

**33RD ANNUAL
CONFERENCE
EXHIBITION
2024**



**COLLECTIVE
REGIONAL ACTION**

Toward a Climate Resilient,
Water Secure and
Zero Waste Caribbean



Welcome to the conversation

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Message from the Honourable Marvin Gonzales,
Minister of Public Utilities, Republic of Trinidad
and Tobago

On the Occasion of the CWWA 33rd
Annual Conference and Exhibition

October 21-25, 2024

Hyatt Regency – Port of Spain

Greetings

It is my distinct pleasure, as Minister of Public Utilities, and on behalf of the Government of the Republic of Trinidad and Tobago, to welcome all delegates and visitors to our shores for the 33rd Annual Conference and Exhibition of the Caribbean Water and Wastewater Association (CWWA).

The theme guiding this year's discussions, "Collective Regional Action Toward a Water-Secure, Climate-Resilient, and Zero-Waste Caribbean", is both timely and essential. Like many regions worldwide, the Caribbean faces significant challenges in ensuring reliable access to clean water and effective sanitation services.

These challenges include aged or inadequate infrastructure, declining water quality and resources, high levels of potable water loss, and inefficient solid waste management, policies and practices, among others, and they are further compounded by population growth, unplanned development, financial constraints, and the ongoing impact of climate change. Given this context, our theme and discussions over the next few days could not be more relevant.

Water and sanitation are not merely infrastructure issues; they are foundational to social and economic development and are essential to the preservation of life on this planet. Here in Trinidad and Tobago, we recognize the importance of these sectors for the well-being of our communities and the sustainability of our environment.

While challenges remain, they also present opportunities. With thoughtful planning, innovation, collaboration, and strategic partnerships, we can make significant progress. From modernizing our water and wastewater infrastructure to implementing sustainable water and waste management practices, we can build resilient water and sanitation systems for our citizens and future generations.

Addressing the issues facing our local and regional water and sanitation sectors is crucial. The Caribbean Water and Wastewater Association plays a pivotal role in this endeavour by facilitating regional cooperation, advancing governance systems, promoting knowledge sharing, and building capacity. Together with other regional partners, the CWWA is driving progress and fostering resilience in our water and sanitation systems.

As we engage in meaningful discussions and share ideas during this conference, let us harness our collective strength to create a more sustainable and prosperous future for all. Together, we can overcome any challenge and build a brighter, more resilient future for our region.

Thank you for your dedication and commitment to this important cause. I wish each of you a successful and enriching conference experience.

Welcome to Trinidad and Tobago, our twin island Republic, where the sun shines bright, the people are warm, and the possibilities are endless. Let us renew our commitment to building a future in which every Caribbean citizen has access to clean water and sanitation services, and a sustainable environment for generations to come.

Thank you.

Honourable Marvin Gonzales

Minister of Public Utilities

Government of the Republic of Trinidad and Tobago



It has been an immense honor to serve as the President of the Caribbean Water and Wastewater Association (CWWA) during one of the most transformative periods for our region's water and waste management sectors. As I stand at the close of my tenure, leading my final conference here in Trinidad and Tobago, I am filled with a deep sense of gratitude and pride for the journey that has brought us to this moment.

Since joining the CWWA in 2013, I have witnessed the relentless dedication and passion of our members as we tackled the region's most pressing challenges. From my early days as a member to my appointment as a board member in 2016, and now in my capacity as President, I have always believed that our strength lies in collaboration. Together, we have forged partnerships, advanced innovative solutions, and driven sustainable practices that continue to safeguard the health of our Caribbean ecosystems and communities.

Reflecting on the 31st Conference in the Bahamas, the 32nd in Guyana, and now, the 33rd here in Trinidad and Tobago, each event has been a testament to our collective resolve. These gatherings have fostered meaningful dialogues, empowered young professionals, and built a platform for lasting change. This year's theme, "Collective regional action toward a climate resilient, water secure and zero waste Caribbean," resonates deeply as we recognize that unity and shared purpose are critical to overcoming the threats posed by climate change, rising sea levels, and the waste challenges we face.

A particularly significant milestone is the 20th anniversary of the High-Level Forum for Ministers Responsible for Water and Wastewater, and the 8th consecutive High-Level Forum for Waste Ministers. These forums have been indispensable in aligning regional strategies, fostering deeper collaboration, and driving innovative solutions to address water security and waste management. The dialogues within these forums are not just annual events; they represent the unified resolve of Caribbean leaders to secure a sustainable and resilient future for our region.

As we mark these milestones, it is also essential to highlight CWWA's enduring resilience throughout challenging times. The CWWA has never postponed, never paused, only pivoted. Even during the most trying periods, including the COVID-19 pandemic, we stood steadfast in our mission. Despite the uncertainties, we ensured that every annual conference and exhibition continued, adapting to the circumstances while maintaining our momentum. The commitment of our members and the strength of our network have been the pillars that have carried us through, never missing a year, and solidifying our place as a bedrock institution for water and waste professionals across the Caribbean.

The High-Level Forums for Water and Waste Ministers have been cornerstones of our conferences, allowing ministers and senior officials from across the Caribbean to align strategies and foster regional cooperation. The Water Ministers' Forum has focused on achieving water security and climate resilience, while the Waste Ministers' Forum has driven us towards a zero-waste future, emphasizing the importance of the circular economy and sustainable waste management practices.

As I pass the baton to my successor, I remain committed to supporting the vision of the CWWA. This association has been a home for me – a space where innovation, learning, and progress thrive. I am immensely proud of the work we have done together, and I am eager to see the legacy we've built continue to flourish.

Thank you to every board member, every delegate, and every individual who has contributed to our shared success. The future of water and waste management in the Caribbean is bright, and it is our collective action that will continue to drive us forward.

Sincerely,
Marlon Daniels
Lieutenant Colonel
President –
Caribbean Water and Wastewater Association



It is with great pride and enthusiasm that I welcome you all to the 33rd Annual CWWA Conference and Exhibition. The Association is honoured to be hosting this year's event in collaboration with the Ministry of Public Utilities of Trinidad and Tobago. This Conference continues to serve as a regional platform for addressing the challenges and opportunities facing the Caribbean's water, wastewater, and waste management sectors.

As we gather this year, our thoughts and prayers remain with our sisters and brothers in Grenada and St. Vincent and the Grenadines (SVG). The recent devastating impacts of Hurricane Beryl on Union Island, Canouan, Mayreau, Carriacou and Petite Martinique illustrate just how vulnerable our small island developing states are to recurring threats and further underscores the need for enhanced Disaster Risk Reduction strategies in the region. As the people of Grenada and SVG embark on the process of rebuilding, the CWWA together with other regional partners stand committed to assist in the recovery efforts.

The theme for this year's conference, "Collective Regional Action Toward a Climate Resilient, Water Secure and Zero Waste Caribbean" brings focus to the main issues affecting the water and sanitation sectors and the collaborative approach we expect to adopt. As a community we face common challenges, intensified by the need for appropriate legislation, policies and innovative financing mechanisms to address these issues and allow progressive and sustainable development.

The CWWA Conference and Exhibition provides an ideal regional platform to highlight and discuss these challenges, share knowledge and solutions, interact with new technology and seek opportunities for advancing the sector.

Undoubtedly, one of the highlights of this year's conference will be the High Level Ministerial Forums for Water and Solid Waste, where Caribbean Ministers will convene to discuss regional challenges, strategies and solutions. These annual forums are critical to the development of a unified regional approach to sector management. This year, the CWWA is honoured to celebrate the 20th anniversary of the High Level Forum for Water and 8th High Level Forum for Waste.

I would also like to take this opportunity to thank our development partners including the Caribbean Development Bank (CDB), the Inter-American Development Bank (IDB), the United Nations Environment Programme (UNEP) and the World Bank. These institutions continue to provide regional support to facilitate initiatives such as the annual High Level Forum and other key development programmes.

As we look toward the future, the CWWA remains committed to playing a proactive role in the sustainable development of the Caribbean's water and sanitation sectors. Over the next year, we plan to expand our capacity-building initiatives, strengthen regional collaboration, and work more closely with our regional and international partners to secure funding and technical support for the region. We also plan to enhance our role in policy advocacy, helping to bridge the gap between high-level decision-making and the needs of local utilities and communities.

I encourage all participants to take full advantage of the technical sessions, workshops, exhibition and networking opportunities throughout this week. Your insights, experiences, and innovations continue to drive the progress of our collective efforts. Let us use this platform to foster new collaborations, inspire action, and pave the way for a more sustainable, resilient, and water-secure Caribbean.

Once again,
**Welcome to the 33rd Annual CWWA
Conference and Exhibition.**

Sincerely,
Laurayne Lucky
Executive Director, CWWA



The Caribbean Development Bank (CDB) is again delighted to partner with the Caribbean Water and Wastewater Association (CWWA) to host its 33rd Annual Conference and Exhibition, under the theme

Collective Regional Action Toward a Climate Resilient, Water Secure and Zero Waste Caribbean.

This event has been a consistent feature of the Caribbean landscape, a key meeting of minds of water and waste stakeholders, and a platform for the exchange of ideas, collaboration and launch of solutions that underpin the region's sustainable development agenda. 2024 will mark the 20th hosting of CWWA's High Level Forum (HLF) for Caribbean ministers with responsibility for water, and the 8th staging of a corresponding HLF for policymakers with responsibility for waste management. The vision and commitment to convening such fora must be commended, and highlights CWWA's understanding of the critical role political leadership plays in the Caribbean's water security and environmental stewardship.

As the 2030 deadline for achieving the Sustainable Development Goals (SDGs) looms, we are all keenly aware of the disparities that remain in the water and waste services our people receive. However, we should be encouraged by the progress made over the last year, particularly those achievements directly linked to outcomes of previous CWWA conferences.

- At last year's conference in October 2023, we emphasised that "private capital is needed to accelerate implementation, improve efficiency, and leverage cutting-edge technologies and scalability". In March 2024, CDB became a technical partner of the Global Infrastructure Facility (GIF), an initiative that brings together diverse partners to

build bankable infrastructure projects that attract private financing. CDB is actively exploring opportunities within the waste sector through this partnership, reflecting our ongoing commitment to driving change.

- In May 2024, the region added a valuable resource to its knowledge base through the completion of the Caribbean Sub-Regional Report to the 10th World Water Forum, under the theme "Water for Shared Prosperity". This report, a collaborative effort between CDB and the Inter-American Development Bank (IDB), captures regional best practices and was informed by consultations held during last year's conference.
- Finally, in June 2024, the Caribbean Water Utilities Insurance Collective (CWUIC), a product of this event, and an ongoing investment of CDB, issued its first parametric insurance policies to three of CDB's client countries, in time for the earliest arriving Category 5 storm on record, Hurricane Beryl. Grenada's National Water and Sewerage Authority (NAWASA), which was impacted, benefitted from a USD 2.2mn payout.

The foregoing is evidence that the international, regional and sub-regional collective action enabled by the conference is already impacting the lives of our Caribbean people. CDB continues to work with and for our client countries to bolster that success regionally and at the national level. Over the last year, we approved grant financing for Trinidad and Tobago to develop a climate risk-informed water resources master plan, which would build capacity for evidence-based, gender responsive and socially inclusive management of water. We also approved funding for a regional project to develop rainfall intensity-duration-frequency curves, a necessary tool to mitigate water-related disasters. In the coming months, we will be raising awareness of WaterRISK, a self-assessment tool supporting the integration of climate resilience in the Caribbean water supply service sector.

This week as we gather in Trinidad and Tobago – home of the iconic steel pan, a symbol of innovation and resilience – let us draw inspiration from the enduring creativity of this nation. We hope that the same spirit will guide our discussions over the next few days, rethinking the old and forming new relationships and initiatives that will redound to the benefit of our region. CDB joins you in working collaboratively towards a Climate Resilient, Water Secure and Zero Waste Caribbean!

William Ashby
Division Chief (Ag), Economic Infrastructure Division
Caribbean Development Bank



The collaboration between the United Nations Environment Programme (UNEP) and the Caribbean Water and Wastewater Association (CWWA) continues to grow stronger which in turn redounds to success of water and waste initiatives for the Caribbean region. UNEP's steadfast dedication to environmental sustainability perfectly complements CWWA's mission to address the critical water and wastewater challenges faced by the Caribbean Region. Together, we have fostered dynamic collaboration that continues to yield significant and positive impacts.

