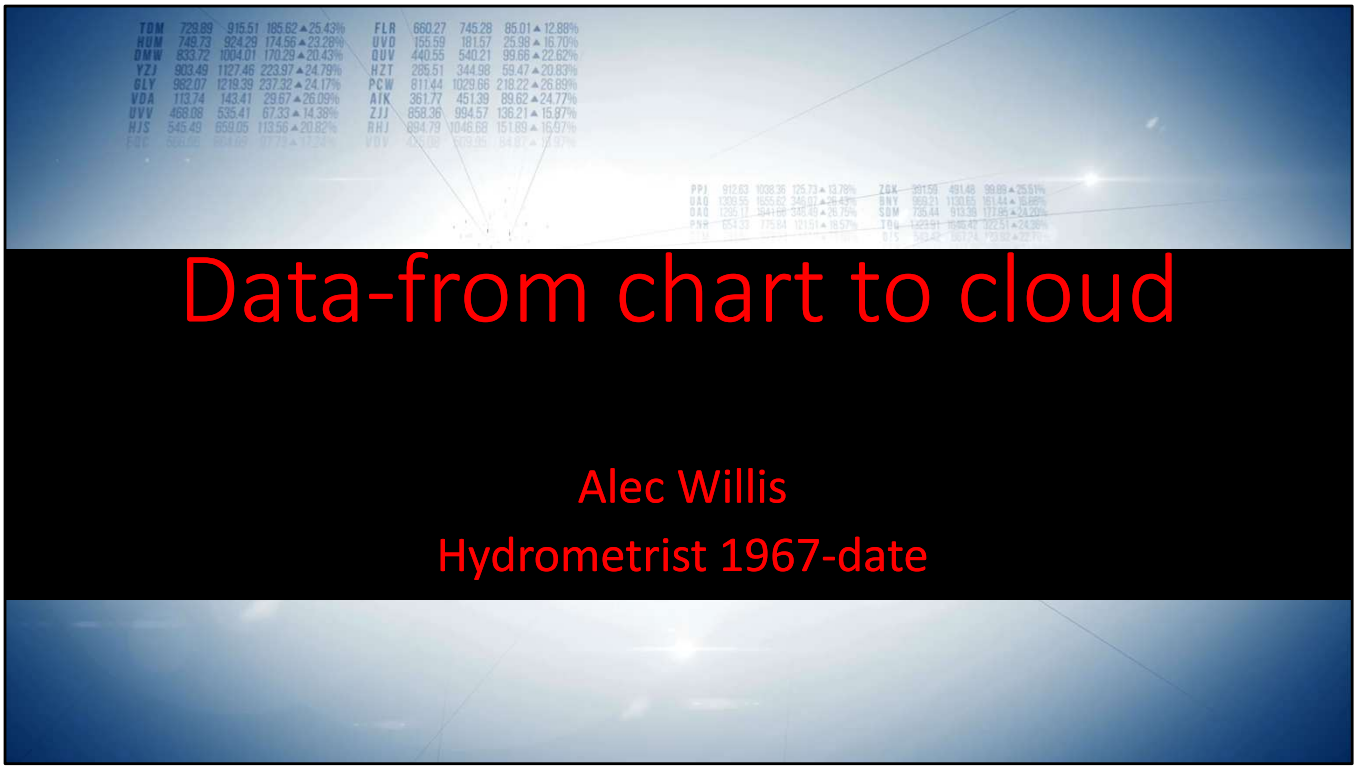


Data-from chart to cloud

Alec Willis

Hydrometrist 1967-date

Met Office 1967

- Met O 19
- High atmosphere research
- KDF 9 8000 48bit words





Hi my name is Alec Willis and I'm a high drama tryst.(actually a hydrometrist but that was Word's attempt at interpreting dictation and it's a more interesting career choice) It all started in the summer of 1967, I had underachieved at A levels and my parents thought I should go out to work . Since they both worked At the Met office this seemed a logical place to start .I began work on rain gauges at the experimental site in Easthampstead but after a couple of weeks was transferred to head office to work on ozone concentrations in the high atmosphere writing computer programmes to analyse data retrieved from Skua rockets launched from Benbecula.

