Australasian Hydrographer

April 2022

AUSTRALIAN HYDROGRAPHERS ASSOCIATION

AHA

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Bells Rapids, Western Australia

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.

ZACHARIAH WARD

Editor's Introduction

Not only have we seen a multitude of unprecedented events over the last few years with global pandemics, ongoing international conflicts, and political upheavals/ unrest (only to name a few), but recently seeing the catastrophic climate events unfold over the east of Australia has no doubt left everyone feeling exposed and extremely vulnerable. The extent of damage, destruction and heartache seen from the recent rainfall/flood events in areas of NSW and QLD has struck a chord for many and in-particular the multitude of hydrographers, first responders and support staff/emergency services on the front line of it all need to be extensively applauded. Witnessing all this from the Western side of Australia personally I'd like to extend my most positive thoughts, well-wishes, and empathy to all those attempting to rebuild, recoup and reset their lives with my deepest sympathies and condolences going out to those who may have lost possessions or loved ones. This serves as a constant reminder of how important the data collection, modelling and hydrometric measurements that we're all involved with is. Both in the overall understanding of changing climactic conditions and the predictions/warnings of potential impacts on existing infrastructure and inhabited environments.

Please continue to send in submissions for upcoming Australasian Hydrographer editions as we're always on the lookout for more hydrometric material, photos, case studies, innovative instrumentation solutions and in simple, 'water-nerding' metadata to share with our members. This edition sees some intriguing instrumentation-uses and also some more 'thought-provoking' pieces on the future of our environmental monitoring industry.

In closing I'd like to take this opportunity to wish our current Editor In-Chief Jacquie Bellhouse a very gracious and heartfelt farewell as she has chosen to move on from the role that she has so amazingly embodied for over 10-years! At this stage the June 2022 edition of the Australasian Hydrographer will be Jacquie's last and I'm sure there will be more detail and many, many kind-words to come then from all people AHA and beyond.

But for now, I feel I need to publish and make known the mighty contribution that Jacquie has made to this publication and the AHA in general. Her drive, professionalism, rigour, and commitment to the cause of pushing the importance of hydrometric data and hydrography as a profession has been felt here in WA and by myself in-particular. She has been an amazing mentor, coach, leader, and inspiration to many (including myself) in this industry and I wish her all the best into the future within the water/ environmental industry.

Enjoy the next chapter in your hydrographic career Jacquie and to everyone else, stay safe and keep measuring!

Zac Ward CPH

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P +61 7 4936 3388
Unit 2/11 Sturt St, Rockhampton QLD 4702

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P +61 2 4721 3477
24A Lemko Pl, Penrith NSW 2750

ARRAN CORBETT

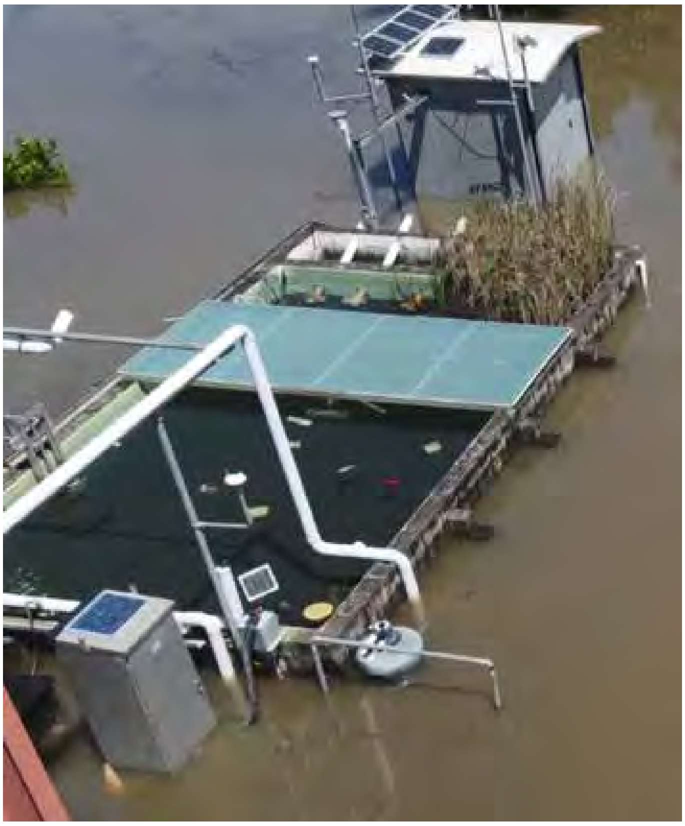
From the President

Another La Nina wet season has well and truly left its mark! With devastating flooding across Southern Queensland and Northern NSW taking lives, homes and leaving a truly astounding clean-up bill. Sadly, it will be some time before our communities are back up on their feet.

There is much work yet to be done in the space of flood management and preparation across the country. I am confident that our colleagues in the Floodplain Managers Association (www.floods.org.au) will be hard at work reviewing, planning, and preparing for the next big event.

From a hydrographic perspective, there are also many lessons for us to learn from recent events. We will take the time to review what has worked and where we could have done better. I am happy to say that most of the State-owned assets in the Southeast corner of Queensland held up admirably with (I believe) only two river-end wash outs causing concern. I am awaiting feedback from our NSW colleagues but suspect their network impact may be significantly higher. Building resilience into our network remains critical in ensuring we continue to deliver the data required for effective flood preparation & response.

On a lighter note, the Hydrographic Support Unit at Rocklea (SW Brisbane) has found an unusual visitor in the flood clean up. A 400mm long barramundi was left stranded in the current meter test flume as flood water receded. Baz, as he has now come to be known has been safely housed in with the two oversized goldfish that inhabit the instrument test pond. The test pond itself escaped inundation and provided a haven for the fish that call it home.



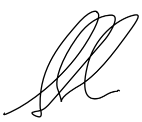
Top left: Baz, Top right: Instrument Test pond, and Bottom: Inundated flume Feb 2022.

In association news... we (the committee) are preparing for our COVID delayed 2021 Annual General Meeting. During this AGM there will be an election process for several positions:

1. President
2. Treasurer
3. Committee members x3

I ask that you have a think about any capacity that you may have to support our association. A call for nominations and papers will be sent with the AGM notification.

Stay safe,



Arran Corbett CPH
AHA President

Gatton On-Farm Survey Report – Emerging Technologies

Arran Corbett, Mark Findsen, Dejan Subaric & Dane Goddard, Department of Regional Development, Manufacturing and Water (DRDMW), Qld

Overview

In late 2021 and continuing into early 2022, the Department of Regional Development, Manufacturing and Water (DRDMW) via the Enhanced Measurement Project undertook a series of trials with Fyfe Pty Ltd to investigate methods for topographic and bathymetric data collection for the construction of storage volume curves.

This work was performed at an archetypal farm water storage facility in Gatton, Queensland. The site selected was based on its features including fringing vegetation, depth, access and location, symmetry, overflow capacity and the storages geomorphology.

Some of the technologies and techniques used, during the survey include photogrammetry, Sonar and Drone LiDAR.

The following photos demonstrate the range of tools tested and highlights some of the challenges encountered.

It is expected a full outline on this work will be shared with AHA members in a future Australasian Hydrographer publication.

Figure 1. Archetypal On-farm water storage facility, surveyed during the trial, Gatton, Queensland.

Figure 2. True View 515 LiDAR mounted on a DJI Matrice 300 RTK.

Figure 3. Correlating survey coordinates and reference points using RTK Base Station.

Figure 4. DJI Matrice 600 RTK with a True View 635.

Figure 5. DJI Matrice 600 RTK with a MALA GPR.

Figure 6. Access issues provided challenges to the trial but reflect real world hindrances.

Figure 7. McBathy RC Boats both Single beam and Sonar Side scan with Surface LiDAR units were trialled.

Figure 8. DJI Matrice 600 RTK with a drop sonar cable.

Figure 9. TB9s RC-Pod Boat with Sonar Side Scan and LiDAR.

Figure 10. DJI Matrice 600 RTK with Amuse-Oneself TDOT 3 Series – Drone LiDAR.
Representatives from Amuse-Oneself, Japan were present for the trial.

State of Environmental Monitoring 2022

Argos.io Pty Ltd (eagle.io)

Data collected via an industry-wide survey conducted between 15/09/2021 and 22/10/2021 of 208 participants within the Environmental Monitoring industry

Summary

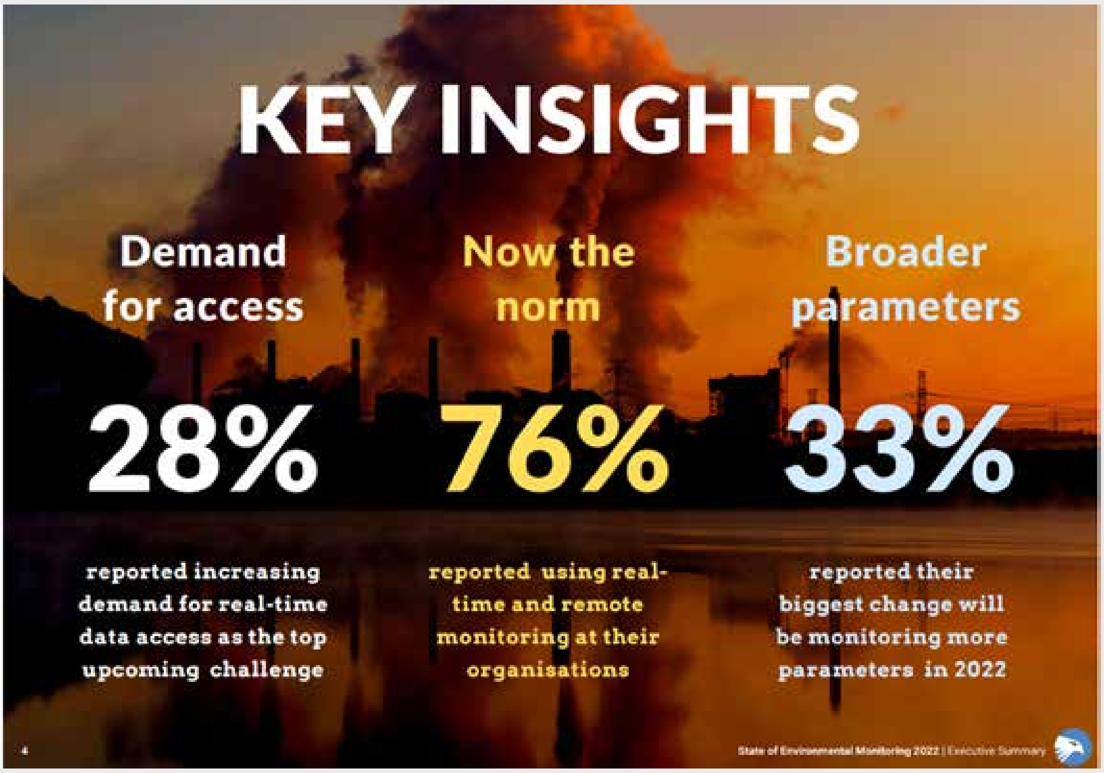
The Environmental Monitoring industry is changing rapidly. We're seeing a proliferation of new technologies, IoT platforms, sensors, telemetry options, gateways, and protocols. Regulators and stakeholders are increasingly demanding more data transparency and access to real-time conditions.

This report provides a snapshot of industry direction and understanding of the current landscape, formed by the expert opinions of over 200 scientists, engineers, and industry specialists.

End-users are moving to real-time with more than a quarter reporting an upcoming move in 2022 to real-time and three quarters expecting they will be monitoring predominantly remotely by 2025. According to responses, this is largely (41.3%) driven by organisational needs for real-time data in decision-making processes.

Given this real-time drive, almost a third (30%) of end-users are already reporting a shortage of talent as their most pressing challenge. This skills gap could be addressable by connecting organisations with technical sensor deployment skills to these end-users switching to real-time methods.

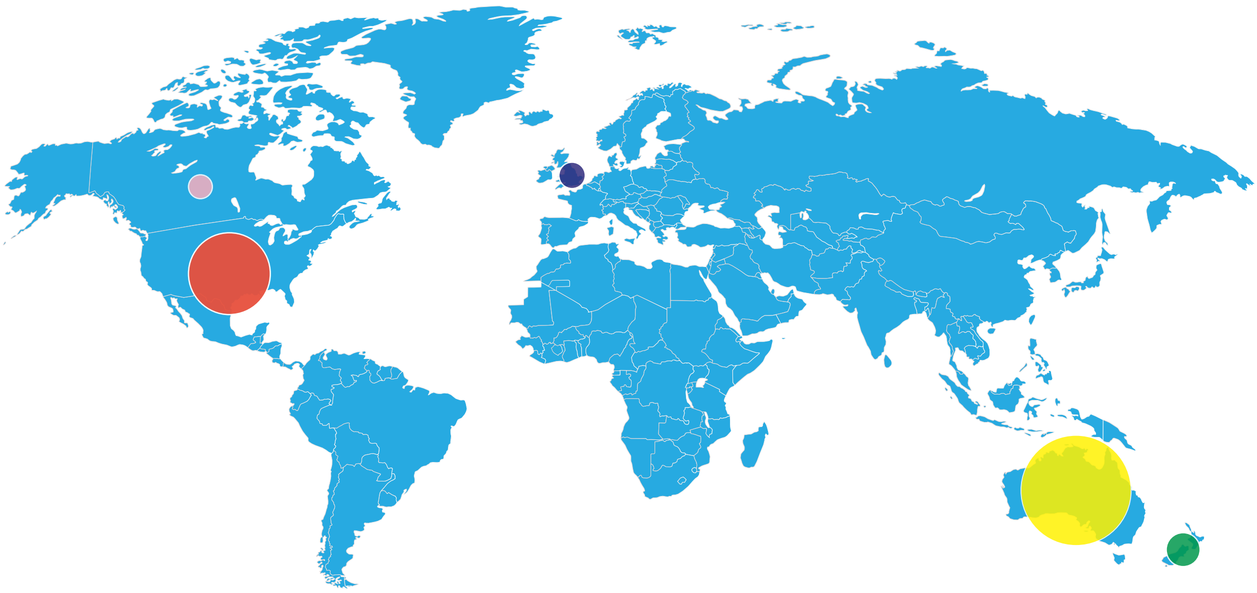
Respondents also identified multiple limitations in sensing hardware inhibiting the broader uptake of remote monitoring, from maintenance costs to lack of suitable sensors for their analytes. Additionally, it is expected that monitoring programs will expand in 2022 as over thirty per cent (31.5%) of respondents reported an increase in parameters and analytes as their biggest upcoming change for the year.

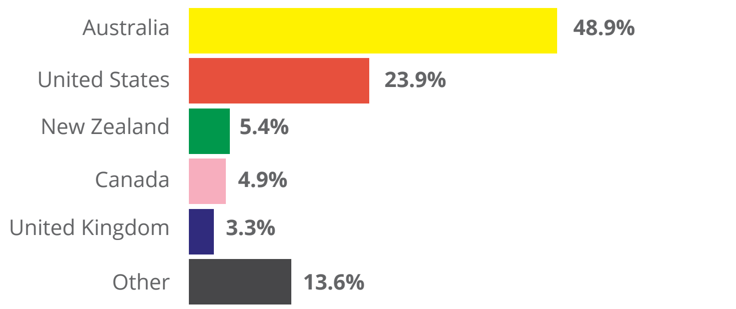


Survey Demographics

Of the 208 survey responses, almost half the participants (48.9%) were in Australia, just under a quarter (23.9%) in the United States and the remaining distributed across Canada, the UK, New Zealand with outliers such as Brazil, Indonesia, Germany, Sweden, and Kenya.

The geographic spread was skewed by eagle.io's operations across Australia, New Zealand and the United States. However, we believe the resulting findings retain broad multi-national application due to the maturity of these markets.





