Global Water
Research Coalition

Overview of Activities

2019-2020

OUR MISSION

"To maintain a strong partnership between leading world water research organisations to strategically generate, exchange and communicate knowledge through research collaborations to support safe and sustainable water supply and sanitation for the protection of public health and the aquatic environment."

Global cooperation for the exchange and generation of water knowledge

In 2002 twelve leading research organisations have established an international water research alliance: the Global Water Research Coalition (GWRC). GWRC is a non-profit organisation that serves as a focal point for the global collaboration for research planning and execution on water and wastewater related issues.

The Coalition focuses on water supply and wastewater issues and renewable water resources: the urban water cycle. The function of the GWRC is to leverage funding and expertise among the participating research organisations, coordinate research strategies, secure additional funding not available to single country research foundations, and actively manage a centralised approach to global issues.

The GWRC offers its members and partners the opportunity to leverage resources through cooperative planning and implementation of research.

The current members of the GWRC are listed below.

- Canadian Water Network (Canada)
- KWR Water Research Institute
- PUB (Singapore)
- SUEZ (France)
- Stowa - Foundation for Applied Water Research (Netherlands)
- TZW DVGW - German Water Centre (Germany)
- UK Water Industry Research (UK)
- VEOLIA (France)
- Water Research Australia (Australia)
- Water Research Commission (South Africa)
- The Water Research Foundation (US)
- Water Services Association of Australia (Australia)

The US Environmental Protection Agency has been a formal partner of the GWRC since 2003. The Global Water Research Coalition is also affiliated with the International Water Association (IWA).

A new partner has joined the Coalition in 2018, namely the Research Center for Eco-Environmental Sciences (RCEES) affiliated with the Chinese Academy of Sciences (China).

GWRC members represent the interests and needs of 500 million consumers and has access to research programs with a cumulative annual budget of more than €180 million. The research portfolio of the GWRC members spans the entire urban water cycle and covers all aspects of resource management.

GWRC Activities Overview

The focus of the last 18 months has been on sharing and learning from each other in these unprecedented times, whereby the COVID-19 pandemic has led to an increased exchange between the members and partners via webinars and the immediate attention was put on how members and partners were dealing with the pandemic within their respective organisations and the challenges and change in working conditions that had impacted everyone around the globe. The exchange of information and ongoing discussion of emerging issues regarding present and future developments within the urban water cycle continues to be a deliverable of interest to all members. The main activities completed during the period are summarised below.

A Compendium on Phosphorous Recovery and Recycling from Wastewater was compiled and completed. The objective of this project was to develop a Compendium and Database with information from GWRC partner organizations on P-recovery technologies currently in use in the wastewater (municipal or industrial) sector for each member country. This compendium provides an overview of promising and implemented technologies used for phosphorus recovery from wastewater and highlights why some were successful and others not after analyzing drivers and barriers in selected countries. It focuses on centralized infrastructures, covers operational and regulatory issues.

A Fact Sheet entitled **"Global Summary of Phosphorus Recovery"** was completed in 2019 summarising the results of the P recovery compendium and was made public via the GWRC website, linked in and Twitter.

The GWRC commissioned a project to develop **a tool that prioritises the research needs for candidate trace chemical contaminants**. The framework is available as a Bayesian Network running in freeware software (Netica). It is intended to be applied to organisations including water and wastewater utilities and others including water research providers and water research agencies and allows each utility to assess a contaminant against their organisational requirements and facilitates transparent decision making. As such, the tool provides an opportunity for enhanced communication to stakeholders, including the community, regarding why particular chemicals have been priorities for further research effort and expenditure. The tool is now available and has already been used by various members and their stakeholders.

The GWRC has completed an inter-laboratory comparison of **Microplastic** analytical techniques (Round Robin) coordinated by the German Water Centre (TZW) in an effort to standardise methods and protocols and to compare and evaluate results of microplastic analysis in an international context. The report has been finalised. The results of the round robin study underline the urgent need for harmonized test protocols and states that reliable results on microplastics in waterbodies will only be obtained if sampling, sample preparation and sample analysis are performed using a harmonized protocol. A final report is available on the GWRC website.

Antibiotic resistance (ABR) / Antimicrobial Resistance (AMR) is a rapidly evolving health issue extending far beyond the human health sector and numerous projects are underway worldwide. The Water Research Foundation (WRF) is planning to collaborate with the GWRC to organise a dissemination Workshop to be entitled " risk assessment and risk management of AMR" with the overall objective to update the GWRC members about the AMR risk assessment WRF project 4813 and to discuss where input from AMR risk assessment is most urgently needed to support risk management policies and actions of water utilities. The workshop will take place either in Copenhagen mid May 2021 before the IWA World Water Congress or via webinar (tbc).

Per- and Poly-Fluoro Alkyl Substances (PFAS) have been labelled as the biggest water quality issue of the 21st century. PFAS (PFOS, PFOA, etc.) are highly water soluble and resistant to degradation and hence widely present in the environment. They bioaccumulate and are now a major concern in many countries with groundwater, soil and drinking water contamination, accumulation in wastewater and biosolids, and potential impacts on the environment and human health.

The "State of Knowledge" report that was going to be compiled to capture the current state of knowledge of PFAS has been converted into a series of 4 Fact Sheets to remain up to date: Water industry risks and challenges, PFAS and Drinking Water, PFAS and Wastewater PFAS and Biosolids. The Fact sheets have been drafted and are being reviewed and member's comments are being integrated. They will be finalised towards the end of 2020.

A new project has commenced on **"Effect Based Monitoring" for water safety planning**. The main added value of this project is to combine substance based to effect-based monitoring tools to capture any adverse toxic pathways missing from current substance based targeting.

A new GWRC project on **"International Trends" in valuing research & innovation** has commenced in 2019. GWRC members have expressed keen interest in collaborating on a project that will provide a basis for improving their respective abilities to advance their own organizational objectives. As such, GWRC members are considered the primary "clients" for this project, which is being led by the Canadian Water Network (CWN) on behalf of GWRC members and partners.

A white paper on **"The Digital Water Utility of the Future" (Enablers, Applications and Risks of Digitalisation)** has been completed and is currently being reviewed.

