Australasian Hydrographer

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AUSTRALIAN HYDROGRAPHERS ASSOCIATION

AHA

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Photo Information:
Path to 708002 Fortescue River at Gregory Gorge, Gauging Station Shed visible in the background.

Contents

Acknowledgement of Country

The AHA acknowledges the Australian Aboriginal and Torres Strait Islander peoples of this nation. We acknowledge the traditional custodians of the lands on which our association is located and where we conduct our business. We pay our respects to ancestors and Elders past, present and emerging. The AHA is committed to honouring Australian Aboriginal and Torres Strait Islander peoples' unique cultural and spiritual relationships to the land, waters and seas and their rich contribution to society.

JACQUIE BELLHOUSE

Editor's Introduction

It seems like only a short time ago since Harrison Schofield and myself began assisting our current Editor-in-Chief Jacquie Bellhouse with the *Australasian Hydrographer* and the AHA Publication ThinkTank, but here we are +1years down the track and five issues under our belts. Whilst sadly Harrison has now parted ways with the *Australasian Hydrographer* he will remain involved with to the Publication ThinkTank and continuing as an AHA committee member. Thanks for all your hard work Harry!

So now it appears it's my turn to try and put together some relevant and thought-provoking articles for our fellow hydrographers and members. Hopefully I can live up to the high standard set by Jacquie and all of her years of commitment to the publication, but much the same as Jacquie has done in the past, I need to remind everyone that the *Australasian Hydrographer* is always looking for feedback (how are we doing?, are we hitting the mark?) and also a continued call to arms for new article submissions.

As can be seen in this edition there is a continued focus and growth into the image and Artificial Intelligence (AI) space with regards to hydrometric monitoring. Whether it be AI learning to 'train' the next breed of algorithm-based hydrographers, improving the way that image velocimetry techniques such as LSPIV and STIV are utilised in the industry or simply thinking outside of the box with regards to surveying and velocity measurement in non-standard monitoring situations. Be sure to keep the *National Industry Guidelines* in our focus and stay safe (either in lockdown or somewhat freer with some social distancing) as we approach the end of year, festive season. Not long now :)

Zac Ward CPH
Editor

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ARRAN CORBETT

From the President

As I flagged in my previous President's Message, the AHA committee are actively engaged in a process of change in order to better serve our members. An example of this change that I wish to share is the recent alterations to our Ends Policies. The Ends Policies are the guiding principles by which we guide and shape the focus of our National Office. They set the framework for activities to be carried out under the AHA banner. Our committee has decided to change the Ends Policies to allow for the creation of a Training Team with direct reporting line through to the committee.

The creation of a Training Team is intended to facilitate the following:

1. Allow for dedicated focus on this critical AHA activity,
2. Create greater support and improve communication with our students,
3. Continually review and improve our course materials,
4. Investigate and develop new opportunities for upskilling our members.

Whilst training is a core activity it is not the only function undertaken by the AHA. In separating the responsibilities for training from our National Office we intend on increasing engagement and value adding activities for our members and partners. Whilst, of course, continuing to meet the ongoing administration obligations that come with being a National Not for Profit organisation. I hope to be able to bring you more information on our plans for increased engagement in future updates.

One last thing if I may, I wish to give my thanks our new corporate partners – your support is invaluable. It is great to see emerging tech start-ups and companies investing in technology for our industry. Businesses such as Zepiro with their low-cost satellite transmitters and Metasphere with the cellular IoT transmitters are making a real difference to monitoring now. Through their partnership with us they are giving back to our industry – thanks!

Arran Corbett CPH
AHA President

AHA Graduate Profile: Bianca Brucciani

Describe your current job?

After completing the *Diploma of Water Industry Operations (Hydrography)* earlier this year, I am now acting as an Asset Monitoring Officer in the Asset Monitoring and System Investigation (AMSI) section at the Water Corporation in Western Australia. One of the main aspects I enjoy about my role is that it is quite varied. Not only do we carry out traditional surface water stream flow monitoring, station commissioning and site maintenance at our gauging stations around the metro area and the Great Southern. Our team also carries out wastewater compliance monitoring at various flumes at wastewater treatment plants, wastewater flow and odour monitoring within the sewer network, groundwater monitoring and operating a few weather stations; works that take place all over the state and are either long term or short term projects. The data we collect and validate are for a range of purposes, including licence compliance, asset performance, asset capacity, environmental monitoring and future planning.

Figure 1. Selfie at the Albany Wind Farm (in-between groundwater sampling)

Aside from Graduating with a Diploma what do you consider your major career achievement to date?

I graduated with a Bachelor of Science majoring in Biology at the University of Notre Dame, Fremantle in 2014. Soon after graduating I became the recipient of the Royal Society of WA Student Medal for the University of Notre Dame. Medals are awarded to the most outstanding graduating science student in the Physical and Biological Sciences in each of Western Australia's five universities. I started working at the Water Corporation in 2017 where I had two roles prior to the Traineeship; these were as a Technical Support Officer and a Data Analyst. Some major achievements for me during my time practically applying the principles I was studying during the Diploma include commissioning some new gauging stations in the Perth Hills. Here I got to put into practice many aspects of what I was learning and see it all come together to produce a quality customer output. Another major short-term project I was a lead on was the Culeenup sewer flow and gas monitoring project. This involved using some new instruments (like the GasClam, RigRat methane sensor and Eureka water quality sonde) and measuring a whole range of variables including wastewater flow, methane, hydrogen sulphide, humidity, pH and EC in order to help determine the effectiveness of dosing a main sewer line with magnesium hydroxide and its effect on gas production and odour.

Was there anyone who is a major influence?

Blaz Kurilj (Senior Asset Monitoring Officer) has been my mentor throughout my Hydrography Traineeship. Having 20 years of experience in the profession, I've learnt a great deal from Blaz. We have spent countless hours in the field and worked on specific projects and investigations together, such as one currently taking place at Samuels Culvert gauging station in Walpole. We are investigating a discrepancy with the rating and in-situ discharge measurements, and have upgraded the site with a Doppler, new data loggers and getting telemetry working in a low signal area through some creative means. We have also commissioned a new gauging station together which even incorporated constructing a weir ourselves. I have found that I learn really well working with Blaz because we work through problems and troubleshoot as a team. He's so resourceful and proficient in all aspects of hydrography and problem solving, it instils a great sense of motivation and capability within myself.

What has been the most memorable experience so far?

This got my heart racing... I was carrying out a solo routine site visit at a gauging station in Albany in 2019. I wandered over to the weir to carry out a volumetric discharge measurement. Upon collecting the water for the first DM, I tipped out the container of water, along with a very long snake! I quickly got myself away from there and watched the snake eventually slowly slither away downstream. Couldn't believe my timing, having caught the snake swimming through the weir at just the right (or wrong) moment. I abandoned carrying out any more DMs after that.

What do you think makes hydrometric monitoring interesting?

For me, it's a combination of place, purpose and progress. The locations of our sites and the places we are lucky to get to travel to can be really beautiful. The applications of monitoring are so varied and diverse, and we are a capable of so much with great technology, instrumentation and some creative thinking. Lastly, the progress in innovations seems never ending and always developing.

What do you do when you're not at work?

I love exploring and trying new things, so in my time off work I make the most of my time travelling to new places and immersing myself in the natural world. Camper-vanning and hiking around Tasmania this year was such a highlight, as was a road trip on the Gibb River road with some friends. In my day to day, I go bouldering frequently, get some sun at the beach and socialise over good food or a show with friends.

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New Surface Velocity Guidelines - Setting the standard internationally!

Mark Randall, Department of Regional Development, Manufacturing and Water, Mareeba

We are pleased to announce that WaMSTeC members have endorsed a new *National Industry Guideline document,* ***Part 11: Application of Surface Velocity Methods for Velocity and Open Channel Discharge Measurements***. This is the first Standards Document in the world to govern the data collection and processing of surface velocity measurements using image velocimetry and surface velocity radar (Figures 1-2).