Indonesia, Brazil, Europe, Saudi Arabia, Germany, Sweden, Kenya, Africa

Organisation Type

Service providers include: environmental consultants, engineering consultants, hardware integrators

Product providers: Hardware & software vendors

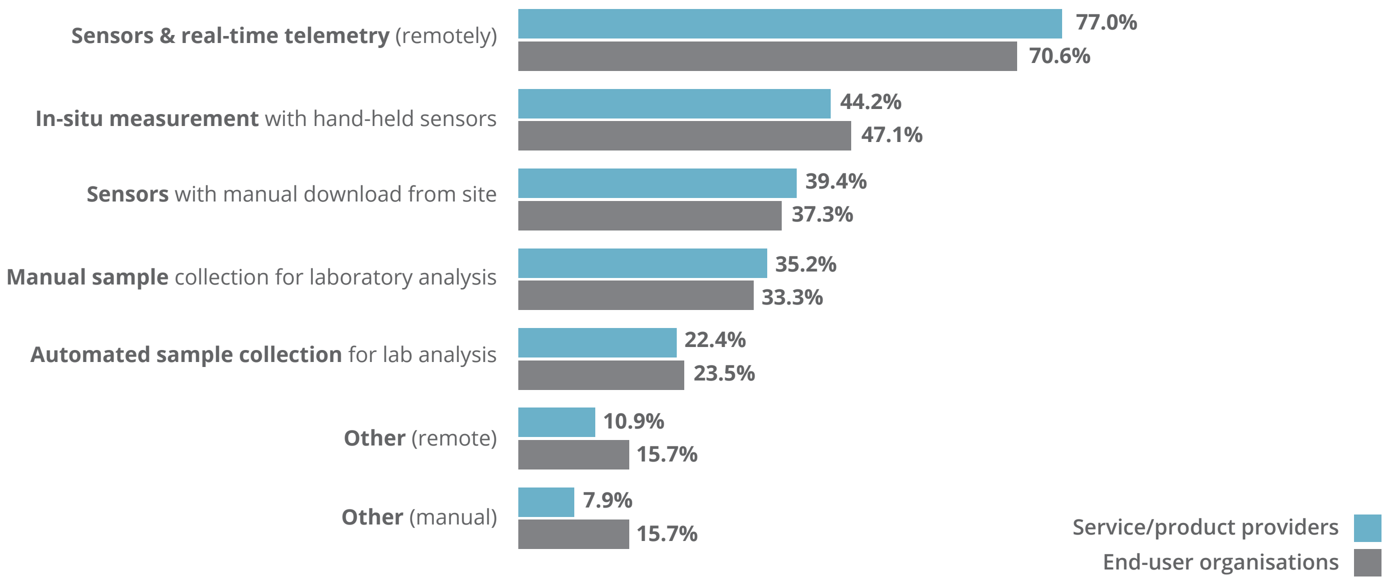
End-users: Construction, Mining, Oil and Gas, Transport (Rail/ road/ tunnels/ ports), government sectors

Going Real-Time

Real-time monitoring via remote sensors was the most prevalent monitoring method across the industry. However, a large proportion of both service providers and end-users still feature manual monitoring methods in their practice. This suggests the industry is in a transition period from manual to real-time. The factors that appear to be driving and inhibiting remote adoption will be covered later in this report.

Monitoring method adoption

The distribution was also heavily skewed towards sensor monitored methods vs sample collection.

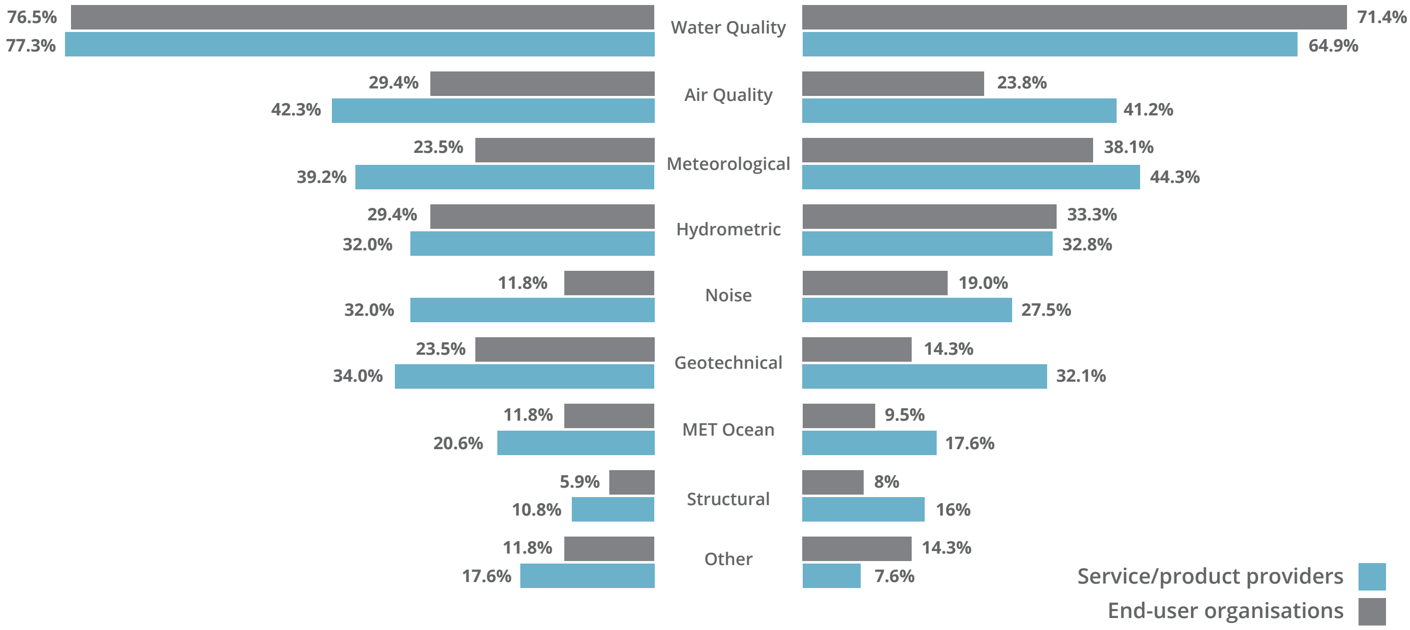


What is Measured

Water, Air (quality and meteorological) and Hydrometric (ground and surface water level measurement) were the most commonly monitored analytes across respondents. With remote sensor talent shortages reported in both Air and Water Quality by end-users, there's a market opportunity for providers who have these capabilities to service end-user demands.

A note of caution on extrapolating market size from this count data. Although there are fewer companies and end-users undertaking structural or geotechnical monitoring by count, the number of sensors and scale of these monitoring systems when deployed can be very large.

Proportion of respondents monitoring each measurement

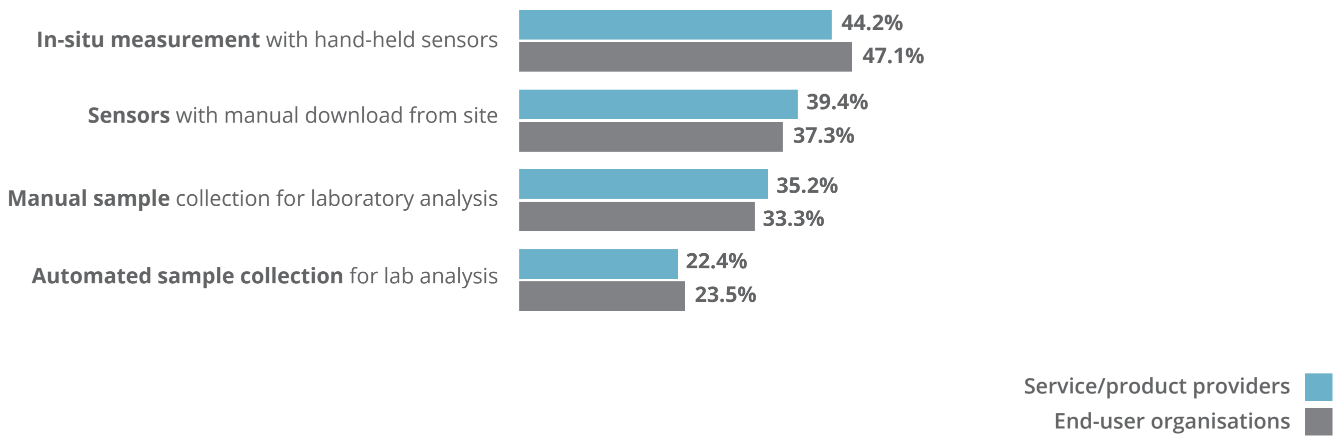


State of Manual Monitoring

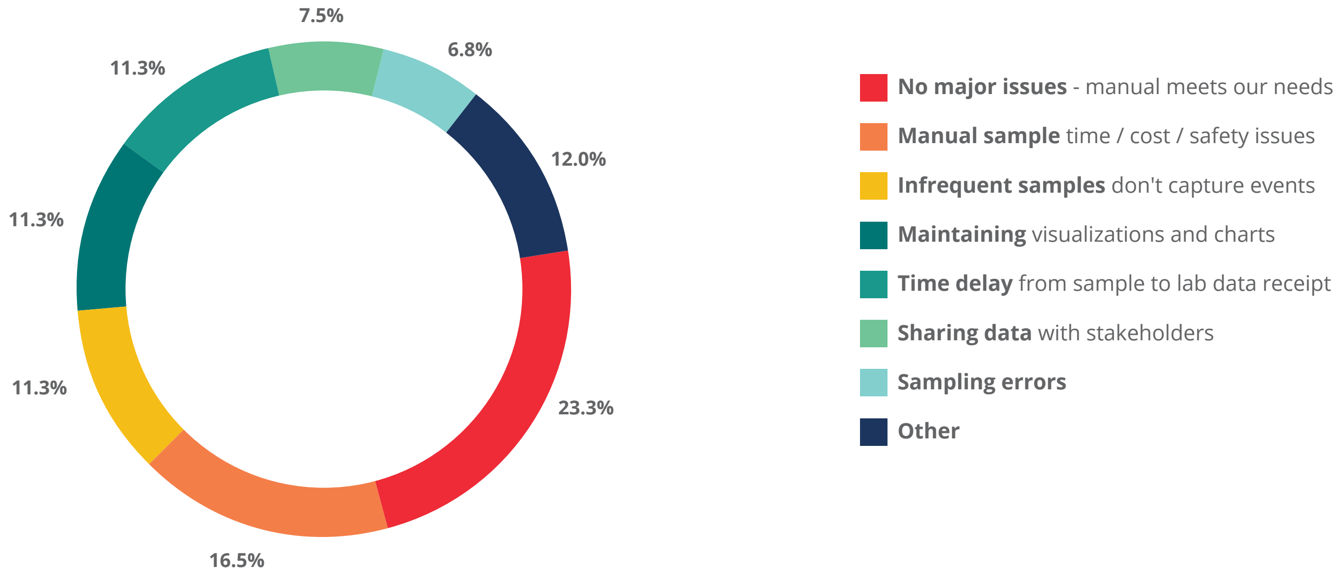
Manual remains relevant

More than half of respondents reported some form of manual monitoring method still in use within their organisation, with Water Quality (22.4%) being the most manually monitored media. But this seems set to shift as nearly three quarters of monitoring professionals (71% end-users and 74% of service providers) reported intent to switch some, or all their manual monitoring to real-time in the next 4 years. The strongest drivers moving respondents away from manual monitoring were the time, cost and/or safety issues, poor sampling density (missing events), maintaining data charts and time delays. Even given these difficulties, a quarter of respondents were completely satisfied with their current manual monitoring.

Manual methods by usage



Biggest challenges in manual monitoring



State of Remote Monitoring

Remote, Widespread

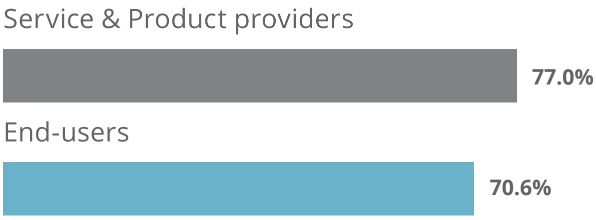
According to responses, remote monitoring is already widely adopted across environmental monitoring industries and sectors. Of the 208 respondents, almost three quarters of end-user organisations (70%) and more than three quarters of product/service providers (77%) reported using some form of remote environmental monitoring.

The factors driving the adoption of remote monitoring included operational needs (benefits), cost reductions, and legislative requirements. The survey responses indicate an industry sentiment that we will continue to see a rise in remote monitoring over the next few years. Almost half (48%) of environmental monitoring consultants and technicians who responded said in 5 years' time (2026), remote environmental monitoring will be a significant part of their operations.

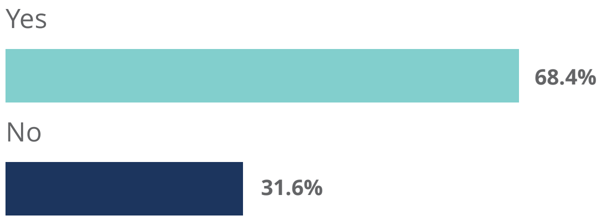
Operators and professionals who prepare for this shift may position themselves to succeed as remote monitoring proliferates.

Real-time adoption

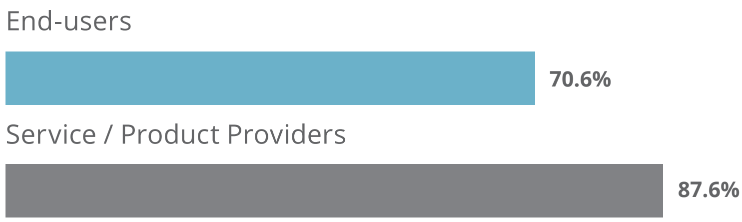
Currently monitoring remotely



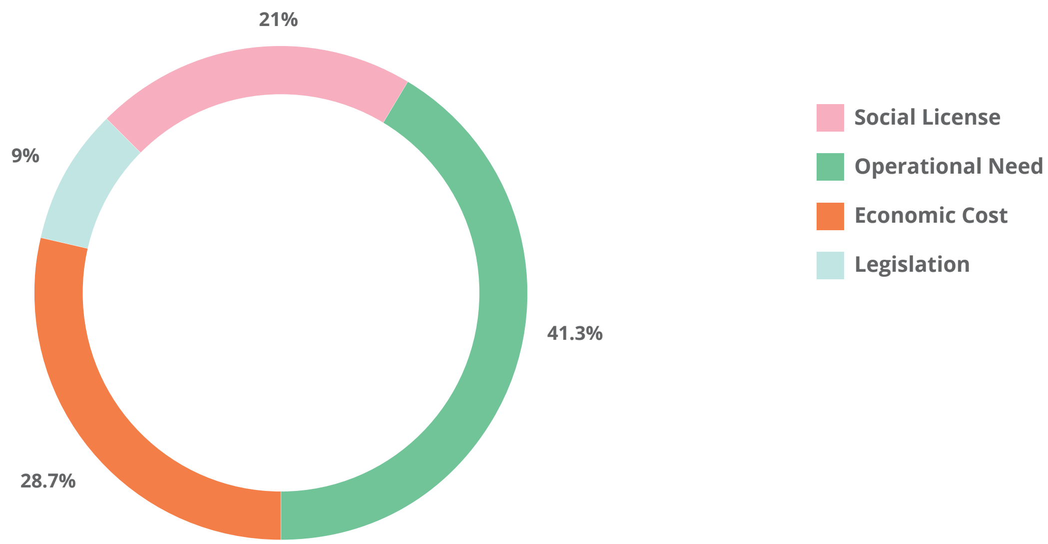
Considering switching to remote



Able to monitor parameters remotely



Factors driving adoption



Addressable challenges to remote adoption

Skills - although a second-tier barrier to hardware limitations, the identified skills gap is solvable today. Primarily via the connection of those organisations with the technical sensor deployment skills required, and the engineers, scientists and end-users seeking this capacity.

Sensing Hardware - respondents identified a number of hardware related limitations inhibiting the broader uptake of remote monitoring, including direct and maintenance cost of sensors and telemetry units and lack of commercial availability of sensors for analytes of interest. There is a clear need for lower cost, more robust sensor and hardware solutions, presenting a large market opportunity for new instrumentation start-ups to play a role in further adoption.

Water Quality and Hydrometric Monitoring

The survey revealed a massive demand for real-time Water Quality telemetry services in the next three years, requiring a strong response from engineering and environmental services to build capability and capacity in deploy and maintain real-time systems.

Currently only 25% of end-user companies surveyed use telemetry to collect sensor data in real-time but this is set to change. By 2025 100% of end-user respondents predicted they would move completely to remote monitoring. However, this is not without challenges. A shortage of in-house expertise to deploy remote monitoring systems was the primary barrier to further adoption of remote monitoring reported by end-users, along with high perceived costs of real-time operations. This planned uptake of remote monitoring by end-users presents a market opportunity to engineering consultants and environmental service organisations to meet demand.

