Australasian Hydrographer

November 2015

Wollongong Water Recycling Plant.
Photographs courtesy of Sydney Water, 2007

AUSTRALIAN HYDROGRAPHERS ASSOCIATION

Contents

AHA

Australian Hydrographers Association
National Office
Australian Hydrographers Association Incorporated
PO Box 1506
Fyshwick, ACT 2609

Journal Editor

Jacquie Bellhouse
Email: journal@aha.net.au

Design and Advertising

Association Management Consultants Australasia Pty Limited
1/9 Beaconsfield Street
Fyshwick, ACT 2609
Ph: (02) 6239 2336
Fax: (02) 6239 3338
www.npaust.com.au

JACQUIE BELLHOUSE

Editor's Introduction

Welcome to the November 2015 Issue of the AHA Journal.

Firstly a big thanks to our outgoing Journal Editor, Frank Davies. Frank has been a dedicated and prolific editor of the journal since 2011 and I am sure you will all agree leaves pretty big boots to fill. I understand that Frank is keen to enjoy his retirement and fully intends to redirect his thoughts to as home maintenance, travel, and a little bit (or a lot) of golf thrown in.

As this is my first issue I have called in a couple of favours. As a consequence November's journal has a bit of a personal flavour. In this issue we have included two a personal hydrographic profiles one for myself and a second from my first employer, mentor (and coincidentally my dad) Kelvin Baldock. We have also included an article from a former co-worker of mine on the co-ordinating the supply and installation of Internet Protocol (IP) Telemetry Systems in WA. Thank you to the Western Australian Department of Water's Hydrographic Newsletter for allowing us to republish this interesting piece.

Finally we have reprinted an abridged version of Harrison Schofield's winning paper from the 17th Australian Hydrographers Conference in Sydney. I was lucky enough to be directly after Harrisons impressive and award winning presentation, he was a very hard act to follow. For the full paper please refer to the AHA Website.

The member profiles will continue to be a regular journal feature, introducing you to a range of people in the industry. If you would like to have someone profiled, please forward your suggestion. I hope, like me, that you find them interesting.

As always thank you for your journal contributors. Please keep sending your papers in so that we may continue to live vicariously through your achievements and experiences.

Regards,

Jacquie Bellhouse

BILL STEEN

Chairman's Address

Hi Everyone,

I must first offer on behalf of the AHA sincere thanks to Frank Davies who has stepped down from the role of editor. Frank stepped into this role several years ago to help out and has been outstanding in his production of the newsletter. A very suitable replacement for editor has been found and we welcome Jacquie Bellhouse, who is also on the AHA committee. Jacquie has taken up the challenge and you will find Jacquie's profile in this edition of the newsletter.

Also on behalf of the AHA I also extend our heartfelt thanks to the outgoing secretary Krystal Hoult. Krystal is a pure gem, her contribution to the AHA was outstanding and I admired her dedication and commitment. I wish Krystal all the best in all of her future endeavours.

Grant Robinson has taken up the reins of the secretary position. Many will know Grant from his role as Publicity Officer.

In regards to the activities of the AHA there has been continual progress with the certification and accreditation process, a review of the current membership structure, along with review of multiple administration requirements. These have included a review of the accounts and reporting, communication strategy and IP and copyright.

Hope to catch up with you around the traps.

Regards,

Bill Steen
Chairman AHA

North Gnangara Groundwater IP Telemetry Installation by the Department of Water, Western Australia

Michael Whiting
Department of Water WA

Since 2011 the West Australian Department of Water - Hydrologic Technology Centre (HTC) has been coordinating the supply of Internet Protocol (IP) Telemetry systems to Regional Measurement teams for installation at surface water gauging stations and meteorological sites across Western Australia, utilising the Unidata Pty Ltd Neon IP Data Logger hardware (Mobile 3G or Globalstar Satellite) and Neon Server software solutions.

The missing piece of the puzzle has always been groundwater monitoring bores, until recently. The HTC has been working closely with the Departments Water Resource Assessment Branch to provide near real time reporting of groundwater level at the NG3 (North Gnangara) site approximately 70km's north of Perth. Jon-Phillipe Pigois Senior Hydrogeologist with Water Resource Assessment Branch provided the following background to the site.

"...The NG3 bores were installed as part of the North Gnangara groundwater investigation, funded out of the State Groundwater Investigation Program (SGIP).

The NG3 site is particularly interesting because it is located in a small area where there is direct hydraulic connection between the superficial and Yarragadee aquifers. Hydrogeological, chemical and geophysical data all show the connection between aquifers and confirm this area as an active recharge zone for the generally confined Yarragadee aquifer in the Perth Region…".

NG3 Site prior to installation of IP Telemetry.

Due to the nesting of monitoring bores at this site, two drilled into the superficial aquifer and two drilled into the Yarrigadee aquifer, the installation of IP Telemetry introduced a challenge to utilise one mobile 3G telemetry solution across all four bores. Also due to the remote location in the Gnangara pine plantation area any infrastructure installed at this site could experience persistence vandalism due to unobstructed access to the surrounding bush by dirt bikes or four wheel drives.

Prior to any upgrade work being undertaken a security compound was erected around the site, with flattened rolls of razor wire at the top and bottom of the mesh fence, fairly standard configuration for other Agencies and Utilities to protect this type of infrastructure. This was then followed by installation of new monitoring bore head works with below ground spigots for connecting conduits that ran back to a central Instrument Cabinet and stand-alone swing down pole.

The possibility of vandalism also presented an opportunity for the HTC to trial high quality 5 Megapixel (MP) camera technology from Axis Communications in combination with the IP Telemetry to not only send daily images of the site but also record movement dependent video. This was seen as valuable experience to develop camera/video solutions for other monitoring sites in the near future.

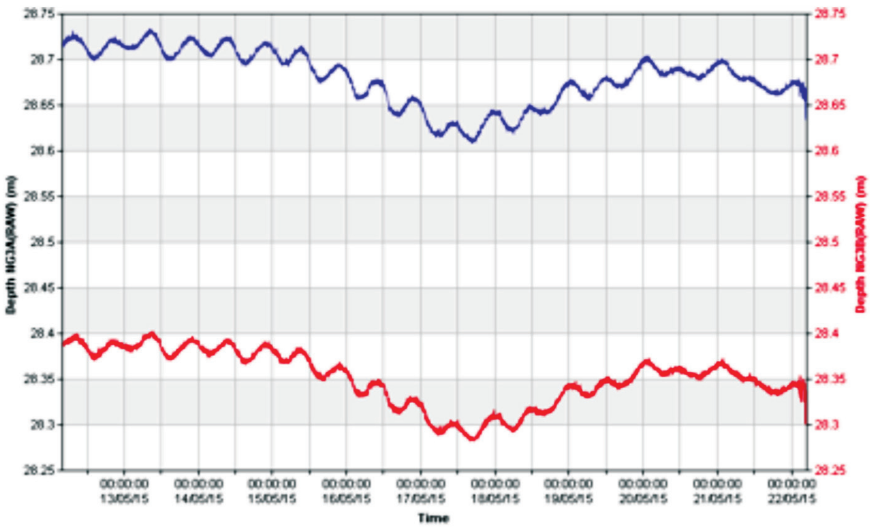
Given the open nature of the site and the elevated equipment, lightning protection was paramount at this site. This provided an opportunity for lightning protection refresher training for measurement staff from the Peel, Swan Regions offices, installing a complete system utilising a single air terminal and an array of ground rods.

NG3 IP Telemetry site with IP Camera.

The site was commissioned in March 2015 and has been sending groundwater level, temperature and associated data every ten minutes of the day with time based photographs taken three times a day at 08am, 12pm, and 4pm. The IP Camera is also recording to an on-board memory card motion dependant video, along with a picture triggered by the opening of the Instrument Cabinet door.

The IP Camera system works well, but the captured pictures and video aren't thrilling viewing with the same image being presented at various times of the day with minor variations in the colour of the sand after rain, and the subtle oscillation of the solar panel mounting pole in the wind.

Picture from IP Camera.



IP Data presented on the Neon Server.

The groundwater level transducers used in this installation are In-situ Level TROLL 500 loggers communicate to a single NRT unit via SDI-12 with two 40W solar panels and two 38aH batteries providing continuous power to the site. After two months of operation the single largest consumer of power is the IP camera with an average of 800+mA. Available power is significantly reduced during extended overcast days which can and has nearly flattened the two batteries.

To boost the power supply capacity two high capacity 65aH batteries and an extra 40W Solar Panel (120W in total) has been installed, along with scheduled powering down of the camera at night due to the limited value of the low light pictures. The upgraded power supply was installed mid-winter and the system has been operating successfully despite predominance of overcast days.

Upgrade solar panel array installed.

The HTC has managed the installation and testing of the equipment and given the fledgling nature of this instrument setup it was important to iron out any wrinkles prior to eventual hand over to the Water Resource Assessment Branch for ongoing operation.