UNEP's initiatives in the Caribbean have been instrumental in addressing the region's most pressing environmental issues. Through targeted programmes, UNEP has played a pivotal role in preserving the Caribbean's unique biodiversity, combating climate change, and promoting sustainable development. UNEP's contributions have equipped the region with vital policies and strategies that ensure economic growth is balanced with environmental stewardship.

The CWWA Conference and the High-Level Forum (HLF) on Waste Management have emerged as vital platforms for action and dialogue. These events bring together key stakeholders from across the region to exchange ideas, share best practices, and drive innovation in waste management and wastewater treatment. The value of these fora cannot be overstated, as they serve as catalysts for critical change in regional waste management practices.

Through the UNEP-CWWA collaboration, the Waste Management initiatives have gained considerable momentum. Innovative approaches recognize waste not merely as a challenge but as a resource, leading to sustainable solutions that reduce environmental impact while generating economic opportunities.

UNEP, supported by CWWA, has mobilized financial and technical resources to address the region's pressing environmental challenges, including marine pollution, water scarcity, and ecosystem degradation. By empowering local communities and governments to adopt eco-friendly practices and invest in resilient infrastructure, we continue to safeguard the Caribbean's natural heritage while fostering economic resilience.

In conclusion, the UNEP-CWWA partnership is a shining example of how international organizations and regional bodies can collaborate effectively for the benefit of the environment and the people of the Caribbean region. UNEP's vital work programme, coupled with the value generated by the CWWA Conference and the High Level Forum on Waste Management, promises a future where environmental protection and economic growth go hand in hand, paving the way for a more sustainable and prosperous Caribbean Region.

Vincent Sweeney

Head, Caribbean Sub-Regional Office
United Nations Environment Programme, UNEP



Ensuring reliable water supply in rural and vulnerable areas is increasingly challenging due to climate change and population growth.

WS009

Allen Gilbert

Senior Technical Advisor

GIZ Grenada –

Climate-Resilient Water Sector

in Grenada project (G-CREWS)



The IDB was proud to share information about key initiatives that support sustainability in the Caribbean at this year's CWWA Conference. The Solid Waste and Circular Economy Hub is a platform that supports the digital transformation of Latin America and the Caribbean by enhancing data availability and statistics. Building on this data, the IDB uses its "Too Good to Waste" initiative and the GEF incubator to transform solid waste management through circular economy to promote sustainability and cut emissions, particularly in small island states. To improve the sustainability, efficiency and resilience of water and sanitation providers, AquaRating offers comprehensive assessments and focused analysis tools for over 100 utilities in nearly 30 countries. As a leader in innovative risk management, the IDB partnered with the UKFCDO, CCRIF, and CDB to launch the Caribbean Water Utilities Insurance Collective Segregated Portfolio (CWUIC SP), which offers coverage against natural disasters and technical assistance to boost preparedness and resilience. The IDB remains dedicated to supporting the collaborative efforts of RSAP. I encourage all utilities to engage with us, explore these innovative tools, and work together to strengthen water, sanitation, and solid waste management across the Caribbean.

Sergio Campos

Division Chief – Water and Sanitation
Inter-American Development Bank



WORLD BANK GROUP



The World Bank is honored to support the Caribbean Water and Wastewater Association (CWWA) during its 30th Annual Conference and Exhibition. This event provides us with a valuable opportunity to strengthen our partnership with the CWWA, particularly through our support in the preparation of the 20th High-Level Forum of Ministers Responsible for Water. This forum is crucial for understanding and promoting a concerted dialogue on the pressing needs of Caribbean nations in the water and pollution management sectors, to enable pushing forward a stronger vision for a more water-secure and pollution-free future.

As part of the World Bank's mission, we are intensifying our efforts to assist Caribbean countries in achieving their Sustainable Development Goals. In pursuit of creating enabling conditions that empower these nations to meet their development aspirations, we recognize the vital role that CWWA and its stakeholders play in advancing water security and waste management agendas. This is especially important given the multisectoral and devastating impacts that inaction could have on these critical areas.

The World Bank has identified a set of priority global challenges that will guide our work in the coming years, including water security and access, climate change adaptation and mitigation, and environmental sustainability. We believe that addressing these challenges is essential for driving economic development in a livable environment. Accordingly, we will prioritize initiatives that closely align with the goals of the CWWA and its members, focusing on developing resilient and sustainable solutions while maximizing financing for these efforts.

We eagerly anticipate continuing our collaboration with the CWWA to effectively support the Caribbean region's development needs in water and pollution management and beyond. Moreover, we aim to leverage the Conference as an opportunity to identify synergies and potential collaborations with other development partners and local and regional agencies to maximize the impact of our collective efforts.

I want to take this opportunity to express our gratitude to the CWWA Secretariat for their outstanding work in making this conference possible. I wish everyone a successful event and look forward to fruitful discussions and partnerships.

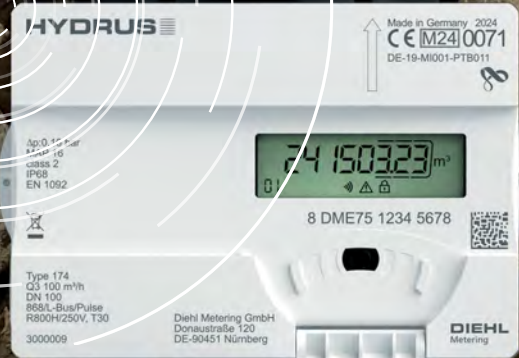
Lilia Burunciuc

World Bank Director for the Caribbean

2.533 m³/h

176.6 m³

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Amarise Khan
Emerging Geoscientist
Trinidad and Tobago
Sponsor
Ronald Roach, Consultant

Amarise Khan is a young geologist from Trinidad and Tobago with a keen interest in sustainable water management and environmental sustainability. A recent graduate from The University of the West Indies, Mona, Amarise holds a BSc in Geology with a minor in Geography. In her budding career, Amarise focuses on the critical intersection of geology, water resources, and climate change. Her areas of interest include sustainable water management practices, environmental sustainability initiatives, and community engagement strategies. As an emerging professional, she aims to address regional environmental challenges through scientific research and its applications in policy and public awareness.



Diandra Jno-Baptiste
Water Production Specialist
St. Kitts and Nevis
Sponsor
Caribbean Development Bank

Diandra Jno-Baptiste holds a bachelor's degree in mechanical engineering and currently serves as an Assistant Water Engineer at the St. Kitts Water Services Department. In this role, she focuses on water supply, distribution, and quality management, ensuring that the island has access to safe and reliable water. Diandra is dedicated to applying engineering principles to enhance water systems and promote sustainable practices, as well as climate adaptation initiatives in water management.



Dorraine Duncan
Urban Planner
Jamaica
Sponsor
Integrated Sustainability & Ecohesion

Dorraine is the founder and executive director of Island City Lab. Island City Lab aims to democratize the processes that initiate, build, inform and maintain our towns and cities across the Caribbean. Dorraine is a city planner, policy analyst, and researcher dedicated to reimagining and decolonizing Caribbean infrastructures. Through community engagement, historical analysis, mapping, and systems thinking, she critically analyses urban infrastructure and supports communities in their efforts to recreate more resilient and just infrastructures.



Jhordan Channer
Urban Designer
Jamaica
Sponsor
Florida Aquastore

Jhordan Channer is an urban designer who engages with urban issues across multiple scales by utilizing a diverse set of tools from planners, policy analysts, and architects. He has applied this toolkit to design public spaces, infrastructure, and architectural projects in Kingston, New York City, and Atlanta. Jhordan is particularly interested in the socioeconomic dynamics of communities and how cooperative economic systems can contribute to building resilient communities.



Romiero Griffiths
Water Specialist
Jamaica
Sponsor
Belize Water Services Limited

Romiero Griffiths is an Assistant Hydrologist with seven years of experience at the Water Resources Authority in Jamaica. He specializes in data collection, data analytics, water allocation, water management, and public engagement on water-related issues. Romiero earned his Bachelor of Science degree in Geology from the University of the West Indies. As a dedicated water professional, he continuously seeks to expand his knowledge by enrolling in courses



Young Professional Rapporteurs 2024

focused on climate and water-related topics. His enthusiasm led him to present at the 2023 Caribbean Symposium on Water, where he discussed the 'Per Capita Domestic Water Abstraction Rate for Jamaica,' and at the 2024 CaribDA Biennial Conference and Expo, focusing on 'Urbanization and its Impact on Wastewater Generation in Portmore, Jamaica.'

THEME 1

Water Security in an Uncertain Climate (WS)





Title

Goal Zero – How A Smart Meter Can Autonomously Find Leaks in your Distribution Network

WS001

Author

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Understanding the main drivers and total impacts of having a successful Non-Revenue Water Program will be presented.

All Utilities should have a Water Loss or Non-Revenue Water Program in place, however not all programs will be equal given Utilities around the world face unique challenges with size and type of service area and geographical impacts.

We are going to discuss a solution that truly captures the most return on investment for water utilities to address both apparent and real losses with a single device - a water meter. Integrated within the meter, with no external wires, is patented acoustic technology that continuously listens and records acoustic values every day for 20 years. Every water utility needs water meters. Why not install a water meter that can listen to Utility side distribution leaks at the very same time? Wouldn't a continuous and proactive solution for 20 years provide more payback than no solution? More accurate than lift and shift technologies with much greater lifetime? Doing away with the need for annual or quarterly surveys? All in the same RF network?

Furthermore, we'll go over specific case studies from several utilities across the U.S. that have successfully used water meters to find not only service line leaks but leaks on mains as well - up to 14" water mains! Utilities are not only using the technology to be notified instantly of current and future leaks in their system but are able to significantly reduce costs because awareness is near real time and localization of leaks is easier as well. Water loss calculations are included within the intuitive software platform allowing all utilities to easily track, repair, and report on leaks to corresponding stakeholders, as applicable. There simply is no other solution that provides more return on investment for water utilities.



Title

Lessons Learned – Hawaii Water Loss Control WS002

Author

Jessica Jagdeo

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One of the major challenges in developing a water loss control program is bringing together the right partners to make meaningful changes over time. This presentation will highlight a community-led training program in Hawaii that brought together more than 100 water system managers, regulators, and consultants to help develop water loss management skills over four years. The program helped system managers develop American Water Works Association (AWWA) water audits for each of the 100 water systems to both quantify and financially value losses. Every participant was equipped with the skills to track their system's losses over time.

Ultimately, building upon the foundation laid during the initial training program, the Hawaii Department of Water Supply (HDWS) took what they learned and implemented a water loss control pilot project. The pilot included prioritized water loss control field activities such as leak detection surveys, pressure management, and customer meter assessments in three water systems over two years. Lessons learned from the pilot results will be shared with presentation attendees.

This story brings together elements of community organizing, technical training, and skill development with boots-on-the-ground field implementation of water loss control strategies. It is a unique case that presents a successful blueprint for developing water loss management partnerships that brought about meaningful change.



Title
Advancing a Smart Network through the use of a Geographic Information System and Supervisory Control and Data Acquisition System.

WS004

Author

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Water security is increasingly at the forefront of any country as climate change continues to impact humanity at a global scale.

This highlights the need for water utilities to maximize the use of their available water resource by effectively managing their water infrastructure in a holistic manner. Belize is not exempted from the effects of climate change and its uncertainties that it poses to its available water resources. Therefore, Belize Water Services has taken a proactive approach in managing its water supply infrastructure through the implementation of a Geographic Information System (GIS) and a Supervisory Control and Data Acquisition System (SCADA). This allows for the effective and efficient management of its water and wastewater infrastructure through innovation as it promotes a sustainable future by advancing a smart network.

A powerful tool such as a GIS Platform, allows for network and asset management as it is designed to provide operational intelligence, advanced planning and engineering, access to real time information and many other advantages to a utility. This is key in advancing a

smart network as it empowers its users to make informed decisions through the modernization of its infrastructure data. Data accuracy and reliability is fundamental in any decision-making process; therefore, a GIS Platform becomes an essential tool for any organization to take advantage of technology and maximize the use of its resources.