Reported Parameters, Vendors & Instrumentation

REPORTED SOFTWARE VENDORS

eagle.io, Envirocoms, ThingsBoard, In-house platforms, Campbell Scientific, Hardware vendor supplied

HARDWARE VENDORS

YSI (a xylem brand), SonTek (a xylem brand), xylem, libelium, ELSYS.se, Campbell Scientific, YDOC.biz, SignalFire, munisense, dataTaker, Valeport

Parameters

Providers

VOC, NAPL, ph, TSS, DO, EC, Flow, Level, Pressure, Particulate, Turbidity, TRC, TN, TP, Chlorine, NTU, Waves, Currents, Depth, Salinity, Temp

End-users

VOC, NAPL, TSS, DO, EC, Flow, Level, Pressure, Particulate, Turbidity, TRC, TN, TP, Chlorine, NTU, Waves, Currents, Depth, Salinity, Temp, OH, pH, Level, Switch, Stormwater, Groundwater, Potable Water, Trade Waste, Dust deposition, Biosecurity, E coli, Conductivity, Microplastics, SO4, Cl, Hardness, Metals (dissolved and total concentrations)

Instruments

Providers

YSI meters, Handheld PID, Waterlevel loggers, pH meters, Convertors, Handheld (electrodes), Multi-probes sensor, Water level meters, Pressure loggers, ADP's, Turbidity sensors, Salinity sensors, Multi-meters, WQM, SLM, Turbidimeter, Sondes

End-users

YSI meters, Handheld PID, Water level loggers, pH meters, Convertors, Handheld (electrodes), Turbidity sensors, Salinity sensors, Multi-meters, WQM, IP, SLM, Turbidimeter, Sondes, Piezometer, Ultrasonic flow meters, Multibeam TSS, Submersible pressure sensors, HVAS

Sensors (parameters)

Providers

Xylem multi-probe (Level, Rain, EC, Temp., Turb., DO, pH)
YSI Meters (Temp, EC, pH, DO, Redox, Turb.)
Valeport (Tidal, Weather, Water Quality)
Hydralab MS5 sonde (Temp, DO, pH, Turb., Salinity/EC)
YSI Pro DSS (pH, EC, DO)
Sontek M9/Flow tracker (Turb., Flow)
YSI multiparameter sonde (Turb., EC, pH, DO, Temp),
YSI Multiprobe (pH, ORP, DO, Temp, Conductivity)
SignalFire Ranger (Flow, Level, Pressure)
Sontek ADCPs (Stage, Velocity, Discharge, WQ Big 5)

End-users

YSI water meters (HVAS, Stormwater, Groundwater, Potable Water, Trade Waste)
EXO2/OPUS/OTT (TSS, NOx, N, P, Pesticides, Water Level, Discharge)
Multi-parameter probes with lab analysis: (pH, EC, SO4, Cl, Hardness, Dissolved metals)

Air Quality

Skill Shortages in Air Quality

In-house Air Quality monitoring is still largely manual, with just over a quarter (25.8%) of end-users monitoring remotely and most respondents reporting on-site manual downloads from sensors or in-situ measurements. End-user organisations who reported using manual measurement methods, for monitoring Air Quality parameters, also reported their biggest challenges as a shortage of talent and increased reporting requirements around real-time data obligations.

The survey results suggest end-users lack the ability to monitor and report on Air Quality remotely, and there may be an opportunity for service providers who are able to assist here. Interestingly, 31% of service/product providers who monitor Air Quality for their clients indicated that a technical gap in skillsets was the key factor prohibiting expansion of real-time Air Quality monitoring.

Reported Parameters, Vendors & Instrumentation

Parameters

Particulate
VOC
Asbestos fibres
Micromet gas
LEL
O2
CO
CO2
H2S
PM10
PM2.5
NH3
No2
COD
Atmospheric dust
Gravimetric dust
Particle release
Nitrogens
Sulfides
Natural Gas
BOD Landfill gas
AFM

Instruments

LPWAN
Dust/gas sensor
Electrochemical Sensors
Optical Particle Counters
Light scatter
NDIR
PID Analyzers
Probes
Detectors
Convertors
LFG Meters

Sensors (parameters)

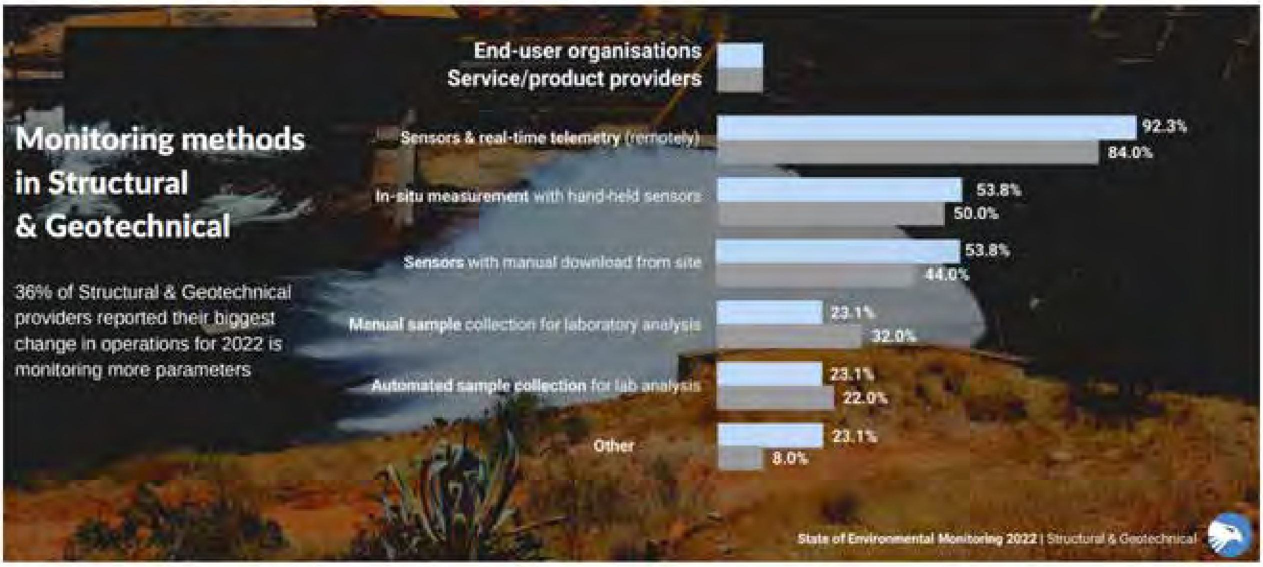
Purple Air (PM10)
CEMS with fence line units (PM O2 CO2 NOx SOx CO THC VOC H2S HCL ETO)
Electrochemical Sensors and Optical Particle Counters (PM1, PM2.5, PM10, O3, NO, NO2, SO2, H2S, CO, CO2, TVOC, Temp, Pressure, Relative Humidity)
Light scatter, NDIR, PID (Particulates, Gases)

Structural & Geotechnical

Ahead of the Curve

Both organisation types monitoring Structural and Geotechnical parameters reported higher levels of sensor and real-time telemetry (84% and 92.3%) than the industry average (73%).

Service and Product providers also reported the top upcoming challenge to expanding remote monitoring services (34%) was a shortage of talent. Even with the advanced stage of this industry, talent remains scarce. End-user organisations reported increased reporting requirements (50%) and monitoring a broader array of parameters and analytes (50%) as two upcoming challenges and changes in their practices.



Reported Parameters, Vendors & Instrumentation

REPORTED SOFTWARE VENDORS

eagle.io, alteco, farmo, SIGNALFIRE, ubidots, beadedstream

In-house platforms | Hardware vendor supplied

HARDWARE VENDORS

rst, CAMPBELL SCIENTIFIC, SIGNALFIRE, munisense, dataTaker

Parameters

Providers
- Vibration
- Displacement
- Crack
- Noise
- Strain
- Deflection
- Load
- Ground Displacement
- Structure Displacement
- Geomatics
- Pore Pressure
- Pressure

End-user
- Vibration
- Displacement
- Crack
- Noise
- Slope monitoring
- Strain
- Deflection
- Load
- Ground Displacement
- Structure Displacement

Instruments

Providers
- Optical
- Instantel
- Crack gauge
- Vibrating Wire devices
- Shape arrays
- RADAR
- Manual inclinometer
- Probes
- Pressure depth sensors
- Piezometer
- Accelerometer
- Geophone

End-users
- Piezometer
- Tilt sensors
- Inclinometers
- Handheld probes
- RADAR
- Scanner
- Submersible pressure sensors
- HVAS

Sensors (parameters)

VW Piezometers and 4-20m Amp sensors
(Pore pressure)
Instantel vibration
(Vibration)
Manual inclinometer probes
(Horizontal displacement)
RADARScanner
(Slope monitoring)

Meteorological

More Real-Time Coverage

With 84% of respondents reporting, they will be monitoring 'mostly remotely' by 2025, a surge in demand for remote meteorological hardware and monitoring services by integrators is expected. Others reported the lacking availability of broad-array weather stations and their cost as challenges, with few listing a lag between standards and technology as possible upcoming issues for their operations. 36% of all respondents, who monitor meteorological parameters, reported regulators, community liaisons and internal stakeholders demanding access to real-time data as their top upcoming challenge.

Reported Parameters, Vendors & Instrumentation

REPORTED SOFTWARE VENDORS

Tinytag
eagle.io
ThingsBoard
Campbell Scientific
Airodis
SignalFire
In-house platforms
Hardware vendor supplied

HARDWARE VENDORS

aeroqual
PurpleAir
Campbell Scientific
eState Automation
Barani Design
Tinytag
MAIT Industries
SignalFire
metasphere
Meter Environment
YDOC

Parameters

Providers

Conductivity
Wind speed
Wind direction
BP
Rainfall
Air Temperature
RH
Snow depth
Snow Water Equivalency
Precipitation
Humidity
Cloud height
Visibility
Global radiation
Barometric pressure

End-user

Conductivity
Wind speed
Wind direction
BP Current speed
Current direction
Rainfall
Air Temperature
RH
Snow depth
Snow temperature
Snow Water Equivalency
Precipitation

Instruments

Providers

Multi-parameter weather station with data logger
CEMS and fence line units
Light scatter
NDIR
Electrochemical
PID
IR radiometers
Ultrasonic snow depth sensors
4-way net radiometers
Snow Pillows
GNSS Storage Cans
Pressure Transducers
Load Cells
Thermistors

Sensors (parameters)

Providers

MeteoHelix (Weather)
atmos 41 (Weather)
Vaisala and Lufft sensors (Wind speed & direction, Pressure, Temp, Humidity)
Kipp & Zonen sun trackers and solar radiation sensors (Solar energy parameters)
Tiny Tag (Temperature, Humidity)
ICT International Devices (Full SPAC)
ClimaVUE (Weather)

Noise

With only 25% of integrators monitoring noise, and even fewer end-user organisations, noise was a smaller subsector of survey respondents. Considering this relatively smaller footprint in the monitoring ecosystem, organisations monitoring noise almost always used remote or real-time methods (93%). The challenge for this measurement service seems to be communicating this data to stakeholders. The top challenge (34%) was reported as increasing demand by stakeholders (regulators, community groups, internal departments) for access to real-time data from monitoring programs. We anticipate more demand for noise level alerts and public-facing communication assets.

Reported Parameters, Vendors & Instrumentation

REPORTED SOFTWARE VENDORS

eagle.io, Sigicom, mooven, eRUIDO, Cirrus Research plc, Hardware vendor supplied

HARDWARE VENDORS

Airodis, Sigicom, eRUIDO, aeroqual, Cirrus Research plc, AVA monitoring

Parameters

DB peak noise
Cumulative noise
dBA levels
Vibration in mm/s
Velocity/Frequency
Equivalent Noise Pressure Level
LAeq
LA90

Instruments

Environmental Noise Monitors
Class 1 Condenser Microphones
Sound level meters
Noise dosimetry
Vibrating wire sensors
Sound Level meters

Sensors (parameters)

eRuido Monitor Model U20 (Equivalent Noise Pressure Level)
Sigicom (Vibrations)
Aeroqual (All parameters)
01dB fusion (dB)

METocean

More Parameters

METocean respondents represented a smaller segment of the survey responses (13%). Of this smaller subset, 85% reported monitoring via sensors & real-time telemetry. Of respondents 32% reported that expanding the range of parameters measured by sensors and monitored in real-time to meet client demands is the biggest change currently occurring in their organisation. Additionally, 36% responded that their biggest challenge is increasing demand for access to real-time data and visualisations (charts, dashboards) from regulators, community groups, internal departments, and partner organisations.

Reported Parameters, Vendors & Instrumentation

SOFTWARE VENDORS

eagle.io
ThingsBoard
Campbell Scientific
Envirocoms

HARDWARE VENDORS

xylem – Let's Solve Water
SonTek – a xylem brand
Campbell Scientific
libelium
YSI – a xylem brand

Parameters

pH
EC
DO
NTU
PAR
Depth
Temperature
Salinity
Benthic cover
Waves
Currents
Tides
Turbidity
Seabed chemistry
Flow

Instruments

YSI meters
Water level loggers
pH meters
Convertors
Multi-probes
Flow sensors
Water level meters
Pressure loggers
ADP's
Turbidity sensors
Salinity sensors
Multi-meters
WQM
IP
SLM
Turbidimeter
Sondes

Sensors (parameters)

Valeport (Tidal, Water Quality)
YSI Pro DSS (pH, EC, DO, Turb)
Sontek M9 Flow Tracker (Flow)
YSI multiparameter sonde (Turb, EC, pH, DO, Temp)
SignalFire Ranger (Flow, Level, Pre)

Industry Trends

Breaking Down the Trends

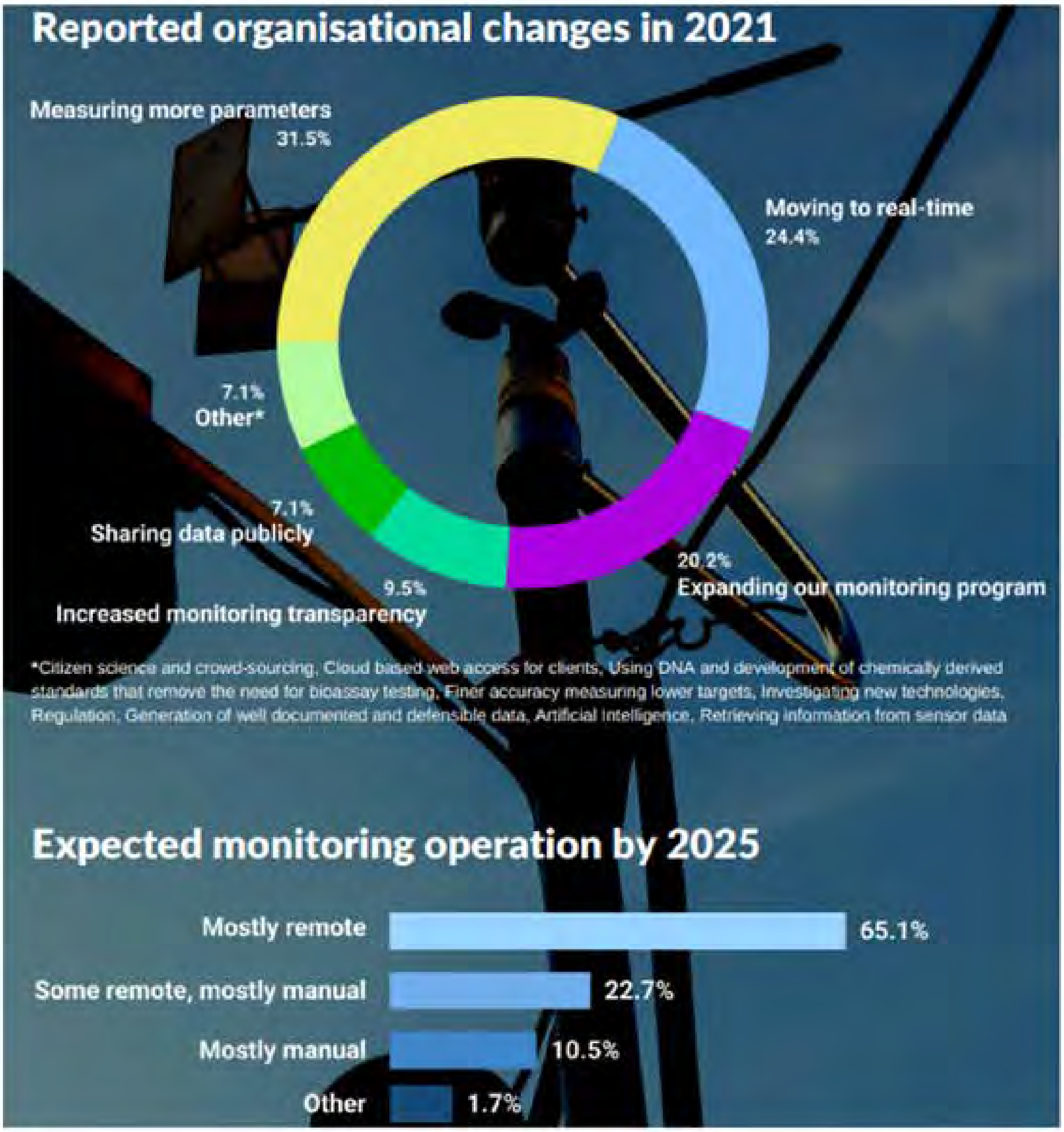
Across a series of questions regarding changes in organisations, trends, upcoming challenges and adoption practices, respondents identified these four major industry trends in environmental monitoring:

Remote monitoring: Over 50% of all end-user organisations and service or product provider respondents reported remote, or real-time via IoT and telemetry to be the top upcoming industry trend. 65% of the surveyed industry are expecting to be mostly remote by 2025, and 24.4 % of all respondents moving to real-time in 2022.