A **workshop** took place in Paris in February 2020, on "Microplastics in the Water Sector" – An International Challenge, to present the state of knowledge and to discuss future scientific developments and practical needs to fill the main knowledge gaps. The workshop was kindly hosted by SUEZ and organised by TZW and SUEZ. This type of international collaboration and presence is important in building up the credibility of the GWRC.

Board meetings, workshops and topic discussions were organised for the Board of Directors in Toronto (Canada) in May 2019 and Nanjing (China) in October 2019.

The Board meeting that was scheduled to take place in London (UK) from the 1st to the 3rd of April 2020 to be hosted by UKWIR had to be cancelled due to COVID-19. The next Board meeting will be a virtual meeting and is scheduled to take place in October 2020.

In this period member visits and meetings with staff were organised but reduced since due to the COVID-19 pandemic.

The Board of the GWRC bid a fond farewell to Rob Renner (WRF) at the Board meeting in Toronto (Canada). Rob retired from the Board of Directors after having served 14 years on the Board and acting as Vice-Chair and Chair. The Board will miss his positive outlook, engagement, dedication to the GWRC mission and vision and participation.

The Board of the GWRC bid a fond farewell to Harry Seah (PUB) at the Board meeting in Nanjing (China). Harry retired from the Board of Directors after having served 17 years on the Board. The Board will miss his experience, enthusiasm, collaborative spirit, and valuable insights.

The Board also had the pleasure to welcome the new Board members Peter Grevatt from the Water Research Foundation, Reynald Bonnard from SUEZ, Steve Kaye from UKWIR and Kala Vairavamoorthy from IWA who joined the Board of Directors.

Harry Seah (PUB) receiving his Farewell gift from Adam Lovell (Chair) in Nanjing (China).

Rob Renner(WRF) Farewell Dinner in Toronto (Canada).

GWRC Research Agenda 2019/20

The joint research agenda of the GWRC addresses the urban water cycle and covers a number of research areas including Water Quality and Health, Wastewater Management and Resource Recovery, Asset Management/ Resilient Infrastructure and the Sustainable Water Cycle. For each of these areas research strategies have been developed including a set of specific projects. For the projects, tailor-made teams of experts from GWRC members are formed and agreements are made on the joint funding and execution of the projects.

Research Areas

The joint GWRC research agenda (Figure 1) is regularly updated based on the actual needs of members and their stakeholders. The GWRC members interested in each topical area collectively develop specific research strategies and an accompanying portfolio of research projects to address the identified information gaps. An inventory of past and present research and a research-planning workshop are part of this process. Individual members of the GWRC coordinate and manage the joint research projects.

For each of the areas, teams of experts of the collaborating members are formed when required to address knowledge gaps and research needs.

Figure 1: Current GWRC Research Agenda

For this period, the research focus areas were on continuing research in the field of Water Quality and Health and in particular on microplastics and perfluorinated compounds with a particular focus on PFAS, the digital water utility, and effect based monitoring for water safety planning. The research agenda will be updated to include new areas of interest in 2021.

Overview of Ongoing Projects and Activities

Effect Based Monitoring for Water Safety Planning

Following the successful project Tools to detect estrogenic activity in environmental waters a second GWRC project was started in 2014 named the **"EDC Toolbox 2"** project, the GWRC has commenced an extensive research project on "Effect Based Monitoring for Water Safety Planning" This project is in some parts a continuation of the GWRC EDCI and EDCII projects but putting all the knowledge into practice and looking at the One Health approach and different water qualities (via case studies).

The main added value of this project is to combine substance based to effect-based monitoring tools to capture any adverse toxic pathways missing from current substance based targeting.

As we are becoming more and more aware of the large number of **organic micropollutants** in the aquatic environment, it is no longer possible to evaluate the elimination of the individual organic micropollutants in (drinking) water treatment plants (DWTPs) or to guarantee the absence of their transformation products (TP), including metabolites and disinfection by-products (DBP). It is also difficult to evaluate which mixtures may induce adverse health effects at a later date, given that very low concentrations may already cause adverse effects, e.g., endocrine disrupting effects. While these low concentrations are unlikely to pose a significant health concern, there is a scarcity of toxicity information on many of the chemicals currently in commercial use, and in most cases it is impossible to conduct a proper risk assessment for all organic micropollutants.

The possible health impacts of these substances are of major interest to water operators and public consumers alike. As these concerns are widely debated today, they require a scientific, objective and rigorous assessment of consumer exposures. There is an increased requirement to assess the level of risks to human health under premium cost-effective and predictive monitoring frameworks to better ensure that there is no exposure to these early biological effects.

The project is coordinated by the KWR Watercycle Research Institute (Geertje Pronk and Stefan Kools) and work package leaders are amongst others the GWRC members Veolia and Suez and Griffith University.

A kick off meeting for the project took place at KWR on the 30 September and 1 October 2019 at KWR (Netherlands).

Project team meeting at KWR's Head office

The key challenge of this demonstration project is to assess under innovative effect based methods, the water quality profiles potentially triggered by residual organic micropollutants at different parts of the DWTP, from resource to tap and through the whole water cycle (water cycle DWTPs, WWTPs, conventional and alternative water treatment schemes and water reuse). In fact, water resources can be impacted by different types of chemical pollution, and specific treatment - in interaction with specific type of pollution - even designed to remove them, may generate other water quality profiles, by degrading some compounds into by-products or metabolites.

The main added value of this project is to combine substance based to effect-based monitoring tools to capture any adverse toxic pathways missing by substance based targeting.

A new deliverable of the project is a Factsheet on "Defining requirements for fit with WHO and HACCP framework and identification of needs for protocols and user guides" which is available to download on the GWRC website.

Value of Research

Today's water management sector is facing increasing uncertainty about future conditions, heightened expectations about the role of water utilities in achieving community goals, and the need to develop financially sustainable solutions. In response to these challenges, water utilities have an increasing incentive to leverage research and innovation to effectively identify priorities for action and develop resilient and adaptive solutions.

The GWRC members have identified a shared need to: (1) better understand how water utilities perceive and recognize value from research and innovation activities, and (2) access appropriate metrics to measure and demonstrate this value in a way that is meaningful for their individual contexts.

This project will leverage the knowledge of all GWRC member participants by consolidating information on the nature of the research ecosystems and practices in the different jurisdictions, allowing members to access insights from the expertise in the group and apply them to their respective organizations. In addition, the project will provide a structure that enables the contribution of diverse, local information to a useful, high-level synthesis of international trends in research and innovation valuation.