The implementation of a SCADA system within a water utility has the potential to transform how the operation and management of water systems is being done.

Through instant access to information, it is possible to detect problems as they happen and even identify potential problems in advance whereby downtime is reduced, as resources are more efficiently distributed to carryout repairs. This vastly empowers utilities to carry out advanced problem solving as it allows the identification of critical systems that can be optimized.

This can be further enhanced by further integrating SCADA with GIS as effective communication is essential for any company whereby more control is gained on the management of all its resources through the modernization of its digital data by advancing a smart network.



Title

Assessment of Water Sustainability in Guyana's Hinterland

WS005

Author

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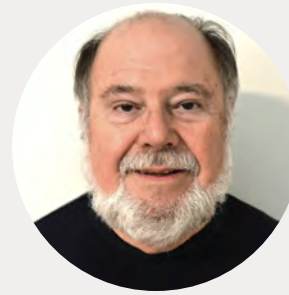
Guyana is Located in the continent of South America and consists of over two hundred Amerindian communities spread across the ten Administrative regions of the country. These communities are referred to as Guyana's Hinterland and consist of more than ten percent of the country's population. There have been significant challenges in providing potable water to these communities to achieve Sustainable Development Goal number 6 which is "to ensure availability and sustainable management of water and sanitation for all by year 2030". Notwithstanding this, the Government of Guyana has targeted to achieve the provision of water for all in the Hinterland by the end of 2025. A strategic plan has been developed and is being implemented by Guyana Water Incorporated, the public utility company, to achieve this target. This plan is being implemented for the period 2021 to 2025.

The research employs a multidisciplinary methodology that integrates policy analysis, community participation, and some hydrological studies that look at the sustainability of water supply in Guyana's Hinterland.

Surveys of water sources and an investigation of the environmental and socioeconomic factors affecting water supply are all part of the research. The results show that a variety of interrelated variables, such as remoteness and village accessibility, climatic unpredictability, infrastructure, and community resilience, interact to cause water supply challenges.

The study emphasizes how crucial it is to use indigenous knowledge and include local populations in decision making to guarantee the long-term viability of water delivery projects. To increase the resilience of hinterland communities, the report will also highlight the importance of infrastructure investments, legislative reviews, and capacity-building initiatives.

These observations are intended to assist stakeholders in creating a plan of action for accomplishing the challenging objective of providing universal and sustainable water supply in Guyana's Hinterland.



Title

Smart Water Audit tracks NRW in Trinidad and Tobago

WS007

Author

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The Inter-American Development Bank (INE/WASA) is engaging the Government of the Republic of Trinidad and Tobago with a 5 Year Program that seeks to improve the country's existing water shortages and over time significantly reduce dependence on desalinated water and reliance on surface water sources. The Program intends to improve the operational efficiency, quality, and resilience of water service provision, while in the short-term finance immediate interventions (procurement of goods and services and/or urgent works) required to ensure access to underserved communities. The specific objectives of Program are to: (I) prevent further service decline and ensure access to water, sanitation, and hygiene to unserved and underserved households through the National Water Stabilization and Improvement Program (NWSIP); (ii) support the transformation of WASA and the Water Sector through the execution of the Transformation Plan, institutional strengthening and capacity development of the MPU in order to strengthen the coordination of water sector transformation and stabilization; and (iii) modernize WASA's network using a robust, technology-driven data system to reduce losses, manage pressures and improve the provision of 24/7 water.

The objective of this paper to present the results of a water audit of the water system input, transmission flows, offtakes, and losses on the Caroni North, Caroni South, Hollis, Navet and North Oropouche systems. This shall include setting up data integration and automation management systems for the provision of real-time data analytics and digital reports. The work assignment also included developing hydraulic models for the five (5) systems mentioned. The models were completed and were calibrated. The models can be used by WASA to improve decision making and inform strategies for improving network performance and reducing water losses.



Title
**Re-thinking Sustainable Water
Use-Related Ecological Flows**

WS008

Author

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Like many catchments in the Caribbean, the Río Frío and Río Sevilla Basins in Colombia's Magdalena region face challenges in allocating water among diverse users while ensuring protection of environmental flows.

These rivers, originating in the Sierra Nevada de Santa Marta (SNSM) and flowing into the Ciénaga Grande de Santa Marta (CGSM) wetland, are crucial for local populations, agricultural irrigation, and sustaining natural ecosystems. Balancing water extraction with ecological needs is a significant issue, driven by two main factors: high-water intake concessions misaligned with year-round environmental flow patterns and insufficient research on environmental flow governance. In response, various stakeholders have initiated projects to promote sustainable water use in the region and increase water use efficiency in the banana and oil palm sectors, ensuring they meet ecological water requirements.

Building on recent advances in environmental flow calculations and water management in the study area, we conducted a baseline assessment of water resources and management practices. The assessment aimed to evaluate water supply, demand, and environmental flows, identifying key shortcomings in water allocation. The results indicate that environmental flows calculated for each river segment suggest that water resource management in these basins should be dynamic, adapting to seasonal flow variations. While the current concession for ecological flow aligns with national guidelines, the concession for irrigation are excessively high, compromising the desired ecological flow.

As a result, the ecosystems in the Río Frío and Río Sevilla catchments receive insufficient freshwater.

The study provides valuable insights into the current state of water resources and their ability to meet ecological requirements. It also offers information to foster dialogue among user groups and aids authorities in making informed water allocation decisions based on actual data about water availability and environmental flow needs in the basins.





Title

Building Resilience in Water Supply – A Case Study of Community-Based Rainwater Harvesting in Grenada

Topic

Community Based Interventions for Enhanced Water Supply

WS009

Author

Allen Gilbert

Senior Technical Advisor

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Ensuring reliable water supply in rural and vulnerable areas is increasingly challenging due to climate change and population growth. This paper explores "Community-Based Interventions for Enhanced Water Supply," focusing on rainwater harvesting (RWH) systems and community engagement, with key insights from projects in Grenada, particularly in the community of Blaize, St. Andrew.

In 2015, a **50,000-gallon RWH system** was constructed in the Blaize community, located **427 meters** above sea level.

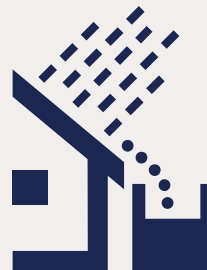
Despite this effort, the system partially failed to meet the community's water needs, even after expanding the catchment area. In 2018, the introduction of a water pumping solution from the nearby Carrier tank to the Blaize RWH tank resolved these issues. An assessment conducted in 2022 revealed the reasons for the partial failure relating to inadequate roof size and ongoing problems such as inadequate maintenance and high winds impacting water collection.

Recommendations included utilizing a hybrid system: combining rainwater and pumped water and improving the systems' maintenance.

Additionally, the Climate-Resilient Water Sector in Grenada (G-CREWS) project, through its G-CREWS Water Ambassadors Program (GWAP), empowered six young individuals in extensive RWH training. They promoted RWH in communities such as Crochu, Mt. Craven, and Jean Anglais. The youth involved residents in designing, constructing, and maintaining RWH systems, advancing sustainable water use and raising awareness about climate change impacts.

Moreover, G-CREWS is bolstering water resilience by constructing or rehabilitating communal RWH systems in Carriacou and Grenada, and in health centres across the country. The project also advocates for regulations mandating RWH installation in new and existing buildings, ensuring proper maintenance through community involvement and legal frameworks.

The paper concludes that integrating technical solutions with community engagement and youth empowerment, along with Lessons Learnt from Blaize and other communities can guide the development of more effective and sustainable RWH systems in the future.





Title
Strategies for Disaster Preparedness and Recovery
WS011

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In the face of increasing frequency and intensity of natural disasters, bolstering resilience and minimizing vulnerability has become imperative for communities and organizations worldwide. This abstract explores effective strategies for disaster preparedness and recovery, drawing insights from hurricane preparedness plans and case studies across the Caribbean and flooding impacts in Peru.

Being prepared for a hurricane or any natural disaster necessitates a comprehensive plan for asset recovery and resorting vital services like water supply. Key elements include safeguarding employees and providing them with the necessary resources for preparation, recovery, and resumption of operations.

Assigning roles and responsibilities ensures everyone understands their contribution towards disaster response and recovery efforts. Effective communication and access to adequate supplies and equipment are pivotal for weathering the storm and its aftermath. Facilities should be inspected and equipped with the appropriate supplies. Rigorous testing and quality checks should be done on a regular basis to ensure readiness when emergencies arise.

Drawing from case studies across the Caribbean and incidents of flooding in Peru, this abstract sheds light on real-world applications of disaster preparedness strategies. By implementing these measures, communities and organizations can enhance their resilience, reduce vulnerability, and mitigate the adverse impacts of natural disasters, ultimately safeguarding lives and livelihoods.



Case Study
Community-Based Interventions for Enhanced Water Supply

Topic
Water Sector Resilience Nexus for Sustainability in Barbados Project – Boosting Climate Resilience through Water Supply Interventions
WS013

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Freshwater systems on small islands are exposed to dynamic climate impacts and are among the most threatened on the planet. The Caribbean continues to face increasing frequency and intensity of droughts, and other extreme weather events which can negatively impact water supply. Barbados' freshwater system is dominated by 98% of groundwater for public consumption. Barbados, a small island developing state faces increasing challenges to water and energy security which is further exacerbated by the negative impacts of climate change. To improve climate resilience nationally, the WSRN S-Barbados project, funded by the Green Climate Fund and implemented by the Caribbean Community Climate Change Center and the Barbados Water Authority, seeks to increase water supply through the installation of potable and rainwater harvesting water storage systems. This initiative at the community level has installed water storage systems across healthcare centers, community centers, farms, and schools, targeting vulnerable communities in Barbados.

The project aims to enhance climate resilience and reduce water insecurity by ensuring a reliable water supply during droughts and periods of low water quality. Each sector presented unique challenges, including logistical constraints and varying environmental conditions, which were addressed through adaptive and context-specific strategies. Results from the project indicate significant improvements in water access and quality for the targeted populations.

The systems provided critical water storage capacity, particularly in areas affected by low water supply and frequent water outages, thereby enhancing overall water security. The project also highlights the importance of community engagement and flexible management approaches in successfully implementing water resilience initiatives.

This case study underscores the effectiveness of targeted interventions in improving water security for vulnerable communities in Barbados. The lessons can inform similar efforts in other regions experiencing similar challenges, demonstrating the potential for integrated and adaptive water management.



Title
**Dry Season and Drought
Planning, Management and
Mitigation**

WS014

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Water security is becoming an increasingly critical issue amidst the challenges posed by an uncertain climate. Each year, there is a significant decline in the dynamic levels of water wells, both inland and in coastal regions of Belize. The dry season is extending in duration and intensity, necessitating the implementation of alternative water abstraction methods. Belize Water Services (BWS) has taken proactive measures to ensure a sustainable water supply by forecasting future demand, diversifying water sources, enhancing infrastructure and improving maintenance execution. Where feasible, BWS has shifted to direct river abstraction, such as the recently completed San Ignacio Intake Gallery project at the Macal River, which has boosted water supply by approximately 1650 gpm. New wells have been drilled to reach deeper aquifers and increase redundancy; however, much more are needed. Short- and long-term plans are focused on added wells and above ground water sources. This is since the extended dry seasons demand an even greater redundancy in water resources, as current provisions are rapidly depleted.

Each dry season exacerbates the strain on water resources, highlighting the urgent need for comprehensive and resilient water management strategies to secure future water supply.

The effects are significant because it affects our pumps resulting in an increase in maintenance. This is being addressed by ensuring that we procure more energy efficient equipment such as Reverse Osmosis systems along with purchase of critical spares and inventory. River level monitoring has become even more critical because even direct river water abstraction can become compromised. Mitigation must include increased water exploration of above and underground water sources with the inclusion of increased quality monitoring to protect our sources and customers. Dry season, drought planning, management and mitigation becomes full circle and requires the right actions from all stakeholders involved between companies, countries and among regions.