More parameters and data points: 31.5% of all respondents reported that monitoring more parameters is their biggest change in their organisation for 2021.

Increasing stakeholder demand for real-time: Pressure from communities, regulators and internal stakeholders around data-transparency and access is increasing, with over 1 in 4 of respondents reporting delivering on these demands as the biggest upcoming challenge in the industry.

Automation: Respondents reported data-automation and fully automated monitoring systems as one of the biggest upcoming trends.



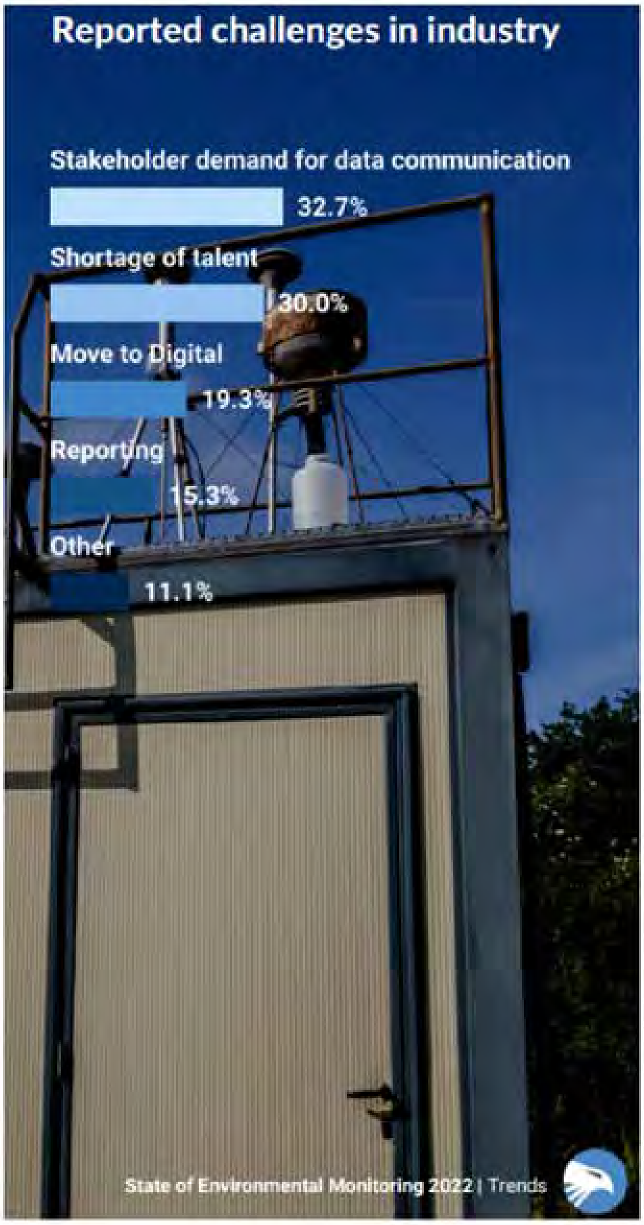
Challenges in Industry

Just over 1 in 4 respondents indicated a shortage of talent across the environmental monitoring industry. This skills shortage was worse in those companies focused on real-time/remote monitoring programs with 30.2% of these respondents reporting a shortage of talent as their biggest upcoming challenge.

For end-user organisations, an increased requirement for reporting from regulators and stakeholders came in as the top challenge.

Together with the skills shortage, and appetite for end-user organisations to move to 100% real-time by 2025, this presents an interesting opportunity for service/product providers to meet this supply and demand gap. Several respondents also list cost factors of hardware (particularly relating to sensors in the water sector) and flagged potential supply issues as challenges on the horizon.

From an industry standpoint, the push to digital data management and increasing demand from stakeholders for data transparency, could put pressure on sourcing talent across the industry, with several measurement verticals (Air Quality, Water Quality and Noise Quality) already reporting talent shortages (over 30% of respondents reported this as their biggest challenge).

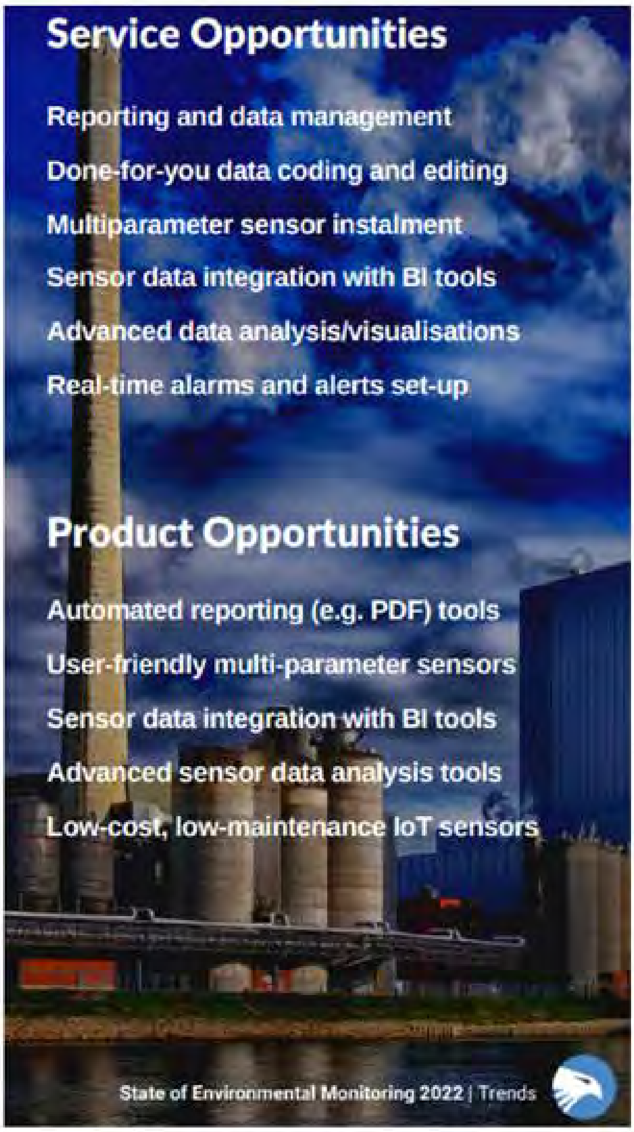


Client Demands in 2022

The automation of reporting and data management was the most reported client demand in responses.

Service and product providers also reported the following key demands from clients for 2022: multi-parameter sensors, sensor data and visualisation software integrations with B.I. tools, real-time data transmission from sensors and more advanced sensor data analysis. Across responses, service and product providers also reported end clients demanding more real-time data access, alarms and alerts, with end clients requesting to integrate their remote-sensor data software into other data tools (BI platforms like Power BI, YellowFin etc) for more advanced modelling and data transformation. From a service perspective, providers reported rising demand for automated data interpretation (such as automated PDF reports) services. End clients seem to be seeking more assistance with editing, coding, transforming and reporting on their data.

Service or product providers should consider tailoring solution offerings to match demand for this type of done-for-you data service.



Upcoming Trends

According to respondents, we're going to see a rise in data volumes, wider uptake of data analytics and data management over the coming years. This presents opportunities for employees skilled in these specialities, and service/product providers who cater to these needs for organisations. There is also an expectation of improvements in IoT sensor technology with smaller sizes, cheaper costs and higher quality data.

Progress in remote or telemetry technology: Respondents expect better remote access and setup and low orbit satellites from new companies, taking market share from historically strong companies over reliant on past technologies and hence not able to adapt to remote monitoring.

A move to automated systems: More organisations are transitioning to fully automated IoT systems with data centralisation and self-serve system automation. Respondents also noted the push to 'set & forget' technologies with automated alerts and reporting.

Improved IoT sensor technology: Respondents anticipate smaller, cheaper devices that use small data packets with wireless sensors to become more affordable and miniaturised with longer battery life.

Rural Water Futures, Contactless Water Flow Monitoring

Proof of Concept Summary Report – July 2021

Department of Regional Development, Manufacturing and Water, Qld

Contactless Water Flow Monitoring (CWFM) Elements

Capture: Image velocimetry (STIV / SSIV) based water flow monitoring relies on the provision of high-definition video streams (and metadata) as the starting point for the end-to-end process.

Storage: Video footage required to support STIV analysis must be stored in a manner that makes it highly secure, accessible, and is also subject to the relevant retention and archiving requirements.

Access: Raw data should be highly accessible (in accordance with a defined security model), allowing approved users and platforms to consume raw data for the purposes of modelling and other approved uses.

IV Processing: Processing includes the application of image velocimetry or videogrammetry, including the use of a range of variables that allow the contactless calculation of water flow in water bodies. A series of outputs are created which are then stored and made available.

Distribution: Processed video data is distributed to a number of organisations for further analysis, processing and/or integration with other systems (e.g., GIS platforms, etc.)

Analysis: Further data analysis including overlays and mashups can occur to provide additional insights and impact analysis for a range of different use cases and scenario contexts.

Contactless Water Flow Monitoring Principles

The future state principles will be used to drive the delivery of a Contactless Water Flow Monitoring (CWFM) solution that will have a transformational impact upon the broader Value Chain.

Intelligent & Accurate: Automated STIV processing will have built in intelligence and be highly accurate, ground-truthed and subject to validations, checks and balances.

Increased Reach: We will increase our ability to measure water flow across the state, using a range of cost-effective commoditised capabilities.

Deployable: Our solutions will be easily deployable and not require significant long term, permanent supporting infrastructure.

Open and Integrated: We will make processed STIV data open, accessible and readily available for use by other organisations and platforms via an open data approach

Reuse and Leverage: We will leverage a range of deployed infrastructure (public and private) and technologies to collect data from an increased number of sources.

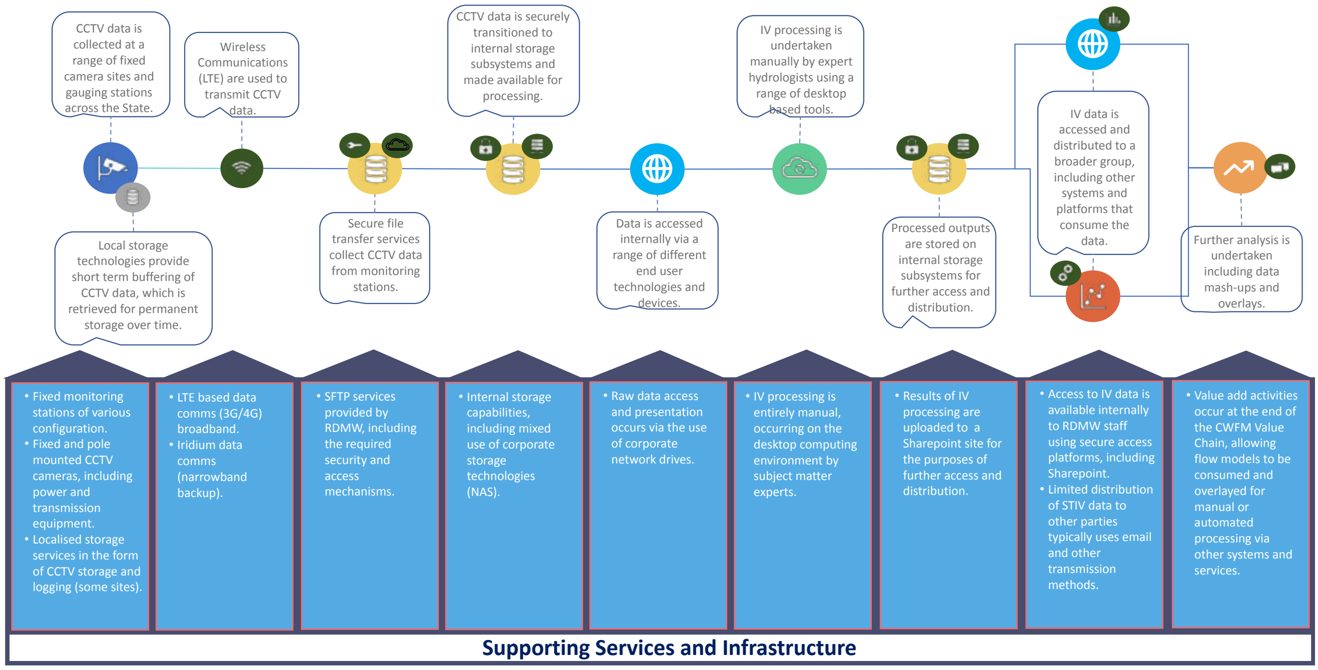
Extensible: Our approach towards contactless water flow monitoring will be extensible and scale to meet future requirements and new use cases as they emerge over time.

Innovation: We have an innovation focus and seek out new ways to deliver improved water flow monitoring to support our precious natural resources.

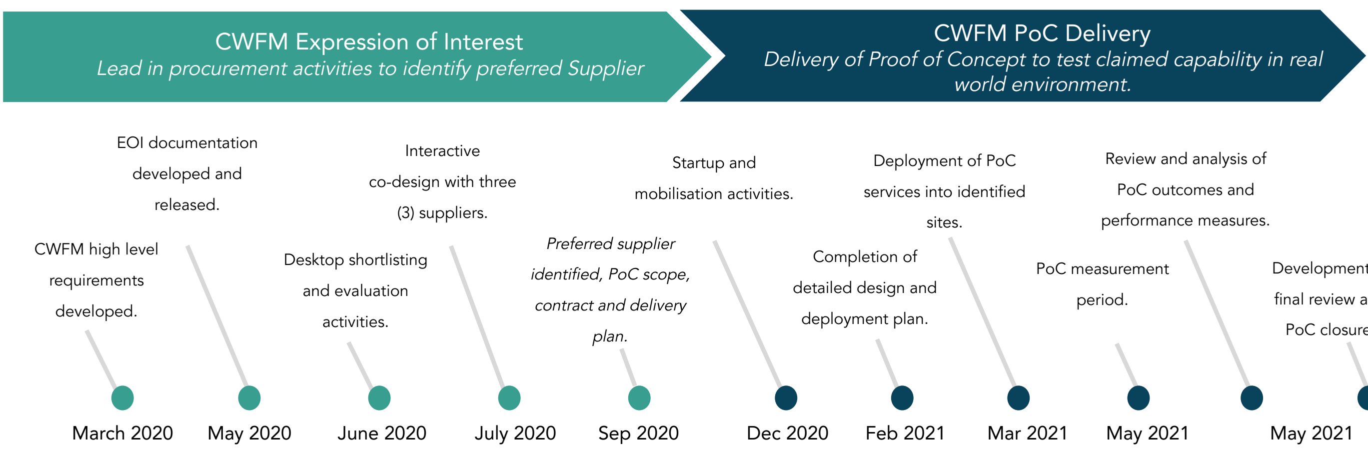
Commercially Mature: Suppliers are commercially mature and enable future commercialisation opportunities within Australia and internationally.

Standardised: We will minimise the use of proprietary systems and technologies in favour of open standards-based solutions.