The Canadian Water Network (CWN) has kindly agreed to coordinate a project on "International Trends" in valuing research & innovation which has commenced in 2019.

To date, two Phase 1 reports have been submitted, representing overviews of the Dutch water landscape (collaboration between KWR and STOWA) and the Australian national water service and water research landscape (collaboration between the Water Services Association of Australia (WSAA) and Water Research Australia (WRA).

PFAS

Per- and Poly-Fluoro Alkyl Substances (PFAS) have been labelled as the biggest water quality issue of the 21st century. PFAS (PFOS, PFOA, etc.) are highly water soluble and resistant to degradation and hence widely present in the environment.

They bioaccumulate and are now a major concern in many countries with groundwater, soil and drinking water contamination, accumulation in wastewater and biosolids, and potential impacts on the environment and human health. PFAS seems to be on the agenda of most members and partners and it was deemed important to collate information on the current status of research within the membership. The State of Knowledge" report that was going to be compiled to capture the current state of knowledge of Per- and Poly-Fluoro Alkyl Substances (PFAS) has been converted into a series of 4 Fact Sheets to remain up to date: Water industry risks and challenges, PFAS and Drinking Water, PFAS and Wastewater PFAS and Biosolids. The Fact sheets have been drafted and are being reviewed and members comments are being integrated and will be finalised towards the end of 2020.

Workshops

The presence and effects of **microplastics in the aquatic environment** have raised considerable concerns over the past years. Governmental agencies, water managers, food safety authorities and plastic producers face uncertainties with respect to abundance and effects of microplastics in the environment, which hampers the development of sustainable solutions and feeds alarm within the public opinion.

As a follow-up action of the Global Water Research Coalition (GWRC) workshop on fate and occurrence of emerging contaminants and pathogens that was held at TZW (German Water Centre) in Germany in June 2015, in May 2016 in Nantes ahead of the SETAC conference entitled "Microplastics in Water", a round robin test study was drafted and coordinated by TZW, in order to compare several methods for microplastic identification between laboratories worldwide. The aim was to identify the suitability and limitations of individual methods that are commonly used in microplastic analysis. The results have been analysed and a final report and refereed paper has been produced and sent to all members and involved research partners.

Meanwhile, different partners have started their own activities on the issue and research projects on national levels, which are also financed outside of the GWRC. In order to strengthen GWRC activities, knowledge sharing on the different on-going activities are of utmost importance and will add value to the GWRC network by learning from each other, sharing outcomes and minimising duplication.

A follow up **workshop** took place in Paris in February 2020, entitled "Microplastics in the Water Sector" – An International Challenge, to present the state of knowledge and to discuss future scientific developments and practical needs to fill the main knowledge gaps. The workshop was kindly hosted by SUEZ and organised by TZW and SUEZ.

The workshop brought together GWRC members and partners and external experts from the European Commission, WHO, OECD, G7 Group on Microplastics

Monitoring, and the Karlsruhe Institute of Technology, to present the state of knowledge and to discuss future scientific developments and practical needs to fill the main knowledge gaps.

The presentations are available upon request.

GWRC members and partners and group of experts attending the Microplastic Workshop at CIRSEE (research headquarters of SUEZ in Paris)

White Papers/Fact Sheets/State of Science Reports

The Global Water Research Coalition recently tasked WSAA and PUB Singapore to draft a white paper on "The Digital Water Utility of the Future" (Enablers, Applications and Risks of Digitalisation) on behalf of the GWRC members and partners and in close collaboration with IWA. The paper has been completed and incorporates in-depth case studies that correspond with each step of the water loop (i.e. watershed management – water treatment – networks and distribution – used water treatment).

This paper suggests a four-part approach to digital maturity (Figure 1) designed to complement the IWA Digital Water Report. This report is structured from internal focus (left) to an increasingly external focus (right). Potential benefits from digitalisation are achievable at each stage. The internal approach starts with improving business maturity within business groups (far left) to establishing strong cross business integration (centre left), enhancing the interface with customers and suppliers (centre right), then finally leveraging tighter integration with the community and external agencies (far right). Whilst these stages are comparable to a business maturity model, the difference is that digital technology is allowing these advances in maturity to occur with greater ease and rapidity than in the past. Customers are starting to see many of these changes in businesses they interact with. Consequently, they are likely to expect and demand the outcomes that these advances can deliver from all their service providers.

Utilities are at different stages of digital maturity, often with a mixture of components from each stage. While a step-wise approach is not needed, jumping to an external focus without first having prepared the internal business for digitalisation can limit a utility's ability to store, manage or extract the maximum value from the data collected and systems installed.

Whilst there are many benefits from digitalisation (Figure 1) there are also challenges and risks. Realising the full potential of digitalisation means considering a more integrated business, both internally and externally.