This site is perhaps the ‘Rolls Royce’ of groundwater IP Telemetry, but for long term target sites probably the most effective configuration.

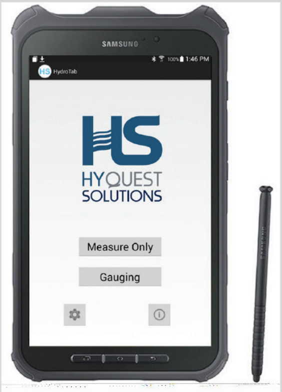
Testing of alternative smaller cellular 3G connected IP telemetry systems for discrete placement inside the head works is currently underway at the HTC, in the likelihood that this method of data collection (as with surface water) will become the norm across a wider network of sites.

To overcome increased power requirements the HTC will also be investigating wind powered turbines (vertical and horizontal blades) to boost the power supply, eliminating the need for large solar panel arrays which would require significant investment in infrastructure.

NEW FROM HYQUEST SOLUTIONS PTY. LTD.

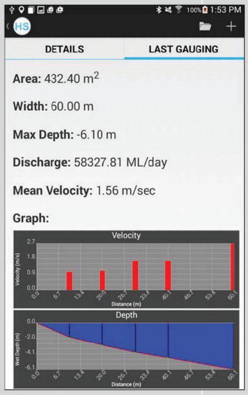
'HydroTab' Stream Gauging Application

The HydroTab offers the latest technology for collection, computation, display and transmission of manual stream discharge measurements using mechanical current meters. The software operates on a "Samsung Galaxy Tab Active" tablet, designed for harsh environmental conditions. Utilising Bluetooth technology, direct point velocity readings and distance/depth measurements can be measured and input to estimate total stream discharge, with calculated results emailed from the field back to a central office location.



Features:

* Low powered (up to 11 hours battery life)
* Capture and transmission of images from field sites
* GPS feature (to record location)
* Waterproof and shock proof case (IP67)
* Easy to read screen in high levels of sunlight
* Calibration formula for unlimited number of fans
* Maximum of 100 verticals per gauging with a maximum of 11 observation points per vertical
* 'Mean' or 'Mid' section user selectable computation methods
*'Neck' or 'Top Set Rod' mounted versions available



<u>FULLY</u> Automated Tipping Bucket Rain Gauge Calibrator

This product offers the user a fully automated system for bench calibration of a wide range of Tipping Bucket Rain Gauge brands and models.

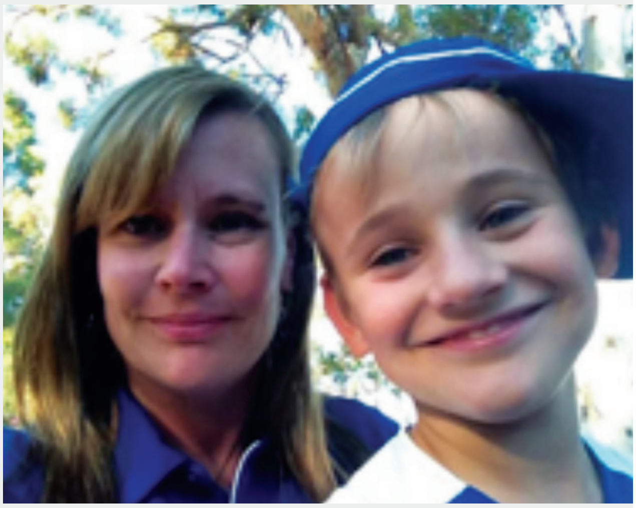
Features:

* Calibration method in conformance with Australian Bureau of Meteorology procedure
* Load Cell enhancement for better accuracy and more reliable results
* Suits Tipping Bucket Rain Gauges with catchment diameters from 200mm to 305mm
* Dual stations (2) linked to a single software package for higher throughput
* Automatic selection of simulated rainfall intensity using standard nozzles 50/100/200/300/500mm per hour with additional intensities available using a combination of installed nozzles
* 110 - 240 VAC input range
* Support for the testing of HS and non-HS Rain Gauges alike through custom product setup
* Run in feature allowing a set number of tips to be passed through prior to calibration
* Live update of historical tip count throughout the test
* Progress tracking of test and individual runs
* Database storage of historical results
* Automatic generation of calibration reports (print and/or PDF format)

For further information please contact Mike Lysaght:
T: +61 2 9601 2022 E: mike.lysaght@hyquestsolutions.com.au

AHA Member Profile - Jacquie Bellhouse

Describe your current role?



My formal title is Senior Water Resources Advisor but I think of myself as an Ecohydrologist. I also identify with John Haynes HydroInformaticist moniker (see John's Profile in the Australasian Hydrographer, June 2014) as, like John, my areas of expertise range widely but generally have a connection back to water/natural resources data and computing/data management theme.

As a Senior Water Resources Advisor I am responsible for developing and delivering products for the efficient and effective delivery of water resource asset investigations so that the Water Corporation may continue to supply water and wastewater services making Western Australia a great place to live.

I work within a team of Hydrogeologists and Hydrologists but also work closely with our engineers, field hydrographers, researchers and other external data suppliers.

What hydrographic or other qualifications - relevant to your role - do you have?

I started out in the industry with a BSC in Biological Science and some field experience developed through accompanying my father on various field trips to service gauging stations in the South West of WA.

After juggling a wide range of roles in the Hydrometric industry with rearing two boys I managed to achieve my Certificate IV in Hydrography in 2009, complimenting my existing practical experience.

My first job in the industry was as a casual with Hydro-SMART a private Hydrologic Monitoring and Research Consultancy. I worked there on and off for approximately 10 years doing any job or role that came my way.

In 1997 I joined the Water Corporation as a Technical Officer but quickly became an Engineering Hydrographer and later Team Leader Hydrographic Projects.

What are your major achievements?

To date I consider my major professional achievement to be my contribution to the development of the National Industry Guidelines for Hydrometric Monitoring with other Agencies around Australia.

However recently I have become instrumental in the conceptualisation, development and will eventually implement of a major change project within the Water Corporation. Alongside giving the role of Editor AHA Journal a go I am busy designing (with a view to deploying to 1400 + users mid next year) a set of integrated tools that will enable the Corporation to more actively drive the efficient running of its business.

Where has hydrography taken you in the world?

To be honest I haven't ventured outside of Australia in a professional capacity. It's not that there aren't opportunities to do so, but rather with two young boys to raise there hasn't really been a right time.

I have however been fortunate enough to be able to attend multiple AHA Conferences around Australia, providing me with the chance to see the issues that we all face.

How did your career related to hydrography commence?

When I finished University there were so many of us in the Earth Science/Environmental Management Field that getting a job proved to be challenging.

Coincidentally and luckily for me at around the same time my father left the then (Water Authority of Western Australia) in order to start up his own private Hydrographic Consultancy. Having accompanied my father on various field trips since a young age it quickly became a fairly natural step for me to start working for him.

Was there anyone who had a major influence on your career?

I have had a number of major Influences on my career starting with my dad. Later in my career my previous boss Allan Dean, a number of close business consultants such as Russell Marks and lately my current boss have all been strong influencers.

Each and every one of the above has empowered me in their own way. As I am quite a big introvert sometimes this has involved a gentle push on their part, but has always lead to bigger and better things for me.

What has been the most memorable experience in your career?

Because I am mostly bound to a desk these days, most of my memorable career experiences relate to the opportunities offered by the AHA Conferences and my previous time in the field as and Engineering Hydrographer with the Water Corporation.

To be absolutely honest however some of my memories from my time in the field are not necessarily because they were pleasant experiences, for instance visits to the Northam Wastewater Treatment Plant Inflow are always a memorable experience. However for each one of the not so pleasant memories there are multiple pleasant ones for instance working on the large rivers in the Pilbara during its wet season.

What makes hydrography interesting?

For me there are a number of facets. I have always loved working outdoors and watching the subtle interactions that occur throughout our ecosystems and how they in turn relate to our water systems. This is most likely why I have over time drifted into the merging of my Ecological and Hydrographic expertise.

However in the later part of my career I have found that I have a particular aptitude/talent for the data management side of the hydrography profession. In my experience while the data management side is not as glamorous (and does not have the profile that our field counterparts have) in today's climate it should by no stretch of the imagination be undervalued, after all it is the Data Managers that care for the data that our field counterparts have so diligently collected.

I love that some parts of Hydrography can be a bit of a black art giving some rise to our creative sides, but at the same time that it is a great mix of tradition v's innovation.

What do you do when you are not at work?

Outside of work I am a full time mum which means taxing and cheering on my sons at their various sporting endeavours (i.e. Rowing Regattas, Tee ball Carnivals and Baseball games). I do however get some time to myself, during which I fit in a few social Softball games (during the Summer Season), tend to my garden and put together the odd flower arrangement whenever I can (my dad once mentioned that I was perhaps WA's only Ecohydrological Florist).

Where do you see hydrography in 50 years?