Figure 1. Fixed camera collecting videos for image velocimetry analysis.

Figure 2. A handheld surface velocity radar gun (right). Source: Mark Randall.

This document has been developed over the past 15 months by a voluntary Technical Reference Group (TRG) of leading industry experts. Particular thanks go to the two primary authors responsible for writing the "document's technical content" as part of the TRG.

Mark Randall of the Queensland Department of Regional Development, Manufacturing and Water is the guideline sponsor and has collected and validated thousands of image velocimetry discharge measurements using both drones and fixed cameras since 2016. Mark provides training and guidance to government monitoring agencies from around the world on how to use these techniques.

Mic Clayton from Snowy Hydro has been operating radar-based systems over a number of years developing considerable experience and knowledge on how to achieve the best from these systems.

Why is this document so important?

Technological advances in recent years have allowed surface velocity measurements to measure velocities and discharge that, **when applied correctly**, are comparable to other commonly accepted measurement techniques. Image velocimetry methods in particular have become increasingly utilised internationally due to the increased ability to capture data previously unobtainable, in particular flash flooding events such as those in Europe recently.

Without standards and guidelines in place there are no regulatory controls to help ensure the quality of data produced. This guideline document looks to address that shortfall by providing knowledge and establishing clear data collection and processing criteria to ensure confidence in both the data and the methodologies (Figure 3).

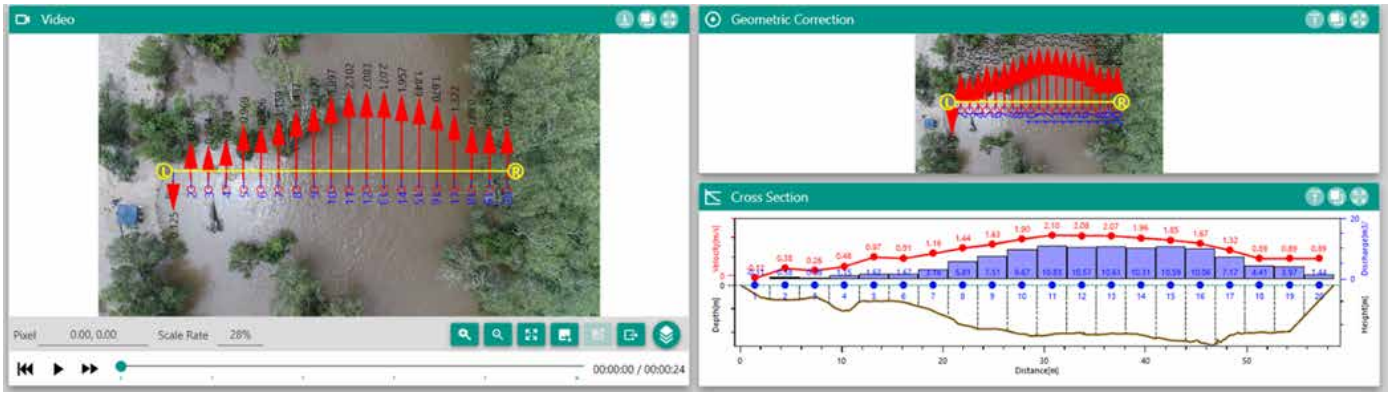

Figure 3. Image velocimetry discharge measurement collected using a drone and processed using HydroSTIV. Source: Mark Randall.

This guideline is to the benefit all of those wishing to utilise image velocimetry and radar systems to confidently collect velocity and discharge data. Importantly, in what was an unregulated environment this document now sets the required operational criteria for both hardware and software developers who release commercial products for these techniques, just as the USGS[1] guided the operational requirements and quality controls for hydroacoustic development.

So, what exactly does the document cover?

Image Velocimetry

- Guidance and importance of choosing the correct algorithm - Cross correlation based 'Large-Scale Particle Image Velocimetry' (LSPIV) or Gradient Tensor based 'Space-Time Image Velocimetry' (STIV)
- Site setup, data collection and processing requirements
- Drones and fixed camera deployments
- Data quality checks

Surface Radars

- Fixed and mobile radar deployments
- Site setups
- Data quality checks

Surface Alpha

- How to determine

The document will be published in due course in the Bureau of Meteorology's *National Industry Guidelines for hydrometric monitoring* series[2].

[1] United States Geological Survey
[2] http://www.bom.gov.au/water/standards/niGuidelinesHyd.shtml

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NIWA New Zealand freshwater researchers developing autonomous intel for war on waterway weeds

Jeremy Bulleid and Daniel Clements, National Institute of Water and Atmospheric Research (NIWA)

Introduction

In an ideal world alien bio-invaders would not impact our freshwater environments. But in the real world they do, often competing aggressively with and displacing native species, posing a serious threat to the long-term function of freshwater aquatic ecosystems. As a result of human activity, introductions of invasive aquatic weeds threaten environmental, social, and economic resources worldwide and represent a significant management problem to economies and the natural environment. If left unchecked, dense infestations of aquatic weeds cause significant habitat alteration, impact on recreation, cultural values, navigation and hydroelectric generation, and compromise agricultural productivity by impeding water delivery.

In the absence of control of aquatic weeds, these species will have increased impacts on New Zealand aquatic environments and further spread is likely. Prevention and early intervention are recognised as the most cost-effective means to manage invasive species that pose a biosecurity risk.

Effective detection and surveillance strategies are key to achieving eradication, so that control strategies can be enacted.

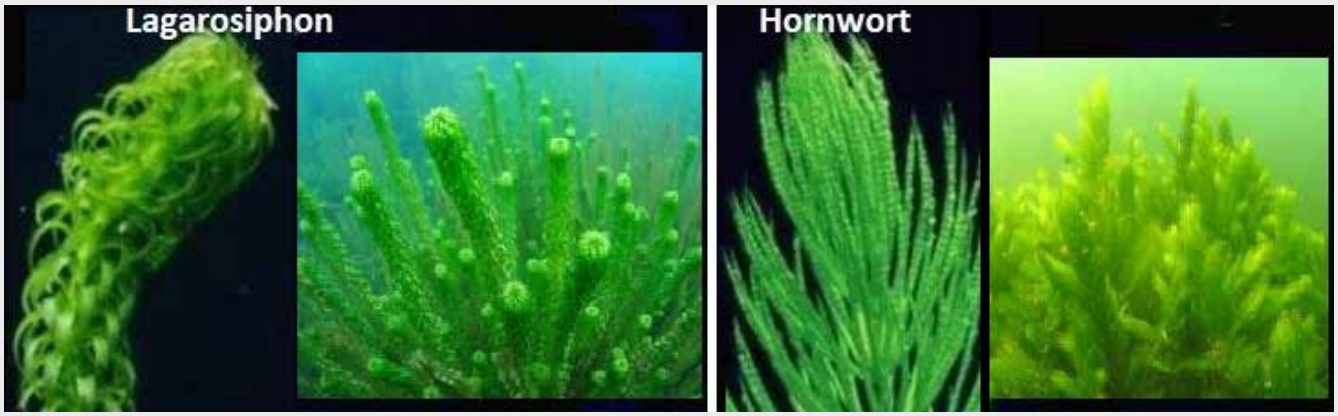


Figure 1. Two of the worst introduced underwater weed species currently present in Aotearoa New Zealand waterways. Lagarosiphon and Hornwort are currently under significant active management programmes.

Current surveillance strategies are partially effective and have paved the way for new options. Diver surveys have been heavily relied upon and are now complemented by surveys carried out with autonomous boats collecting both video and hydroacoustic data. These methods generate hours of video recordings, and whilst these capture a picture of part of a lake or river at a particular time, it still leaves us with a practical problem.

The Video Conundrum

What should we do with these enormous video files? Transferring and storing thousands of hours of video, shot at typically 30 frames a second, is problematic. And how might we process the raw imagery into useful, verifiable intel? The human resourcing that would be needed to post-process video on that scale is also a problem.