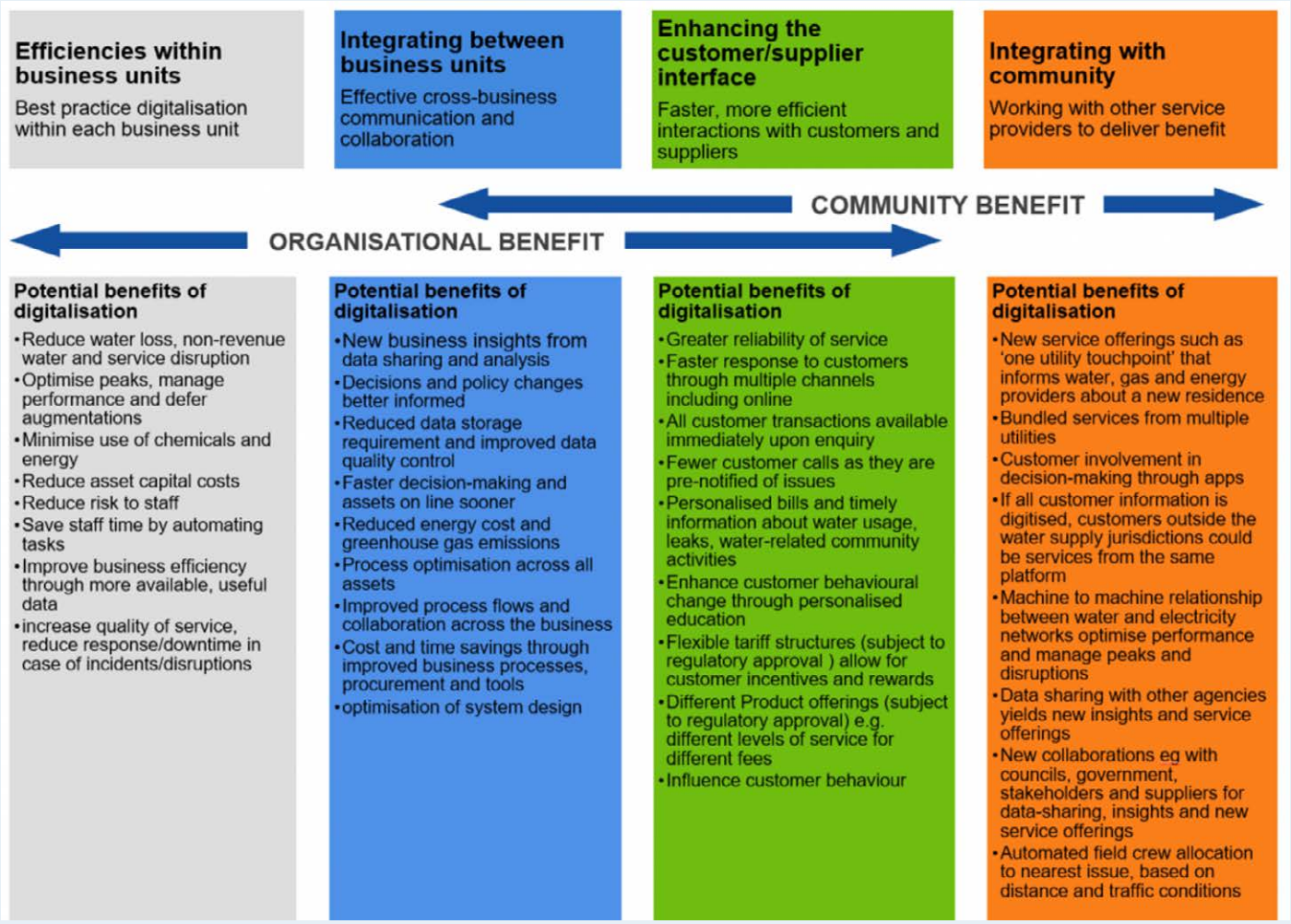


Figure 1: The four components of a mature digital water utility, from an internal focus (left) moving to an increasingly external focus (right).

This discussion paper lays out the many opportunities the digital age offers water utilities, along with the risks and challenges, and how these can be managed.

COVID -19

Many activities in relation to the COVID-19 pandemic in relation to water have taken place and members and partners were kept informed of what each other were doing in that space and how everyone has been addressing the challenges and issues and many activities were set up amongst which a fact sheet was produced, a portal was set up to exchange the latest information, a working group was set up with the leading experts in the field and the board members were invited share their insights and challenges during webinars.

Fact Sheet:

A GWRC Fact Sheet on " COVID-19 Virus" Water, Sanitation and Wastewater Management- was drafted and linked to the GWRC website below. It was updated on the 26 May 2020.

Factsheet

Global Water Research Coalition

COVID-19 Virus

Water, Sanitation and Wastewater Management

As the COVID-19 Virus associated respiratory disease is rapidly spreading worldwide, this fact sheet will provide up to date information as it becomes available to inform the public and water sector professionals on the attributions of this virus and any measures needed to protect both workers and public health.

The COVID-19 Virus

The virus, technically named SARS-CoV-2 (also referred to as COVID-19 Virus), is a newly identified virus and the resulting illness is referred to as COVID-19. This virus is in the same Coronavirus family as severe acute respiratory syndrome coronavirus (SARS-CoV or SARS) and Middle East respiratory syndrome coronavirus (MERS-CoV or MERS), which caused the two previous coronavirus outbreaks in 2003 (SARS) and 2012 (MERS)[1].

Since SARS and MERS are from the same family of coronaviruses, they have similar physical and biochemical properties and comparable transmission routes as COVID-19 Virus. In the absence of COVID-19 Virus specific data, we rely on SARS, MERS, and coronavirus surrogate data to extrapolate, assess, and manage risk.

The morphology and chemical structure of the COVID-19 Virus is very similar to other surrogate human coronaviruses for which there is evidence on both survival in the environment and effective inactivation measures[2]. Currently, there is a lack of evidence regarding the survival of COVID-19 Virus in drinking water or sewage.

COVID-19

The COVID-19 disease was identified in late 2019 associated with an outbreak of pneumonia in Wuhan City, Hubei Province, China. Initial cases were spread from animals to humans. However, there is now confirmed direct human-human transmission, likely via droplets, direct contact with nasal secretions, and contact with surfaces that have been contaminated by someone coughing and sneezing. The features of COVID-19 bear some resemblance to those of SARS and MERS[1].

Drinking Water and Sanitation

The presence of the COVID-19 Virus has not been detected in drinking-water supplies and based on current evidence the risk to water supplies is low[2]. There is also no evidence that the COVID-19 Virus is transmitted by drinking water. The current evidence is that COVID-19 is most likely transmitted from person-to-person by sneezing and coughing. There is no evidence that drinking water will be affected by the COVID-19 Virus[4].

Is the COVID-19 Virus removed from Wastewater?

There is no evidence to date that the COVID-19 Virus has been transmitted via sewerage systems, with or without wastewater treatment. Furthermore, there is no evidence that sewage and wastewater treatment workers contracted SARS, another type of coronavirus that caused a large outbreak of acute respiratory illness in 2003. As part of an integrated public health policy, wastewater carried in sewerage systems should ideally be treated in well-designed and well-managed centralised wastewater treatment works.

Some coronaviruses can potentially survive in the gastrointestinal tract and be spread by the 'faecal-oral' route or via inhalation of contaminated wastewater droplets. There have not been reports of faecal-oral transmission of COVID-19 to date[4]. Two studies have reported detection of COVID-19 fragments in faecal matter of COVID-19 patients[7,8]. Whilst plausible, because it's newly discovered, it is not yet certain how well the virus is able to survive in water and wastewater. However, nasal secretions are found in wastewater (e.g. due to flushing of tissues) and most likely COVID-19 will enter wastewater systems. Furthermore, the most similar virus tested, SARS-CoV, was shown to be present in wastewater and to persist in faeces, urine, water and wastewater for periods up to 2 days at 20°C, at least 14 days at 4°C, and survive for 4 days in diarrheal stool samples with an alkaline pH at room temperature in spiked samples[5,6].

