started using resistive loops to test the EC sensor. Once a the transducer has been characterised, the resistive loops can be used a calibration check method without the need for standardised KCl standards.

Signed

Figure 3: An inspection form for a conductivity sensor at a water quality station.

CONCLUSIONS

There are up to 14 components of a monitoring station that can contribute to the overall uncertainty of the recorded data. The value of the data and the confidence that can be placed in it depends on each of the components being understood and taken into account when the station is designed and commissioned, and on the implementation of an appropriate station inspection program.

AKNOWLEDGEMENTS

John Fenwick is thanked for producing Figure 1. Jeremy Bullied, Graham Elley, and Charles Pearson are thanked for helpful review comments.

SonTek Field Day

Rocklea Testing Facility, Qld NR&M.
Report Compiled by Paul Webb

On the 30th August Chris Ward of SonTek and Fadi Gemayel of HS in Sydney presented Queensland hydrographers with a chance to understand and handle some of the SonTek Doppler equipment. The day was hosted by the SE NR&M Hydrographers and Hyd support at Rocklea. The presentations and exercises gave a great chance to get a feel for the equipment beyond the specs and pictures.

Only limited testing was done but it was enough to give a reasonable feel for the potential of the equipment. The following is based a brief summary only based on personal impressions.

Flowtracker

See http://www.sontek.com/product/flowtracker/flowtracker-ov.htm for specifications and details.

In short the Flowtracker is a current meter for use in wading gaugings. It is apparently hardy and offers a few conveniences compared with propeller type current meters. I was impressed with the equipment and, if setting up from scratch, would choose it over a C31 and Ott minor combination. The Flowtracker is used as per a propeller current meter but the graded rod and attached logger make one person measurements more comfortable. It is not magic in that it does not avoid the getting wet or setting up the wire/tape. However, it does give an answer at the end of the measurement and can be readily downloaded for detailed analysis or reporting of the measurement details. During the measurement a number of validation tolls allow the Hydrographer to evaluate the quality of each velocity reading and effectively the whole measurement.

I saw enough to convince me that it is a good and useful alternative to existing current meters. Some attendants later expressed concern that it was not tested in slow velocities which is the area of concern at the moment with propeller type meters. This is an area that would warrant further testing. Links on the website above give USGS onsite and towtank testing indicating accuracy and reliability from .1 to 5 feet/s.

Current price is about $11k Aust.

MiniADP with Rivercat

See http://www.sontek.com/product/rivercat/rivercat.htm

The miniADP is a useful alternative to the Workhorse Riogrand currently in use with NR&M. The unit trailed was a 3MHz. This has a reliable operating range of about 1-6m. In effect this makes it the next step up from wading gaugings. This gets better shallow depth readings than the 1.2MHz Riogrande but the 6m max depth is likely to be a prohibitive factor. Chris Ward explained how the assumptions made by the profilers (that all beams are in measuring in the same water column) are a bit dangerous in shallow water. In situations where it is too deep to wade the 1.5MHz miniADP will get the shallow edges at least as well as the 1200 RioGrande and will get to over 20m. The single mode operation and the intuitive software make the miniADP a good tidy unit. Recent in the software also allow point observation mode as an option (IE use tape for distance and hold ADP insitu for individual vertical profiles). Radio link to PC is another aspect of the sonTek gear that make it a tidy setup.

Rio Grand instruments have probably improved their products since NR&M purchases and so, their current products should be revisited before any commitment to SonTek equipment. However, from what I saw, I would prefer a SonTek 1.5MHz to our current 1200 RioGrande. Remote deployment options for the existing RioGrande would probably be a more useful immediate step with a view to considering SonTek miniADP for the next major purchase. Chris Ward indicated that SonTek is pursuing the development of a multi frequency ADP which may be a significant enhancement for shallow readings and for suspended sediment concentration estimates.

Current price is about $22k up to $25k Aust with the river cat.

Differential GPS option is probably not cost effective for our operating conditions. The Omnistar subscription is an extra requirement and cost, and its availability in Australia has not been confirmed.

DGPS eq approx $8k Aust.

Argonaut Time Series ADP options

See http://www.sontek.com/arg-family.htm

The Side looking Argonaut looks like providing a useful alternative to existing gauging station setups. This instrument is set up in the water and measures water level and water velocity. The velocity measurement is performed in a horizontal layer from the instrument. By design, this measured velocity is correlated with historic (gauged) mean velocity and cross-sectional area to give time series discharge. I see this as setting the standard for future streamflow monitoring as it has the potential for better real time flow estimates and it eliminates the rating loop problems with rising/falling stage.

Cost is approx $13k Aust with additional cost of logger/phone/shelter installation. There will be significant risk associated with installing the Argonaut in streams due to the debri damage potential. They take up about as much space as the existing WQ 4" pipe T-pieces.

The uplooking ADP was not considered in detail as all present saw bottom mounted equipment as being subject to excessive silt problems.

Software

All software for the above instruments is offered free from SonTek. In the field trials several staff had a look and play with the software and it was generally fairly intuitive. The simple (standard) setup options leave a good audit trail and limited scope for unrecoverable errors due to oversights in the field.