Title
**Non-Revenue Water (NRW)
Reduction Project in Linden**

WS015

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Non-Revenue Water (NRW) refers to water that has been produced and is "lost" before it reaches the customer. This loss can occur due to several reasons and is typically categorized as physical and commercial losses. The impact of NRW can be significant, leading to financial losses for utilities, increased operational costs, and inefficient use of water resources. Reducing NRW is crucial for improving the efficiency of water supply systems and ensuring sustainable water management. The NRW value at Guyana Water Incorporated (GWI) has raised concerns about its impact of the operations of the organization. Fittingly a Caribbean Regional Fund for Wastewater Management (CReW+) project facilitates NRW works in Region 10, Linden Guyana. This NRW work entails the investigation of the physical and commercial losses within seven Domestic Metered Area (DMA) in Linden. The data were analyzed using quantitative method to identify trends and correlation on the water losses.

Two thousand five hundred forty-one (2541) customers were visited where

2.6% or 65 of those showed signs of physical wastage.

Further, 7% or 182 were found to have discrepancies (unregularized, illegal and non-existing) on the database which amounts to wastages in the commercial aspect of water.

The results thus far show that excessive wastage of water is related to physical losses (leaks, wastages and illegal services) and commercial losses (unmetered services, unregularized water lines and inaccurate database). These findings suggested that significant opportunities exist for reduction of the water losses to improve the NRW indices. Hence, aggressive loss reduction works are being undertaken with the use of in-house and contracted staff. The results were favorable for GWI and customers of Linden. There are ample opportunities to further improve the NRW values in Linden by arresting the water losses.



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Blake Michal, Kamstrup
Solution Manager



Case Study

Reduction of Physical Water Losses in Cali, Colombia 2019-2022

Topic

NRW Reduction – Limiting the Losses and Advancing a Smart Network

WS018

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This paper presents the key findings, challenges and lessons learnt while executing the project Water Losses Reduction, Leak Detection and Repair, and Pressure Control Optimization in the city of Santiago de Cali, Colombia (population of 2.2 million).

EMCALI (local Water Utility) launched a Water Loss Reduction Program to address technical and commercial losses in 2015. The target was set to achieve an IPUF of 16.16 by 2022.

Specialized Contractor, WMI – ConIngenieria SAS consortium, executed the design-and-build Project focusing on technical losses using Active Leakage Control and Pressure Management (2019-2022).

The success of the Project is attributed to the contractual integration of study, design, and construction activities, which allowed the Contractor to focus on the final results. The key factors were the close coordination between all Project activities, and dedication of the EMCALI management team.

Field measurements, hydraulic modelling, 52 DMZ investigation and design, leak detection and repair (5000km), valve repairs (2500 valves), 26 control chambers construction were all performed simultaneously. Clear and effective interactions between teams led by international experts, and most EMCALI departments was key. WMI/EMCALI participants were dedicated to make a positive impact on the water infrastructure despite the challenging social and political environment (COVID and social unrest).

With this 7-year Programme, EMCALI recovered 170,000 m³/d. IPUF dropped to 13.49 in 2022, beyond EMCALI's target. The ILI dropped from 27 to 18 in 2022, displaying a good trend to be continued in the future.

Current NRW ratio is in the range of 47% (more than 10 point below initial level, despite limited apparent loss activity during the period), visible leaks reduced by 36%.

With a Benefit-to-Cost ratio of 3, the Programme has proven more effective than initially anticipated. The Project being over, EMCALI needs to take over activities to maintain and further improve the performances of the infrastructure.

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Title

Caribbean Watershed Nexus and IslandSheds – Digital Solutions for Future Water Security Planning and Action

WS020

Authors

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The Caribbean region faces significant environmental challenges, including climate change, deforestation, land degradation, and water resource management. Addressing these issues requires regional collaboration, shared information, and common datasets, as exemplified by projects like Integrating Watershed and Coastal Areas Management (IWCAM) and Integrating Water, Land, and Ecosystems Management in Caribbean Small Island Developing States (IWeCO). This paper introduces two pivotal digital solutions designed to enhance information management and sharing for effective water resource management.

The first solution, the Caribbean Watershed Nexus platform, is an interactive, web-based tool that facilitates research, data sharing, and collaborative problem-solving among stakeholders. This platform enables users to visualize watersheds across the region, contribute their own research with geospatial access by watershed, and fosters a collaborative environment for researchers, policymakers, and local communities to share insights and develop sustainable management strategies.

The second solution, **IslandSheds**, is a cross-platform software package available in Python and R that standardizes access to comprehensive watershed datasets across the Caribbean. IslandSheds integrates a robust GeoPackage file containing detailed shapefiles of all watersheds and country boundaries within the region.

The package enables users to download specific country-level watershed data and seamlessly integrate them into Geographic Information System (GIS) projects. This standardization and the use of prominent languages enhance the quality and comparability of hydrological studies, fostering regional collaboration by providing all researchers with access to the same foundational data.

Together, these digital solutions – **Caribbean Watershed Nexus** and **IslandSheds** – represent significant advancements in Caribbean participatory watershed management and research. They highlight the importance of leveraging technology and collaborative frameworks to enhance environmental governance and resilience in the Caribbean, ultimately contributing to broader goals of environmental sustainability and climate resilience.



Title

NRW Reduction – Limiting the Losses and Advancing a Smart Network

Topic

BWSL Being SMART with NRW

WS024

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Non-Revenue Water (NRW) has always been a major concern for water utilities as it puts a strain on water resources and incur additional and unnecessary costs. Through its NRW strategy, consistent monitoring and implementation, BWSL has managed to reduce real and apparent losses, yielding a consistent reduction over the past 4 years. True to its vision of being a leading utility in the developing world, BWSL has taken additional steps towards advancing a Smart Network through its **Smart Meters Pilot Project**. A digital transformation had already begun for all distribution systems country wide through GIS and for WTPs and pumping stations through SCADA system.

a. Smart Network

The incorporation of a Smart Water Network with a methodology for the management and operation of the system would allow to diagnose, prioritize areas and define actions for improved efficiency.

- **Smart Meters:** Pilot project for Caye Caulker and San Pedro islands, which would allow for a real time network monitoring, reducing both real and apparent losses.
- **Surveillance:** Real-time monitoring would allow us to categorize bursts and evaluate its impact on water loss volumes, identifying operational inefficiencies regarding detection and repair times. Studies have shown a reduction of up to 8% in NRW is possible.
- **Additional benefits:** reduction in overall operational expenses, meter maintenance, improved stakeholder relationship, and increased resilience to climate change driven water scarcity.



Case Study

Community-Based Interventions for Enhanced Water Supply

Topic

Insights from Grenada's Journey to Efficient NRW Management

WS025

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Grenada's National Water & Sewerage Authority (NAWASA) is on a mission to improve Non-Revenue Water (NRW) management through a comprehensive

b. Sustainability and Environmental Responsibility

Having completed an energy efficiency study, BWSL is working on the action plan, which would decrease our carbon footprint and contribute to reduce NRW through efficient pumping and pressure management. An efficient pumping regime would reduce breakages.

c. Road Ahead

- Incorporate pumping data (SCADA) and distribution system information (GIS), into a real-time network monitoring system.
- Roll out Smart meters project country wide and upgrading SCADA system.

strategic plan focused on digitization. Crucial to this transformation is the Geographic Information System (GIS) which details network mapping. Despite integration challenges into Standard Operations Procedures (SOP), GIS's role in data organization and NRW management is significant.

Several pilot projects have been initiated, showcasing various methods to combat NRW. The IWA Water Balance, using the Easycalc tool, indicated an NRW of 26% for 2023, with a 15% error margin. Physical losses were 7,347 m³/day out of 35,924 m³/day total production. The importance of these losses was highlighted during a recent drought, which saw production fall 9,000 m³/day below demand.

Pilot District Metered Areas (DMAs) have been monitored alongside traditional reading and billing systems, with digital meter reading tested. Monthly readings revealed highly variable NRW rates, from 5% to 69%, prompting immediate leak detection campaigns. Additionally, 60 existing bulk meters were monitored monthly, with unexpected flow increases triggering further leak detection. Insertion flowmeters logging Minimum Night Flow (MNF) were installed at strategic locations, with plans to procure EM Flowmeters for enhanced data transmission and analysis.

Digitized repair and maintenance documentation has been tested, enabling georeferenced activity logs via tablets. This data helps identify network vulnerabilities and track repair efficiency. The current system for reporting and addressing leaks remains challenging and NAWASA plans to implement sophisticated Asset Management software to enhance customer communication, dispatching, documentation, and evaluation of repairs.

To coordinate these initiatives efficiently, NAWASA will establish a dedicated NRW Unit with dedicated staff. This comprehensive approach to NRW reduction, leveraging digital tools, network restructuring, and improved customer relations aims to sustainably manage water resources, enhance service delivery, and ensure the long-term viability of the water supply infrastructure.



Title

From Meeting Demand To Decreasing Demand – A Look At Water Conservation Challenges and Prospects in Grenada

Topic

Water Conservation- Stakeholder Involvement and Appropriate Technology

WS026

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Water consumers are often times so far removed from the realities of water provision and water management that this often leads to an oversimplistic view of the pressures faced by the regions' water sectors. These perceptions lead to the increased vulnerability on the part of water consumers who are oftentimes unprepared for the exposures faced during severe drought or periods of climate uncertainty. This is dubbed the new norm for many Caribbean islands.

In a KAP survey conducted in Grenada in 2023, 60% of Grenadians were slightly to moderately concerned about the future of water availability. Although many reports reveal that climate change is expected to affect the availability of water leading to increased water stress, particularly for Small Island Developing States, a variety of surveys revealed nonchalant attitudes towards climate change and freshwater supply, mixed with various conspiracy theories based on the belief that there is no scientific consensus. Added to this, non climatic factors such as increasing population and urbanization continue to worsen and greatly amplify the existing pressures surrounding the provision of fresh water supply.

While the concept of water resilience remains largely under developed, studies have shown that implementing water saving techniques can reduce risks and vulnerability to climatic hazards. More particularly, communications campaigns that reach a wide audience, capture their attention and build awareness.

The paper explores techniques implemented under the Climate Resilient Water Sector in Grenada project (GCREWS) to increase stakeholder participation on all levels in the face of water challenges faced locally in Grenada. These techniques implore the population to save water and are also aimed at promoting the uptake of technology such as water efficient devices (WED) and rainwater harvesting (RWH) among water consumers in Grenada.

The paper will also analyze how in 2024, due to unprecedented low levels of water in reservoirs, and the declaration of an official water crises, some of these water conservation campaigns became more effective.

With increasing population growth and accelerating human activities coupled with climate change, the regions' water problems are likely to get worse adding additional financial strain on existing water management systems.

The traditional view of meeting demand must be looked at from the transformative lens of decreasing demand.

The insights gained from this project are intended to serve as a model for replication across other Caribbean islands seeking to enhance climate resilience.



Topic

Enhancing Water Security in Trinidad and Tobago – A Modular Data Processor for the Water Resources Agency

WS027

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The Water Resources Agency (WRA) in Trinidad and Tobago collects data from various sources, including rainfall, river flow, groundwater levels, and water quality. Managing this multidimensional data efficiently is essential for informed resource management. Additionally, with climate patterns becoming increasingly erratic, adaptive strategies demand more efficient and accurate data processing.

To achieve enhanced data management and accuracy, the Water Data Processor (WDP) project drew upon the expertise of water resources subject matter experts. We conceptualized the WDP as a suite of individual, modular tools, each designed to address specific data dimensions and their associated challenges. By leveraging various technologies, primarily MS Excel and VBA macros, we developed user-friendly modules that can seamlessly integrate with existing WRA systems. This user-centric design allows WRA personnel to choose and customize the tools they need for their specific data analysis tasks.

The WDP suite comprises the Rainfall Analyzer, Flow Assessor, Climate Examiner, and Groundwater Investigator. The Rainfall Analyzer visualizes rainfall data, identifies trends, flags suspected instrument errors, and even fills missing data points using hydrologically sound methods. The Flow Assessor focuses on data visualization and comparison, highlighting sudden changes and



Title
Sustainable use of Water-Related Ecosystems – The Dakoura Creek Watershed an Untapped Jewel to Preserve
WS028

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The Convention on Biological Diversity (1992) defines an ecosystem as a complex of living organisms and the abiotic environment within which they interact in a specified location. Water-related ecosystems, therefore, are a subset of these ecosystems comprising reservoirs, wetlands, rivers, lakes, creeks, springs, etc.