Based on this, it is possible that the COVID-19 Virus may be present in wastewater where COVID-19 infections are present. Importantly, the same is true for a wide variety of pathogens, such as other viruses, bacteria and protozoa. But what we do know is that the COVID-19 Virus is an enveloped virus that is expected to be more sensitive to disinfection than non-enveloped viruses such as coxsackievirus, Hep A and adenovirus.

COVID-19 Virus Updated 25 May 2020 /1

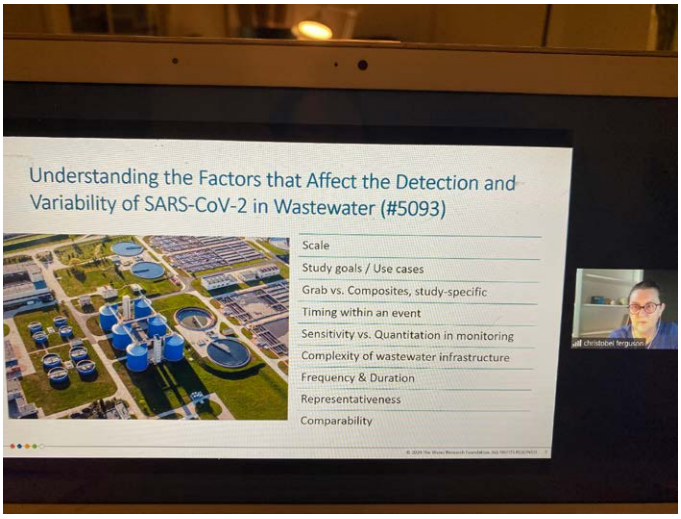
http://www.globalwaterresearchcoalition.net/_r4285/media/system/attrib/file/826/GWRC_Factsheet_COVID-19%20Virus_25May2020.pdf

GWRC COVID-19 Sewage Surveillance Research Working Group:

A "GWRC COVID-19 Sewage Surveillance Research Working Group" was created for the members, partners and other key researchers to have a discussion platform to share, exchange, and collaborate on the topic of sewage surveillance of COVID 19.

This committee will meet on an ad hoc basis, and preferably every month, and members will be invited to share their research in this field and requirements for harmonised protocols, interlaboratory studies, white papers, fact sheets will be discussed.

The committee is chaired by Gertjan Medema (KWR) and the administration and organisation of meetings is done by the MD. Three working groups via zoom have taken place so far with presentations from Australia, South Africa, Canada, France, US, Italy, Netherlands, .



Christobel Ferguson (Water Research Foundation) presenting aims of the new call for projects (WRF #5093)

The deliverables are: exchange of information, harmonised protocols, white papers, reports, fact sheets, interlaboratory studies (Round Robins), other collaborative opportunities (discussions are underway with the European Commission).

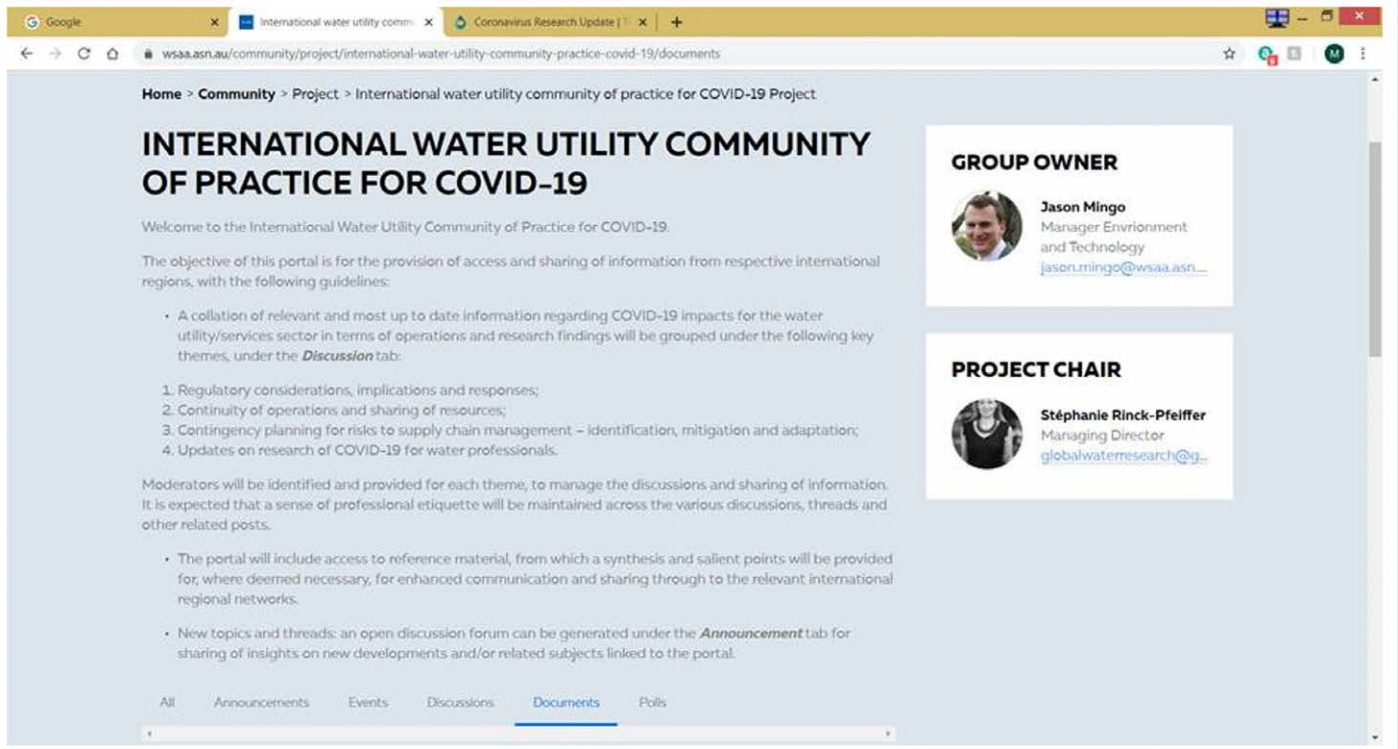
Sharing Portal:

A sharing portal entitled "International Water Utility Community of Practice for COVID-19" was set up in March 2020 and is kindly hosted and supported by WSAA.