We are already seeing the subtle shift from the more traditional Hydrography to the remote "real time" model. In the future it is possible that Hydrographers will become more desk bound. I do hope that this does not go too far down the path after all can you really consider yourself a Hydrographer if you have never felt the sensation of wet socks at least once during your career.

The other encouraging change over the past 6 to ten years is the shift in the Hydrographic demographic. With more women and younger generations entering the field from school it is my hope that in 50 years Hydrography will be a great balance of guys v's girls and youth v's experience.

AHA Member Profile - Kelvin Baldock

Describe your current role?

For the last two decades – Director, Hydrologic Measurement & Research with Hydro-Smart.

While accepting the responsibilities and obligations of a 'Director' of a small company, I do like to keep a hands-on approach to all of the elements of hydrographic and research work, from measurement site design, right through to the delivery of 'qualified' information to the client.

Certainly in the past decade, as the company's work load and work-force has stabilised, I have concentrated more on training and support, mentoring and the application of standards and guidelines as 'benchmarks' in our everyday work approach.

Fortunately, the business has people with a professional approach, flexible disposition to a work/lifestyle balance and an overall great focus on delivering information & products to our clients' which meet their needs.

Kel early in his career servicing a USGS Auto Sampler.

Kelvin today.

What hydrographic or other qualifications - relevant to your role - do you have?

Following high school in a Western Australian country town, a failed attempt to get into the RAAF (colour blindness & restricted vision) and a completely wasted 1970 at University of WA studying science (geology), I was accepted to a Traineeship in Hydrography in early 1971, with WA's Public Works Department.

This required that I complete the 'Certificate in Hydrography' in three to four years, before being considered for appointment to a Hydrographer position with the Department.

I completed the Certificate in 1978 and simultaneously, in that seven years, a tremendous list of excuses/reasons/justifications, for my lack of progress. In retrospect, I was pretty fortunate to be retained by the Department in that period. Someone must have seen a 'spark of potential'.

In 1995, in preparation for a move to the 'private sector' I completed a Certificate in Small Business Management.

What are your major achievements?

Accepting and absorbing the wisdom and practicality of a great number of associate Hydrographic, Engineering and Environmental professionals, with whom I worked in the first twenty years.

Adapting to the significant technological changes, which have impacted many facets of hydrographic data collection and information provision.

Establishing, and maintaining the viability, of a small business survives on the delivery of water information.

Being involved with, and contributing to, the National Industry Guidelines for Hydrometric Monitoring.

Where has hydrography taken you in the world?

I have worked exclusively in Western Australia, both as a 'public service' and a 'private sector' Hydrographer. WA is sufficiently large and varied to emulate the physical & climatic conditions found in some other countries, but without the really cold and mountainous bits.

In collaboration with a couple of other hydrographic/environmental associates, we did compile and deliver, in 1998-99, a comprehensive 'handbook' on surface water and groundwater monitoring techniques, along with water sampling and general water chemistry requirements. The client was a gold mine in Argentina. Unfortunately, none of us 'left the desk', let alone had a visit to the site. The handbook was well received, both the English version and its translation to Spanish.

How did your career related to hydrography commence?

Pretty much totally by chance, in responding to an advertised 'traineeship' opportunity in late 1970. It flagged a chance to see, and work in, most parts of WA. It required - a good background education, the ability to swim (demonstration not required) and to be a 'team player'.

I'm not sure how, but I must have ticked all the boxes, and was accepted into a group of five trainee hydrographers. Three of this group stayed in this profession until retirement.

Was there anyone who had a major influence on your career?

Many people had major influences on my career and it is difficult to consolidate the major influence to an individual.

The 1960's to 1980's approach to the hydrographic traineeship model in Western Australia is best described as pseudo-military. In retrospect this was valid, as the leaders of the function were faced with building a skilled and effective work-force, during a period when the State's water infrastructure was in a very strong development phase. In turn, this demanded widespread and reliable water information across most of the State. Many of the early leaders of the function had an armed services background, mostly in overseas locations.

During the 1980's and 90's, with previous 'leaders' nearing and entering retirement, combined with the implementation of some major structural reforms to Government Agencies, some of the earliest 'Trainee Hydrographers' advanced to senior leadership positions. It was a 'changing of the guard' period, combined with the 'distribution' of Hydrographers to a much wider range of functions, agencies, utilities and businesses than they had previously experienced.

Without under-emphasising the influence of people such as Phil Hulbert, Bernie Hawkins, Barry Halligan, Allan Deane, Brian Chester and Russell Marks throughout the 'two-staged' eras above, I consider that Keith Barrett had a big influence on my professional career.

Keith is a Hydrological Engineer, appointed to lead the Water Resources information gathering functions (including Hydrography) in the early/mid-1970's. Not only did he develop (and hone via the team) an innate understanding of hydrographic measurement practices, Keith also has great skill in passing on the hydrologist's perspective of how water information is analysed, interpreted and used. To me, this puts the onus back on the Hydrographer to provide a professional appraisal of the information collected. After considerable gaps in contact with Keith (now retired) I had the recent experience of working with him again on a project that had 'taxing' requirements for hydrographic measurements at a number of sites. This experience reinforced the appreciation I have for Keith's skill and understanding, the rigour he demands, and feedback he provides.

What has been the most memorable experience in your career?

Being one of the only two people to see, in early 1974, Lake Argyle (Ord River Dam) fill and then 'spill' for the first time. I was sent to the site to identify potential gauging sites & sections and obtain a gauging if possible. Colin Temby, District Engineer was also at the 'spillway' site, but for a different purpose.

Together, we dug a shallow channel through a sandbar just upstream of the point where the dam's water enters 'Spillway Creek' and watched it trickle through with a celebratory drink of water. Had I attempted a gauging, it would have been my last. An hour later the section was a ragging torrent and, later in the day, the downstream sections of Spillway Creek (a deep, blasted channel) were just spectacular.

What makes hydrography interesting?

Many aspects of any job can be boring and mundane. The same is true for hydrography, especially if an individual's efforts are limited to only one or two of the multi-faceted work components, which make up hydrography.

Regular involvement through all the facets of hydrographic work, from collaboration with the client to define requirements, right through to the delivery of information, is a fulfilling experience. This, and the challenges that are always confronted in the processes between 'formation' and 'delivery' make the work interesting. It is also rewarding to see a client's understanding of the processes, standards & guidelines involved and the rigour that needs to be applied in working to these 'benchmarks', develop through time.

What do you do when you are not at work?

My wife (a product of Ireland, and then an early settler in WA's Kimberley) and Co-Director of the company, always has a never ending list of home-based projects to be completed, and places in far-flung parts of the world, to be seen.

Occasionally I sneak away from those obligations for a bit of involvement with a horse (pacer) in which I and my son have a small share (we are not sure which bits is our share!).

I enjoy fishing, but rarely venture out these days.

Most of all I enjoy people, including the huge variety of characters that you meet in overseas holidays, or those that you run into in everyday life.

Where do you see hydrography in 50 years?

It is uncannily appropriate to be answering this question on 'Back to the Future Day'.

In 50 years' time, technologically advanced tools, and how these are applied by 'the Hydrographer' is impossible for me to interpret and predict.

At present, we have the technology, but not necessarily the funds, to locate hi-res cameras, drones with cameras and a dedicated robot at every gauging station/monitoring site in Australia. These beasts can/do/could provide real time information to verify, and assist to calibrate, much of the time-series information collected and transmitted.

The drone can be remotely deployed, or deployed by the robot. As long as he does not need to swim the water body, the robot can set up and deploy an ADCP to do a gauging, check the result, re-run the ADCP if necessary, compare results, do a scan of the physical conditions of the channel, update the gauging result (and it's uncertainty) in a hydro-data package, and send a message to the Hydrographer!!

What hydrographer? – The one that has been retained by the organisation to PROGRAM the robot, the drone, the cameras, the recorders, the hydro-data & information package. The hydrographer is also responsible for programming the boss (client, engineer, environmental advocate, planner/strategist). The boss is responsible for programming the Minister.

With such a small team, and low salary budget, the function has limitless operating funds.

That is all you will need. I'm glad I'm no PROGRAMMER, and regardless, by this time I'll have 'Gone Fishing'.

OTT MF pro

Electromagnetic Current Meter

Reduce resources and time spent in the field with the OTT MF pro: a user-friendly, low maintenance, electromagnetic current meter for cost-efficient in-stream discharge measurement.