The Dakoura Creek Watershed is one of five watersheds in Linden, the second largest town in Guyana with a population of approximately 27,000 residents (population Census 2012). It is approximately 13 kilometers long and drains into the Demerara River, through the Dakoura Creek and its tributaries. The Watershed has an abundance of fresh water with an estimated annual flow of 52 MCM (GoG 2009). According the Dakoura Creek Management Plan, 2012, the watershed is highly forested, mostly uninhabited, and unimpaired.

inconsistencies for further investigation. Similarly, the Climate Examiner facilitates efficient data review, detecting inconsistencies, potential instrument failures, and anomalous data points. Finally, the Groundwater Investigator tackles water level data, adjusting it to sea level and flagging inconsistencies that deviate from agency norms. These tools used in concert provide a robust system for understanding and managing water resources.

The Water Data Processor (WDP), developed as a suite of individual tools, represents a significant step toward water security in an uncertain climate. By empowering users with customizable solutions, the WDP contributes to resilient water resource management. Its capabilities ensure more reliable and complete datasets, ultimately enabling informed decision-making by the Water Resources Agency.

The UN Waters under the theme Water and Ecosystems presents dire facts relating to climate change and water-related ecosystems.

Among these facts are: **85%** of the world's wetlands are already lost to agriculture activities, **4.2%** declines in areas covered by mangrove and 1/5 of river basins experiencing negative changes.

Given these phenomena, the UN is calling on Governments to implement and enforce policies and laws at the national and river basin levels to sustainably manage freshwater ecosystems. Stressing the need to balance communities, businesses, and the environment. It is upon this premise that the government of Guyana, with support from the GEF Crew+ Project Guyana, is executing at major project in Linden, geared at protecting the Dakoura Creek Watershed.

The paper will proceed with the presentation of pertinent information of the watershed including the diversity of life within, the quality of water it holds and its importance to the residents of Linden. Additionally, the paper will discuss a plethora activities being implemented under the project, and the correlation between this project and the Government of Guyana UN commitment and its developmental thrust.

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THEME 2

Water Quality – Human Health and the Environment (WQ)



Title

Water Safety Standards – Monitoring, Prevention, and Response towards eliminating Waterborne Diseases and Other Threats

Topic

BWSL Water Safety Plan for the Double Run Water Treatment Plant WQ001

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Water Safety Plans (WSP) are the most effective means of consistently ensuring the safety of a drinking-water supply through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in the water supply from catchment to consumer. In 2019, a WSP for Belize City was developed under a collaborative initiative with Belize Water Services Limited (BWSL), Pan American Health Organization (PAHO) and Caribbean Public Health Agency (CARPHA). The plan is now coming to fruition and addresses monitoring, prevention and response towards eliminating waterborne diseases and other threats via the following points:

a. Monitoring and Surveillance

1. **Water Quality testing:** BWSL continuously monitor the distribution system for microbial contamination, chemical constituents and more importantly for disinfection on a daily and weekly basis.
2. **Surveillance:** The current Laboratory Quality Manual ensures that the data generated is able to track and detect potential outbreaks of waterborne diseases.

b. Prevention

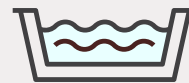
1. **Water Treatment:** The Double Run Water Treatment Plant ensures proper treatment through sedimentation, filtration, and chlorination to eliminate pathogens and contaminants.
2. **Source Protection:** The laboratory conducts quarterly river monitoring and compliance monitoring of the Belize River that is the source water for the Double Run Water Treatment Plant.

c. Response

1. **Emergency Plan:** The WSP also addresses emergency response plans for water contamination incidents, including public advisories, system restoration and water quality testing.
2. **Interagency Coordination:** The WSP includes several stakeholders' involvement in the response to waterborne diseases.

d. Next Steps

WSP are vital in ensuring the safety, reliability, and sustainability of drinking water through a structured approach to risk management. It provides enhanced public health protection and builds consumer confidence while ensuring compliance with regulatory standards. BWSL's next steps include completion of the plan and eventual roll out to other distribution systems to address any waterborne diseases and other threats.



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Title

**Assessing Nitrogen and
Phosphorus Levels in Drinking
Water Sources of Southern
Grenada**

WS005

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To determine the physicochemical characteristics and nutrient concentration of surface and subterranean sourced water in the southern region of Grenada, seven duplicate samples were taken from three water treatment facilities (Vendome, Annandale, Chemin) in the southern region of Grenada during the rainy and dry season.

Field parameters including pH and salinity were determined during sampling, while total nitrogen, nitrates, ammonia and phosphates were determined by standard colorimetric techniques. In both seasons, the pH increased after treatment, generally higher in the untreated surface water sources during the dry season. The temperature did not change greatly when comparing the two seasons. The overall conductivity was higher in the dry season, and the ground sourced water had notably higher conductivity than surface sourced water. The total nitrogen concentrations of ground water were higher than the surface water sources in both the rainy and dry seasons. Notably, the Vendome plant was the only plant where the nitrogen concentration decreased after treatment. The highest concentrations of phosphates were found in ground sourced water, with higher concentrations prevailing during the dry season. However, nitrate and ammonia concentrations from all sources were higher in the rainy season, as opposed to the dry season. Though nutrient concentrations were generally below guideline values, in the current absence of regular municipal monitoring, these results suggest that continuous monitoring is warranted, especially in the case of phosphates and ammonia, where obtained values were close to and at times higher than guideline values.



Title

Collective Regional Action toward a Climate-Resilient, Water Secure and Zero-Waste Caribbean.

Topic

Behaviour Centered Design Project
WQ006

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Port Kaituma is a busy community, said to be the gate-way to the North-West district of Guyana in Region 1. The main economic activity is gold mining and logging along with many businesses to support the needs of the miners. It is divided into the five sections: Citrus Grove, Central Kaituma, Oronoque, Fitzburg, and 1 Mile - 4 Miles; with the total population being 2529 persons. Within Port Kaituma, there are 3 schools, one Nursery, one Primary and one Secondary. Infrastructure includes a hospital, a police station, a commercial bank and many other business places. 54 % of the population receives access to potable water from public water supply. Some of the residents use water directly from the river for their daily activities however wastewater is discharge into this river. A behaviour centered design project was implemented to involve all stakeholders with the aim of understanding the root causes of wastewater pollution in river and to develop solution that will cause a change in people's behaviour.

A pre surveying exercise with shop owners at the Waterfront area revealed, that the main polluters were the residents, commercial businesses (restaurants and shops), mining activity, and barges. The Guyana Water Inc. however, abstracts water directly from the river and distribute to population without any form of treatment. This water is only use for non-potable purposes (cleaning, flushing of toilets). The shop owners and residents spends 30- 50 USD for drinking water per week.

A sanitary block was rehabilitated, and an educational campaign was conducted to encourage persons to use the facility. A post survey conducted revealed that there was a reduction of pathogens in river, reduce reported cases of sickness relating to exposure to untreated wastewater, reduction of water purchasing, job creation, more willingness of person to uses sanitary block and increase community cooperation in Government initiatives.



Title

Manganese Dioxide Pressure Filters – for high filtration rates and excellent iron removal without the use of chemicals

WQ007

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The Government of Guyana through the Ministry of Housing and Water is financing the Coastal Water Treatment Infrastructure Programme (CWTIP) to increase the treated water coverage to 90% by 2025 at a cost of 40 billion Guyana dollars. The CWTIP is currently constructing seven new large water treatment plants, fifteen small plants, upgrading twelve existing plants and installing 200 KM of transmission mains to improve water quality, continuity of service and level of service in Regions 2, 3, 4, 5 and 6.

Friendship WTP is one of the treatment plants on the upgrade list. It is supplied with 372m³/h by one well with an iron concentration of 1.3mg/l. This level of iron easily causes significant discoloration in water and fosters the proliferation of colonies of iron bacteria which adds slime, unpleasant odour and taste to the water supply.

Additionally, iron –while not directly harmful to health - when oxidized, increases turbidity levels in water which when coupled with the iron bacteria, create conditions for the growth of other disease causing micro-organisms.

For several years there was never any treatment system in place to remove the iron, until now with the use of the manganese dioxide pressure filters. These pressure filters use manganese dioxide as the filter media which facilitates a very high filtration rate and is very effective at removing iron (even without pre-chlorination).

Five filters were put into operation, processing 100% of the water supplied by the well at a filtration rate of 18 -23m/h: which is five times faster than the typical conventional gravity filters used companywide.

This means that much higher volumes of water can now be processed using far less filter units, and hence the footprint of the facility is significantly reduced, thus capitalizing on space optimization.

These filters have been performing optimally, reducing the iron levels from 1.3mg/l to an average of 0.08mg/l which depicts an iron removal efficiency of 94%. This shows very good compliance with the WHO drinking water guidelines for iron (which stipulates a value of less than 0.3 mg/l).

The total cost for the installation of these filters (including rehabilitation of filter tanks, foundation, piping, backwash pump, compressor, media and 50% redundancy etc.) is \$USD 425,000. Since the filter media does not require chlorine for iron removal, it provides a saving in operational cost of approx. USD\$ 27,377 annually. The filters have been performing optimally, producing sparkling water and the residents can now breathe a sigh of relief with a safer supply and improved water quality after approximately three decades.



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THEME 3

Efficient & Effective Wastewater Management (EEW)



Title

Capital Planning Using Asset Maintenance Scoring – A Municipal Perspective

EEW001

Author

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Wet infrastructure utility operators – like all asset managers – are informed by maintenance strategies, industry practices and standard operating procedures (SOPs) to improve operational efficiencies, constituent service levels and business outcomes. This involves recognizing the critical need for deploying systems and technologies that support a whole lifecycle asset management journey. A key aspect of this journey is tracking metrics such as asset maintenance scores, business risk (probability and consequence of failure analysis) and workforce productivity that enable stakeholders to optimize their capital planning programs.

We'll look at asset maintenance scoring in the context of municipal organizations through the following factors –

- Scoring algorithms for asset condition and risk assessment (using predefined or configurable weights and ratings; failure types, interval, likelihood; treatments, interventions). Prebuilt asset condition and scoring models can be utilized by organizations, typically small and medium size municipalities, when no asset analytic framework exists.
- Generate asset condition scores based on maintenance data together with asset attributes such as age, material, and other factors affecting the life expectancy of an asset.
- Scoring assets based on type of work performed against them. A new asset may start with a score of 100, decreasing over time with usage, then increasing as certain types of work treatments or replacements are performed.
- Utilizing condition data for auto-generating maintenance activities for assets based on scoring parameters.

- Viewing reports and dashboards that show how asset conditions have changed over time including past work histories. Analyze maintenance and lifecycle trends by visualizing in GIS.
- Planning for future operational costs by combining asset scoring and condition data with life expectancy to prioritize work (Capital Improvement Planning/CIP and Budget Forecasting).



Title

High Head Centrifugal Grinder Pumps In Low Pressure Sewer Applications

EEW002

Author

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Pressure Sewer Systems (PSS) have become increasingly common in today's society. Pressure Sewer systems are no longer just an "alternative" to gravity fed sewer collection systems but rather the "appropriate" solution for collection systems around the country and globe.

Traditionally, pressure sewer systems have been used to provide sewer service to areas where gravity sewer could not be installed, or the cost to do so was prohibitive. Now, pressure sewer systems are gaining widespread acceptance in providing a viable, sustainable, and cost effective solution to expensive traditional gravity systems and shrinking O&M budgets. PSS has paved the way to a more "Green" solution to troubled existing septic systems or potential gravity system leaks that have threaten our waterways in recent times.

A key component of the system reliability is self-cleansing piping system. Pipe scouring velocity is achieved by realistic current and future flow estimates, proper pipe sizing. And use of piping equipment that will provide adequate velocity. When flows do not meet the expectations, problematic issues develop.

With the advances in trenchless technologies for economic pipe installation, reduction in I/I, protection of waterways due to closed system design, system design flexibility, reduced plant treatment footprint, pump and related equipment advances in the past decade, all promote an alternative collection system as a preference over traditional gravity in many applications.