Lancaster University 1968-71

- Gauging the Conder

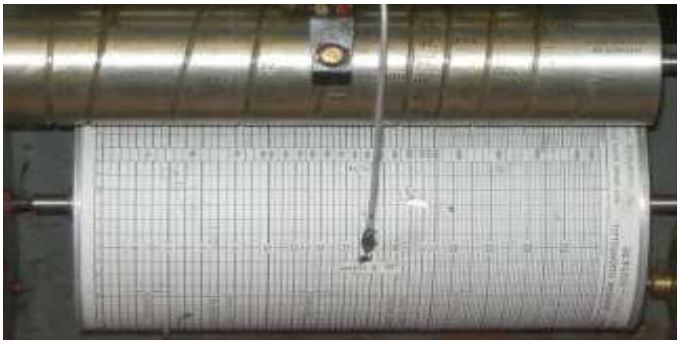


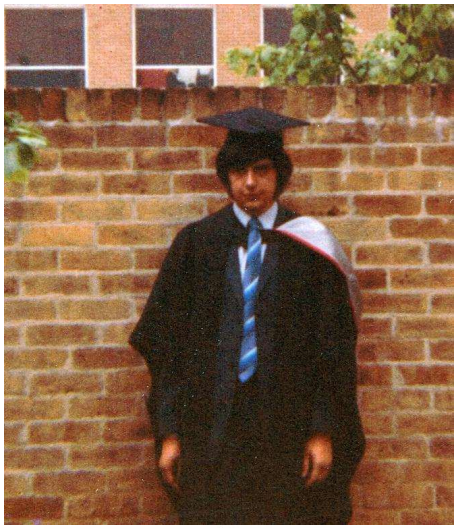


I managed to improve my grades and got a place at Lancaster University. One of the highlights was dilution gauging on the river Conder. We'd been taught the theory and when we heard that the Conder was in spate we decided to put the theory into action. We took a bottle of Rhodamine B but unfortunately misjudged the dosage and turned the river bright purple. Fortunately Lancaster still had a linoleum industry and brightly coloured rivers were not uncommon.

Lancaster University 1968-71

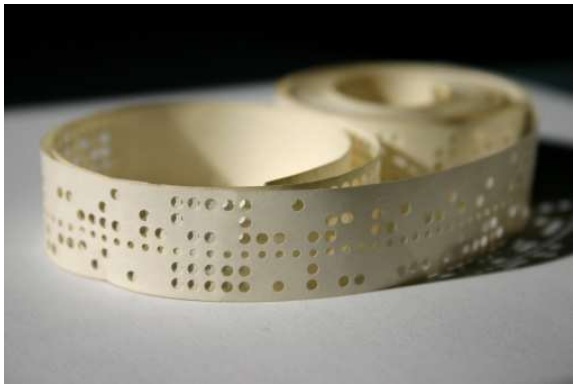
- Bottoms Beck model





When the subject of final dissertation came up I opted to analyse drumlins in north Shropshire but fortunately my supervisor worked out I just wanted a quiet summer and persuaded me that I should write a mathematical model of a local catchment based on Stanford Mark IV. This was Bottom's Beck run by Fylde Water Board and the data came in autographic charts. I needed to read it off by hand. Fortunately my fiancée helped me and we managed to get the input data onto computer. The model was successful if the catchment was saturated but couldn't cope with drier conditions. The job market was different in those days and I was offered a job by the Water Resources Board in the January of my final year.

Water Resources Board 1971-74





My main task was facilitating the processing of punched paper tapes. But I also ended up writing programmes to calculate flow over various weirs and flumes and developing an automated process to calculate rating equations from a set of gaugings.

Water Resources Board 1971-74

- Research
  - Electromagnetic gauge
  - Time-of-flight ultrasonic
  - Location of head measurement for compound Crump weirs
  - Pulsations



The Water Resources Board had a generous research budget. One of the projects I got involved with was an electromagnetic river gauge at Princes Marsh in Hampshire. Which suffered from the adjacent Third Rail electric railway. Meaning that we had an expensive railway timetable.

There was also the time of flight ultrasonic at Sutton Courtenay. One highlight from this was as we've got the cable stretched across the river for the current meters we were using and all of a sudden a rowing 8 came hurtling round the bend. And have you ever tried to stop one of those? It's not easy. Fortunately, we did

Water Resources Board 1971-74

- Research
  - Electromagnetic gauge
  - Time-of-flight ultrasonic
  - Location of head measurement for compound Crump weirs
  - Pulsations



Another experiment that was going on at Sutton Courtney was to try and determine the effect of pulsations on river gauging. This involved a bank of six gauging poles across the river, each with four actual meters on, Data was fed back by cable to a box which contained 24 electromagnetic counter timers. These racked up the counts digitally and a photo was taken of the box every 30 seconds. Then the lady back at the office had to type all these into the computer so the data could be analyzed. One other project was determining the optimal location of head measurement in a compound Crump weir, which involved going up to St. John's Beck in Cumbria and spending a couple of days getting data to determine what was going on. Main memory from that was that was where I decided to join the Campaign for Real Ale