Maintenance-free electromagnetic sensor head, ideal for low-flow conditions and streams with heavy organic matter

Only one person needed for measurement and an economical electromagnetic sensor provide a cost-effective solution

Compact handheld automatically calculates discharge based on ISO method and graphs velocity on a color display in real-time

aqualab scientific

sales@aqualab.com.au
www.aqualab.com.au
Sydney t 02 9894 4511
f 02 9894 4522
Adelaide t 08 8342 5343
f 08 8342 5363

OTT Hydromet

From the Walls to the Ocean, An Overview of Contemporary Hydrography in the City

Harrison Schofield
Formerly Sydney Water Corporation

Introduction

Sydney Water Corporation has a Hydrometric Services Group (HSG) which is responsible for measuring clean and dirty water throughout the Sydney Water network (Figure 1). The network spans from Warragamba Dam, where fresh, raw, untreated water enters the delivery network and works through many and varied processes ending up as potable drinking water, used by our customers and eventually discharged via direct or indirect means to the Pacific Ocean. Throughout this large and interconnected network of underground pipes, sewer carriers, filtration plants, pumping stations and water and wastewater treatment/recycling plants, hydrographers are required to accurately measure levels, flows, rainfall and related parameters for various asset management, planning, environmental protection and licence purposes. Within the HSG group, six teams of hydrographers are engaged in the routine monitoring of stages of the network: 1) potable water pressure and flow 2) sewer level and flow 3) wastewater treatment/recycling plant influent, effluent, reuse, bypasses and overflows.

This article provides an overview of the current hydrometric activities that Sydney Water “city” hydrographers face day to day, with focus on some of the accurate monitoring of underground sewers and treatment/recycling plants.

Pressure Recording Gauge Network

The PRG network includes over 500 permanent monitoring sites in Sydney’s CBD and suburban areas, many of which are connected to telemetry systems. In addition, a number of temporary sites are monitored on a seasonal basis in the Illawarra and Blue Mountains to detect zones of low pressure and assist with water usage demand. These are also routinely calibrated and audited to verify the reliability of the data.

Sewer Network

The sewer network spans across the greater Sydney region with over 44,000km of sewer pipes (Sydney Water, 2014). This large interconnected network, which is predominantly underground, covers Sydney, the Illawarra and the Blue Mountains (Figure 1). The sewer monitoring network collects wastewater flow and overflow data from 230 permanent gauges, and approximately 180 of these are licence points (Sydney Water HSG, 2014). The monitoring sites are located strategically over the Sydney Water Network. Monitoring stations can be for both long-term and short-term projects. Sewer monitoring stations include a network of 142 rain gauges that are strategically located in urban catchment centroids nearby to key sewer monitoring points, all of which combined provides essential data for modelling, operational and environmental licence compliance purposes.

Treatment Plant Network

HSG currently monitors at 29 WWTPs and WRPs that are spread throughout the Sydney Water network (Figure 1). The network treats over 1.5 billion litres of wastewater from over 1.8 million homes every day (Sydney Water, 2014). The plants locations range from the Blue Mountains, to the Northern Beaches, to the Eastern Beaches and down to Bombo on the South Coast. HSG has 250 monitoring points present at treatment plants that require continuous quality controlled data to be collected and reported 21 of the monitoring gauges are at licence points where untreated and treated water is released into surrounding waterways or supplied as highly treated reuse to clients. The monitoring points are located at effluents, bypasses, overflows, reuses and other various processing points.

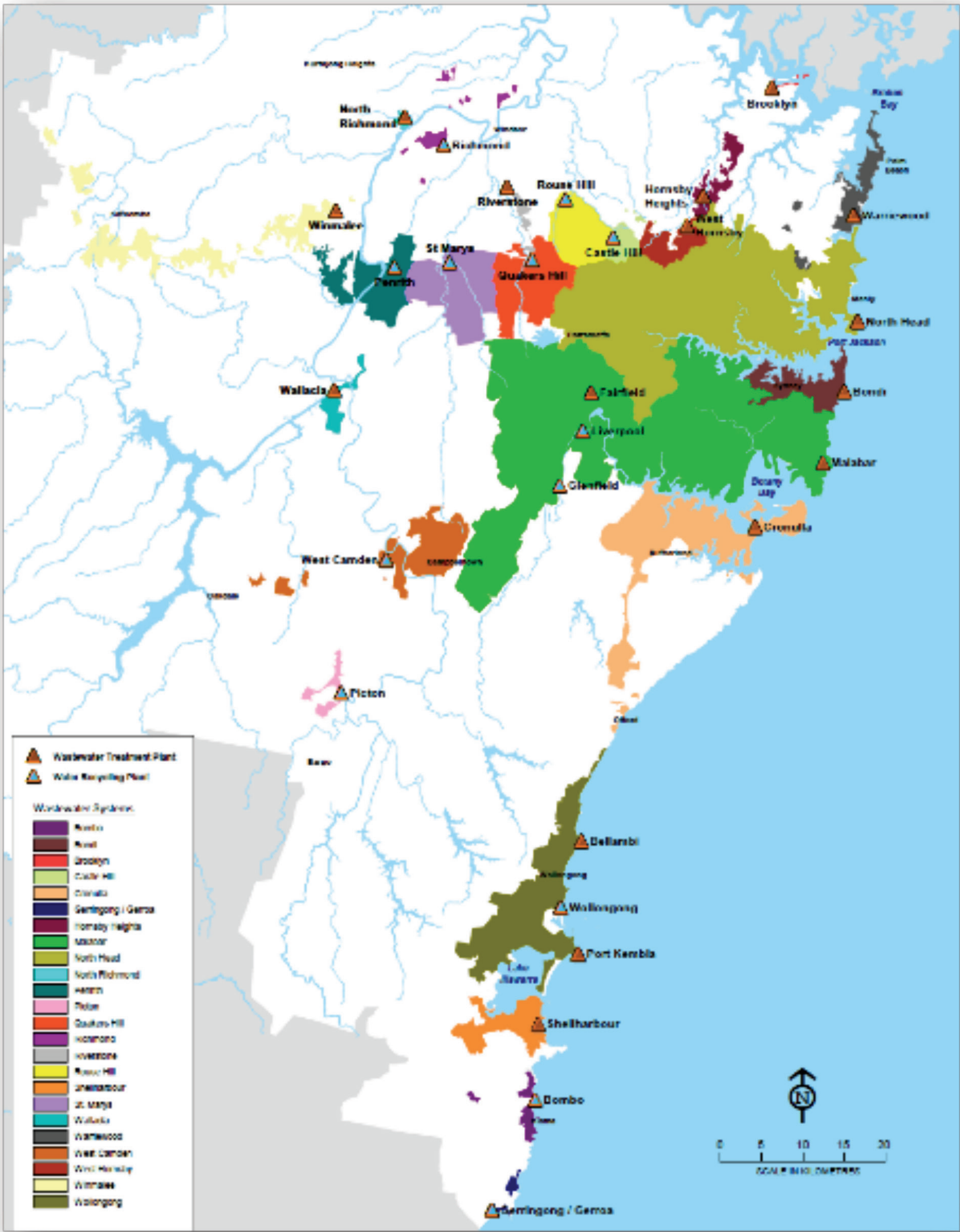


Figure 1. Sydney Water Network (Sydney Water, 2014). The figure shows every treatment plant in the Sydney Water network and their associated sewer catchments.

Hydrometric monitoring of clean water

HSG along with the Supervisory Control and Data Acquisition (SCADA) group continuously measures water pressure throughout the drinking water networks with over 500 gauge locations (water mains, reticulation and reservoirs) to meet the Environmental Protection Agency licence requirements (Sydney Water HSG, 2014).

Data must be collected for:

- verification of meeting water pressure delivery at a minimum of 15 metres heads to each customer
- operational purposes and system management
- maintenance
- modelling of reticulation, drinking water and water reuse networks
- future planning to meet the needs of future development, growth and drought proofing

How water pressure is monitored

At non SCADA, permanent monitoring sites a typical PRG is installed by tapping into a water main with copper pipes that lead into a nearby pit. The end of the copper pipe is fitted with a ball valve which attaches to a small hose and then to the telemetered logger (Figure 2). For temporary monitoring sites a small absolute pressure gauge (Radcom Lo-log®) is attached to a brass fitting that screw into the top of any water hydrant. The disadvantage of the Radcom lo-log® is that the data needs to be manually collected at the site and data can be lost when the battery runs out.

HSG hydrographers are required to install, operate, calibrate and maintain hydrometric equipment. Site visits are only required if; data needs to be downloaded manually, a calibration is due (once one year after installation and then scheduled every three years thereafter), data anomalies are detected during data validation, a site upgrade is required or termination is necessary.