Title
Re-engineering of the Cheddi Jagan International Airport Water and Wastewater Systems

EEW003

Authors

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The Cheddi Jagan International Airport is the primary international airport of Guyana. The airport is located on the right bank of the Demerara River and 41 kilometers from the capital city Georgetown. The state and practices of the water and wastewater systems at Cheddi Jagan International Airport (CJIA), were not keeping with the expected practices envisaged under the current and future developmental plans of the airport. As a result, CJIA has partnered with the Guyana Water Incorporated (GWI) to commission activities that will lead to the rehabilitation of the existing water and wastewater management system and installing systems that will see the effective and sustainable operation and management of the facility.

The works entailed assessing existing water distribution network, water quality testing, optioneering to select most suitable water treatment option. A study on the wastewater system was conducted which includes condition assessment of gravity sewer network, wastewater testing and characterization, optioneering to wastewater systems.

The water distribution network was design and built to allow for redundancies. An ADEEDGE inline water treatment unit producing 80 gals/min of water was installed reducing iron from 3mg/l to 0.3 mg/l thus meeting WHO standard.

The wastewater study reveals that tank from existing wastewater treatment plant can be repaired and reuse as an equalization tank and construction of new wastewater treatment plant to treat 556m³/d. Wastewater treatment process includes, screening, grit removal for removal of solids, Blivet for biological treatment reducing organics and nutrients, UV treatment for removal of pathogens and a resources recovery component for aquifer recharge. The water and wastewater systems selected are of low capital and operational cost, easy to maintain, high removal efficiency, robust, modular, small land footprint and can be remotely operated.

Title
Wastewater Reuse, a Sustainable Way to Mitigate Water Scarcity

EEW004

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The availability of freshwater is becoming more limited and it is increasingly difficult to find adequate sources to meet future demand requirements. It is projected that Global freshwater demand will outstrip supply by 40% by 2030, and in regions with extended drought conditions, the situation is even worse. Cities will thus need to tap into additional freshwater sources - one of these being wastewater. Reuse of wastewater comes in many forms and the reasons for reuse are related to the existence of local conditions such as accessibility to freshwater in the environment, population, climate, industry irrigation and agriculture needs.

Membrane bioreactor (MBR) technology combines biological, secondary and tertiary wastewater treatment in one step and has been used to not only treat wastewater to high effluent quality standards for over 30 years but is a well-established means of enabling the reuse of wastewater. The MBR process guarantees a solids-free effluent, allows for biological treatment system to be optimized for nutrient removal, and produces permeate that is disinfected to levels safe for recreational use. For reuse flow sheets that incorporate reverse osmosis (RO) to achieve more stringent limits, MBR provides ideal RO feed as it achieves SDI values of less than three on a constant basis. In addition, MBR will reduce equal and greater amounts indigenous virus/coliphage in the range of 2.6 to 3.2 and based on the virus rejection and the relative size of protozoa, Comparatively, MBR offers a solution that can enable cost savings, reduce plant footprint and can simplify the treatment flow sheet, while fitting into all types of reuse flow sheets spanning the range of applications for wastewater reclamation.

This paper will review the performance of a wastewater treatment plant with MBR technology operating in the Caribbean for over a decade. We will share design information, performance and lessons learned of this specific case study



Title

Improving the Water Supply Within Residential Communities in Trinidad and Tobago – A Proposal

EEW005

Author

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Residential development is on the rise in Trinidad and Tobago and as migration arises from residential development there is an increased water demand in residential communities across the country. In Trinidad and Tobago, residential development is taking place at an expeditious rate, especially in the areas of Sangre Grande, Couva/Tabaquite/Talparo and Chaguanas.

The increased water demand is causing these respective areas to become water stressed and a more reliable source of supply other than the current sources is needed exigently. This paper proposes a model for greywater collection, treatment and distribution within residential communities in Trinidad and Tobago and which should be made mandatory for real estate developers.

The construction of individual dedicated greywater treatment plants and its use within residential communities can quell the water stress placed on the supply and use of potable water within the community and by extension the water utility company. Greywater reuse would also allow residential communities the advantage of being self-sustained and its residents would become more aware of the importance of water conservation and recycling, whilst simultaneously adapting to climate change.



Title

Circular Technologies for Wastewater Reuse in Small Island Developing States

EEW006

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Trinidad and Tobago’s Water and Sewage Authority treats approximately 144 million cubic meters of wastewater annually, consuming between 70,000 and 288,000 Megawatt hours of energy and emitting around 31,680 to 126,720 tonnes of CO₂.

Previous studies have shown that conventional wastewater treatment plants contain 9.3 times more energy in the wastewater than is used to treat the effluent. Implementing circular frameworks and technologies in wastewater treatment can recover energy and other valuable products from this underutilized asset. The opportunity cost of inaction ranges from 30 to 107 million TT dollars per annum in wastewater treatment costs. This paper presents emerging technologies used globally to enhance circularity in wastewater treatment and explores their potential implementation in Trinidad and Tobago and other Small Island Developing States (SIDS). The results of some microbial fuel cell systems employing indigenous cultures to reduce biological, and chemical oxygen demand, while producing electrical energy from wastewater, shall also be presented.



Title

Innovative Biological MBBR Wastewater Treatment, Technology, Benefits and Case Study

EEW007

Author

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Learn about the benefits of highly efficient, innovative MBBR domestic wastewater treatment, this technology produces a low level of sludge, reduces the space needed for a treatment plant, provides options for retrofit to existing plants, eliminates dead zones in biological treatment tanks, has long lasting media reducing cost, has a low energy consumption, provides a large surface area and security for biomass growth and is a low maintenance treatment option.

A case study will be presented highlighting the new waste water treatment plant for the Canada Cedar Valley Lodge in Kitimat, BC which applies state of the art technologies to provide safe wastewater treatment that meet or exceed the most stringent federal standards.

Designed and manufactured in Surrey, BC by BI Pure Water Canada Inc., the WWTP system was factory fabricated as modular building sections. This approach allows factory testing of the process and greatly reduced the construction time on site.



Title

How Domestic Wastewater Connects Water, Food and Energy – Anaerobic Digestion as an Enabler for Nutrient and Energy Recovery

EEW008

Authors

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Anaerobic digestion occurs naturally in marshes and swamps where high organic content and stagnant water lead to oxygen concentration below detection limits. Anaerobic microorganisms decompose organic matter in a series of steps to produce a mixture of methane and carbon dioxide, called “biogas” or “marsh gas”. Anaerobic digestion is now a mature technology that controls the digestion of municipal wastewater sludge to produce combustible biogas. In addition to producing a renewable source of energy, anaerobic digestate is rich in phosphorous and nitrogen, which are essential agricultural nutrients. At the end of anaerobic digestion, the digestate is separated into sludge and effluent. The effluent is rich in phosphorus and nitrogen and has been recognised as a source for nutrient recovery. Several nutrient recovery processes, including struvite precipitation (P) and ammonia stripping (N), have been successfully applied to anaerobic digestion effluent. Additionally, the anaerobic digestion sludge, or biosolids, can be directly applied to agricultural fields for its fertilizer character. The Robert O’Pickard Environmental Centre (ROPEC), a municipal wastewater treatment plant in Ottawa, Canada, is a successful case study for the direct land application of biosolids from anaerobic digestion. A literature review on the regulations and guidelines for the direct use of biosolids across Canada, as well as the development of a survey to identify the concerns and perspectives of the farmers who apply biosolids to their agricultural lands, is being conducted and will be presented in this technical paper. Additionally, a new process for maximising the bioavailable phosphorus in biosolids are being developed by our research group at McGill University. A significant fraction of the phosphorus in biosolids is insoluble and therefore not useful to plants. Progress on this new process that uses sulphur chemistry to increase the bioavailable phosphorus in biosolids, will be presented.



Title

The Growing Use of Composite Materials in Water and Wastewater Systems

EEW009

Author

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The use of composite materials, such as fiberglass, carbon fiber and mixed fabric such as Kevlar/carbon is well documented in diverse industries from aerospace to oil and gas. Currently we are seeing a remarkable growth in composite use within the water and wastewater community. This growth is due to several converging technologies and the overall education of this community.

Composites and composite repairs of existing infrastructure is growing in use within industries and new industries are quickly adopting this technology. This, in part, is due to strict compliance with standards such as ASME-PCC2 and NSF/ANSI 61, and the development of epoxy and polyurethane matrix resins that offer distinct advantages, such as high pressures, heat resistance, chemical resistance, wear resistance and longevity. In addition, the favorable costing and speed of repairs on existing infrastructure is fueling this adoption. Systems no longer need the extended offline periods required for conventional repairs. Metal, concrete and other structures can be repaired, far quicker than conventional repair procedures. In addition, these composite materials are far less affected by corrosion and heat/moisture degradation that are common in the Caribbean. Repairs can even be made underwater when required so the ground/air and water/air interfaces that are a high corrosion risk are easily mitigated.

Some of the current repair strategies include piping in pipe galleries and distribution/collection lines, water and wastewater storage tanks, pressure filters shells, concrete piling and pipe supports, thru wall piping and metal and steel poles, such as lighting. The list of potential uses is growing rapidly.



Title

Use Of Septic Tanks In Trinidad And Tobago – Historical Applications and Future Prospects

EEW010

Author

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Before the early 1960s, sewage in Trinidad and Tobago was disposed of via septic tank and soakaway systems or via pit latrines. Central municipal wastewater collection and treatment in Trinidad & Tobago was introduced in 1962, in the City of Port of Spain and the Boroughs of San Fernando and Arima. Since that time, there has been a progressive shift to the installation of central sewage treatment systems in new housing developments. Notwithstanding, it is estimated that as of 2019, 70% of the population of the country were still being served by septic tank and soakaway systems or septic tank and drainfield systems.

This paper begins with a description of septic tank systems, focussing on the typical quality of effluent produced by these systems. It also identifies various types of disposal systems that may be installed downstream of septic tanks, highlighting the soil characteristics to which each is best suited. The paper continues by describing different types of septic tanks (cast-in-place concrete or prefabricated plastic) and how each type is installed. Available adaptations to septic tank systems are discussed, and undesirable practices in the installation and use of septic tanks are highlighted.

The reasons/objectives behind the shift toward centralized sewage treatment plants in Trinidad and Tobago are briefly indicated, and comments are made on whether those objectives appear to have been met. Finally, the practicality and desirability of the near-universal replacement of septic tank systems by centralized sewage treatment plants is explored.



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Title

Enhanced Nitrate Adsorption and
removal from Wastewater using
Amine-grafted Agricultural Waste
functionalised Biomaterials

EEW011

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Learn about the benefits of highly efficient, innovative MBBR domestic wastewater treatment, this technology produces a low level of sludge, reduces the space needed for a treatment plant, provides options for retrofit to existing plants, eliminates dead zones in biological treatment tanks, has long lasting media reducing cost, has a low energy consumption, provides a large surface area and security for biomass growth and is a low maintenance treatment option.

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Designed and manufactured in Surrey, BC by BI Pure Water Canada Inc., the WWTP system was factory fabricated as modular building sections. This approach allows factory testing of the process and greatly reduced the construction time on site.

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THEME 4

Regional Solid Waste Management – Reducing Our Waste Footprint (RSW)





Title

Alternative Renewable Energy From Solid Waste

RSW001

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The quest for sustainable and renewable energy sources has led to a growing interest in harnessing the energy potential of solid waste. Solid waste, a significant environmental challenge globally, presents a valuable opportunity for generating alternative renewable energy through various innovative technologies. Processes such as anaerobic digestion, gasification, and incineration have emerged as promising methods to convert solid waste into energy, offering a dual benefit of waste management and energy production.

This abstract examines the potential of solid waste as a renewable energy resource and explores the environmental and economic advantages associated with its utilization. By diverting organic waste from landfills and utilizing it for energy generation, communities can reduce greenhouse gas emissions, minimize reliance on fossil fuels, and promote sustainability. The production of renewable energy from solid waste not only helps in addressing waste management issues but also contributes to the transition towards a circular economy.