Given that all the members and partners are dealing with the same challenges and implications in regards to the COVID-19 pandemic, and have been running webinars and platforms to exchange and discuss options on how to best coordinate the current crisis and long haul issues in dealing with COVID-19, we thought that we could do this on an International scale and within our GWRC community. This is what this group is all about sharing information, helping each other and learning from each other !!

The portal has been providing access for nominated representatives from GWRC members and partners, with the following proposed functionality based on the responses received:

1. A collation of relevant and most up to date information regarding COVID-19 within the water utility sector in terms of operations and research findings under the following key themes:
2. The portal provides access to reference material, from which a synthesis and salient points will be provided for enhanced communication and sharing through to the relevant regional networks internationally.
3. New topics and threads: an open discussion forum for sharing insights on new developments and/or related subjects linked to the portal.



GWRC Board of Directors

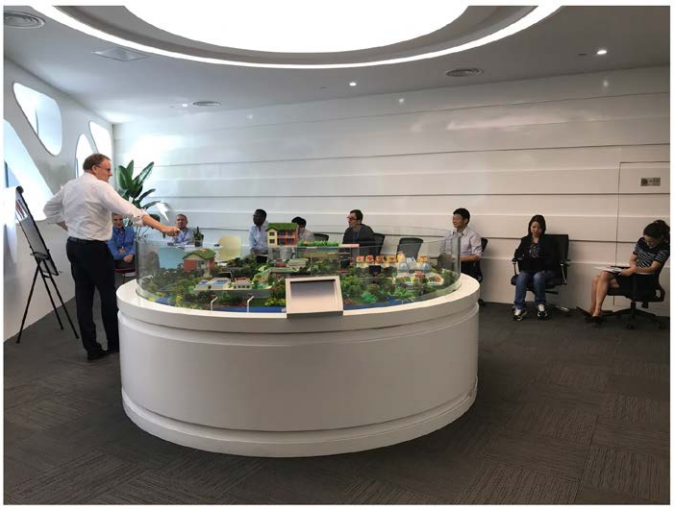
The GWRC Board of Directors is made up of the representatives of the GWRC members. Adam Lovell (WSAA) is the Chair of the Board and Bernadette Conant (CWN) is the vice chair of the Board.

Board meetings, workshops and topic discussions were organised for the Board of Directors in Toronto (Canada) in May 2019 and Nanjing (China) in October 2019.

Board meeting in Toronto (Canada) in May 2019 hosted by the Canadian Water Network & Peter Grevatt (WRF) presenting at the Dajiang Summit

A mini workshop took place during the Board meetings in Toronto on **"UKWIR's Big Questions '** moderated by UKWIR's CEO Steve Kaye and another one on « Contaminants of Emerging Concern (CEC's)".

The Board meeting in Nanjing (China) in October 2019 was preceded by the Dajiang Summit and involved presentations by many board members including Peter Grevatt (WRF) and Adam Lovell (WSAA).



Board of Directors Meetings in Nanjing (China), October 2019, hosted by RCEES (photo on the left) and brainstorming new research areas of interest moderated by Joost Buntsma (STOWA)

The exchanges of information between members and partners has developed into a very valuable part of the Board meetings. The presentations by the hosting organisations and their stakeholders give an additional dimension to the Board events.

The MD also attended various Water JPI Advisory group meetings, and the IWA Strategic Council meetings in person and via webinars (as of March 2020).

The board meeting scheduled to take place in April 2020 in London (UK) was cancelled due to the pandemic.

Members of the Board (2019/20)

Bernadette Conant	CEO, Canadian Water Network (Vice-Chair)
Marielle van der Zouwen	Manager Knowledge Management Group, KWR (Netherlands)
Chee Meng Pang	Chief Engineering and Technology Officer, PUB (Singapore)
Joost Buntsma	Executive Director, STOWA (Netherlands)
Reynald Bonnard	CIRSEE Research Centre Director, SUEZ (France)
Josef Klinger	CEO, TZW (German Water Centre) (Germany)
Steve Kaye	Executive Director, UK Water Industry Research
Bruno Tisserand	Water Programme Director, Veolia (France)
Dhesigen Naidoo	CEO, Water Research Commission (South Africa)
Karen Rouse	CEO, Water Research Australia Limited (Australia)
Peter Grevatt	Executive Director, Water Research Foundation (US)
Adam Lovell	Executive Director, Water Services Association of Australia (Chair)
Stéphanie Rinck-Pfeiffer	Managing Director, GWRC (secretary/treasurer)

Suzanne van Drunick (National Program Director Safe and Sustainable Water Resources, US EPA), Kala Vairavamoorthy (Executive Director, IWA) and Prof. Yang Min (Deputy Director General , Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences) have an ex-officio position on the Board and are partners of the GWRC.

GWRC Reports

Reports of the joint GWRC research activities (2002 – 2020) are presented below.

Contaminants of Emerging Concerns (CEC's)	
Decision-Making Framework for the Prioritization of Research into Constituents of Concern	January 2019

Endocrine Disrupting Compounds (EDC)	
Occurrence of EDC in water systems	September 2003
Overview of EDC sources and biological methods	September 2003
Priority list of EDC	September 2003
EDC Knowledge gaps and research needs	September 2003
Workshop EDC Analytical Methods (Karlsruhe)	July 2003
EDC in sewage sludge: analytical method development	August 2003
EDC in sewage sludge: a comparison of analytical method	February 2004
Comparison of analytical chemical methods for EDC in water and sludge	May 2006
In Vitro Bioassays to Detect Estrogenic Activity in Environmental Waters	May 2006
Tools to detect estrogenic activity in environmental waters	February 2008
Bio-analytical Tools to analyse Hormonal Activity in Environmental Waters	June 2012
Bioanalytical tools to analyse hormonal activity in environmental waters (WP1 & WP2 Interim reports)	July & September 2015
Bioanalytical Tools to analyse hormonal activity in environmental waters (Final Project Report)	April 2017
State of Science Report on *In Vitro Bioassays*: Current Status and Future Application for Water Management	August 2018
Factsheet "Use of effect-based monitoring for the assessment of risks of low-level mixtures of chemicals in water on man and the environment"	April 2020