Usk River Authority 1974-5



Usk at Chain Bridge

- Gauged at 3 and 300 m3/s
- Whisky and sixpences for high, also fence posts with 6in nails at the bottom
- Davenports beer for low flows.
- Bad – Ebbw when Valleys Trunk Sewer burst

We couldn't afford to buy a house in Reading. Prices were three or four times salary and that wasn't achievable even though my wife was a full time teacher. And no that's not the fiancée referred to earlier. So we moved to South Wales, where I joined the Usk River Authority and gained valuable field experience there. I can remember gauging the Usk at Chain Bridge at both 3 and 300 m^3/s. The 3 m^3/s gauging involved a really hard day's work. Basically do 1 wade gauging in the morning. The Chain Bridge is named after the adjacent Davenport's pub, so a 90min lunch in there .And then do another gauging in the afternoon and that was deemed an acceptable day's work at the time.
We occasionally did night flood gaugings. Tools for that were a bag of sixpences, (2½p) which we needed to operate the coin operated phones, and a bottle of whisky which we needed so that we kept our enthusiasm going throughout the night.

Usk River Authority 1974-5



Usk at Chain Bridge

- Gauged at 3 and 300 m3/s
- Whisky and sixpences for high, also fence posts with 6in nails at the bottom
- Davenports beer for low flows.
- Bad – Ebbw when Valleys Trunk Sewer burst

Another tool we used for gauging was basically an 8 foot 4 by 4 fence post. (2.5*0.1*0.1m). Into the bottom of this we hammered in a dozen 6 inch (15cm) nails to give it some bottom weight. Then it was thrown into the River Usk at gauging stations like Trallong and Llandetty in order to do a gauging. The floats were timed over a 100yd (100 metre) stretch. We were quite pleased when we when we installed the cable ways and found that the float gaugings we'd done were quite close to reality.

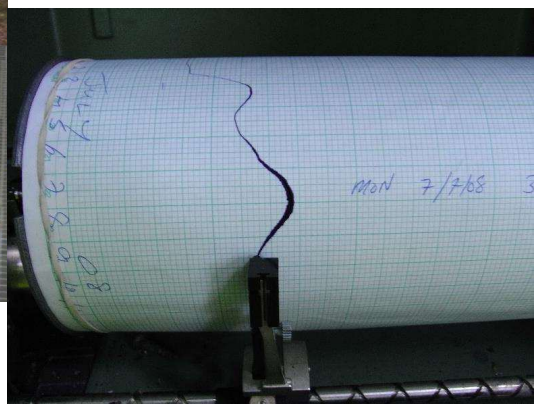
Probably the worst day I had was when the main trunk sewer across the river Ebbw had burst and we had to gauge upstream and downstream. Upstream was reasonably unpleasant because the at the time the river was quite polluted, but downstream was horrible because the contents of the trunk sewer was spilling into the river and wrapping themselves around the meter impeller.

Wessex Water 1976-87



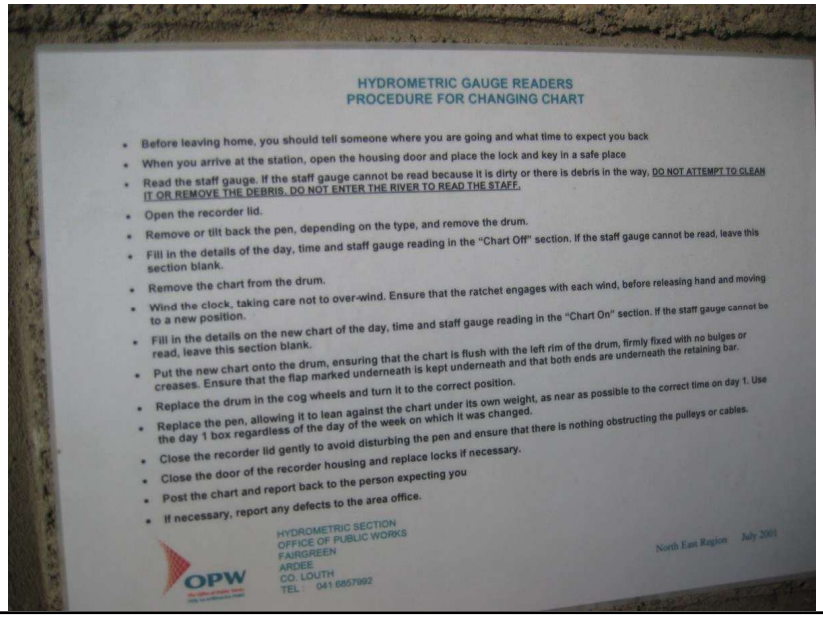
I didn't get on with my boss so after 18 months I moved to the Somerset Division of Wessex Water based in Bridgwater, just in time for the 1976 drought.