The solution must come in the form of automation. In principle this could remove much of the need for human processing.

But even if automation were attainable, this would not solve the mass video archival problem. Furthermore, to enable us to map the target species, we would have to detect and locate the targets in real time, from an autonomous boat travelling at a speed of perhaps 2 m/s.

A resolution

Fortunately, we have found a way to resolve both the mass storage and processing conundrum at the same time, by replacing human eyes and brains with 'computer intelligence'.

The project explored and applied an Artificial Intelligence (AI) Deep Learning (DL) approach to detect the target species. Once trained, the detector 'looks' for the target in the video frame-by-frame. Then if a video frame contains one or more detections, we simply record the GPS location and choose whether to keep/discard the video frame.

Using a well-trained AI approach we can now build a very small file containing only GPS detection locations. These locations are then ready for input to a mapping application such as ArcGIS or Google Earth ready for control methods to be fully implemented. This approach ideally avoids the problem of having to deal with large video files. We typically however, retain still images to verify target detections.

Arming with Artificial Intelligence (AI)

There are three parts to the AI process we are using:

- Designing the AI network
- Training the network (Figure 2) to create a detector
- Using the detector (Figure 3).

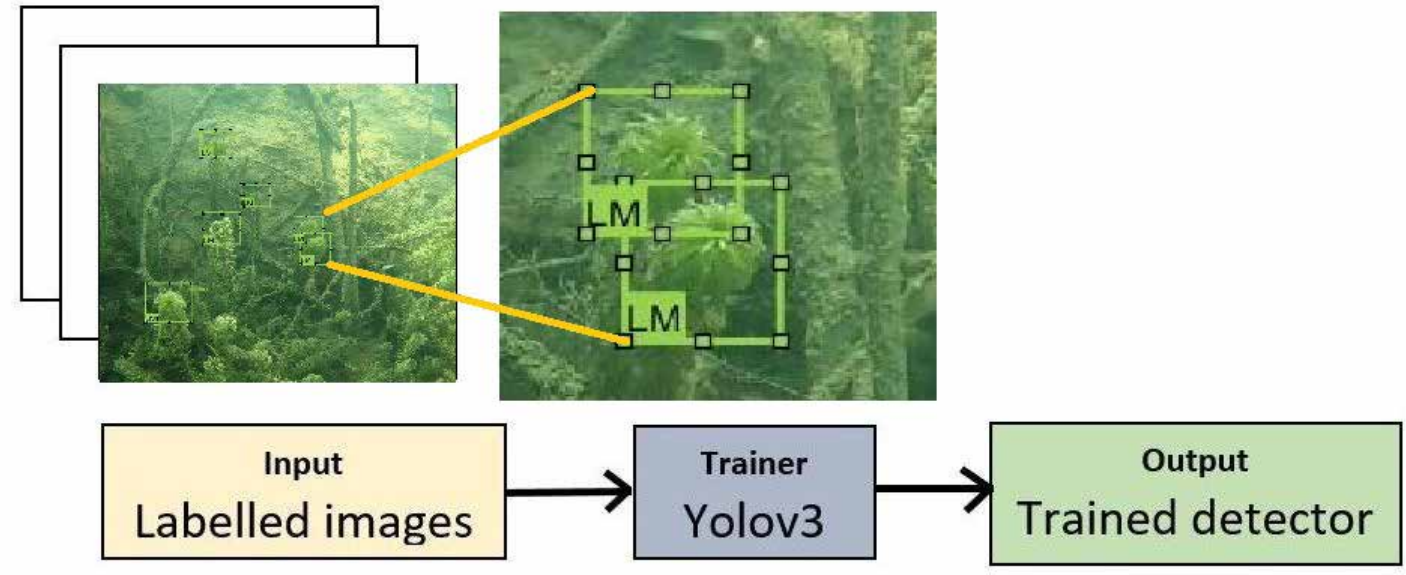


Figure 2. Training a detector.

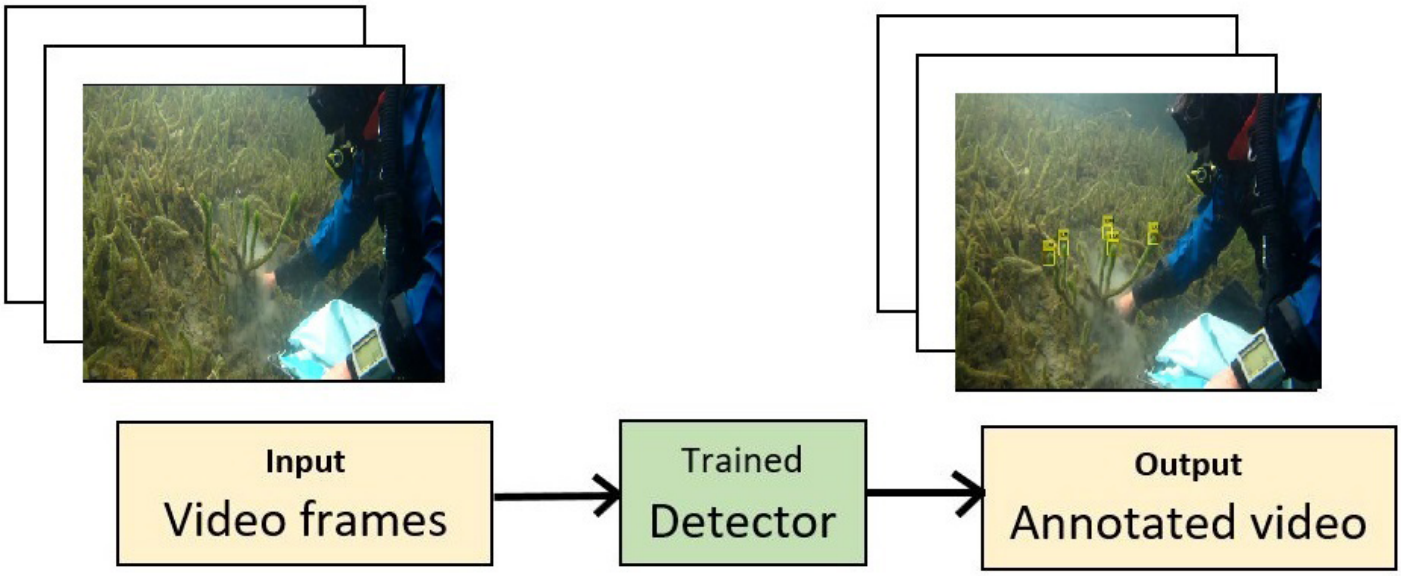


Figure 3. Using the trained detector.

Preliminary Artificial Intelligence (AI) Trials

The project team is currently refining the development of this AI Deep Learning (DL) detection system. The first trials were undertaken in a mesocosm environment, a hydraulic flume planted with three common New Zealand underwater plant species, including the target species *Lagarosiphon*. Post-processing the video shot from the boat has produced very encouraging results (Figure 4).

Figure 4. Autonomous boat with GoPro camera mounted underneath (left). Annotated detections; Red = agarosiphon (LM), Yellow = Myriophyllum (MT), Green = Elodea (EC (right)).

In subsequent tests we have post-processed in-situ video footage from both South and North Island lakes (Figure 5). This yielded surprisingly good results considering the modest amount of AI training data currently available. We will continue to train the detector until we achieve sufficient accuracy and enable it to work in a range of waterways and environmental conditions.