Pharmaceuticals	
Pharmaceutical and Personal Care Products in the Water Cycle – An international review	March 2004
Pharmaceutical and Personal Care Products in the Water Cycle – Report of the GWRC Research Strategy Workshop	March 2004
International Priority List of PhAC relevant for the Water Cycle	April 2008
GWRC Science Brief – Occurrence and Potential for Human Health Impact of Pharmaceuticals in the Water System-	June 2009
"Predictive bioanalytical tools in water" from research to implementation (Workshop Report)	February 2017

Nitrosamines	
Analysis, Toxicity, Occurrence, Fate and Removal of Nitrosamines in the Water Cycle	February 2007

Antibiotic Resistance	
Antibiotic Resistance- Report of the GWRC Workshop	June 2016
Antibiotic Resistance in the Water Environment (Grey Paper)	October 2016
Antibiotic Resistance (ABR) in the Water Environment "setting up a risk based project" (Vienna) (Workshop Report)	September 2017

Microplastics	
GWRC Science Brief on Microplastics in Freshwater Resources	September 2015
GWRC Global Fact Sheet on Microplastics	October 2017
GWRC Report "Method Harmonization and Round Robin Comparison for Microplastics (MicRobin)"	October 2018

Per- and Poly-Fluoro Alkyl Substances (PFAS)	
PFAS Workshop Summary (Singapore, July 2018)	September 2018

Hardness and Cardiovascular Disease	
Evaluation of the Epidemiological Evidence	June 2006
Hardness: Reasons and Criteria for Softening and Conditioning of Drinking Water	April 2007

Algal Toxins	
Management Strategies for Algal Toxins – An International Review	May 2004
Management Strategies for Algal Toxins – Report of the GWRC Research Strategy Workshop	December 2005
International Guidance Manual for the Management of Toxic Cyanobacteria	

Sensors and Online Monitoring	
Real-time online Monitoring of Contaminants in Water	May 2008
Compendium of Sensors and Monitors and their Use in the Global Water Industry	June 2014

Asset Management	
GWRC Research Strategy on Asset Management – A Scoping Study	April 2005
Asset Management – Report of the GWRC Research Strategy Workshop	October 2005
Tool for Risk Management of Water Utility Assets	May 2008
Methodology for Benefit and Cost Valuation in Asset Management	April 2009
Compendium of Best Practice in Water Infrastructure Asset Management	January 2010
Key Asset Data for Water and Wastewater Utilities	June 2012

Membrane Bioreactors (MBR)	
Membrane Bioreactors for Municipal Wastewater Treatment – State of the Science Report	October 2005
Membrane Bioreactors for Municipal Wastewater Treatment - Report of the GWRC Research Strategy Workshop	October 2005
Investigation of MBR Water Effluent Quality and Technology	May 2012

Water Reuse	
Status and Role of Water Reuse – an International View	August 2005
Water Reuse – Report of the GWRC Research Strategy Workshop	August 2005
Water Reuse – Identifying Future Challenges and Opportunities	April 2012

Desalination	
Desalination – Brine and Residual Management	April 2012

Wastewater	
Energy and Resource Recovery from Sludge	November 2007
Wastewater Treatment 2030 – Improvement Energy Efficiency in Municipal Wastewater Treatment	May 2011

Waterborne Pathogens	
A review on Current Knowledge on Waterborne Pathogens (2nd edition)	November 2009
Waterborne Pathogens – Report of the GWRC Research Strategy Workshop	June 2006
Fate and Occurrence of Emerging Contaminants and Pathogens - Workshop Report	July 2015

Energy and Climate Change	
Water and Energy – Report of the Research Strategy Workshop	February 2009
Energy Efficiency in the Water Industry – Compendium of Best Practice and Case Studies	March 2011
Toolbox for Water Utilities Energy and GHG Emission Management	March 2013
Water Footprint in the Urban Water Sector (4 volumes)	October 2011
N_2O and CH_4 emissions from Wastewater Collection and Treatment Systems – State of the Science	November 2011
N_2O and CH_4 emissions from Wastewater Collection and Treatment Systems – Technical Report	November 2011
GWRC Science Brief on N_2O and CH_4 emissions from WWT systems	August 2013

Resource Recovery	
Inventory "Resource Recovery Projects" (summary of member activities)	September 2015
Global Compendium on Phosphorus Recovery from Sewage/ Sludge/Ash	February 2019
Global Compendium on Phosphorus Recovery from sewage (Fact Sheet)	November 2018

COVID-19 (SARS-CoV2)	
Fact Sheet "Covid-19 Virus "Water , Sanitation and Wastewater Management"	May 2020

Digital Water	
White Paper : The digital water utility of the future"	October 2020

GWRC Members

Canadian Water Network (Canada)

The Canadian Water Network (CWN) is a national nonprofit organization that is driving Canada's progress on water challenges. CWN connects researchers with water managers from both industry and government, to collectively identify and address shared needs. Areas of focus include protecting public health, ensuring sustainable water infrastructure, and protecting Canada's watersheds and ecosystems. CWN's consortium approach to research encourages collaboration across disciplines and ensures that the right combinations of knowledge yield tangible results. The network's expertise is increasingly sought to inform water policy as well as improve water management and stewardship across municipal and provincial boundaries. CWN initiatives currently engage more than 37 Canadian universities and connect them with more than 100 partners from industry, government and non-governmental organizations.

www.cwn-rca.ca

KWR – Water Research Institute (Netherlands)

KWR is an independent water research institute covering the whole of the water cycle. It was formed in 2008 by expansion from Kiwa Water Research which had specialised in the field of drinking water. Building on a solid foundation from over 60 years of research and development for the Dutch drinking water sector companies, KWR is now applying this knowledge base and research capability more broadly to serve all partners in the watercycle. KWR's worldwide activities and high-quality research are aimed at scientific knowledge that is practically applicable, to allow the building of bridges between science, business and society.

www.kwrwater.nl

PUB (Singapore)