Current State Image Velocimetry Processing



CWFM Journey to Date

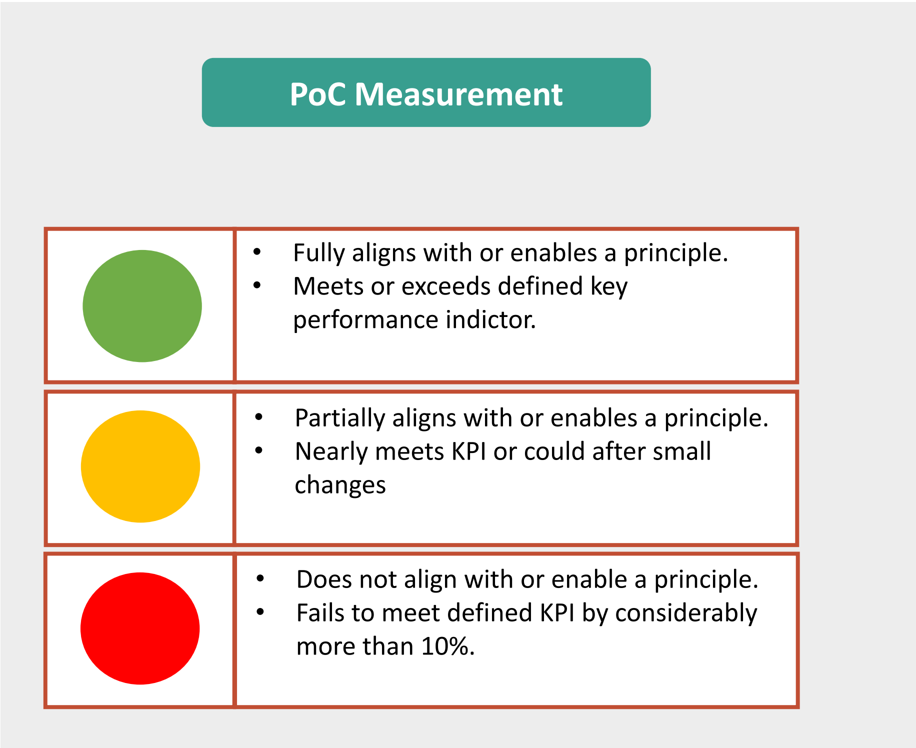


Success Criteria

The Proof of Concept (PoC) has been measured against a range of success criteria that have been measured in terms of alignment and overall performance. The criteria and rating methodology are outlined further below.

Principles: The PoC principles define the characteristics of the future state CWFM environment and formed part of the EOI evaluation process.

Key Performance Indicators (KPI's): KPI were developed during the design process to clearly measure performance. Solution measurements were compared with traditional measurements to determine deviations and overall performance.



KPI's

In addition to the principles, a range of KPI measures were developed during the detailed design process and agreed between the parties to be suitable to clearly measure performance. The eight identified measures are detailed below.

1. **Water Height Error Rate** - Demonstrate that DischargeKeeper can measure water height within a 10% error rate compared to discrete values measured by DRDMW with an approved sensor measurement device during the trial period.
2. **Water Velocity Error Rate** - Demonstrate that DischargeKeeper can measure velocity within a 10% error rate compared to discrete values measured by DRDMW with an approved sensor measurement device during the trial period.
3. **Water Discharge Error Rate** - Demonstrate that DischargeKeeper can measure discharge within a 10% error rate compared to discrete values measured by DRDMW with an approved sensor measurement device during the trial period.

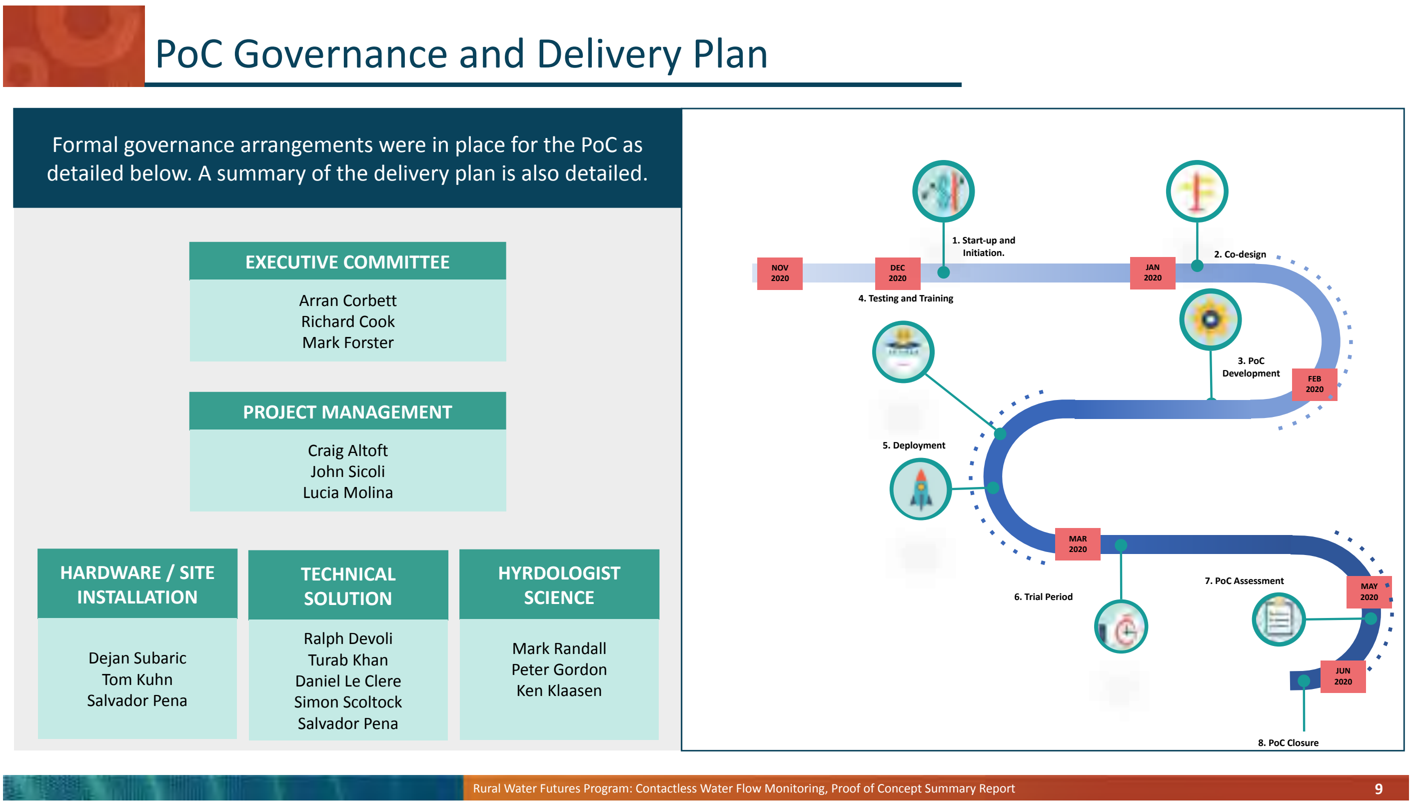
4. **Compliance** - DischargeKeeper must be compliant with the "National Industry Guidelines for Hydrometric Monitoring" and with ISO 748:2007 (Hydrometry — Measurement of liquid flow in open channels using current-meters or float), with Minimum exposure time with video capture configured to use all 25fps for 30 secs at 1080p resolution for discharge calculations

5. **Measure Water Height Optically** - Demonstrate that DischargeKeeper is able to measure water height optically at a site. The site must have gauge lines or a well-defined plane (e.g. wall, pillar). Depending on camera resolution and/or other markers, work towards an accuracy of within 5 cm for water height.

6. **Automation of Flow Rate Calculation** - Demonstrate that DischargeKeeper can fully automate the calculation of flow rates from high-definition videos provided from commodity cameras requiring no manual analysis once site is set up.

7. **Demonstrate that DischargeKeeper works** on both an edge device (i.e., industrial PC) as well as in the cloud for calculating flow rates regardless of the type of network that is used for data transportation.

8. **Information Latency** - Demonstrate that the latency of information is less than 30 mins, measured from the time a reading is transmitted from a site to it being available to HydroTel for the PoC.


PoC Governance and Delivery Plan

Formal governance arrangements were in place for the PoC as detailed below. A summary of the delivery plan is also detailed.

EXECUTIVE COMMITTEE
Arran Corbett
Richard Cook
Mark Forster

PROJECT MANAGEMENT
Craig Altoft
John Sicoli
Lucia Molina

HARDWARE / SITE INSTALLATION
Dejan Subaric
Tom Kuhn
Salvador Pena

TECHNICAL SOLUTION
Ralph Devoli
Turab Khan
Daniel Le Clere
Simon Scoltock
Salvador Pena

HYRDOLOGIST SCIENCE
Mark Randall
Peter Gordon
Ken Klaasen

Rural Water Futures Program: Contactless Water Flow Monitoring, Proof of Concept Summary Report 9

Solution Overview

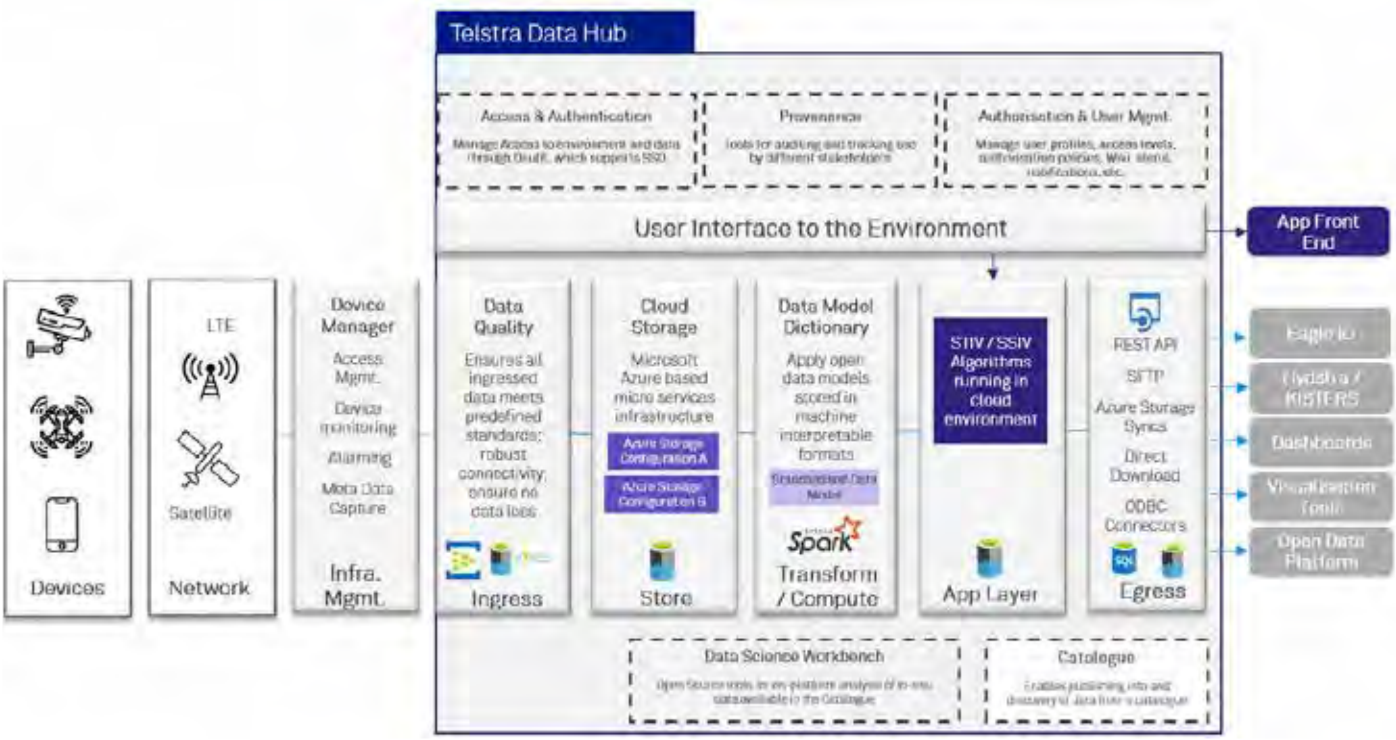
As a result of the EOI process, Telstra proposed a solution based upon a new partnership with Photrack that was to operate on the Telstra data hub to achieve PoC outcomes.

High-Level Architecture

Telstra have provided the diagram beside as an indication of the high-level solution architecture they are proposing. They note the use of the Telstra Data Hub, which is a cloud-based platform designed to reduce the friction and cost of securely sharing data within an organisation (e.g., employees with different levels of access to data) and across organisations. Telstra claims that the TDH enables the sharing of data, sourced from multiple entities to be merged into shared data communities where each data contributor retains data ownership, granting controlled access to community groups to derive analytics and insights in a highly secure environment.

Telstra indicate they can provide the following resources:

- IoT devices (edge compute, cameras, routers, sensing technologies, drones) Networks (4G, LTE-M, NB-IoT, and Satellite) edge computing and emerging capabilities of 5G and the 5G edge compute infrastructure.
- Advanced image velocimetry algorithms (in partnership with Photrack).
- Edge processing or real time data image processing in the Cloud.
- Consumer mobile applications (useful for crowdsourcing) and hosted applications for water measurements (via Photrack).
- AI / ML across massive data sets to automate insights and recommendations.
- Augmented reality / virtual reality applications in water flow monitoring.
- Data management, security, privacy and data exchange platforms.
- Applications development and systems integration practices.



Summary Against CWFM Elements

Capture

Telstra have proposed two solution options:

- Where the site is in range of Testra's LTE 4G/4GX network coverage, heavy data transmission and processing of short video files will occur via the cloud.
- Where extended coverage is achieved using the Telstra IoT network, processing will be done in edge to keep data transmission light. They note the use of cameras, determination of appropriate power solution, a suitable LTE gateway to complement the selected camera, a device manager to serve as the interface between the devices and data platforms, reliable site network connectivity. They have not referenced whether they would utilise existing capture mechanisms.

Storage

Telstra have proposed to the Telstra Data Hub (TDH) for data storage, which currently uses Microsoft Azure services for all data storage, transformations and security requirements. They note this platform as a service storage technology is geographically redundant, highly available and underpins services for:

- Azure Event Hub for streaming raw data.
- Azure Event Hub Capture for data backup and retrospective replay.
- Azure Data Lake Storage for assisting in and storage of transformed data; and
- An egress serving storage layer. They note there are protections in place for security and access control to TDH data.

Access

The TDH enables the data owner to set permissions on data, determine who can see the data and apply data sharing agreements to the datasets. Access to the TDH is managed by Azure Active Directory, allowing use of local accounts or authentication via a trusted, federated identify provider. Single sign-on is maintained throughout. Telstra note they believe access to data should be based on the FAIR principle – that is findable, accessible, interoperable, and reusable. They achieve this through several mechanisms, including an easy-to-use data catalogue system and use of the CKAN open data standard for data catalogues.

IV Processing

Telstra have proposed two solution options, in partnership with Photrack:

- Surface Structure Image Velocimetry (SSIV): The Photrack SSIV based application has been commercially deployed to over 35 organisations. They offer Discharge technology as a windows application (DischargeKeeper for fixed sites) or mobile android app (DischargeApp). The approach relies on a camera to take 5 seconds of video and pass it onto the DischargeKeeper application. The video is automatically processed based on a range of derivations (e.g., river height, discharge etc.).
- STIV: Implementation of a new module in Photrack technology to utilise this methodology.

Distribution

TDH supports both push and pull mechanisms to provide access to data. Currently TDH supports the following interfaces to egress data:

- Secure RESTful APIs to consume data from TDH.
- SFTP servers to push data from TDH.
- External applications in some circumstances, pending security review. They note that future releases of the TDH will enable:
  - Egress of data via direct downloads and ODBC connectors to common visualization tools like Tableau and Excel.
  - Integrations to eagle.io and Kisters.

Analysis

The TDH platform provides a range of functionality for data analysis:

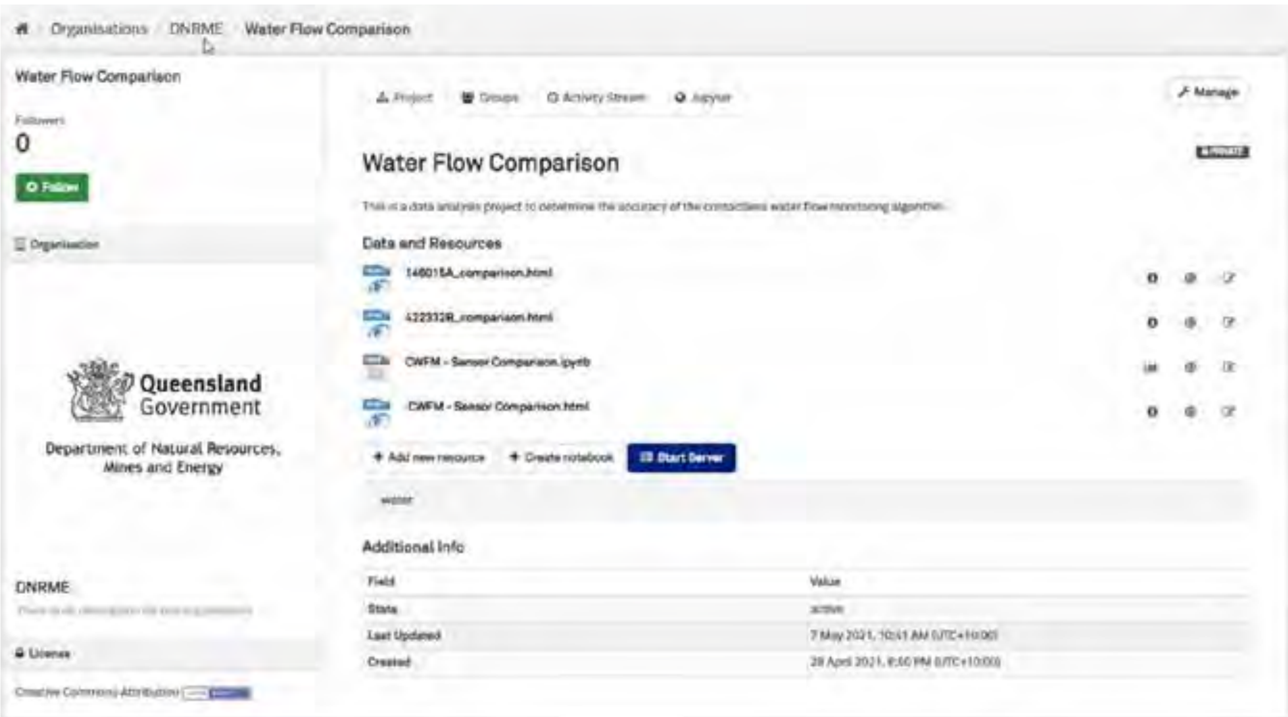
- High performance data science workbench capabilities to combine data sets or build / test new algorithms to automate identification of data trends and patterns.
- Support any data standards, dictionaries and schemas.
- Egress data to dashboards and visualization tools via secure data exports.