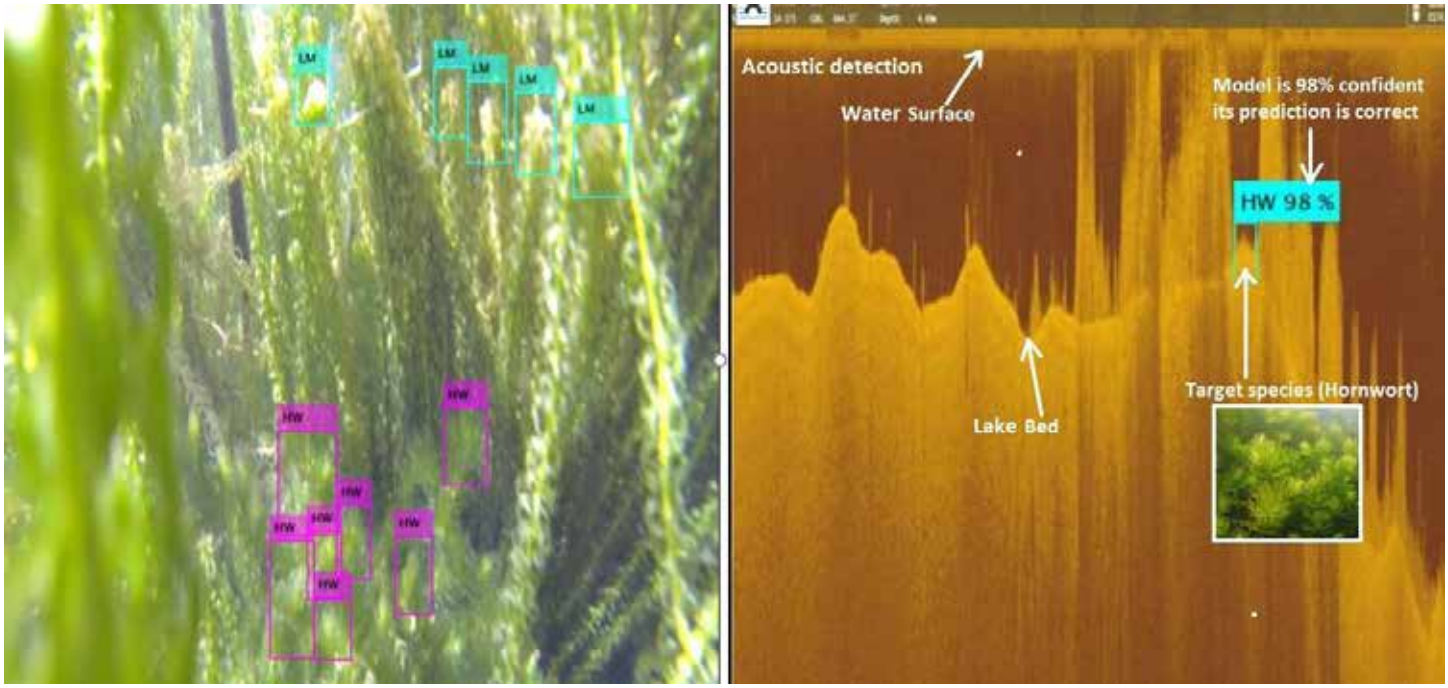


Figure 5. Detecting Lagarosiphon apical tips (LM) and Hornwort (HW) in Lake Ōkataina, North Island (left). Detecting hornwort in Lake Rototoa, North Island from hydroacoustic (for low-visibility) images (right).

From Concept to Prototype

From the 'proof-of-concept' we have now developed a prototype module that can be easily strapped to a boat (Figure 6). It contains a software detector that can be configured via a simple user interface, with an AI network that has been specifically trained to detect the target species. It will log GPS detection locations and optionally send them to NIWA's Neon Telemetry Server for archiving and export to a mapping programme. From here benchmarking, planning mitigation, eradication, and control strategies can be implemented. There are plans to build a more sophisticated user interface (a local web page) that will enable a user to configure the system and view data via an app on a wirelessly connected device.

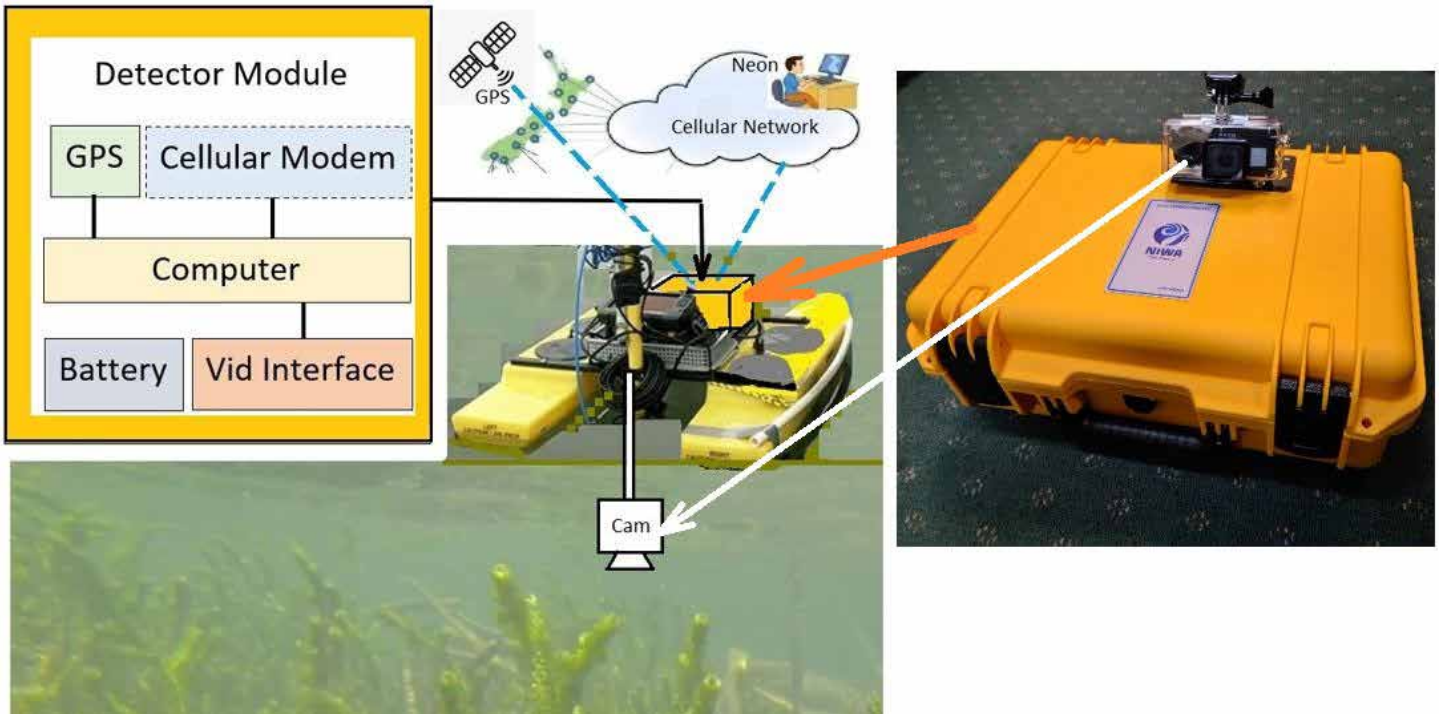


Figure 6. The detector - from proof-of-concept to prototype.

Bench Testing the Prototype End-to-End

Further laboratory and field testing of the prototype detection module is imminent. Recent bench testing (Figure 7), has achieved good results using videos shot in various waterbodies from around New Zealand.

Figure 7. Simulated Bench Testing. GoPro in the foreground (input) is 'viewing' a screen showing a video of a diver hand weeding Lagarosiphon (left). The output from the module showing five annotated detections, labelled with time, latitude and longitude (right).

Desired Outcome in Sight

The project is currently in an early phase of the research cycle and looking at ways to optimise detection efficacy through improved training and increased computing capacity. These modules will enable faster, more cost-effective/extensive surveillance and provide early warning of existing and emerging threats to our freshwater ecosystems.

Detection modules will be replicable and deployable on a wide range of surface craft. The module has a high-tech inner core, but with a low-tech outer shell it will require only minimal skills to set up and may be operated by different agencies or citizen scientists.