At the time the primary technology for recording river levels and hence flows was punched tape recorder backed up by a chart running off a float well at a purpose built gauging station. We used a mixture of Lea recorder wax charts and OTT paper charts. One of the benefits of charts is that you can record your notes onto them as a permanent record. This came back to bite me after about 15 years. Hydro-logic got a contract to digitise Somerset's charts. I got a call from Alison in our Reading office to ask “what were you doing in April 1978?”. I said I can't remember. She pointed out that on the chart she was processing the chart stopped with a vertical line and it said “sorry, forgot to wind clock” .Signed AW.

How to change a chart



HYDROMETRIC GAUGE READERS
PROCEDURE FOR CHANGING CHART

- Before leaving home, you should tell someone where you are going and what time to expect you back
- When you arrive at the station, open the housing door and place the lock and key in a safe place
- Read the staff gauge. If the staff gauge cannot be read because it is dirty or there is debris in the way, DO NOT ATTEMPT TO CLEAN IT OR REMOVE THE DEBRIS. DO NOT ENTER THE RIVER TO READ THE STAFF.
- Open the recorder lid.
- Remove or tilt back the pen, depending on the type, and remove the drum.
- Fill in the details of the day, time and staff gauge reading in the "Chart Off" section. If the staff gauge cannot be read, leave this section blank.
- Remove the chart from the drum.
- Wind the clock, taking care not to over-wind. Ensure that the ratchet engages with each wind, before releasing hand and moving to a new position.
- Fill in the details on the new chart of the day, time and staff gauge reading in the "Chart On" section. If the staff gauge cannot be read, leave this section blank.
- Put the new chart onto the drum, ensuring that the chart is flush with the left rim of the drum, firmly fixed with no bulges or creases. Ensure that the flap marked underneath is kept underneath and that both ends are underneath the retaining bar.
- Replace the drum in the cog wheels and turn it to the correct position.
- Replace the pen, allowing it to lean against the chart under its own weight, as near as possible to the correct time on day 1. Use the day 1 box regardless of the day of the week on which it was changed.
- Close the recorder lid gently to avoid disturbing the pen and ensure that there is nothing obstructing the pulleys or cables.
- Close the door of the recorder housing and replace locks if necessary.
- Post the chart and report back to the person expecting you
- If necessary, report any defects to the area office.

OPW
HYDROMETRIC SECTION
OFFICE OF PUBLIC WORKS
FAIRGREEN
ARDEE
CO. LOUTH
TEL : 041 6857992

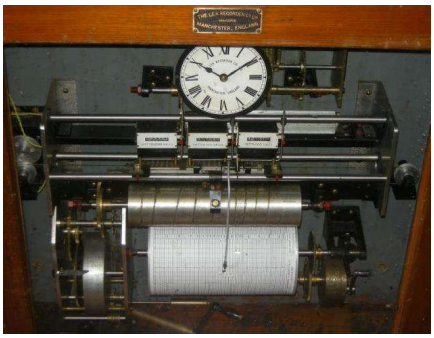
North East Region July 2001

We had a methodology for changing charts, not dissimilar for the one the OPW used in Ireland. Although we didn't have it printed off at every station.

Man's inhumanity to hydrometry



Langford Springs



I got an early insight into the importance of giving intelligible and unambiguous instructions to staff. We were puzzled by the data coming back from Langford Springs which was a compensation gauge managed by Bristol Water. While the charts suggested they were releasing the compensation flow, our gaugings downstream suggested something different. I went to site and met the guy responsible. It was a Lea recorder, chain driven with a big float and counterweight. There was a nail in the chain. I said to the technician, "What's that nail there for?". He said "When I started this job, they said under no account must the trace go below the compensation level. So I made sure it doesn't" .And he was doing was doing exactly what they told him to do.