Key User Interfaces

The Telstra Solution was comprised of a series of user applications that were deployed throughout the PoC and are explained further below.

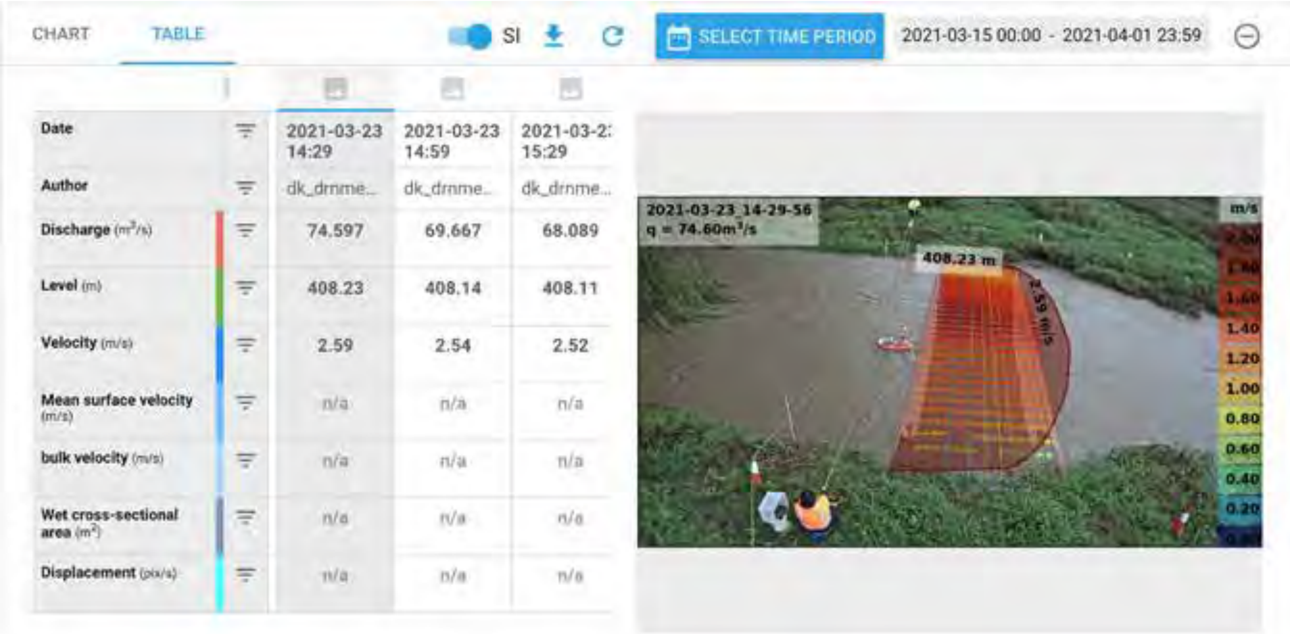
Telstra Data Hub Portal

The TDH is intended to be single hub for all information as well as a portal for services. Ingress of captured data such as water flow videos or results processed from videos either on the edge (on site) or in the cloud will all reside in the TDH. The TDH will also allow egress of data to other systems such as Hydotrel. The image above shows a published time series from discharge data stored in the TDH.



Photrack DischargeKeeper DK Portal

DischargeKeeper is the results SSIV portal for videos processed by Photrack. The portal allows for viewing organisations and site as shown in the left menu. Results are shown in tabular format with overlaps of velocity, profile, flow on proof images.



The mobile app (DischargeApp) was included in the PoC as a value-add solution to enable water users to take flow and discharge measurements in a roaming capacity without the need for a specialist fixed infrastructure. The Department elected to include the App within the PoC however the focus remains on the primary sites identified within the report.

Menu: The side menu contains organisation, site, measurement navigation and access to change settings.

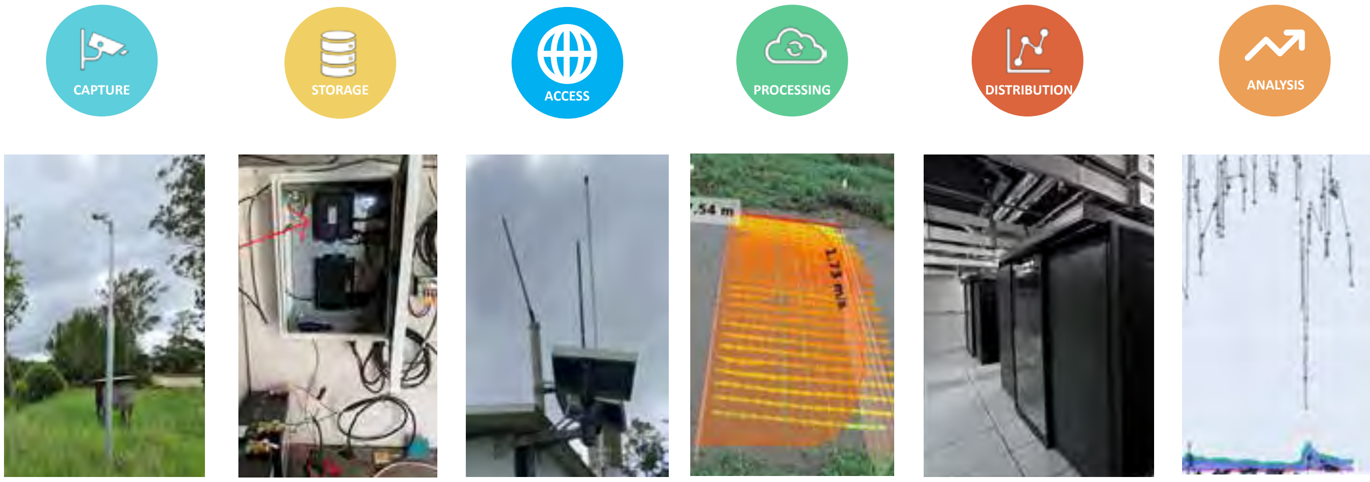
Site Info: Details about each site are available including the river profile and the ability to take and process new videos.

Video Recording: Discharge allows user to record and process videos on the device.

Results Overlay: After videos are processed the results are overlayed on a proof image which show velocity vectors and magnitude.

Site Hardware

The PoC solution relied upon a range of supporting hardware and software to achieve both local processing and remote processing use cases which are outlined further below.



Sites and Design

Two sites were selected to conduct the PoC activities due to their relative proximity to Brisbane and a range of other characteristics that aligned with the 'well connected' and 'remote site' use cases.

Sites

Site One – Numinbah

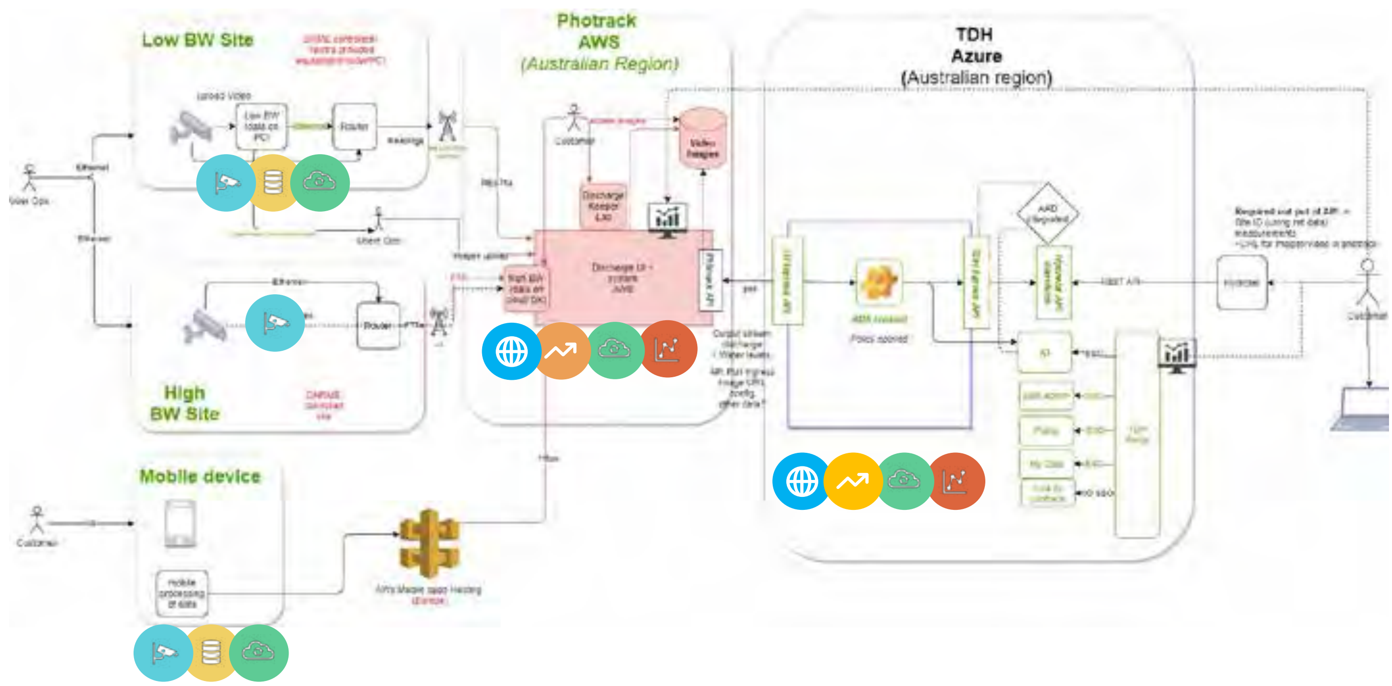
- High bandwidth site / LTE 4G.
- Medium flow site.
- 240V mains to 1x 50Ah battery / IR capable.
- Videos transferred & processed in cloud.
- Existing hardware provided by DRDMW.
- Existing secure housing.
- Existing physical water level & gauges.

Site Two – Oakey

- Low bandwidth site / LTE-M / NB-IoT.
- Low flow site.
- 2x 40W solar panels to 2x 45Ah batteries.
- Videos processed locally.
- Edge PC located on site.
- Results transferred to cloud.
- New hardware provided by Telstra.
- Existing secure housing.

Design

The PoC Solution design is outlined at a concept level in the diagram below and includes an overview of where core CWFM functions are conducted throughout various sites and Cloud Services.



Numimbah Site

Overview Of The Site

Existing site is both the high bandwidth site and high flow site. It is one of only 5 sites in Queensland that have access to mains power. Mains power would allow the site to test InfraRed IR camera SSIV video processing if needed. Site is configured to film and transmit one 30 second video every 30 minutes.

Use Case Alignment

1. Not minimalist.
2. Not typical.
3. Not green field.

Deployed Hardware

- 6-meter Camera Pole.
- Secure Site Hut.
- 240V Mains Power & 50 Ah Battery.
- AXIS 1365 MK II Camera.
- IR Illuminator.
- 4G Maestro E210 Modem & Antennas.
- Gauge Board & Ground Control Points GCPs.
- Physical Water Level Sensor.

Deployed Software

- Camera firmware.
- Modem firmware.
- Router configuration file.

Summary

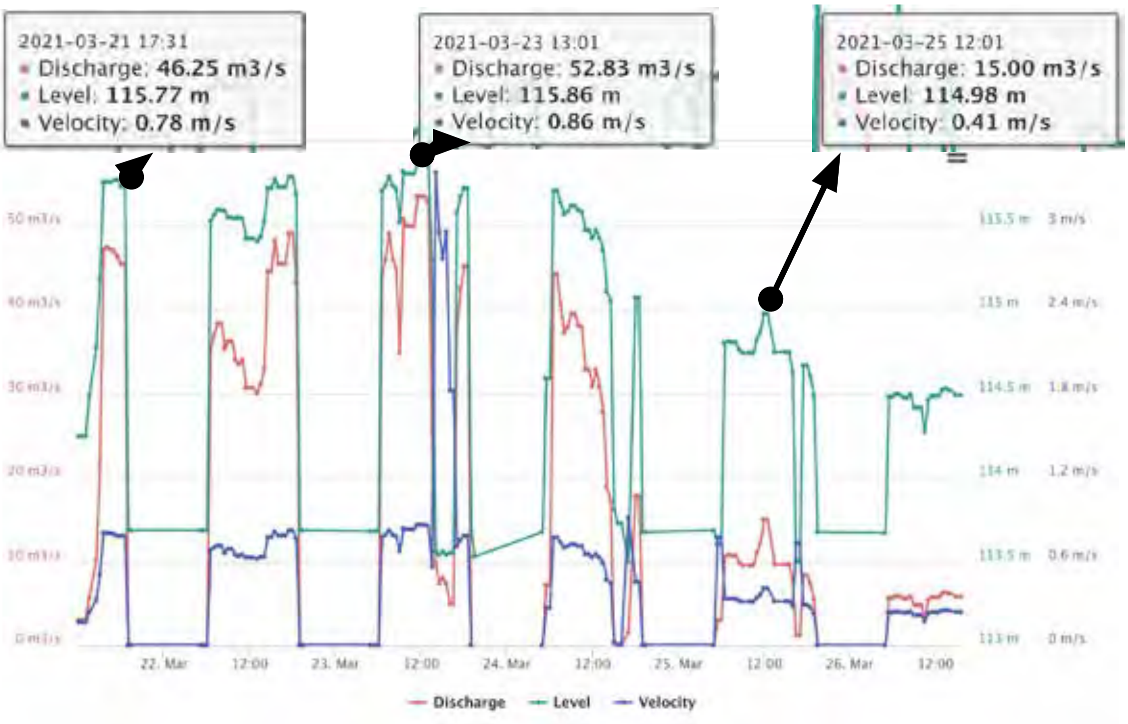
- Successful setup, configuration and video recording.
- Successful transfer of videos and cloud processing.
- Minor issues with camera configuration occasionally.
- Optical water level not possible due to vegetation.
- Successful integration with SSIV processing & HydroTel level data via API.
- No attempt at IR use.
- Occasional lost videos possibly due to uncompressed video size and modem timeouts.

A range of flow events allowed measurement activities to be conducted.