Whilst the project primarily developed the detection module to target invasive species in New Zealand waterways, in principal there is little to prevent global use if the detector was trained to recognise geographically-relevant target species (e.g. localised invasive weeds, fish, invertebrates).

Contacts

For further information contact Jeremy.Bulleid@niwa.co.nz or Daniel.Clements@niwa.co.nz

Engaging the Next Generation of Hydrographers; can the AHA play a role?

Justin Stockley, Surface Water Business Development Asia Pacific, Xylem Analytics

Abstract

The Australian Hydrographers Association (AHA) serves its existing membership well by managing training and certification programs (in the hydrometric monitoring discipline), providing representation on industry guidelines development through consistent production of relevant articles and events for members. This article reviews industry promotion for the surveying (including hydrography aka hydrographic surveying) industry and discusses whether there is a future role for the AHA in promoting awareness of the hydrometric monitoring discipline as a potential career beyond its existing member base.

Background

Whilst it is acknowledged that the hydrometric monitoring discipline does not face the potential skill shortages forecast in some professions, should the AHA be considering taking a more proactive role in raising awareness of the profession beyond its existing members, with a view to attracting more candidates into the hydrometric industry in Australia and New Zealand?

The danger for any industry, where the professional profile is not well understood by potential candidates, is described well by Narelle Underwood, Surveyor General NSW as below:

"Because you can't be what you can't see – there are so many career opportunities in surveying, geospatial or related fields and people miss out on those opportunities because they just don't know about it as an option"[1]

Inspiration for this article is drawn from industries with active recruitment programs, due to declines in qualified candidates, as well as national programs that encourage student subject participation across Science, Technology, Engineering and Mathematics (STEM) that may provide a pathway for industry involvement.

Figure 1. Get Kids into Survey Ambassador, Australia Poster.

The Surveying Industry: in danger of closing out OR a benchmark for an industry securing its future?

Some industries face or are already facing problems with recruitment due to a lack of qualified applicants. This can be associated with a marked decline in subject participation across Science, Technology, Engineering and Mathematics (STEM).

[1] https://www.getkidsintosurvey.com/blog/ambassador-spotlight-narelle-underwood/ accessed 3 October 2021

This issue is well-documented in the surveying industry, an industry that has a number of parallels and overlap with that of the hydrometric monitoring discipline. For example, in the UK, according to the Royal Institution of Chartered Surveyors over 85% of UK surveyors said they have problems recruiting due to a lack of qualified applicants[2]. The issue has also been identified in Australia and as early as 2010, 'The Surveying Task Force Victoria' was created with a goal to attract people to a career in surveying[3].

Subsequently, 'A Life Without Limits National Alliance' (https://www.alifewithoutlimits.com.au/) was formed and operates as an independent sub-committee of the Surveying Task Force. The alliance comprises representation from New South Wales, Queensland, South Australia and Western Australia as well as Victoria.

This project aims to transform how the surveying sector in Australia develops, implements and supports initiatives that attract people to a career in surveying. Examples such as the "Day in the Life of" Profession Spotlights and Profiles (Figure 2) and Career Resources (see Figure 5) demonstrate the excellent resources for prospective candidates across Primary and High Schools, as hosted by the website, and is perhaps a great source of inspiration for future initiatives within the AHA.

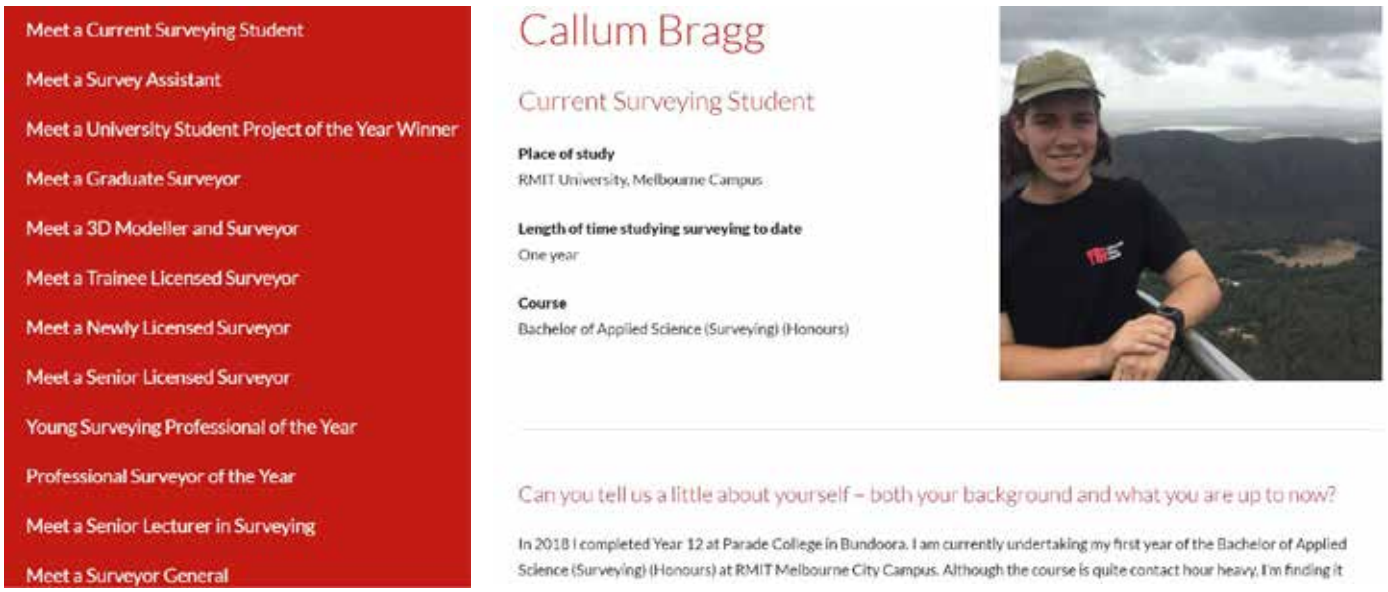


Figure 2. "Day in the Life of a...Meet a...", Profession Spotlights and Profiles[4]

Profession Overview Video

Excellently produced overview videos of the varied surveying specialisations are also available to view. For example there is an excellent video for Hydrography aka Hydrographic Surveying as practised by members of the Australasian Hydrographers Society (Figure 4) and a great talk about Geospatial Science by Lee Hellen.

[2] https://www.getkidsintosurvey.com/about/for-surveyors/ accessed 30 September 2021
[3] https://surveying.org.au/wp-content/uploads/2018/04/Marketing_Update_July_2010.pdf accessed 30 September 2021
[4] https://www.alifewithoutlimits.com.au/meet-a-current-surveying-student/ accessed 30 September 2021
[5] Hydrographic surveyors map the sea floor and other waterways. These surveyors work in coastal areas and overseas.
[6] The Australasian Hydrographic Society is the South West Pacific and South East Asian regional focus for those interested in hydrography and related sciences. The Society comprises members who are practising or retired hydrographic surveyors, and those that have an interest in hydrography: http://www.ahs.asn.au/