However, challenges exist in the effective implementation of solid waste-to-energy technologies, including variations in waste composition, technological efficiency, and regulatory considerations. Overcoming these challenges requires continuous innovation, investment in research and development, and supportive policy frameworks to ensure the sustainable and efficient conversion of solid waste into renewable energy. In conclusion, the conversion of solid waste into alternative renewable energy sources offers a promising solution to address both energy security and waste management challenges, paving the way for a more sustainable and resilient energy future.



Title

Energy-Efficient Batch Reverse Osmosis for Wastewater Treatment and High Water Recovery.

RSW002

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In the realm of disaster response and recovery, the efficiency, scalability, and rapid deployment of utility systems are of paramount importance. Traditional Relocatable Temporary Camps (RTCs), employed by the Canadian Armed Forces in both domestic and international operations, face challenges in minimizing logistics, reducing environmental impact, and optimizing overall efficiency due to the lack of integration among different utility systems. Addressing these challenges is critical, particularly for the Caribbean, which frequently faces natural disasters and chronic water scarcity issues. Improving wastewater management and increasing wastewater recovery are essential steps towards alleviating the region's water scarcity.

The Harmony Desalting team joined forces with the Circular City team for the Pop-Up City contest in Canada, aiming to enhance wastewater recovery for decentralized military stations and disaster response camps. Organized by the Department of National Defense's Innovation for Defense Excellence and Security (IDEaS) program, the contest sought efficient utility solutions for RTCs.

Harmony Desalting's el Titan Brine Concentrator (v2) was pivotal to the team's success. Following extensive testing and upgrades, the unit was deployed to Alberta, Canada, in July 2023. Led by Innocorps Research Corporation, the Circular City team demonstrated the el Titan at CFB Suffield, treating a mix of blackwater, greywater, and surface water, extracting additional potable water, and reducing brine discharge.

The Circular City project showcased significant advancements in sustainable water management, including direct potable reuse, improved serviceability with parallel membranes, and vertically oriented photovoltaic panels for compact shipping.

The integration of a microgrid combining renewable energy with diesel generation, a blackwater treatment system, and a waste-to-energy gasification solution further reduced fuel, potable water, and waste by over 33%.

The initiative highlighted the potential of Harmony Desalting's solutions for decentralized settings in the Caribbean, emphasizing innovations like advanced oxidation, UV treatment, and remineralization to ensure high-quality potable water. The project achieved up to 95% recovery rates with high-recovery reverse osmosis and reduced solid waste ten-fold through gasification.

Partners included Innocorps Research Corporation and Circular City, underlining the value of collaboration in addressing global water challenges. By setting new standards for sustainable water management in disaster-prone and water-scarce environments, Harmony Desalting and its partners have demonstrated the immense potential of circular integrated systems.



Title

Participatory Solid Waste Management in Cassava Piece, Kingston, Jamaica

Topic

Regional Solid Waste Management – Reducing Our Waste Footprint

Solid Waste Management – Policy and Planning for the Local Context

RSW003

Authors

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Island City Lab is developing a participatory and decentralized approach to solid waste management for the self-built community of Cassava Piece in Kingston, Jamaica. The community is a quintessential informal “gully-side” community characterized by its location along a concretized conveyance channel, otherwise known as a gully. The organic nature of the community's layout and the informal land tenure make garbage collection infrequent and wholly inadequate. According to a community profile, only 40% of the households received municipal garbage collection. All components of solid waste management service - containment, collection, and disposal, are severely degraded in these communities. This context has forced residents to rely on imperfect solutions, such as burning or discarding waste in gullies, leading to a legacy of poor public health outcomes and downstream marine degradation.

To fully understand this challenge, the project's current phase includes an existing conditions analysis that includes physical land use mapping, a household community survey, and a waste audit. These results inform a subsequent planning and design phase, where Island City Lab will facilitate a series of community workshops and design charettes to generate decentralized strategies to address the solid waste management issue. This may include micro garbage collection vehicles (bikes, rickshaws, etc), waste separation practices, and on-site organic waste processing.

This initiative investigates the critical role that communities can play in delivering solid waste management services. Specifically, it offers a prototype for community-scale initiatives, where impacts can aggregate across the municipality in similar “gully-side” communities. Upstream, improving solid waste management services at a hyperlocal scale can significantly improve quality of life and public health outcomes. Downstream, it can protect crucial coastal ecosystems.



Topic

Green Solvent Extraction of WAS Lipids

RSW004

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Transformation of current practices in the management of domestic wastewater in Jamaica prompted the study of seeking a sustainable approach to the treatment and disposal of the activated sludge generated during the treatment and disposal of the biosolids. The current study provides the characterization and assessment of the activated sludge generated on three different types of activated sludge systems as a basis to determine the potential use in the agricultural sector and as feedstock for biodiesel using alternative green solvents to extract lipids.

The characterization of sludge provides data to validate the utilization of the sludge in the agricultural sector after further stabilization of the sludge to reduce fecal coliform levels. In the case of lipids content, the results identified the highest mean lipid yield of 6.67% was for ethanol followed by ethyl acetate with 2.14% and hexane with 1.15%. Ethanol produced lipid samples with a saponification and acid value of 162.33 mg KOH/g and 2.26 mg KOH/g respectively. The results of the lipid analysis are comparable to the quality of WAS lipids currently being explored for biodiesel application.



Title

Containerized Bioenergy Plants for Caribbean Islands

RSW005

Author

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The presentation will provide a preliminary assessment of the bioenergy technical potential of the Caribbean. The sources of raw material, sugarcane, oil palm, and municipal solid wastes (MSW) were considered for bioenergy production, considering liquid biofuels (ethanol and biodiesel), and bioelectricity.

The Caribbean region is made up of nearly 7,000 islands, islets, reefs and cays spread over an extensive geographical area and encircled by the Caribbean Sea and the Atlantic Ocean. The Caribbean countries face similar sustainable development challenges, including, for example, growing population, restricted resources, distance, vulnerability to natural phenomena, fragility to external shocks, disproportionate dependence on international trade and a fragile environment.

The Caribbean countries have promising renewable energy potential, especially for solar radiation, wind, hydropower, geothermal and biomass.

Although the Caribbean countries have been increasingly adopting renewable energy sources, essentially for generating electricity, national energy demand continues to rely on imported oil products, for all uses and especially for the mobility of people and goods. Liquid biofuels have been considered in certain countries, such as Jamaica, although with limited effective results.

For members of the Caribbean countries, three raw material sources for bioenergy production are considered in this study:

- Sugarcane
- Oil palm
- Municipal solid waste (MSW)

The presentation will explore the available technologies for bioenergy production for the Caribbean Islands. Given the sizes of these power generation plants, containerized plants with a generating capacity of up to 480 kWh will be presented. The advantage of these containerized plants is that they are mobile and can be shared by various sites in the Islands or between Islands if necessary.

Project case studies with economic evaluation for determining the Return on Investment (ROI) will be presented.





THEME 5

Regional Sector Governance & Financing (RSG)



Title
**Cost Reduction
and Profit Maximisation**

RSG001

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William Baumol, an economist who used cost reduction as a key tool, questioned the conventional economic theory that holds that businesses only seek to maximize profits. Instead, he suggested that businesses may prioritize sales maximization in order to achieve growth and market share, even at the expense of some short-term profit. In fact, Baumol's theory opposes pure profit maximization, suggesting instead that companies should prioritize sales maximization within the bounds of a minimum acceptable profit level.

For the National Water Commission, though it may be challenging to maximize profits while simultaneously achieving a significant increase in sales volume, Baumol's theory is especially relevant owing greatly to the company's high fixed costs and gradual growth. Furthermore, collection (revenue) and cost reduction may have a direct relationship; as collections can increase simultaneously as cost increases. Therefore, this approach is not necessarily cost reduction, but profit maximisation; as cost reduction can be viewed as a reprobate step of regressive actions.

Title

**Operational Efficiency for Utilities,
the Five-point Strategy.**

RSG002

Author

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This report uses a five-point strategy to quantify the strategic advantages of operational efficiencies for Utility Organizations. The negative impacts of divergence caused by a lack of finance, differences in strategic objectives and forecasting, have resulted in utility inefficiencies. This report has identified five key strategic actions for a turnaround framework. These include:

1. the planning and development of water sources,
2. the transmission and distribution of water,
3. the automation of water supply systems,
4. water auditing, monitoring, and control of NRW, and
5. strategies for maximizing revenue collection.

The actions needed to optimize Utilities' operational and managerial capacity are directly related to the investment in their Capital Implementation Projects Program and the resilience of their financial management.

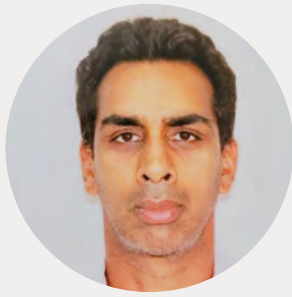
A comprehensive operation plan, and a reliable transmission and distribution system, are two key actions to mitigate the struggles that utilities face in delivering safe and reliable water to their customers. Inadequate infrastructure has been one of the root causes of the failure to maximize operational efficiency and revenue collection.

Optimizing Utility performance requires effectively transforming the culture of its operational and financial management in which it operates. Achieving this entails developing and adopting strategies that strengthen the accountability and responsibility of those charged with the mandate.

An aerial photograph showing a flooded residential area. The water is murky brown and reflects the surrounding environment. Several houses are visible, including a prominent light blue house with a dark grey tiled roof in the foreground. Other houses have red, blue, and black roofs. Palm trees and other vegetation are scattered throughout the area, some partially submerged. The overall scene depicts significant flooding in a tropical or subtropical region.

THEME 6

General Topics (GT)



Title
Prevalence of and Risk Factors for Occupational Slip/Trip/Fall Incidents Among Workers at a Water Utility Company in the Caribbean

GT001

Author

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Slips, trips and falls (STFs) are one of the more frequent causes of accidents and injury in the workplace. This study aimed to assess the prevalence of and risk factors for STFs at a Water Utility Company in the Caribbean. It was a cross-sectional study with a stratified random sample selected from active employees. Data were collected through a self-reported questionnaire which was distributed electronically to the participants between March 2021 and April 2021.

SPSS version 20 was used for descriptive and inferential analysis of data. Logistic regression was used to calculate odds ratio (OR) and 95% confidence intervals (95% CI) for demographic, environmental and task related risk factors. The highest prevalence rate of STFs was 31% (95% CI: 23.8-38.9). Age, work tenure, work center, job position, using the stairs and carrying materials were all associated factors while gender, work hours, obesity and level of physical activity were not found to be associated factors of a workplace STF.

Working with machines (OR=6.174, 95% CI: 1.188-32.090) and rushing to complete tasks (OR = 3.545, 95% CI: 1.507-8.340) were significant predictors associated with an increased risk of a slip or trip event. Reduced risk of STF was observed for persons hours sitting 4-6 hours (OR=0.544, 95% CI: 0.145-2.040) and more than 6 hours (OR=0.207, 95% CI: 0.590-0.733).

Some of the risk factors for STFs found were similar to those reported from other sectors. Continual focus on good housekeeping practices and routine maintenance activities is important. Organisation factors related to management commitment, task pace and promoting safe behaviours are not to be ignored.

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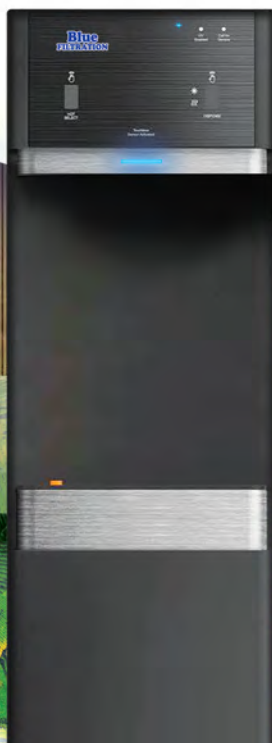
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Title

Approaches to Environmental Assessment in the Aftermath of Disasters in the West Indies

GT005

Authors

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The islands of the West Indies are vulnerable to several types of natural disasters: Hurricanes and Tropical Storms, Tsunamis, Flooding, Earthquakes and Fires. Two types of environmental assessments are necessary in the aftermath of a disaster. First, there must be an assessment of environmental damage that has resulted from the disaster. Second, when disaster response measures have been determined, there must be an assessment of risks to the environment which may arise from the implementation of those measures. Both these assessments must be done rapidly, so as not to delay disaster relief work unnecessarily. For this reason, the types of assessments which are carried out in non-disaster circumstances are considered too time-consuming and costly to be applied in post-disaster circumstances.