Exeter 1982



In 1982 I attended the IHS Symposium Exeter. The thing that caught my eye was the Telegen 1150. Designed by Stuart Walker and Jim Waters at Severn-Trent and built by DTS in Portsmouth, this was a revelation. It could be attached to a shaft encoder recording water levels to a millimetre. It could count pulses from a tipping bucket raingauge. It would store 40 days of data. It would give up that data when asked nicely by computer. And it would also give you the current water level by means of tones if you rang it with from anywhere with an ordinary phone. We justified the investment on the reduction in battery usage because the punched tape recorders required expensive electric fence batteries every year .

Exeter 1982



.We then justified buying the Tektronix 4051 terminal on the grounds, again, that it would save money. It wasn't a computer, it was an intelligent terminal because head office controlled computers and were the only people who knew anything about them. Fortunately, the Tektronix had a Basic interpreter with data storage on cartridges. You could program the screen to display graphs. And it would link to a modem so that you could interrogate the Telegens.

Almost nipped in the bud



Brue at Lovington

I refer to our love affair with the Telegen. This was almost nipped in the bud. Reviewing the data from the Brue at Lovington, we noticed that it has suddenly dropped about 8mm within a 15 minute period. There was no obvious natural cause for that. Maintenance at the time was done by manual labour gangs and they had to fill out timesheets. So we checked back on the timesheet for that particular gang and no, they had not done anything on that Friday afternoon. Fortunately on the next site visit they I ran into them, said explained the problem. They said “Oh no, we cleaned the weir”. “Well it wasn't on your timesheet” .”No”, they said “we're on maximum bonus and if we'd booked any more work, they'd have started checking up on us”. They were quite happy to do the work. They also were quite happy to avoid the complications caused by management systems.

BHS Meeting 17 Feb 1986
Hydrological Data Management in the United Kingdom

Chair – John Rodda
Speakers : Reg Herschy & Mike Lowing & Terry Marsh
Chair – Paul Johnson
Speakers : Frank Singleton & Brian May and Rick Brassington
Chair Mike Hall
Speakers : Bob Sargent, Richard Wood & Yours Truly

It's nice to be back in this hall 37 years after my debut. This was a meeting called by BHS, on Hydrological Data Management in the United Kingdom. Presented by some notable luminaries Reg Herschy from WDU, Mike Lowing from CEH, Terry Marsh from WDU, Frank Singleton and Brian May from the Met Office, Rick Brassington from BGS, Rob Sargeant from Forth RPB, Richard Wood from Severn-Trent. And lastly myself, simply because we had a cheap and cheerful fairly low key hydrometric data processing system going.

Warren Jones Ranger



We had a go ahead design engineer for sewage works who decided that he if had real data from his works he'd be able to do a better design. This was a bit revolutionary. Because of our experience in rivers, where accurate data capture was our only job, he asked us to look into the data coming from sewage works. Out of something like 97 sewage works, we could only put any faith in about 5 datasets. The rest were a mixture of open channel flumes with stilling wells which were filled with organic matter or electromagnetic recorders on pipes, which the only criteria for whether they were working or not was did they produce a signal between 4 and 20 milliamps. We'd come across some portable ultrasonic recorders which had the capability of having flume dimensions built into them to produce flow directly. Again, battery powered, weatherproof. So we bought a couple of these and installed them at works. Cleaned the flumes and got good data. Not quite as good as it could be because when we actually plotted

the data on graph on screen we noticed occasional dropouts. That went back to the makers and sort of did a mutual design upgrade on them.

Health & Safety



Health and safety had a slightly lower priority in those days. Here the slide shows a guy pressure washing the downstream face of a Crump weir. No safety boots, no hi-vis jacket no life jacket, no safety line. Just bracing himself against the back pressure of the pressure washer. But he survived to tell the tale. In the previous slide, there was a young lady downloading the Warren Jones Ranger. She was once sent down a manhole into a sewer to install a temporary flume. Took along a gas detector and when this went off she called up to say “I'll come up now”. The guy whose gas detector it was said “Oh don't worry love, it's always doing that”. Valerie said in a very clipped tone. “ I think I’ll come up anyway”.

Flood warning PC



Weighed 14kg!

At Somerset, we'd developed a flood warning system based on the Apple 2E. But when portable PC's came in, we upgraded it to run on MS-DOS. Which enabled flood warning hydrologists to take the “portable” computer home. It weighed 14 kilos. You also have to take a modem with you. While it was downloading data, you couldn't use the phone. If anybody rang you, the data was lost and you'd have to start again. But even so, it was a step forward. The other step forward, which I haven't got a slide for, was when weather radar came in. Admittedly there we could only watch it from the office, but the ability to see that more rain was coming, or that the rain was stopping was a game changer.