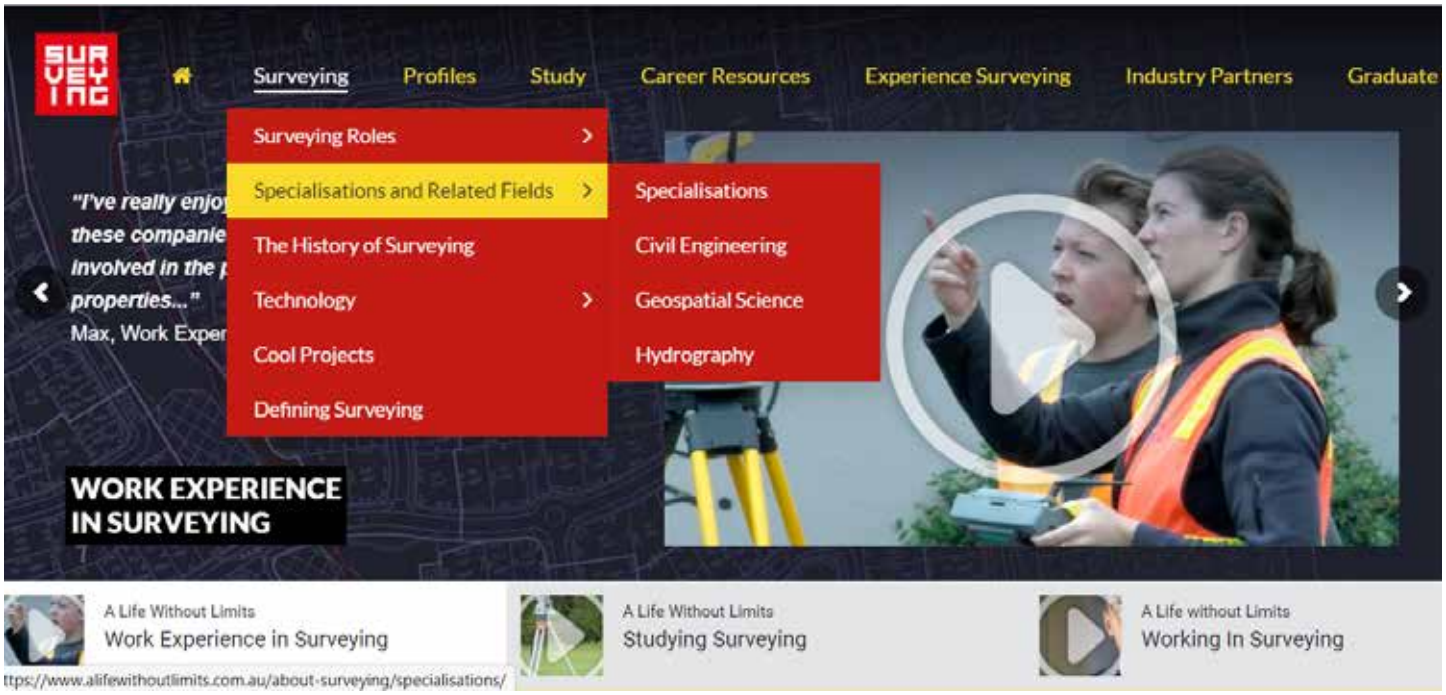


Figure 3. Specialisation and related fields – overviews[7]

Figure 4. Hydrography (aka Hydrographic Surveying) - Profession Overview.

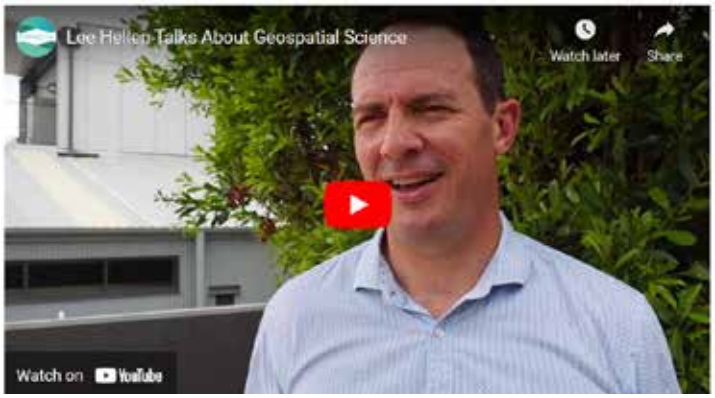


Figure 5. Lee Hellen Talks about Geospatial Science[8]

[7] https://www.alifewithoutlimits.com.au/about-surveying/specialisations/ accessed 30 September 2021
[8] https://www.alifewithoutlimits.com.au/geospatial-science/ accessed 30 September 2021

Career Resources

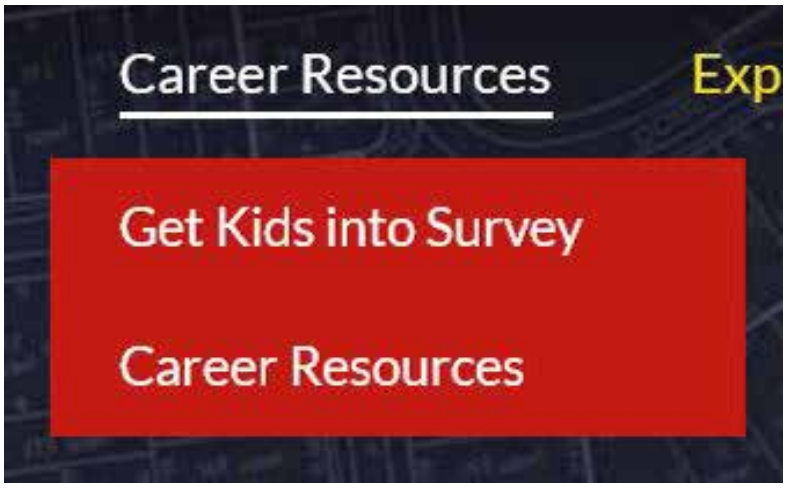


Figure 6. Life without Limits Alliance Website[9]

Figure 7. Get Kids into Survey Student Engagement Resources[10]

From the 'Get Kids into Survey Website'

The 'Get Kids into Survey' project recognises that, in order to secure the future of the industry, they need to unite the geospatial community to inspire a new generation of surveyors. The community members take great pride in their work, and want to share their enthusiasm with young people.

Developed in the UK, 'Get Kids into Survey' poster and comic series puts surveying and geospatial science in the spotlight and renders it approachable by highlighting what makes the professions exciting, challenging and rewarding. Like the 'Where's Wally' puzzles of yesteryear, every poster is crammed with colourful characters, amusing situations and more. With complementary Q&A sheets that can be downloaded online, these educational aids help generate land surveying discussions in the classroom, at home and beyond.

Figure 8. Australian Poster produced by 'Get Kids into Survey'[11]

[9] https://www.alifewithoutlimits.com.au/ accessed 30 September 2021
[10] https://www.getkidsintosurvey.com/resources/ accessed 30 September 2021
[11] https://www.getkidsintosurvey.com/download/australia-poster/australia-poster-4500px-2mb/ accessed 30 September 2021

The examples provided may serve as inspiration to the AHA to consider whether it is worth producing resources or collaborating with interested government bodies such as state and federal water and environmental agencies such as the Bureau of Meteorology to further the awareness of the hydrometric monitoring discipline and the hydrographers who practise it?.

Engagement of Students in Water Measurement through existing State and National STEM Programs

Given persistent declining participation across student subjects in STEM there are current, well established state and national engagement programs beyond school curriculums. These often take the form of Science Competitions and/or Activities.

Some of these competitions include:

- State Science Talent Search (STS) competition (State)
- BHP Foundation Science & Engineering Awards (National)
- Sleek Geeks Science Eureka Prize (National)
- Gamechangers (State)
- Stockholm Junior Water Prize *(…the world's most prestigious youth award given to a High School student for water research)*

Given the importance of water throughout Australia, potential collaboration by the AHA or engagement of members and their families in participation may assist to raise the profile of the industry at the school level.

To inspire AHA members, two example school science project submission excerpts with a water measurement focus are presented by Daisy Stockley (11 years old).

Investigating How Rivers Flow in Minecraft Compared to Real Life STAWA Finalist 2020, Published NZ Hydrological Society Journal

Daisy was specifically interested in river hydraulics. A simple hydraulic investigation was formulated and then undertaken in two components:

Real Life Measurements – Float gaugings were undertaken at two parts of the same river, through a fast-moving steep section and through a slow-moving section with a gentle slope.

Minecraft Measurements – Two channels were created in Minecraft[12] with different slopes and float gaugings undertaken using the available in game software mechanics, namely boats that move with the water current.