This Paper seeks to identify more appropriate methods for post-disaster environmental assessments. It begins with an overview of disasters in the West Indies, documenting recent examples of each type of disaster and identifying the nature and extent of the damage that was caused. It then reports on post-disaster assessment methods which have been adapted internationally, commenting in each case on the facility with which it may be applied in the West Indies. Finally, it discusses the types of expertise that would be required on a team assigned to conduct environmental assessments in post-disaster situations.



Title

The Impact of Road Construction on Water Mains

GT007

Authors

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Road construction projects conducted by the Ministry of Public Works (MoPW) frequently intersect with existing and ongoing underground water infrastructure owned by Guyana Water Incorporated (GWI). This raises concerns about the integrity and performance of water mains. This study investigates the impact of road construction activities on the structural strength and operational efficiency of water mains located beneath roadways. A comprehensive analysis was conducted on several case studies where major road construction projects overlapped with water main networks. Data were collected through field inspections, monitoring, and maintenance records, with a focus on instances of pipe damage, leakage, and service disruptions.

The study employs a mixed-methods approach, combining quantitative analysis of damage frequency and severity with qualitative assessments from engineers and contractors. Results indicate a significant increase in water main failures in areas subjected to extensive road construction, particularly in older infrastructure lacking modern protective measures. The findings highlight the need for improved coordination between MoPW road GWI to mitigate risks. Recommendations include the implementation of monitoring technologies, the adoption of protective barriers during construction, and the development of best practices for joint infrastructure projects.

This research underscores the critical importance of safeguarding underground water mains during urban development activities and offers practical solutions to enhance the resilience of urban water systems amidst ongoing infrastructure expansion. Future research should explore long-term impacts and the efficacy of proposed mitigation strategies to further support sustainable urban infrastructure development.



Title

Two-Dimensional Hydraulic Modelling for Floodplain Mapping of the Caroni River Basin, Trinidad

Topic

Flood Management – Wetlands, Stormwater Retention/Reuse, Green Infrastructure and Other Solutions

GT009

Author

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The Caroni River basin drains approximately one-fifth of the total area of Trinidad and is home to approximately 33% of the national population. Flooding regularly occurs throughout the basin causing loss of life and property, including agricultural losses.

Floodplain mapping is crucial in identifying areas of high risk due to flooding. In the US, the National Flood Insurance Program relies on floodplain maps to guide the development of mapped areas and help protect existing assets through flood insurance. Developing similar maps for the Caroni River basin can result in fewer losses due to flooding on an annual basis.

Hydraulic models are required to develop accurate floodplain maps. Two-Dimensional modelling has several advantages over conventional one-dimensional modelling, including the computation of multiple flow paths, ineffective flow areas, and momentum. Because of these advantages, two-dimensional modelling is the new standard that the industry is moving towards.

Hydraulic modelling to create regulatory products is not common in the Caribbean, mainly due to the lack of data or its inaccessibility. Several high-quality datasets are required to develop reliable hydraulic models including terrain, rainfall, land cover, soils, and observed data for calibration.

This presentation will go over the uses and advantages of two-dimensional modelling with HEC-RAS, and the development of the hydraulic model for the Caroni River basin, Trinidad.



Title

Flood Management – Wetlands, Stormwater Retention/Reuse, Green Infrastructure and Other Solutions

GT010

Authors

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Though it is well understood that any natural phenomena that causes flooding cannot itself be prevented, the negative impacts of flooding are a direct result of the inaction of those affected by it. As flood research indicates the significant impact of climate change on the frequency and intensity of floods, so must we seek to increase the efficacy of our flood management measures. The impacts of floods are not limited to infrastructure but unfortunately also encompasses human health and safety, and as such even areas that are experiencing minimal flood damage now must begin to plan such that future engineering designs include the appropriate flood mitigation measures. Flood management is not limited simply to the control of coastal and wetland flooding, but also inclusive of harvesting techniques of stormwater for treatment and reuse.

This paper outlines the responsibility of the government and all municipal utilities in developing a flood resilient nation. This paper also speaks to Integrated Flood Management (IFM) applications and results in comparison to traditional flood management measures. The viability of Green Infrastructure as a cost-effective technology to significantly reduce stormwater and subsequently flooding particularly in industrial and commercial developments is also weighed as another alternative. Particular focus is paid to The Bahamas as a low-lying archipelago with an underdeveloped flood management system as well as an underdeveloped Sea-Level Rise (SLR) Preparedness Plan. Emphasis is placed on measures most suitable for the Bahamas' two biggest climate risks/vulnerabilities, these being Category 5 Hurricanes and Sea Level Rise.



Title
**Managing Critical Assets
 In Our Water Infrastructure**

GT011

Authors

Thea Browne-Dennis (pictured) & **Michael Skerritt**
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Proper management of assets in an aging water distribution system is critical to prolonging the life cycle of assets and obtaining the optimal value from installed infrastructure. One of the asset parameters that influences asset life cycle cost is the asset material type. Whether the material type is Ductile Iron, Cast Iron, steel, HDPE, or PVC, linear assets must have a robust preventive maintenance program.

In this presentation, the presenter will explore a few common water distribution system asset material types, the pros and cons of each, and what key factors should be considered when making final selections. Critical assets such hydrants, valves including air release valves and boundary valves, and cathodic protection test stations will be reviewed. The information shared will also equip designers and operators with a summary of best practices, and a checklist of the key considerations that precede the development of an optimal predictive maintenance plan. These will be presented in a practical and "easy-to-implement" format. Lastly, case studies and lessons learned will be included to support the best practices and checklist of key considerations.

Exploring the latest innovative ideas and implementing the newest technologies are a critical aspect in the advancement of our water sector, but learning from our challenges so that better choices are made in the future is also a major factor in the success of a utility.



Title
**Safeguarding Our Water –
 Strengthening Cybersecurity in
 Trinidad and Tobago's Water Sector**

Topic

**Risk Management – Increasing
 Resilience and Reducing
 Vulnerability**

GT012

Authors

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Trinidad and Tobago's water infrastructure is critical for public health, economic well-being, and environmental sustainability. However, like water utilities worldwide, it faces a growing threat from cyberattacks. These attacks have been known to disrupt operations, contaminate water supplies, and cause significant economic damage. This presentation explores the evolving cyber threat landscape for Trinidad and Tobago's water sector. Common cyber threats faced by WASA and recent trends in cyberattacks targeting water utilities in the Caribbean will also be discussed. Emphasis will be placed on the importance of a proactive approach to cybersecurity, highlighting best practices for implementing robust cybersecurity frameworks tailored to water utility's needs and fostering a culture of cybersecurity awareness among water professionals.

This presentation explores opportunities for collaboration with regional partners within the Caribbean Water and Wastewater Association (CWWA). By sharing information and best practices, Caribbean Water Utilities can collectively strengthen their cyber defenses. Findings call for WASA and other regional Water Utilities to prioritize cybersecurity investments to ensure the continued delivery of safe, reliable water to communities.



Title

Social Media and Community Engagement as a Tool for Enhanced Sector Awareness

GT013

Author

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The National Water and Sewerage Authority (NAWASA) is a statutory body and the sole provider of water supply and wastewater services in Grenada. Social media has become integral to modern community engagement strategies, revolutionizing communication and interaction. In Grenada's water sector, NAWASA plays a pivotal role in promoting sustainable practices and enhancing sector awareness through initiatives that utilize the power of social media.

Objective:

This abstract will show how NAWASA's social media initiatives contribute to enhancing community engagement and sector awareness. It will explore the effectiveness of specific strategies employed by NAWASA in achieving these goals.

Methods:

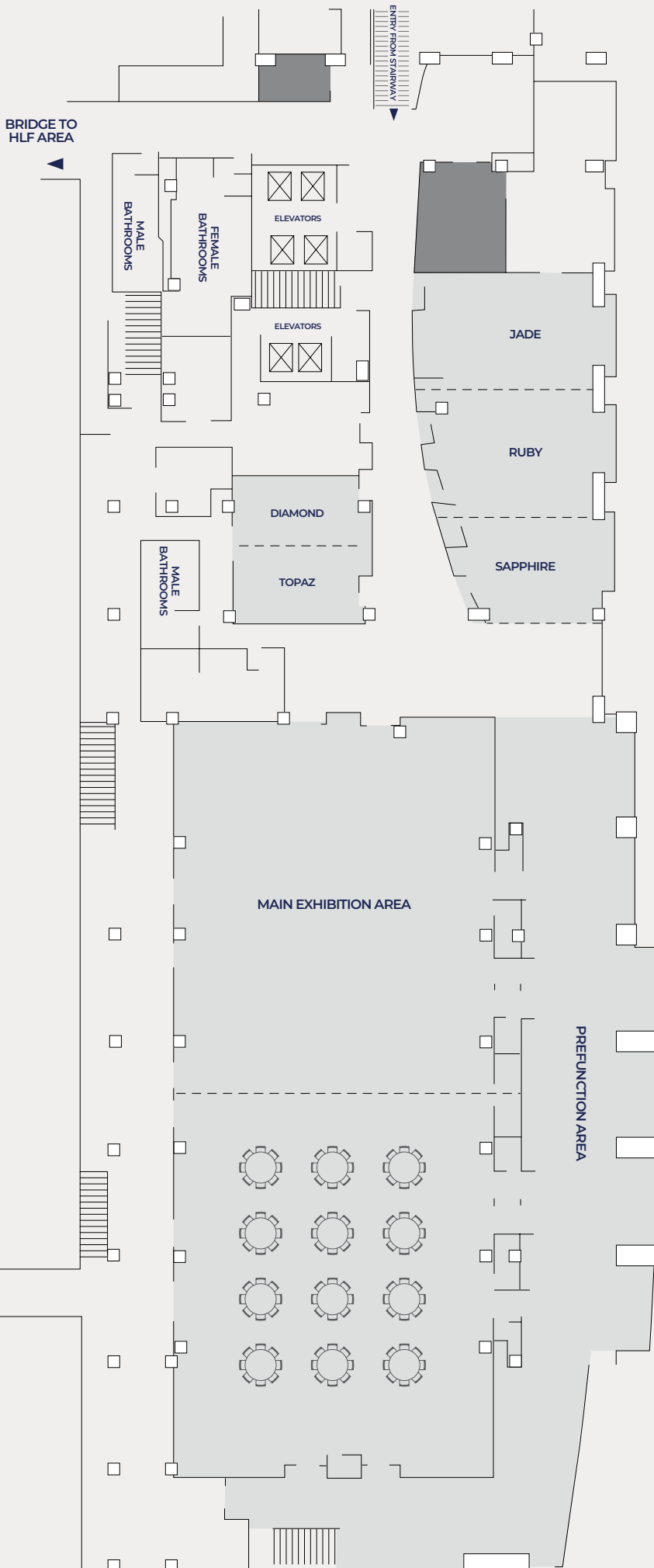
The approach includes qualitative analysis of NAWASA's social media campaigns, content analysis of engagement metrics, stakeholder engagement, community engagement, and awareness levels. Additionally, a quantitative analysis will be incorporated to compare the cost efficiency of social media campaigns against traditional communication channels.

Results:

Findings indicate that NAWASA's social media initiatives have significantly enhanced community engagement by fostering dialogue and promoting behavioural changes towards sustainable water usage. The results also demonstrate that improved sector awareness is achieved through social media, highlighting the positive impact of targeted digital strategies. Moreover, the analysis reveals the significant cost reduction of social media campaigns compared to traditional methods, underscoring their efficiency and effectiveness.

Conclusion:

The findings underscore the importance of leveraging social media for enhancing sector awareness and community engagement in the water sector. Recommendations include optimizing social media strategies to sustain and expand these outcomes and advocating for broader adoption across similar organizations. Recognizing the cost-efficiency of social media campaigns compared to traditional channels further strengthens the argument for their broader use.



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