SAMPLE FLOW EVENTS

- Sample of some of the major flow events during a 1 week period

(Note: Flow dips at night as not measurements were taken in the dark)

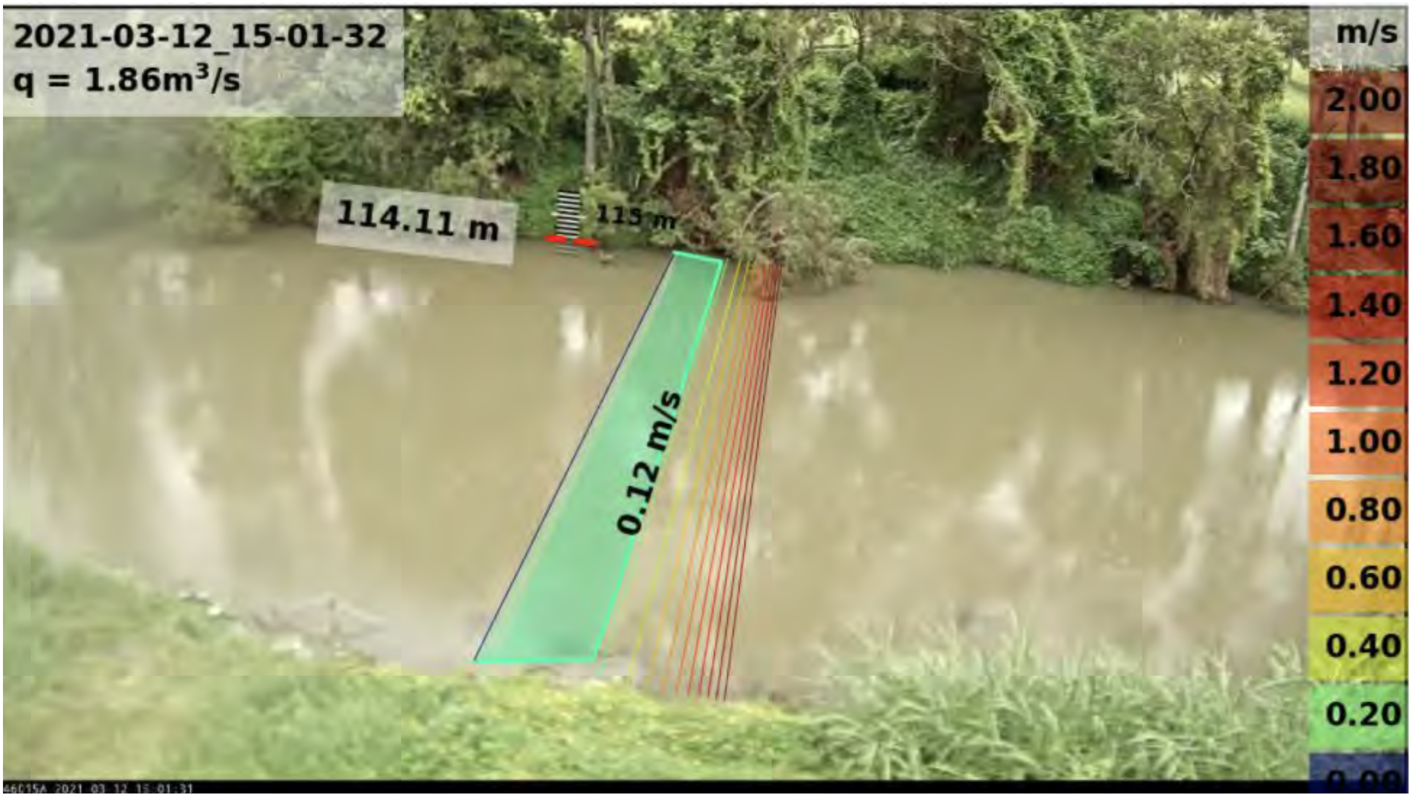


SUCCESS CRITERIA

PRINCIPLES	KPI
1. Intelligent & Accurate	1. Height Error
2. Increased Reach	2. Velocity Error
3. Deployable	3. Discharge Error
4. Open & Integrated	4. Compliance
5. Reuse & Leverage	5. Optical Height
6. Extensible	6. Automatic Processing
7. Innovation	7. Network Utilisation
8. Commercially Mature	8. Information Latency
9. Standardised	

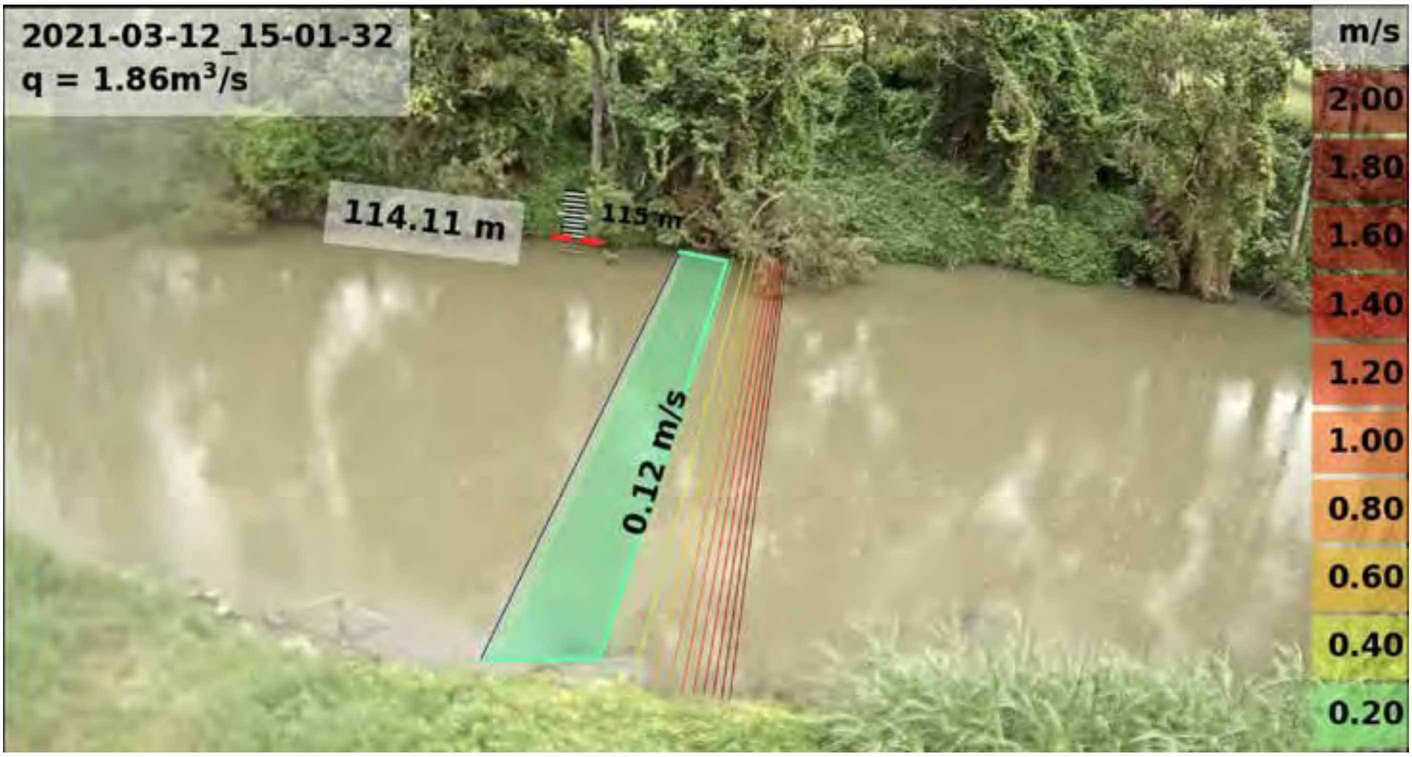
Photrack DischargeKeeper Measurement Table

Photrack DischargeKeeper has several ways to view results. The tabular results are shown below which includes data from several measurements. Clicking on a particular day shows the proof image from that measurement with results, velocity profiles and virtual gauge boards overlaid on the image.

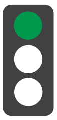
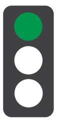
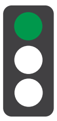


Photrack DischargeKeeper Measurement Chart

Photrack DischargeKeeper has several ways to view results. The chart view is shown above and includes a plot for velocity, discharge and water level.



Performance Principles

	**Intelligent and Accurate** The deployed solution partially aligned with this principle, displaying suitable levels of intelligence in terms of SSIV processing however measurement accuracy challenges were identified throughout the PoC.		**Increased Reach** The PoC partially aligned well with the principle relating to increased reach, providing a potentially commoditised solution that could shift the traditional water monitoring paradigm once matured.
	**Deployable** With limited reliance on local on-site infrastructure, the solution is easier to deploy than traditional infrastructure however the site setup and calibration does add additional operational overhead.		**Open and Integrated** The PoC had limitted integration with Photrack on AWS, Telstra Data Hub on Azure, and Photrack App. Seamless sign-on, user and site provisioning and single point of access to videos were some what disjointed and required manual intervention. The Telstra data hub was already integrated with HydroTel as demonstrated during the PoC.
	**Reuse and Leverage** The PoC reused all existing infrastructure and services at the Numinbah site and did not required installation of new services on-site.		**Extensible** The solution is considered to be extensible based on learning at the edge site, however the scalability of the back end solution requires further analysis prior further deployment on Queensland sites.
	**Innovation** The identified solution is considered to be highly innovative despite limitations that were identified during the PoC.		**Commercially Mature** The emerging nature of the Photrack and Telstra relationship does not pose a commercially mature service offering at this time and requires additional development as part of any future endeavours.
	**Standardised** The proposed service offering is almost entirely comprised of commercially available but proprietary technologies however does use industry standard algorithms for measurement (SSIV).		

KPI's

	1.	**Water Height Error Rate** Photrack was unable to measure the water height optically so the error rate was high. As such Photrack started using the Numinbah water level sensors via a API and the error rate was no longer applicable.		2.	**Water Velocity Error Rate** The Photrack SSIV was only able to accurately measure water velocity part of the time.
	3.	**Water Discharge Error Rate** The error rate varied based on the source of water level height data. When using the data from the API was error rate was low, when using the data from the optical height measurement the error rate was high.		4.	**Compliance** Discharge Keeper is able to process a variety of video configurations including the National Industry standard.
	5.	**Measurement of Water Height Optically** Photrack optical water height measurement capabilllity is mature for well defined river banks such as concrete canals but not suitable for the numerous vegetated river banks in Queensland.		6.	**Automation of Flow Rate Calculation** Discharge Keeper was able to fully automate the processing of videos and display of results, once water heigh variables were provided.
	7.	**Application Functionality** Discharge Keeper worked on all nominated devices including, Cloud Compute, and Android App. Photrack provisioned new instances of the App for the PoC but users were unable to get all of it to function successfully.		8.	**Information Latency** The PoC demonstrated successfully transmission of videos and or results every 30 minutes. Future intervals could be shortened if desired and if solar power budgets allowed.

Strengths

PoC Infrastructure was easily rolled out and integrated into existing sites seamlessly.

- Telemetry services worked almost without issue, transmitting data for Cloud processing.
- Cloud processing operated as expected and proved an important PoC outcome.
- Near time processing operated to a high standard, increasing situational awareness.
- Detection and measurement mostly operated within defined KPIs.
- Sensor API integration operated effectively, proving an important PoC outcome.
- End to end data integration (with some intervention) operated within defined scope.

Weaknesses

Software & site configuration complexity required expert intervention.

- Optical height detection (where vegetation was present) failed to meet KPIs and was not contactless.
- SSIV accuracy & quality rating is subject to further analysis and review.
- Video quality required tuning to for the purposes of telemetry and processing.
- CCTV data under 720p could not produce reliance results.
- Camera glare (and other visual impairments) impacted results accuracy.
- Availability of key SME throughout PoC due to competing priorities.
- Limited intuitive alerting to system events (e.g., Data upload failed).

Oakley Site

Overview Of The Site

Existing low flow and low bandwidth site powered by solar and batteries. Site is configured to film, process, and transmit one 30 second video results every 30 minutes via LTE-M or NB-IoT.

Use Case Alignment

1. Minimalist Site.
2. Typical Monitoring.
3. Not green field.

Deployed Hardware

- Secure site hut.
- Camera mount on hut.
- Two 40W solar panels & Two 44 Ah Battery.
- P 1365 MK II Camera.
- Digi IX 20 (LTE-M/NB-IoT) Router & Antennas.
- Edge PC.
- Ground Control Points GCPs.

Deployed Software

- Camera firmware.
- Modem firmware.
- Computer operating system.
- Photrack processing software.

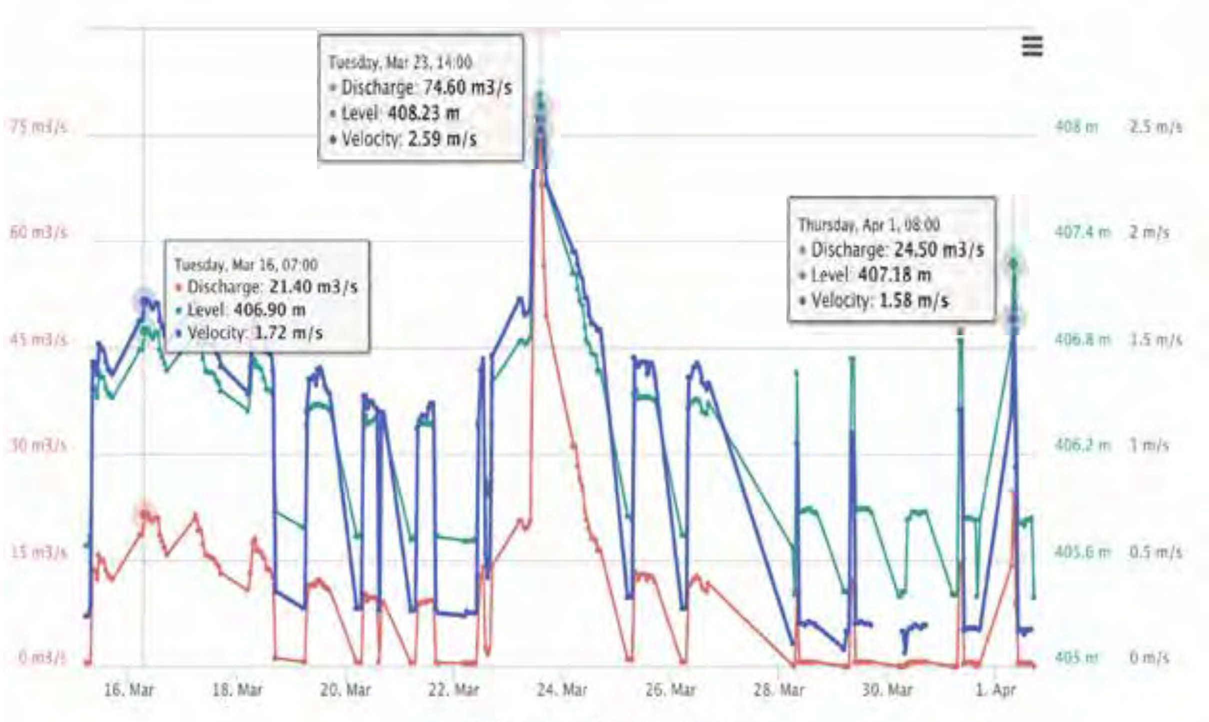
Summary

- Successful setup, configuration, and video recording.
- Successful edge processing of videos and results transfer.
- Solar and battery and edge PC operated within power budget.
- Edge PC operated at extreme hut temperatures.
- Optical height functional but not accurate.
- Edge PC misconfiguration resulted videos recording in variable framerate.