Hydrologic 1987-2010



However, Wessex wanted me to become a full time computer person and that's no life for a man. So I moved on. I'd been at uni with a guy called Rod Hawnt who'd formed a company called Hydro-logic. I joined them in 1987. We started out in his garage (once we got heating put in), moved on to rented accommodation in Leominster and then we bought a property in Bromyard which was Hydro-logic's headquarters until 2020.

One effect of privatisation in 1989



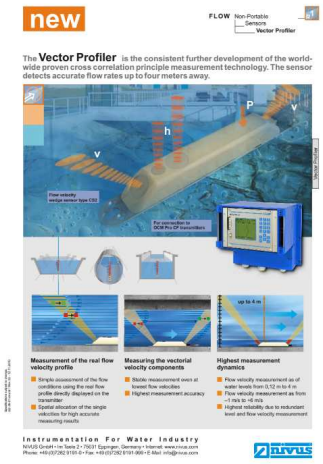
One contract that was interesting was reviewing gauging stations throughout England and Wales. This shows a gauging station in the North-west badly affected by weed growth. When NW was a River Authority there would be weekly ratings depending on the effect of weed growth. Once United Utilities became responsible all of a sudden the same rating applied throughout the year. This went on for a couple of years until pressure was applied that because this wasn't producing the required standard of hydrometric data.

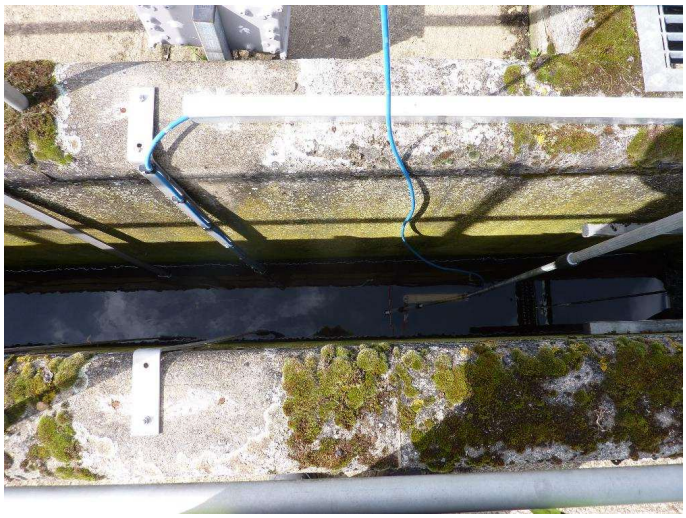
ADCP evaluation



We were involved in some interesting research projects for example evaluation of the first ADCP. We had a bit of a mishap at the Tern at Walcot and it turned upside down, but we found that put the right way up again, it would continue to work. It was fairly robust. Which was reassuring.

Nivus evaluation





We also sponsored an MSc student to evaluate the Nivus. as a project at Birmingham University. Which showed that as ever, the technology had promise and also imitations. We even forgave her the fact she was from Wrexham.

Data loggers



Data logging technology was evolving at a rapid rate. There were a.multitude of manufacturers each providing their own take on things and the loggers themselves are incredibly complicated. Hand built using custom chips. But all the time memory capacity was increasing and weatherproofing was improving. Particular one shown is an SFT logger hand crafted in Milton Keynes.

18 native data logger formats

Dialup Telegen logger and collect data / Accusonic transit time meters / Digitzer / Geotechnical Instruments logger / Leupold and Stevens Punched Tape Recorder / SFT PDL10 loggers / Stage Velocity and Flow data from Detectronics Loggers / Technolog Tinylog loggers / Aqualog logger / Cambertronics Groundwater Logger / Dynamic Logic DL1235 loggers / Hydrologic's Harvest loggers / OCM logger / Scottish Hydro WebSite Telemetry Input / Starflow ultrasonic loggers / Warren Jones Ranger / YSI6000 Files for NRA Anglia / Technolog Newlog loggers

Hydro-logic's Hydrolog, Rainark and Gaugeman software suites were at their peak at the time. The approach we adopted from early days was to convert any format we got into an intermediate format called DTF (Data Transfer Format). This that input into the archive into was consistent. We could process 18 native data logger formats. It was challenging to interpret the different formats, especially when people had used things like 1½ bytes, 12 bits to store data. Or where the customer who commissioned the particular data logger had lost any record of the file format, so we had to sort of work out what was going on from a guess as to probable flow patterns. ..