Suspended Sediment Concentration Estimation

All devices tested record signal return strength and store it in raw data files by default. This data has the potential for subsequent mining for indicative sediment load information after site specific calibration. The processes associated with this use of Doppler data for Sediment load estimates are in early stages. Current indications show significant time is required to calibrate any site due to the variations in signal strength due to particle size, concentration and distance from signal source. My personal opinion is that even the indicative data may show the limitations of existing projects in sediment load estimates and as such, even preliminary doppler data interpretation will give reasonable estimates by current standards.

Most catchment sediment load estimates at present are based on limited data and many assumptions. Recent anomalies in results from hand sampling (near surface) and auto sampler results highlight the need for a better understanding of the stream sediment load profiles to estimate loads. I believe doppler profiling combined with IR turbidity readings (at known depths) and targeted water samples have the potential to more efficiently and more accurately estimate stream sediment loads.

AHA Committee Meeting. Canberra, October 9.

The AHA Committee convened a management meeting involving the Committee and State Reps in Canberra on Saturday, October 9.
This meeting was a flow on from the AGM in Queensland and following further feedback from conference participants.
Committee members in attendance were Graham Armstrong, Scott Walker, Mic Clayton, Michael Whiting and Jim Tilley. State reps were Stephen Buckland and Bill Steen. The venue, at the Ecowise Offices in Fyshwick, was arranged by John Skinner, our Public Officer.
Apologies were received from Max Hayes (Treasurer) and the other State and New Zealand reps.

L-R Stephen Buckland (Tas), Bill Steen (ACT), John Skinner (Public Officer), Mic Clayton (Publicity Officer), Scott Walker (Secretary), Graham Armstrong (Chairman), Michael Whiting (WA), Jim Tilley (Committee Member)

A fairly full day was undertaken with many issues being discussed. Consideration was given to development of proposed amendments to the Constitution, mainly to bring things in line with modern technologies and to review membership grades. When the words are sorted out, eligible members will receive notification of the proposals for their consideration before a ballot is conducted.

In regards to membership management (procedural issue) the following is to be implemented:

- modify how notifications and memberships are handled. Expiry date of memberships will appear on the mailing label.
- Membership renewal advices will be distributed to members showing their current details and members asked to correct any changes to their membership
- Applications and renewals will be sent to the Treasurer so that funds can be banked/credited immediately

- Sate Reps will assist with maintaining member details for members in their state

The Committee is also reviewing the date on which subscriptions will be due.

The proposed changes in these areas will make management of the member register easier.

Discussion was also held into accreditation processes for hydrographers and increasing awareness of our profession. The Committee will be undertaking some investigations into other organisations methods and developing the issue from there.

In the past mini workshops were hosted by authorities and industry, generally a one day event with a social function, which were very popular with regional members. Previous workshops involved industry sponsored technology awareness (ie advertising!) and mini training courses. After discussion, the Committee agreed to encourage and assist State Reps to revive these workshops on a regional basis. Of course members from outside the region would be welcome to attend.

There was discussion as to State groups and the formation of 'official' state branches is not covered under the AHA constitution. The Committee has decided that if state groups wish to form, the best approach would be to form a hydrography interest group or something of a similar name.

Discussion was had regarding establishment of professional forums on issues such as standards, new technologies and appropriate applications and so on. It was agreed to initially facilitate the establishment of discussion/idea exchange forums would be facilitated through the associations web site (that would be mediated) with an aim to share information and knowledge about a range of issues. The way this would be managed is currently being investigated.

The next AGM was discussed it is expected that it will be around the time of the next Kisters/Hydstra User Group Meeting, expected to be in Canberra in August, 2005.

The 2006 Conference was also discussed and initial offers of possibly NSW (again!) or the Northern Territory are being followed up. The last two conferences have now been in NSW (2002)and Qld (2004) so if other states wish to put their hand up they are most welcome!

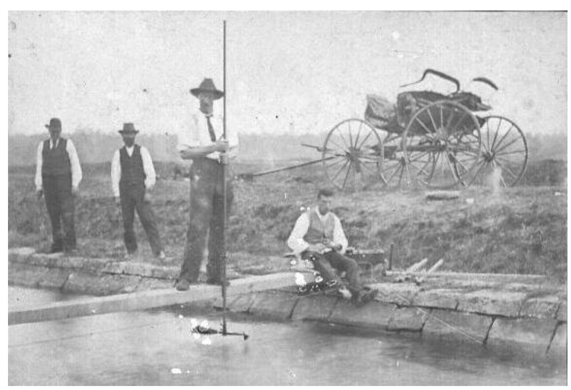
Contributions to the Journal and Newsletter

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.

Contribitors and advertisers are requested to supply copy in Word format, but if PDF is supplied please ensure that protection features are disabled so that cut and pasting can occur as required for AHA use.

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. With improvements in digital technologies and the ease of its use, there should be no shortage of interesting photos for the cover!



Gauging Circa 1913.
Photo source Alex Springall (No, its not him seated.)

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