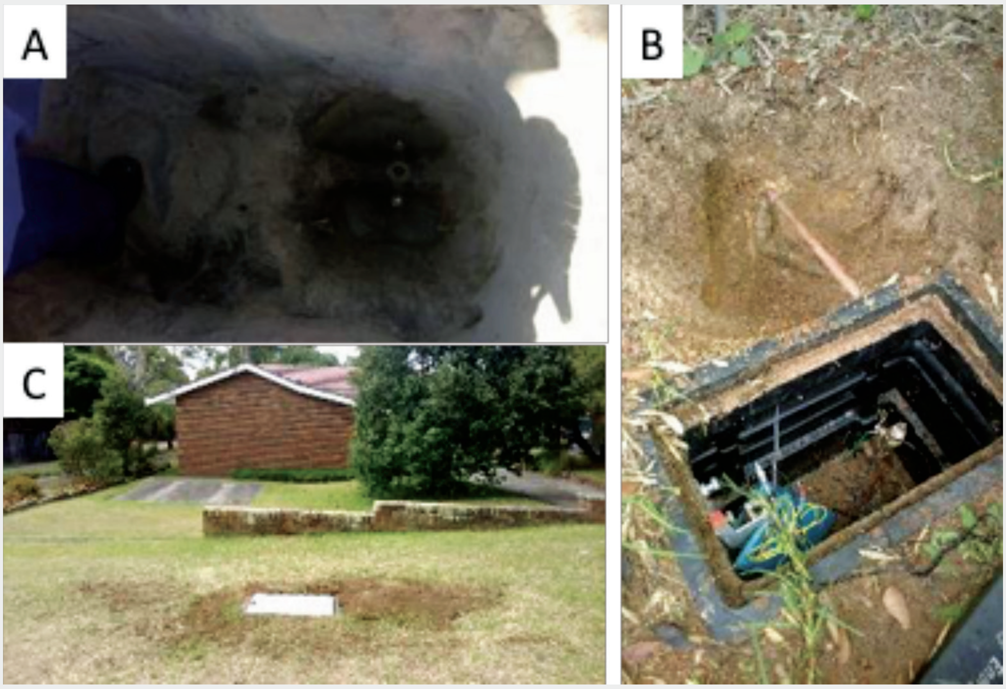


Figure 2. Process of Installing a Pressure Recording Gauge;
A) Tapping into a water main,
B) Connecting copper piping from the main to a ballvalve to a PRG inside a constructed pit,
C) Finished PRG underground monitoring site.

Safety and hazards

A generic Hazard Identification and Risk Assessment (HIDRA) for all PRG sites must be checked and reviewed by a hydrographer before visiting a site. The HIDRA explains all the likely hazards and controls to carry out the work in the safest possible manner. Upon arrival at any site an additional pre-commencement site hazard check is conducted to ensure that no new hazards are present and if so, appropriate controls are put in place. For example, in early 2014, an HSG hydrographer carried out the pre-commencement check to find a snake underneath the lock hatch. After this occurrence the HIDRA was amended to control this potential risk by lifting all hatches with a screw driver.

Current upgrade and replacement program

An efficiency review of Sydney Water has concluded that all PRG data loggers will be upgraded through 2014 with new Remote Telemetry Units which will streamline data collection so that the operational data will receive information directly via the SCADA system. Additionally, the new PRG and loggers will significantly increase the accuracy of water pressure data collected. HSG will continue to calibrate the monitoring network including verification and quality coding of data transferred from the SCADA system database back to the HYDSTRA time series database where it can be used by many for various purposes.

Sewer Monitoring

Hydrometric sewer monitoring is undertaken by HSG to meet requirements for Sewer System Hydraulic Modelling, system assessment, Environmental Protection Licences and for strategic planning (Sydney Water HSG, 2014). Hydrometric measurements must be taken to comply with the licence regulator and the Office of Environment and Heritage, so that any risk to human health or degradation to the environment is minimised. The majority of sewer monitoring sites are strategically positioned at critical wastewater overflow licensing points to provide accurate accounts of the frequency of wet weather and dry weather sewage overflows.

The data that HSG provides to Asset Management and Operational areas is critical for planning development and maintenance functions of Sydney Water. The hydrometric data must be highly accurate, reliable and continuous, especially during wet weather events. For example, when new networks are in the planning stages, models are used to estimate wastewater flows that networks will generate. These estimated flows will result in the carrying capacity of the sewers used, the size of the pumping stations and the capacity of treatment plants. For the models to be accurate they need high quality hydrometric data.

If the data understates the wastewater flows, frequent overflows would result. Conversely, if the data overestimates flows, millions of dollars could be wasted building an over capacity wastewater network.

Sewer flow data is also important for operational functions. For example, under northern Sydney lies a storage tunnel, which can store and transport nearly 500 million litres of wastewater to the North Head treatment plant (Sydney Water, 2014). Flows enter the tunnel through several penstocks from the sewer network above. The opening of penstocks is linked to the levels in the sewer. As the level rises and approaches overflowing, the penstock is opened diverting flows away from the environment and into the storage tunnel. Therefore, hydrometric monitoring of the level in the sewers plays a vital role in important operations of the wastewater network.

Sewer monitoring is also used to identify areas of the Sydney Water network where high infiltration and illegal sewer connections occur, which lead to increased frequencies in wastewater overflows. Spikes in flows during wet weather events, coupled with drops in wastewater temperature, suggest that illegal sewer connections are present in some catchments. Once this information is uncovered, targeted sewer remediation projects can take place. These projects are known as Sewer Catchment Area Management Plans (SCAMPs) and the data collected is vital, not only for identifying areas where inflow is a problem but for calibrating hydraulic models which are used to predict the frequency and volumes of overflows throughout the network. The models are also a cost effective means of planning for wastewater overflows.

Rain monitoring in conjunction with sewer flow monitoring is essential for the calibration of the models to evaluate the extent of infiltration and illegal connections, as well as reflect the success of remediation and rehabilitation projects.

The Sewers

The sewers in the Sydney Water network are diverse and vary significantly in age, condition, material, size, shape, flow volumes and characteristics. The shape, slope and the roughness of a sewer can determine the velocity of the flow and just like in river systems when the slope reduces, velocities drop and depositional environments occur. Deposition is common in sewers and tonnes of silt are removed from Sydney sewers every year. This, along with sewer debris such as toilet paper and rubbish, results in additional complexities in gauging and monitoring such systems.

The largest sewer carriers in the Sydney Water network are the Southern and Western Suburbs Ocean Outfall Sewer (SWSOOS) one and two, the Northern Suburbs Ocean Outfall Sewer (NSOOS) and the Bondi Ocean Outfall Sewer (BOOS). These sewers were built in the early to mid-1900s and are now heritage listed. The sewers carry wastewater from over 80% of the Sydney Water network to the three largest treatment plants and then several kilometres into the Pacific Ocean where the treated wastewater is released.

The sewer network operates in a similar but more complex way to natural water catchments where small service pipes, only 15 centimetres in diameter, feed into larger sewers and submains that eventually link up with the major carriers. The major carriers are often several metres in width and height and transport the vast majority of sewage to treatment plants. The North Head Waste Water Treatment Plant (WWTP) catchment is over 40km in length and the flows that enter the system at the furthest borders of the catchment can take over 10 hours to reach the plant (Figure 3).

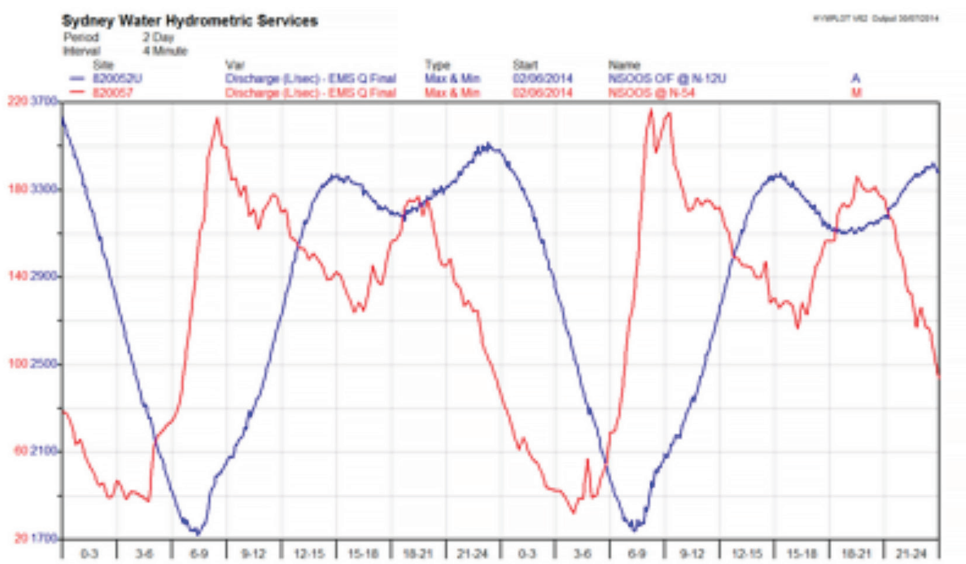
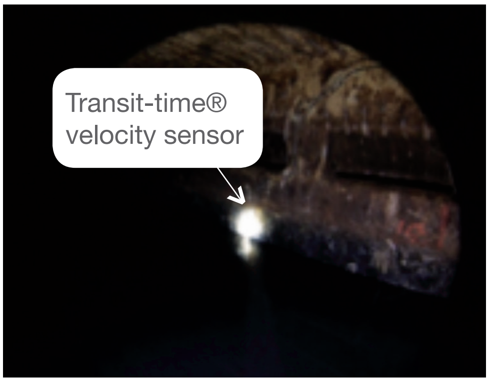


Figure 3. The hydrograph shows two sewer monitoring stations at Seven Hills (blue) and Mosman (red) approximately 35km apart in the North Head WWTP catchment. The comparison reveals how peak flows can occur around 8am in small suburban catchments and close to midnight at the end of the catchment.