Figure 9. Float gauging section 1: Bells Rapids; Steep Section.

Figure 10. Float gauging section 2: Bells Rapids; Gentle Section.

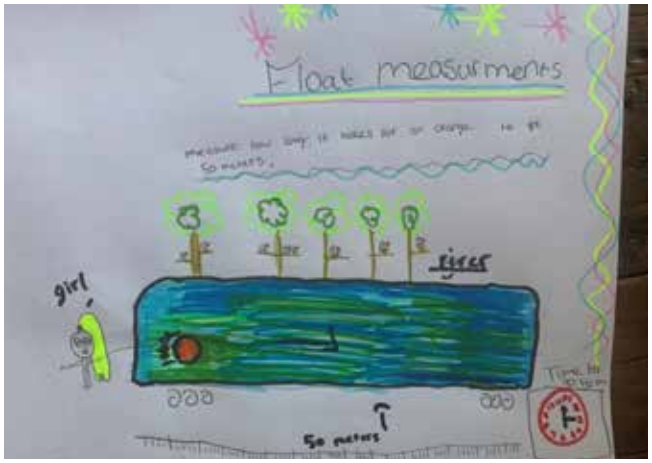


Figure 11. Anatomy of a float gauging in a real river as detailed by an 11 year old.

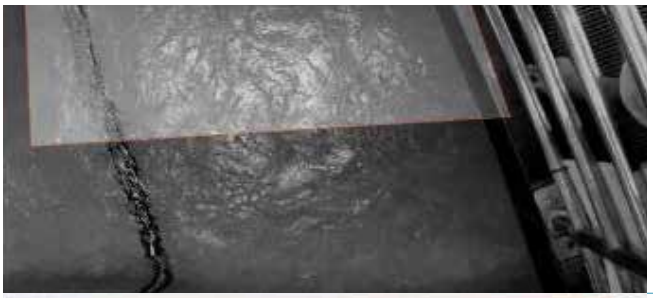
Figure 12. Use of boats in Minecraft to simulate a float gauging. Both boats are pushed into the channel simultaneously using redstone mechanism.

[12] https://www.minecraft.net/ accessed 30 September 2021

Investigation: Measuring the Speed of Rip Currents Safely STAWA Primary School Winner 2021, BHP Awards Finalist

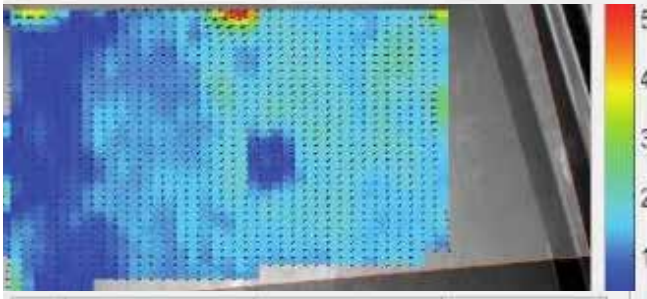
The aim of my investigation is to understand more on the dangers of rips through my own studies. I then want to see if I can measure rip current speed and be able to do it safely. I want to test if you can use video analysis of the rip current to determine its speed. Video analysis is used to check river speed, but I wanted to see if I could use it in the sea. Video is used to see if there is a rip at a beach, but it hasn't been used to actually measure the speed of the water. It is the speed of the water that makes a rip dangerous.

I decided to do an investigation to understand more on rip currents and also work out if there is a way to find out how fast they are moving safely. The faster they are, the more dangerous they are for people that get caught in them. I thought something like this would be useful for a Surf Life Saving Club so they can find out how dangerous a rip current is. It might also be useful for surfers or anyone that does swimming in the ocean.



I analysed the water flowing near the bridge on the right side because on the left it was slow because of the way the jets work.

Here are the water speed lines after it has been analysed. The longer the line the faster the water is moving.



Here is a map showing the speed of the water. Further away from the bridge the water is moving slower.

	Station	Velocity
4	0.2236	1.5135
5	0.2981	1.6199
6	0.3726	1.7707
7	0.4471	1.8514
8	0.5216	1.7447
9	0.5962	1.6153
10	0.6707	1.7744
11	0.7452	1.8901
12	0.8197	2.1215
13	0.8942	2.1477
14	0.9687	1.9472
15	1.0433	1.5688

Here is the actual water speeds in m/s for each arrow in the picture above.

AVERAGE WATER SPEED FOR SECTION ANALYSED **1.8 m/s**

Figure 13. Image Analysis and Summary.

The results from the video analysis (one sample above) were very promising though. I was surprised that the readings of water speed are what I would expect by looking at the video, it was very slow and the software results were good.

Main things I discovered

I learnt that swimming, against a strong current, tires you out very quickly. It is very different to just swimming in calm sea.

I learnt to use the RIVeR software to be able to find out the speed of water from videos of it flowing.

I demonstrated that it was comparable to a float measurement in the lazy river.

I used the method at the beach in very messy conditions and it was able to give me a water speed.

Was my prediction correct?

Yes. It was right although I need to test it more in real life

How could I have made the experiment better?

I need to take more measurements at the beach and I need to test my way of working out the distance which is needed by the software.

Good idea for the surf club

I think surf clubs can use this measurement method to better explain to people the dangers of rips at the beach. They use drones at the moment as I have seen them at the beach, so they could take some water speed measurements and put the information up for people to see.

Figure 14. Beach Sign Prototype.

Case Study: Non-contact Laser System Solves Flow Measurement

Challenges at Rzeszow Wastewater Treatment Plant (WWTP)

Teledyne, ISCO[1]

Figure 1. Aerial, Rzeszow WWTP.

To measure flow rates at two influent channels at a wastewater treatment plant (WWTP) in Rzeszow, Poland, the Municipal Water and Sewage Company (MPWiK Sp. z o.o. w Rzeszowie) decided to install innovative non-contact laser technology. Teledyne ISCO LaserFlow® sensors were placed above the two channels and connected to a Signature® Flowmeter to resolve very challenging conditions without the need for expensive renovations of the channels to build flumes.

Rzeszów WWTP Site Challenges

Shown here is one of two inlet channels at Rzeszow WWTP where poor quality conditions of the wastewater exclude the use of traditional sensors.

[1] Originally published by Teledyne ISCO 24 June 2020.

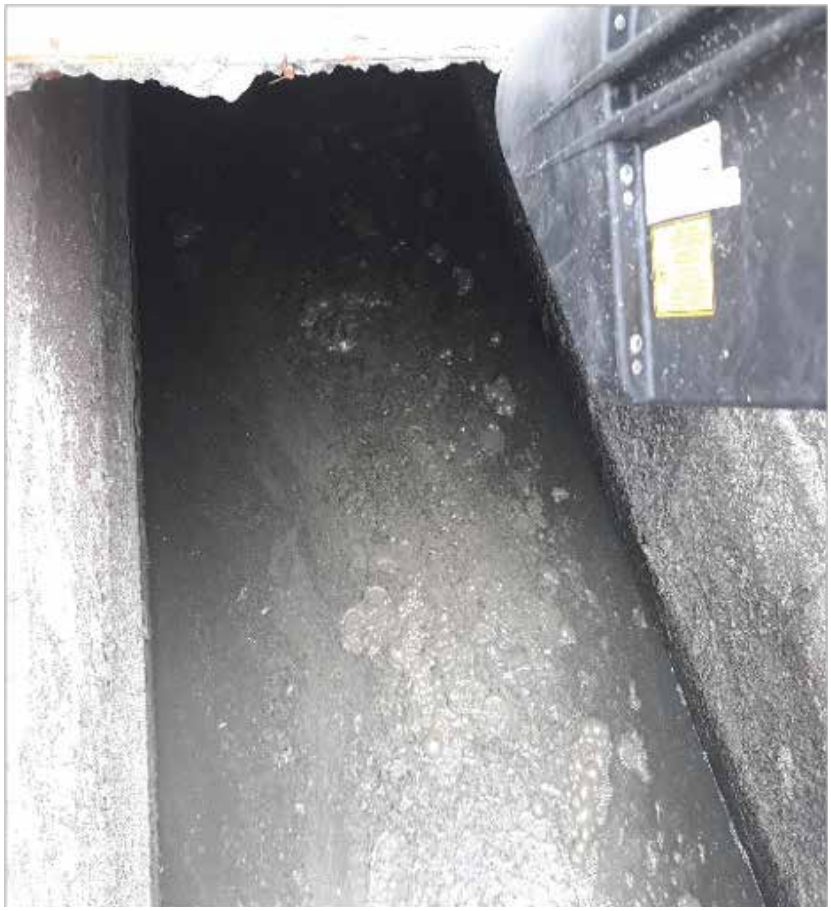


Figure 2. Rzeszow Inlet Channel Flow Conditions.