17 file formats

Didcot Weather Station / Anglian Water database / files from NRA SouthWest telemetry / Hydrolab data files / Anglian Water Daily Flow Files / Read data from Yorkshire NRA Climate Stations / Read data from Anglian Region Telemetry System / Read data from Casella weather stations / Read data from John Mosedale's NRA Wales data base / read files created by GBPlot digitising program / Read files from Mike Lowing's Chiltern Digitizer program / Read Hydrologic DTF files (in case of need to clean archive) / translate SW HIPS files for NRA South Western / UDA customer files / Warren Jones database / EcoWatch File Formats

We could also process a variety of file formats from proprietary archives.

At the turn of the Millennium, the Agency decided it wanted more corporate solution to its data processing needs and invested in WISKI. And so the majority of the market for our software evaporated overnight
From a personal point of view this meant of a few years in the doldrums, career wise. However help was at hand.

MCERTS

Over 4000 hydrometric measurement systems certified for accuracy at the behest of the Environment Agency

The Environment Agency decided that it needed external certification of the accuracy of hydrometric systems from people who are providing data to them. The bulk of this was from the water companies, but also from a number of industrial discharges and they came up with a system called MCERTS, Monitoring Certification. Hydro-logic were in on the early discussions about this. The required accuracy is +/- 8% of daily mean flow. Originally it was set at +/- 2% because the committee had no experience of measuring open channel flow. Then +/- 10% was mooted. This was felt to be too much like a guesstimate. So +/- 8% was decreed.



So in 2010 I turned 60 and retired from Hydro Logic and set up my own company. Mainly to do MCERTS, but also anything else that people would pay me to do. This was a new lease of life. And led me to some weird and wonderful places The slide shows me doing an inspection of a below ground flume which had a Flodar surface velocity meter, but the factory produced human growth hormone and so I had to get a full chemical suit with on full BA to be able to check the meter's accuracy. Another memory was crawling through an underground flume with a throat width of 450mm and realising I was 460mm wide. Space forbids discussion of the Ellesmere Port incontinence or A47 dogging incidents.



Most of the work involved either checking the dimensions of flumes and weirs and their cleanliness (which is obviously next to godliness) and the accuracy of the water level measurement upstream, or checking the accuracy of pipe flow meters. Preferred technique for this was to use a clamp on ultrasonic meter to estimate velocity across the pipe. And compare the readings that it provided with those for the existing meter. Unfortunately meters were often installed by engineers who had fallen for the “fit and forget” fable. Confined Space certification was a pre-requisite.



But other techniques were available in the slide here. I'm doing a volumetric measurement on the outflow from a sewage works. You can prove this is very accurate by taking several readings and looking at the accuracy (assuming you've calibrated the bucket). But we were doing this very early on in the scheme at a Severn-rent site, and because it was very early on in the scheme they had observers from the Environment Agency, from Severn-Trent, from the design engineers, from the contractors and from the consultants managing the design engineers, And we did a volumetric gauging. Nobody said anything on site, but feedback later on said that they thought we were a bunch of cowboys and I had to write a briefing note explaining the accuracy involved and the fact that for this particular site, in these particular circumstances, it was the best available technology



Sometimes checking the accuracy of the flume dimensions was straightforward. This is the inlet flume at Minworth in Birmingham and I could stand up in it. It was built to an extremely good tolerance. In fact I couldn't find more than a millimetre inaccuracy. It was built by Dutch firm because nobody in the UK could cast concrete to that accuracy.



A bone of contention for years has been that the Environment Agency don't apply MCERT's standards to their own sites. I accept that it's very difficult on rivers because of the difference between low and high flows. To get 8% all the way through will be very difficult. But I do think they should use it where they're controlling other people's industrial processes. This particular site, they're only allowed to discharge to the river when flows are adequate, even though the quality of their discharge is probably better than the quality of the river. I looked at the gauge used to control the ability to discharge and it was backed up through weed growth downstream and was over recording by a large percentage. Unfortunately couldn't make a fuss because it was in my client's interest to maintain the status quo. Here I was also told where and why Bernie Taupin wrote "Saturday Nights Alright for Fighting" by a former classmate of his.

Hydrometric Training

Locations in England, Wales Scotland and Ireland

Covered Basics Water level measurement, rated sections, structures, rainfall.

More advanced topics – evaporation, snowfall, uncertainty, radar rainfall

One theme of this day is Knowledge Transfer Between the Generations. Our particular contribution to that was through hydrometric training. This was initiated by the Environment Agency when it realised that standards differed throughout the various divisions. They were applying good practise in very different ways and the Agency felt some more homogeneity was required

Hydrometric training



The initial batch of training was done for people in post at the time, which involved going to divisional headquarters to provide the training to people who probably knew more about it than we did. But we're fairly thick skinned and we learnt as we went so by the end we could be fairly confident.