Monitoring Stations

A typical sewer monitoring site consists of three sensors – ultrasonic level, pressure level, and velocity. The ultrasonic level sensors rebound six ultrasonic signals from the top of the sewer towards the surface of flow to record the primary level data. The pressure sensor is placed on the bottom of the sewer channel, usually in the flow to record secondary level data. The pressure sensors purpose is to record flow when the ultrasonic sensor becomes submerged in large flow events or if the sewer is blocked and is in a state of surcharge. A Doppler velocity sensor is also placed in the flow. Occasionally, sewer sites use a calibrated primary device such as a small weir or flume that allows discharges to be calculated without the need for a velocity sensor. This is often the case for extremely low flows but this can add to the operational maintenance of the site as debris can build upstream of the weir, which may require more frequent cleaning than a free flowing head velocity discharge measurement site.



Transit-time® velocity sensors are installed at six HSG monitoring sites providing high quality velocity data. To record velocity data two of the sensors are positioned at the exact same height on opposite sides of a channel offset at a 45 degree angle. The sensors provide a much smoother, accurate and realistic trace in comparison to the traditional Doppler velocity sensor (Figure 4). Although they provide a significant improvement in the data quality, the installation of Transit-time® velocity sensors is complex and difficult. For example, the sensor has to be submerged to read velocity but needs to be installed above water (pictured right). To overcome this issue, installations can only be undertaken when flow a diversion, usually for sewer maintenance, is taking place. During the installation lasers need to be used for precision and the success of an install can only be assessed once the flows return to normal. Additionally, the sensors must be installed in a straight stretch of a sewer channel and multiple horizontal profiles are required to gain accurate results. If an installation goes well, an accuracy of ±5% for open channels is realistic.

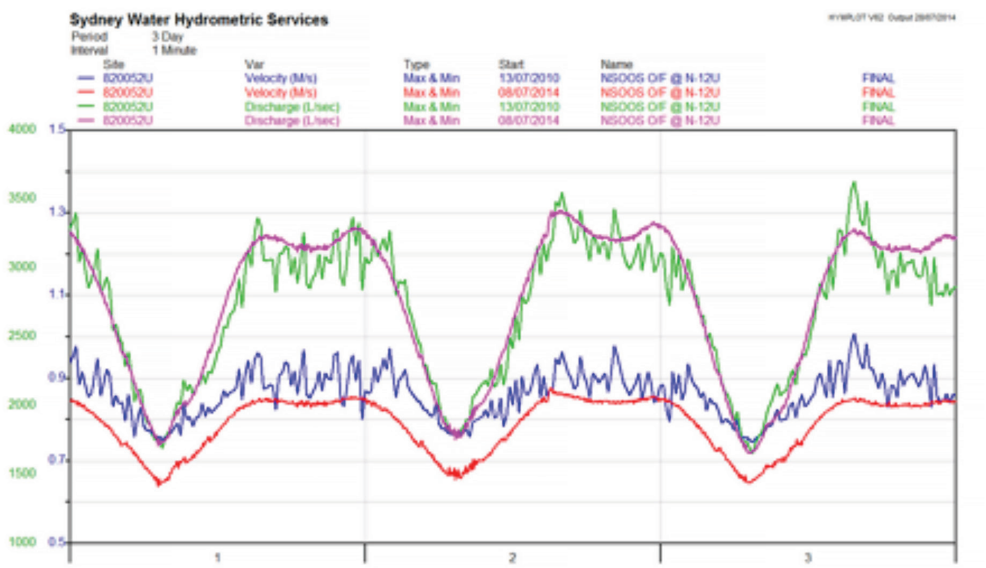


Figure 4. Comparison of data from a Doppler (blue and green) and Transit-time® velocity (red and pink) sensor. The figure highlights the significant reduction in data noise and accuracy when using the Transit-time velocity sensor.

The level and velocity sensors are connected into a smart logger (ADS Flow SHARK® or MACE HVQ®) which converts the sensors' signals into data and logs them. The SHARK® is then connected to communications equipment or external modem unit (EMU®) that sends the data daily to the HSG office. The communications equipment also allows the data to be downloaded at any time and for the configuration to be checked or adjusted with appropriate access and proprietary software.

Sewer gauging

Sewer gauging is an integral part of providing high quality hydrometric data by verifying data at minimum, average, dry weather peak and wet weather peak flows. Due to all velocity sensors only recording velocity over particular sections of the whole cross sectional area, they must be calibrated so that an adjustment factor can be applied to the raw data so it represents average velocity over the whole cross-section. Gaugings which are based on traditional 'stream flow' gauging methodology allows the hydrographers to calibrate velocity and ultrasonic sensors so that the flow data meets standards. Full range gaugings are performed once every two years, during wet weather events and/or when a velocity trace begins to change, suggesting that the sensor is starting to drift or other changes are impacting on the results.

Velocity sensors are required more in sewer monitoring than river hydrography because the same level in a sewer can have varying velocities due to downstream siltation and blockages. A downstream blockage can result in increased levels but lower velocities and without a velocity sensor the flow would be dramatically over estimated.

Sewer gaugings are performed with both pygmy gauging current metres and larger current metres, depending on the dimensions of the flow. High velocity propeller attachments can be used in high velocity flows. For sewers, where hydrographers must enter the sewer, appropriate confined space equipment, gas monitoring and appropriate personal protective equipment (PPE) must be used by fitness assessed and competent hydrographers. The hydrographer positions the pygmy current meter upstream and depending on the size of the sewer and the flow regime, one or more vertical velocity profiles are measured in each gauging. In larger sewers, hydrographers usually gauge from above the sewer using large rods with multiple current metres attached and record up to five different vertical velocity sections. Acoustic Doppler Current Profiler® have also been utilised in these large carriers.

One of the challenges with gauging sewers is that the Australian Standards 3778 for measuring water flow in channels is directed towards and designed for traditional stream and river hydrography. To meet standards HSG uses its own document (HS0076) which describes methods and standards that must be met when undertaking waste water current metre gaugings. These standards originated from the Australian Standards 3778, however, the methods have been modified so that they are more relevant for waste water hydrometrics.

Maintenance of sewer sites

Long-term sewer sites are visited quarterly, unless an issue with the data or equipment arises and a maintenance site visit is required. For example, ants and other insects can interfere with the equipment as they are attracted to warm environments. Low battery voltage is also a common issue which will require site maintenance. Although solar panels do extend the life of the EMU batteries, the loggers' battery, which are intrinsically safe or explosion proof, cannot be charged by solar and they need to be swapped when their voltage drops to 7volts.

Figure 5. Image shows an accumulation of dirt from an ant's colony that has disrupted the external modem unit at a sewer monitoring site.

Hazards associated with sewer monitoring

Safety plays a major role when undertaking wastewater hydrometric work. Most notable is the need to enter confined spaces to undertake the majority of sewer monitoring work. In any confined space, gas testing the atmosphere for harmful or explosive gases is compulsory. Deadly gases, such as Hydrogen sulphide (H2S), are known to occur in sewers and have been the direct cause for multiple deaths in developed countries in the last few years. Last year in Sydney an attempted sewer entry made headlines because of toxic gases that were present in the sewer. After the workers cracked the lid, the fumes in the sewer were inhaled and the men started vomiting and were taken to hospital (Australian Associated Press, 2012). To overcome these life threatening hazards, stringent confined space entry protocols are followed by all Sydney Water employees. These safety measures include; continual gas monitoring from the first crack of a sewer lid until exiting the sewer, harness and winch for entry personal, PPE, ventilation if required, oxygen self-rescuer, man hole covers, barriers and harnesses for stand by workers. Other hazards when working in a sewer include coming into contact with sewage, engulfment, remote locations, working downstream of stored water, and other generic hazards. These and other occupational health and safety issues are mitigated using the HIDRA method described in section 4.3 and by using various other safety measures that are described in project safety plan.

Treatment Plant Monitoring Head

Why we monitor flows at Treatment Plants

Water Reuse Plant, Waste Water Treatment Plant (WWTP) and Water Recycling Plant (WRP) flow data is utilised by Sydney Water and external clients to meet operating and reporting licence requirements. The licence states that Sydney Water must collect hydrometric data for plant effluent discharge including reuse, rainfall, dry weather leakage, all overflows and bypass events for all WWTPs and WRPs. The data collected is used for operational, reporting, costing (e.g. reuse), maintenance and modelling of WWTPs and WRPs. Providing accurate, continuous and reliable flow data to Sydney Water clients (asset management's and operations), particularly during wet weather events, is crucial for planning, licensing and maintenance functions for Sydney Water (Sydney Water HSG 2014). When treatment plant flows are at capacity or instrument failures occur, waste water may be released into nearby environments. It is vital that flow measurements of these releases are accurately obtained for legal obligations and remediation processes that may occur after a wastewater discharge event.