PUB is the national water agency and it manages Singapore's water supply, water catchment and sewerage in an integrated way. PUB is responsible for managing the whole water cycle, from sourcing to the collection, purification and supply of drinking water, to the treatment of used water and its reclamation into NEWater, as well as the drainage of stormwater. Leveraging on technology, PUB has put in place a reliable water supply system known as the Four National Taps. Water reclamation (or NEWater) and desalination make up two of the four water sources, besides water from local catchments and imported water. To ensure the sustainability of Singapore's water supply, PUB continuously invests in R & D to find new sources of water and to produce and treat water cost-efficiently.

www.pub.gov.sg

SUEZ (France)

The International Research Center On Water and Environment (C.I.R.S.E.E.) is the principal SUEZ research centre in the field of water. The multidisciplinary research program focuses on new water treatment processes, understanding factors affecting water quality, and improving real-time system management. CIRSEE also provides analytical services and consultancy, emergency assistance for dealing with pollution events, and technical advice on water and wastewater treatment. Both research and consultancy activities have a strong international involvement.

www.suez.com

STOWA (Netherlands)

The STOWA (Foundation for Applied Water Management Research) was founded in 1971. The foundation coordinates and commissions research on behalf of a large number of local water administrations in the Netherlands. The bodies which contribute to the STOWA include water boards, provinces and the Ministry of Transport, Public Works and Water Management. Central coordination and planning of research through STOWA has permitted more cost-effective and strategic long term research planning, and enhanced involvement and communication between water managers from different agencies.

www.stowa.nl

TZW – The German Water Centre (Germany)

TZW (DVGW Technologiezentrum Wasser) is the centre of applied research of the German Waterworks Association (DVGW). TZW is a non-profit organization and provides scientific consulting to waterworks and to governmental bodies and offices. The mission of TZW is transferring scientific knowledge to the water industry. TZW fulfils this mission by carrying out applied research for the drinking water community and by direct cooperation with the waterworks. TZW provides not only research but practical experience and know-how for the solution of water problems.

www.tzw.de

GWRC Members

UK Water Industry Research (UK)

UKWIR facilitates and manages collaborative research for water and sewage companies in the United Kingdom. Its research programme aims to generate sound science as the basis for sound regulation and sound practice. UKWIR was set up by the UK water industry in 1993 to provide a framework for the procurement of a common research programme for UK water operators on 'one voice' issues. The research contracted by UKWIR is often carried out in collaboration with government departments and regulators, and covers all aspects of the water cycle, and a range of related environmental and regulatory issues.

www.ukwir.org

Veolia (France)

Veolia Research and Innovation (VERI) is the research department of Veolia, a worldwide service company operating in 74 countries. The water activities comprises the operation of urban and industrial water and wastewater plants but also the supply of engineering and technological solutions. VERI portfolio of water related projects is based on an international network and numerous collaborations and includes resource management tools, water treatment technologies, drinking water quality in distribution network and asset management, waste water collection networks management, emerging parameter management to take care of environmental and health risks, global environmental approaches, and sustainable urban development.

www.veolia.com

Water Research Australia Limited (Australia)

Water Research Australia Limited (WaterRA) is a not for profit organisation focusing on initiating, facilitating and managing collaborative research of national application in the priority areas of water quality for the Australian water industry and the community. WaterRA (formerly WQRA) marks the successful transition from the federally funded CRC Water Quality and Treatment, to a company that is owned and funded by its members who include the Australian water utilities, research organisations, government departments and private companies. WaterRA brings together key water research groups and industry members across Australia to conduct targeted, priority research. These relationships place WaterRA in a unique position to draw on the expertise and experience of its membership community to rapidly address current and emerging issues in water.

www.waterra.com.au

Water Research Commission (South Africa)

The Water Research Commission aims to contribute effectively to the best possible quality of life for the people of South Africa, by promoting water research and the application of research findings. This is accomplished by promoting coordination, communication and cooperation in the field of water research; establishing water research needs and priorities; funding research on a priority basis; and promoting the effective transfer of information and technology. Since its formation in 1971, WRC has been successful in promoting a significant expansion and upgrading of expertise in the South African. water industry.

www.wrc.org.za

Water Research Foundation (US)

Water Research Foundation (WRF) is the leading not-for-profit research cooperative that advances the science of water to protect public health and the environment. Governed by utilities, WRF delivers scientifically sound research solutions and knowledge to serve our subscribers and stakeholders in all areas of drinking water, wastewater, stormwater, and reuse. Through careful investment of research dollars from approximately 1,200 subscribers in the United States and abroad, WRF has funded and managed more than 2,300 research studies valued at more than $700 million.

www.waterrf.org

Water Services Association of Australia

Established in 1995, WSAA is an industry association for Australia's major urban water businesses which collectively supply water services to 70% of Australia's population. WSAA's primary goals are to facilitate cooperation to improve the water industry's productivity and performance, and to ensure that the regulatory environment adequately serves the interest of the community. Major areas of activity include identification of priority issues for the water industry, appropriate research and policy response, strategic contribution to industry regulation, and development of industry codes.

www.wsaa.asn.au

GWRC Partners

U.S. Environmental Protection Agency

The mission of the U.S. Environmental Protection Agency (EPA) is to protect human health and to safeguard the natural environment. Within US EPA, the Office of Research and Development (ORD) provides leadership in science and engineering, conducting research on ways to prevent pollution, protect human health, and reduce risk. Water-related research is among the highest priority research programs within ORD.

www.epa.gov

International Water Association (UK)

The International Water Association (IWA) is a global reference point for water professionals, spanning the continuum between research and practice and covering all facets of the water cycle. Through its network of members and experts in research, practice, regulation, industry, consulting and manufacturing, IWA is in a better position than any other organisation to help water professionals create innovative, pragmatic and sustainable solutions to challenging global needs. The IWA network is structured to promote multi-level collaboration among its diverse membership groups, and to share the benefit of knowledge on water science and management worldwide.

www.iwahq.org

Research Center for Eco-Environmental Sciences (RCEES) (China)

The Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, formerly the Institute of Environmental Chemistry of Chinese Academy of Sciences was founded in 1975, and is the first comprehensive research institution engaged in research on eco-environmental science and technology in China. RCEES is positioned as one of the leading research institutes in China with an excellent track record in scientific engineering research, extensive partnership with international experts and compatible values of openness and collaboration.

http://english.rcees.cas.cn/

Global Water
Research Coalition

Global Water Research Coalition

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www.globalwaterresearchcoalition.net

twitter.com/gwrc2

linkedin.com/company/global-water-research-coalition