Hydrometric training



Once everybody who was in post had been through the training, we were left with the new arrivals on the scene. It was deemed politic to centralise the training both geographically and to get people from various divisions at the same place. Part of the benefit was simply this mingling of in different divisions.

Most of the training took place in Ironbridge in Shropshire, although this view is no longer available because the two cooling towers have been blown up with the site being developed for housing. Over the years, several delegates got confused because they saw a road sign saying Newcastle 15 miles. They hadn't realised that it wasn't Newcastle-upon-Tyne that was referred to. They were

amazed they’d got so far north so quickly.

Hydrometric training



Hydrometric training wasn't all hard work. Occasionally you got a chance to sit on riverbank listening to, in this case, John Gill talking about dilution gauging and the importance of equipment maintenance. Although at this site we occasionally came across sheep and horses to cause a little bit of a frisson.

Hydrometric training



We also got the chance to observe other people at work. This is a river where the sediment has quite a high concentration of dioxin from the works upstream and really it's not in the guy's best interest to be working in it bare chested, but those were the days.

Hydrometric training



We had to adapt to circumstances, in this case the gauging training was done in a ditch that you could block with your Wellington boot, because of foot and mouth restrictions in place at the time. We weren't allowed on any of the rivers that we normally used, so we had to improvise.

Hydrometric training



We were also able to deliver hydrometric training throughout the UK. In this case, this is training delivered to SEPA. Again for the first batch of training we were lecturing to people who knew as much about it as we did. But it seemed to go down well.

Hydrometric training

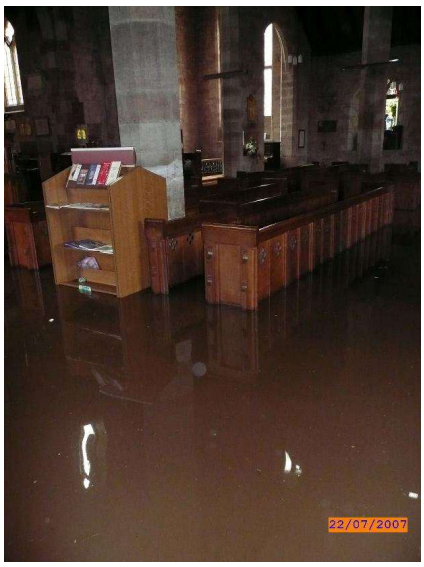


While training in Scotland we had occasion to go and see Hearts play Aberdeen. I was sat next to Elidh Child who later became the captain of Scotland's Commonwealth Games team. Unfortunately, she took exception to my assertion that the standard of football was not dissimilar to that I was used to seeing it Shrewsbury.



We were also fortunate enough to deliver training to the Office of Public Works in Ireland. This was particularly challenging because the guys we were training had been in post for 20 years. And they weren't particularly happy to be lectured to by a couple of English imports. Especially as the training was organised by their new manager – a woman!. To be fair she got quote close to her ambition of giving birth to a future Kerry front five. We think we won them over. Ott were provided some training latterly and the same delegates said, oh, this is what those English guys told us earlier.

Why do we do it?





It's worth remembering why we do this. On a personal level this is the church where my daughter was due to get married in July 2007, pictured a week before the date. There were visible water marks on the pews which showed the 1946 and 1947 floods and this was comparable, so it was a once in a generation flood. We were told we couldn't have the wedding in the church. We were offered a smaller church in Sutton, which meant half the guests would have been outside, or the cathedral in Hereford, which meant half the guests would not have been able to park. So we stuck to our guns as to the venue to the expressed annoyance of the vicar. Fortunately, people in the village helped to clean the church on the Thursday and the wedding went ahead on a Saturday. The human effect of

floods in this instance led to quite a fraught week.

Why do we do it?



It’s not just floods. A drought as well is obviously of major economic significance. Our son-in-law is a dairy farmer and hates periods of drought in the summer, which is when they're making their money because that's essentially when the food is free, If the grass isn't available, they've got to feed expensive supplements and all of a sudden they’re making heavy losses. .And I accept it's worse for arable farmers in the East.



Any questions?

One recent highlight was being sent to Vancouver for a week to learn about a particular software product. And then not having to use that knowledge in earnest ever again. But I did come back with a liking for fried cheese straight from the pan. Also the life story of a wildlife photographer who was conceived in gaol to an abusive mother and the first airline hi-jacker. And a T-shirt.