The Treatment plants

Each treatment plant is unique depending on the inflow volumes received, the level of treatment undertaken, the plants effluent discharge location and geography. Larger plants in the network with higher flow volumes are positioned in densely populated areas and/or service larger catchments. For instance, Malabar WWTP has average dry weather flows of around 500 ML/day and receives flows from south of Campbelltown, over 50km away. In significant wet weather events the flows at Malabar WWTP can more than double to over 1000 ML/day. The treatment plants with larger catchment will have peak flows occurring later in the day, whereas plants that service smaller catchments will have peak flows just after the morning rush around 9 am. The flows work in a similar way that rural catchments respond to catchment inflows. Smaller inland plants such as Riverstone are located in semi-rural areas and flows of 1.4 ML/Day are observed.

Total discharge volumes over the whole network are dominated by three plants, Malabar, North Head and Bondi (figure 9). These three plants account for 80-90% of the total treated water volumes in the network and service over 2.9 million Sydneysiders (Sydney Water, 2007).

The 3 largest plants have large proportions of the plant underground, particularly Bondi WWTP, which is referred to as 'the ants nest' and only has primary treatment levels. All inland plants treat water to a secondary or tertiary level.

To ensure that the treated wastewater does not impact Sydney's beaches and surrounding environments, it is discharged at 2.2-3.7 kilometres into the ocean at depths of 60-80m. The ocean outfalls were commissioned in the early 1990s and continual environmental studies have shown they have significantly improved swimming conditions, elimination of beach grease and there has been no detectable negative effect on marine ecology or sediments (Sydney Water, 2007).

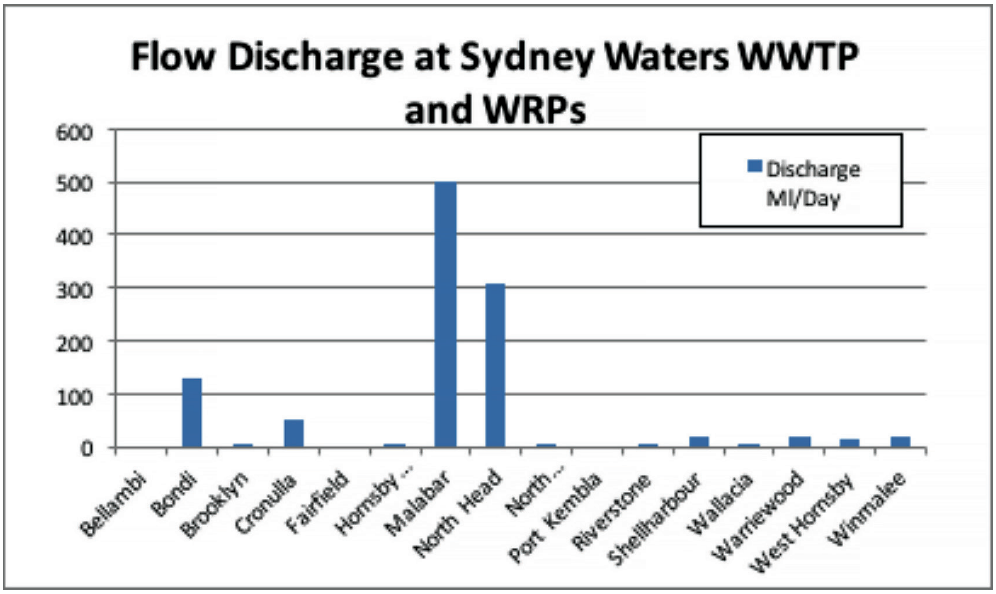


Figure 9. Flow discharge in ML per day at Sydney Waters WWTPs and WRPs. The figure shows that the vast majority of Sydney's wastewater gets treated at three plants; Malabar, North Head and Bondi (Sydney Water, 2014).

Monitoring sites at Treatment plants

At WRPs and WWTPs HSG operate monitoring sites for influents, effluents, bypasses, overflows, process control and rainfall. Each treatment plant has numerous monitoring points spread throughout it. Some small storm plants that only flow in wet weather events may only have one point that is monitored by HSG as this is the licence point (i.e. Bellambi WWTP). Larger plants that have advanced levels of treatment and higher flows (i.e. St Marys WRP) can have over 15 monitoring points.

Most have inflow monitoring stations to calculate and monitor the incoming raw sewage flows. Typically, a flume rated structure will be present at a treatment plant inflow monitoring station. The flume allows for silt and other particles to pass through the channel freely without blocking the flume throat while providing theoretical flow rating curves. Other ways in which inflows are calculated include the use of velocity sensors and magnetic flow measuring devices.

Flows at effluent monitoring stations are commonly calculated using a rated weir structure or other primary device. Effluents at smaller treatment plants where a weir structure is present are not usually gauged. Flow is calculated using level and weir specific formulas. By calculating both inflow and effluent measurements the accuracy of HSG data can be assessed using site water balance comparisons. Typically a site inflow should have marginally higher flows than the inflow due to treatment processes that reduce the volume of wastewater. If the site balance shows higher flows at the effluent or significantly higher at the inflow (>8%) an investigation is required.

Nearly all WWTPs and WRPs will have bypasses and/or overflow monitoring points. These sites usually have no flow and only register flow when the treatment capacity of a plant is exceeded or when mechanical break downs occur. Wet weather events result in increased flows at WWTPs and WRPs and often result in plants having to bypass wastewater treatment processes and discharge untreated water into surrounding waterways. It is paramount that all discharge events are accurately recorded for licensing compliance and public health warnings that may be issued.

Other monitoring equipment associated with Sydney Water WWTPs and WRPs include borehole sites that utilise a bubbler system to calculate effluent levels in the large ocean outfall sewers and at least one rainfall gauge is present at every treatment plant. HSG also has a number of weather stations that provide treatment plants with up to date weather variables, such as, wind speed and direction, humidity, temperature, rainfall and solar radiation. The information is used by plant officers to meet environmental licensing conditions when discharging and for evapotranspiration calculations at plants where the recycled effluent is used for discharges to field irrigation areas rather than directly to a receiving water body. Flows at some plants discharge directly into creeks and river systems which are also monitored for water quality, river health and licence compliance.

Figure 10. Images of hydrometric monitoring stations at WWTP and WRP. The left image shows Riverstone influent monitoring station where a level sensor and a flume structure are used to calculated flows. The Middle image is at Gerroa weather station where rain, humidity, solar radiation, wind speed and direction are monitored. The right image is at St Mary's effluent monitoring station, where tertiary level treated wastewater is released into local waterways.

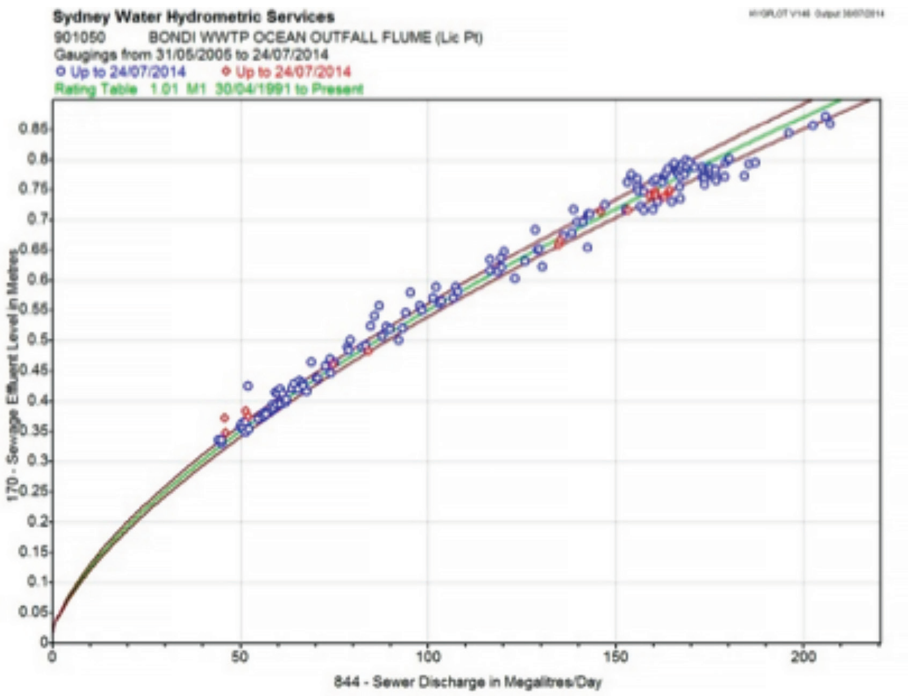
Maintenance monitoring sites

Monitoring sites are visited at least once every three months to ensure the data collected is accurate and meets quality control standards. During a routine service, level sensors are checked for accuracy by taking physical measurements, known as dips, and comparing them with the sensor. Dips are used to adjust the data in the editing and archiving process monthly or to calibrate the sensor in the field. Servicing also includes housekeeping of site instruments, i.e. spraying cabinets and monitoring points with insect repellent, test tipping the rain gauges, cleaning sensors and looking for any occurrences that may impact data quality, such as weeds and other blockages or interferences.