SAMPLE FLOW EVENTS

- Sample of some of the major flow events during a 2 week period

(Note: Flow dips at night as not measurements were taken in the dark)



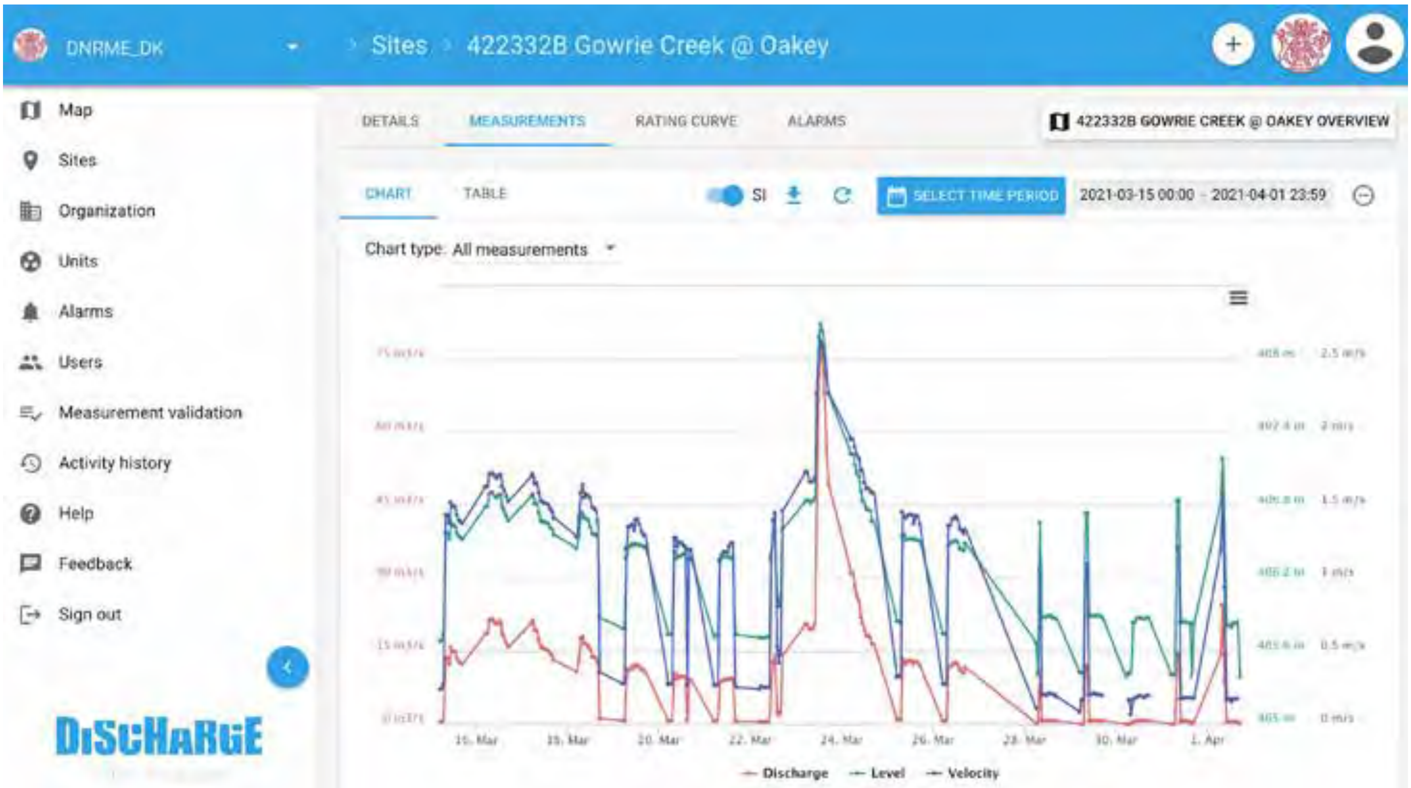
SUCCESS CRITERIA

PRINCIPLES		KPIS	
1.	Intelligent & Accurate	1.	Height Error
2.	Increased Reach	2.	Velocity Error
3.	Deployable	3.	Discharge Error
4.	Open & Integrated	4.	Compliance
5.	Reuse & Leverage	5.	Optical Height
6.	Extensible	6.	Automatic Processing
7.	Innovation	7.	Network Utilisation
8.	Commercially Mature	8.	Information Latency
9.	Standardised		

The PoC Solution design includes an overview of where core CWFM functions are conducted throughout various sites and Cloud Services.

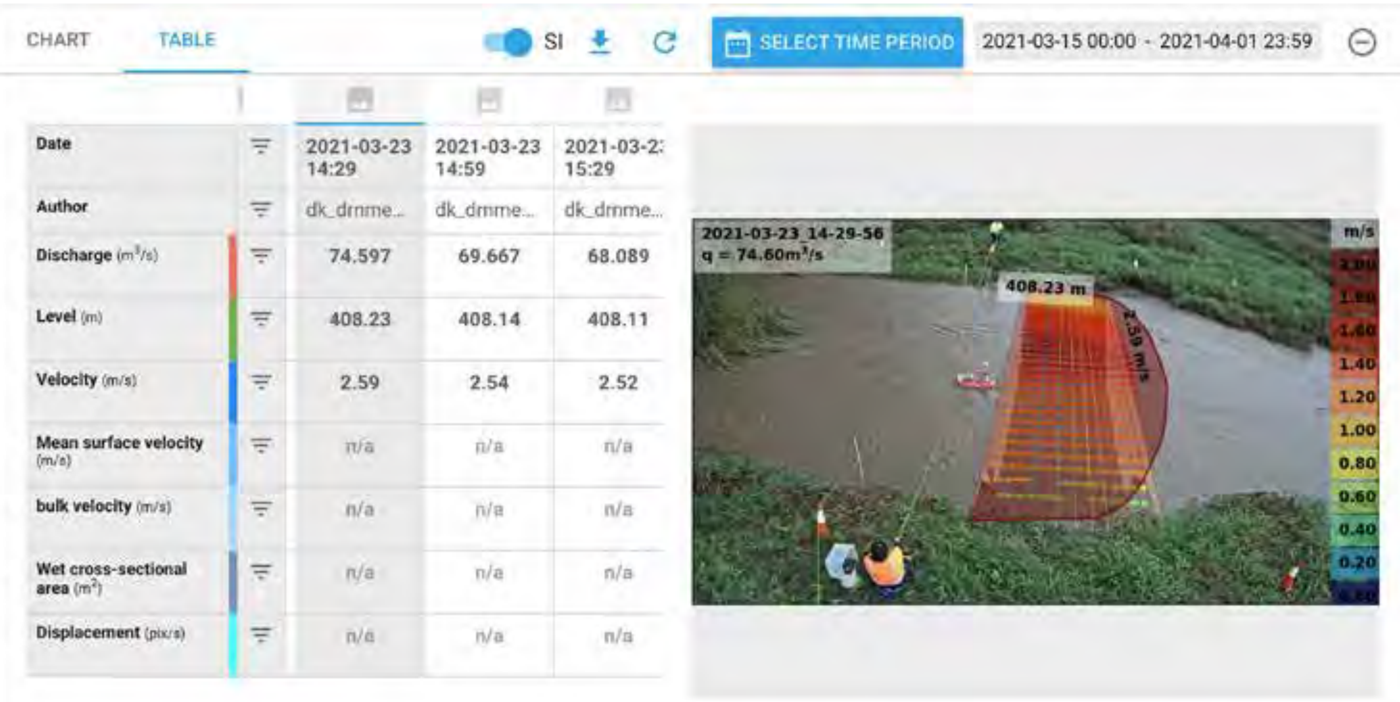
Photrack DischargeKeeper Measurement Chart

Photrack DischargeKeeper has several ways to view results. The chart view is shown above and includes a plot for velocity, discharge and water level.

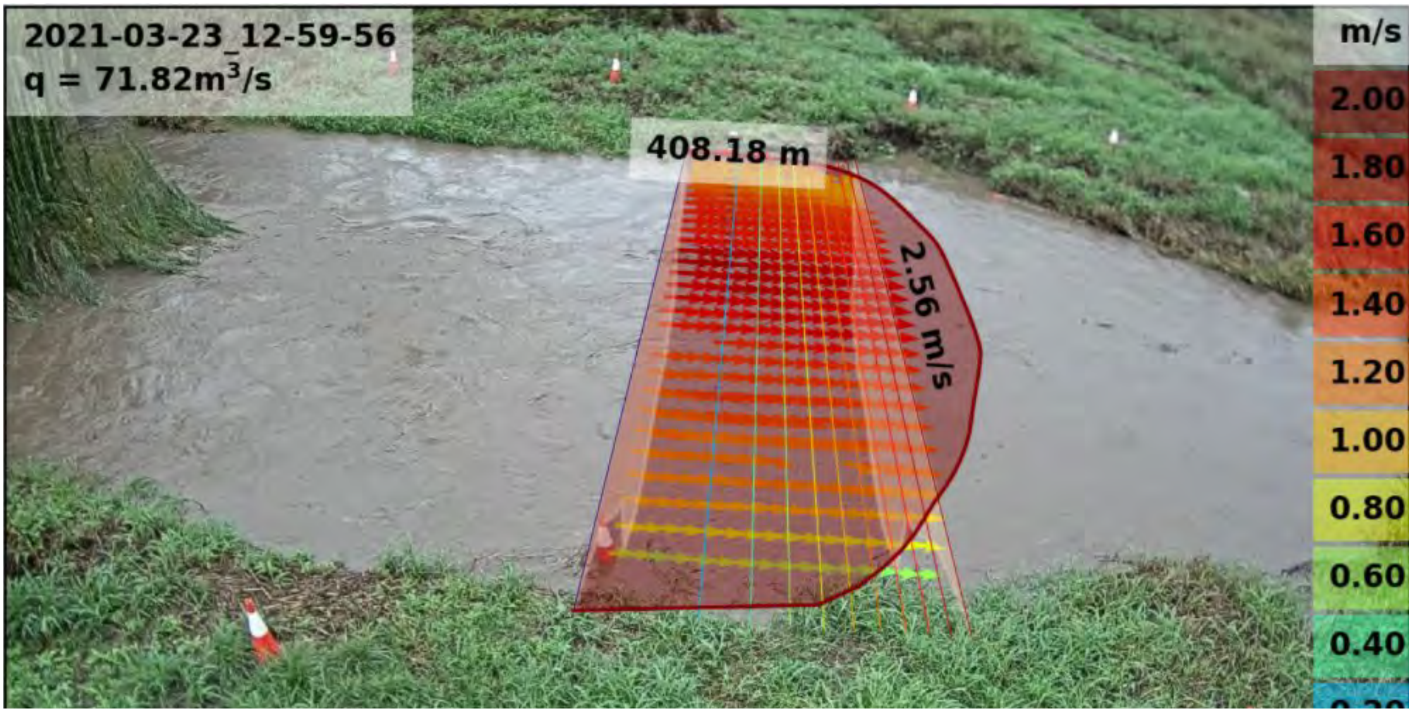


Photrack Discharge Keeper Measurement Table

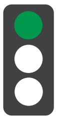
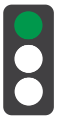
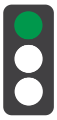
Photrack Discharge Keeper has several ways to view results. The tabular results are shown below which includes data from several measurements. Clicking on a particular day shows the proof image from that measurement with results, velocity profiles and virtual gauge boards overlaid on the image.



Date	2021-03-23 14:29	2021-03-23 14:59	2021-03-2: 15:29
Author	dk_dnrme...	dk_dnrme...	dk_dnrme...
Discharge (m³/s)	74.597	69.667	68.089
Level (m)	408.23	408.14	408.11
Velocity (m/s)	2.59	2.54	2.52
Mean surface velocity (m/s)	n/a	n/a	n/a
bulk velocity (m/s)	n/a	n/a	n/a
Wet cross-sectional area (m²)	n/a	n/a	n/a
Displacement (pix/s)	n/a	n/a	n/a



	Intelligent and Accurate The deployed solution partially aligned with this principle, displaying suitable levels of intelligence in terms of SSIV processing however measurement accuracy challenges were identified throughout the PoC.		**Increased Reach** The PoC partially aligned well with increased reach, however the use of edge processing devices in the Oakey site made deployment more complex. It should be noted that local processing does allow the RDMW to increase reach to satellite sites due to lower bandwidth requirement.
	Deployable The Oakey site partially aligned with this principle due to the increased requirement for local infrastructure and supporting ancilalary services (power, etc).		**Open and Integrated** The PoC had limited integration with Photrack on AWS, Telstra Data Hub on Azure, and Photrack App. Seamless sign-on, user and site provisioning and single point of access to videos are need maturity. The Telstra data hub was already integrated with HydroTel.
	Reuse and Leverage The Oakey site partially aligned with this principle and would have fully aligned without the need for local processing capability.		**Extensible** The overall solution was considered to be extensible however the reliance upon site infrastructure and the additional cost associate with deployment will limit the extensibility of the local processing based solution.
	Innovation The identified solution is considered to be highly innovative despite limitations that were identified during the PoC.		**Commercially Mature** The emerging nature of the Photrack and Telstra relationship does not pose a commercially mature service offering at this time and requires further development.
	Standardised The proposed service offering is almost entirely comprised of commercially available but proprietary technologies however does use industry standard algorithms for measurement (SSIV).		

	1.	**Water Height Error Rate** Photrack was unable to measure the water height optically, so the error rate was high. As such Photrack started using the Oakey water level sensors via a API and the error rate was no longer applicable.		2.	**Water Velocity Error Rate** The Photrack SSIV was not able to accurately measure water velocity.
	3.	**Water Discharge Error Rate** The error rate varied based on the source of water level height data. When using the data from the API was error rate was low, when using the data from the optical height measurement the error rate was high.		4.	**Compliance** Discharge Keeper is able to process a variety of video configurations including the National Industry standard.
	5.	**Measurement of Water Height Optically** Photrack optical water height measurement capabilllity is mature for well defined river concrete river banks but not suitable for the numerous vegetated Queensland sites.		6.	**Automation of Flow Rate Calculation** Discharge Keeper was able to fully automate the processing of videos and display of results.
	7.	**Application Functionality** Discharge Keeper worked on all nominated devices including Edge PC, Cloud Compute, and Android App. Photrack provisioned new instances for the App but users were unable to get all of it to function successfully.		8.	**Information Latency** The PoC demonstrated successfully transmission of videos and or results every 30 minutes. Future intervals could be shortened if desired and if solar power budgets allowed.

Strengths

Proven ability to work within a narrowband telemetry environment.

- Edge processing device proven to withstand environmental conditions.
- Edge SSIV processing operated effectively.
- Edge data retrieval proven to provide chronological record management needs.
- Data was somewhat integrated across end-to-end systems.
- Edge PC operated within power budget on solar and batteries.
- Edge PC operated with temperature range.

Weaknesses

The use of the edge PC created additional configuration and deployment complexity:

- There was a reliance upon the Supplier to resolve issues related to edge device.
- Misconfigured edge PC recorded videos in wrong framerate requiring videos to be reprocessed to get results at the end of the PoC.
- Satellite communications will require further development.
- Monitoring and alerting from the device was limited.
- Reprocessing of data was a labour-intensive process.

Key Issues

A range of key issues were identified during the PoC that have been classified in terms of their impact on any future deployment. These issues should be carefully considered when assessing future options.

Critical

1. Optical height calculations are not suited to the numerous vegetated river banks in Queensland. Water level gauges, sensors or concrete embankments will need to be installed.
2. Integrated single UX/UI for access to Photrack and TDD with SSO including User and Site provisioning and access to raw videos and results.
3. Seamless integration with core systems with links to any new systems.
4. AWS workspaces was not fit for purpose for operation within the corporate network and must be resolved.

Major

1. Variations in SSIV configuration & quality controls.
2. Standardised camera settings.
3. Ability to re-run data sets / add your own sets as an integral UX.
4. Integrated single UX/UI for any related tools such as DischargeLabs.
5. Timely access to ADCP measurements during first few site configurations.
6. Automatic site monitoring and health checks.
7. Ability to push changes and see results in a timelier manner.
8. Ability for timely information to be available in core systems for decision making such as emergency alerts or water access permissions.

Minor

1. Support arrangements between the Supplier and the Department.
2. Tighter SDLC controls on bug triage and fixes especially during SIT.
3. Planned future road map enhance contactless capability so as to be able diminish reliable on gauges or sensors.
4. Improved camera weather proofing and glare protection.
5. Deeper understand of camera and video settings as related to required compression and modem telemetry timeouts.

Proof of Concept Findings

Based on a review of the data and evidence collected (quantitative) and feedback received from PoC participants (qualitative), the following findings are made regarding the CWFM PoC.

1. Overall, the PoC is considered to have met some, but not all the success criteria.
2. Optical water level measurements are not suited to the numerous Queensland's vegetated riverbanks. As such, the solution is not entirely contactless and requires either gauge boards, level sensors or well-defined banks to be installed.

3. Discharge values met KPIs when combined with water level sensors but not with optical water level measurements.
4. Calculations need considerable development and training before it could be used by water monitoring staff in an efficient and accurate manner.
5. Fixed settings may not be suitable for all flow conditions experienced on site resulting in increased data uncertainty.
6. Mandatory requirements definition and SDLC management needs improvement.
7. The PoC did not develop a single integrated end to end UI/UX including user provisioning, site provisioning, video access, SSO, etc which would be required for the future.
8. Video processing software is complex and difficult to understand.
9. Camera video settings and compression understanding needs to deepen in correlation with video processing requirements and modem transmission timeouts.
10. Hydrographer's allocations are weather dependant and therefore can be unavailable to conduct validation measurements or processing.
11. The mobile app had several issues preventing it from being usable in the field.
12. SSIV has a variety of configuration options and quality controls that need further analysis on variety of site types.

Lessons Learnt

Throughout the PoC, a range of lessons learned were gathered that are captured for future reference.

1. That the use of the PoC was a valuable next step to further tests claimed capability of the proposed solution prior to making long term commitments.
2. That collaborative co-design and development was beneficial to all parties and operated effectively.
3. The emerging nature of the Telstra and Photrack commercial partnership became evident throughout the PoC in terms of working relationships, support, and other operational considerations.
4. International time boundaries and competing priorities impacted the PoC in several instances.
5. The PoC scope was reduced in a number of areas and the underpinning architecture was not demonstrative of a future production deployment (e.g., Blended Cloud services, SSO, etc)
6. Australian cases pushed the Photrack software beyond its current functionality, impacting the PoC outcomes.
7. That the inclusion the Hydrography experts was highly valuable to the success of the PoC.
8. Minimum standards for sites will be required as part of any next stage activities (e.g., infrastructure, device configuration, software configuration, etc).

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