Accurate flow measurement at the inlet to the WWTP is essential to maintaining optimal settings for the continuously controlled processes involved in clearing sewage and achieving the required levels of pollution reduction. A highly variable sewage inflow, plus rapidly changing hydraulic conditions during rain events, were two of the most important considerations affecting the choice of flow-measurement technology.

These difficulties were further compounded by high concentrations of silt and suspended solids, which prohibited the use of direct-contact sensors, which would have required renovation of the channel floors and costly routine maintenance to keep the direct-contact sensors clean. The ability to instead mount two low-maintenance, non-contact sensors above the channels was therefore crucial for the customer.

Installing of LaserFlow™ Sensors

To solve this problem, Teledyne ISCO's distributor in Poland, recommended placement of Laserflow sensors above each channel while also performing and validating the installation.

Figure 3. Laserflow Sensor Installations.

Teledyne's innovative laser-based technology allowed the sensors to be positioned above the two rectangular channels (0.8 m x 1.1 m wide), which had very high sludge build-up (0.1 m x 0.3 m). The two Laserflow Sensors were connected to a single Signature Flowmeter. Depending on sensor selection, the Signature is capable of operating with up to nine connected sensors. All readings are relayed continuously to the SCADA system of the WWTP.

Accurate Flow Rate Measurement

The graph below shows the flow rates from the two parallel but independent inlet channels. The different flow rates resulted from different hydraulic conditions, channel dimensions, and silt levels in each channel.

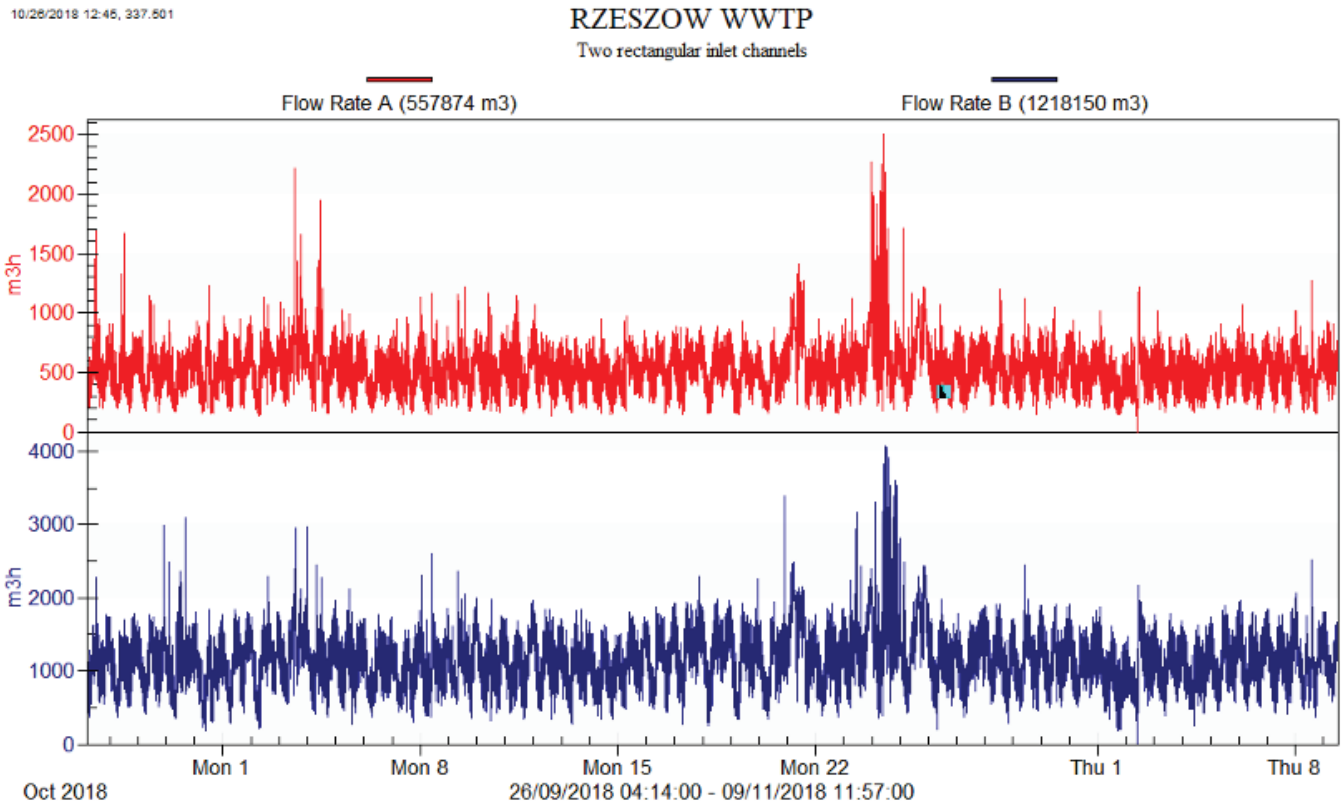


Figure 4. Independent Inlet Channels, Plotted Flow Rates.

Substantial Cost Savings

Because the Laserflow was able to adapt the existing channel conditions, the investment required for accurate and reliable flow measurement was approximately 30% lower than having to rebuild the location to install structures such as flumes. Furthermore, despite the difficult site conditions, the maintenance cost using Laserflow non-contact sensors is reduced to near zero.

Thanks to the unique non-contact laser technology, the Teledyne ISCO flow-measurement system was able to adapt to the existing channels without the need to rebuild. This installation has been working very efficiently since 2018.

360 TIENet Laserflow® Sensor

The TIENet™ 360 LaserFlow™ sensor is an area, velocity, flow and water-level measurement device that remotely senses flows in open channels using non-contact Laser Doppler Velocity Sensing and non-contact Ultrasonic Level Sensing technologies. The sensor uses advanced technology to measure velocity with a laser beam directed at single or multiple points below the surface of the wastewater stream. Therefore, unlike radar technology, it does not require the creation of ripples on the surface of the stream.

- Rugged, submersible enclosure with IP68 ingress protection
- Zero deadband from measurement point in non-contact level and velocity measurements
- Continuous level measurements in submerged conditions
- Advance velocity diagnostics for data quality evaluation and analysis
- Bidirectional velocity measurement
- Low level velocity measurement
- Up to nine sensors can be connected to one Signature Flowmeter

Figure 5. Laserflow Sensor.

Signature® Flowmeter

The Signature Flowmeter from Teledyne ISCO, designed for open channel flow monitoring, supports flow measurement methods including bubbler, non-contact laser area velocity, ultrasonic, and submerged Doppler ultrasonic area velocity.

With the ability to connect up to nine sensors, the Signature Flowmeter provides a broad range of I/O and communications options:

- pH and temperature
- SDI-12
- RS485
- 4-20 mA output
- Ethernet
- GSM/GPRS modem

The Signature Flowmeter is rugged (IP 66) even if the cover of the lid is open. It performs data logging with variable rate data storage and data integrity verification and has the ability to connect a USB drive for data/report retrieval and programming.

Figure 6. Signature Flowmeter.

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