Annual calibrations are an important part of providing quality controlled data to HSG's clients. During annual calibrations, level sensors are removed from their bracket and placed on a calibration jig. The jig simulates the full range of flow and allows the performance of the sensor to be assessed, adjusted if necessary and its uncertainties reported. Calibration certificates are calculated for every sensor, which provides statistically calculated uncertainties for the sensor based of instrument specification, in situ measurements and calibration results. Total uncertainty for the flow data provided to the plants ranges from ± 4-10%. In addition to sensor calibrations, rain gauge calibrations are also performed annually, along with annual inspections of monitoring points, which involves measuring key distances with surveying gear.

Gaugings

Annual full range gaugings are undertaken to accumulate data points so an accurate site specific rating curve can be calculated (Figure 11 A). The rating curve is used to convert continuous level measurements into accurate flow data. The gauging procedure is essential in providing quality controlled data. To produce high quality data, rating curves must be confirmed or adjusted by collecting numerous gauging data points throughout the entire rating curve, for example from minimum flows to maximum wet weather flows. To do this, annual gaugings and wet weather gaugings must cover the full range of a treatment plant's hydrograph. Each plant's hydrograph is similar with minimum flows occurring in the early hours of the morning and peak flows occurring in the mid-morning. Plants with larger catchments, Malabar and North Head, receive peak flows later in the afternoon or night. At pump affected sites the full range of a hydrograph can be observed approximately every 10 minutes or so depending on the pump cycle. As the flows increase at these sites the pump cycles increase to meet the higher demands (Figure 11 B).



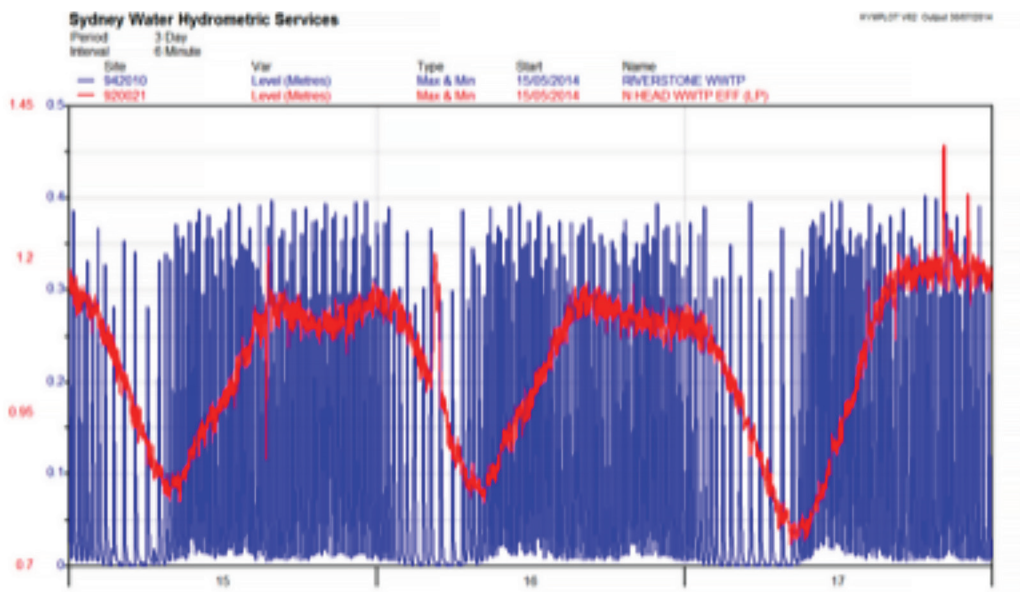


Figure 11. Top) Rating curve and gauging data points for Bondi effluent licensed monitoring point. The curve is adjusted to a line of best fit through the data points. The rating curve is used to calculate flow level data at the monitoring point. Bottom) Comparison of two hydrographs at Riverstone WRP (blue) and Malabar WWTP (red). The figure highlights how treatment plants incoming flows can be vastly different depending if the flows are pumped affected or gravity fed.

Gauging methods at WWTP and WRP vary from plant to plant. At smaller sites one current meter on a gauging rod with one vertical measurement will be recorded during each gauging. Larger plants where the wastewater flows cross sectional area exceed 7.5m^2 can be gauged with a 'winch and weight' gauging method (Figure 12). These sites have three different velocity recording points at each vertical point with up to 6 different verticals across the channel. With multiple velocity recording taken at each point for reproducibility purposes, over 50 velocity readings per gauging can be recorded. A minimum of 15 gaugings per annual full range gauging are calculated, computed and added to the rating curve. A Streampro Acoustic Doppler Profiler® is used for profiling in times in shallow water, in low velocity assessments in sedimentation tanks and other locations as part of special studies.

It is important to take silt measurements at the time of a gauging so the area is accurately measured and the correct flow is calculated. Some sites are especially bad for silt and build-ups where 100mm of silt and gravel can occur.

Figure 12. Left) A gauging rod used to measure the depth of North Head WWTP. Right) The winch and weight method gauging method at North Head effluent channel.

Hazards at WWTPs and WRPs

Identifying and mitigating hazards at WWTPs and WRPs is undertaken using the HIDRA method described in section 4.3 Hazards that are associated with WWTPs and WRPs are varied. Permit to Work Certificate and Plant Specific inductions are compulsory before any work is carried out on site. At Bondi WWTP and Malabar WWTP continual gas monitoring of the atmosphere is required at the effluent channels because they are underground and if ventilation systems fail there is positional for harmful gases to accumulate. Engulfment is also a major hazard at all plants, particularly at a few of the larger ones where the effluent channels have very powerful flows. If a person fell in they would become engulfed by fast moving water and then carried several kilometres out to sea. To reduce risk, barriers are put in place and openings to the channel are reduced in size (pictured right).

Working over treatment processes, such as aeration tanks, has the potential to be fatal as was the case in a Victorian treatment plant in 2011. This tragedy occurred when a worker fell through a dislodged grate into an aeration tank, which had a mixture of treated wastewater and excess oxygen. This process reduces the waters buoyancy dramatically and makes swimming or floating impossible. Wastewater treatment processes use dangerous gases and chemicals as well, such as chlorine and ferrous chloride. Undertaking work around these hazards can be potentially dangerous and nearby rinsing stations are always identified and all staff are first aid trained. Coming in contact with sewage is unavoidable and appropriate PPE is always used.

Summary

Sydney Water Corporation HSG undertakes various urban hydrometric measurements across the greater Sydney Region. These measurements are vital for ensuring the delivery of a high quality product, providing quality operation, management and planning of assets, as well as, adhering to legislation and protecting the environment. The potable water, sewer and treatment plant network spans from Sydney's CBD, suburban and regional areas to the Blue Mountains and the Illawarra and services over four million people. Once the water enters the delivery network over 500 pressure gauges are continually recording and sending quality controlled data. HSG play an important role in ensuring the data is high quality through instrument calibrations, ongoing maintenance, site installations and upgrades.

Once the potable water is used for every day purposes it enters the wastewater network, an interconnected network with over 44,000km of sewer pipes. As the wastewater moves through the sewers HSG has over 370 strategically located monitoring stations collecting hydrometric data including, level, velocity, flow, temperature, rain and conductivity. The majority of these stations are in underground confined spaces and strict OH&S measures are put in place to mitigate the associated hazards when undertaking maintenance, most notably, continual gas monitoring of the atmosphere. The primary purpose of the large monitoring network is to assist in ensuring that wastewater remains in the sewers, adhere to environmental legislation, record wastewater overflows and ensure new sewers are built to acceptable standards. This is done by long-term hydrometric monitoring at all critical overflow points in the network, undertaking short-term SCAMP projects and by undertaking leak-tight monitoring projects. By upgrading sites with improved technologies, undertaking regular site maintenance and by using wastewater specific gauging methods, high quality data is continually being collected and passed on to the various parties so that Sydney Water can meet its obligations as a water utility organisation.

Once the wastewater moves through the sewer network it arrives at one of the 29 WWTPs or WRPs. There are 250 different hydrometric monitoring points at these plants that provide level and flow data at the influent, effluent, bypass, overflow, reuse as well as other various monitoring points inside and outside the treatment plants. Each plant is unique depending on various factors, most notably, level of inflow, treatment level, discharge environment, catchment size and whether it is a coastal or inland plant. Plant monitoring sites are situated so that HSG clients are provided with the necessary hydrometric data for reporting, maintaining, costing and operating purposes. To ensure quality controlled data is collected quarterly site maintenance visits, annual inspections and annual gauging are carried out at all plants. To minimise various hazards that are associated with working at the treatment plant, HSG safety procedures, as well as, treatment plant safety measures are always followed.

AUSTRALIAN
HYDROGRAPHERS
ASSOCIATION