



**INNOVATION & SMART TECHNOLOGIES  
BUILDING RESILIENCE IN THE  
WATER & WASTE INDUSTRIES**

**CW&A** 30<sup>th</sup> Annual Conference  
and Exhibition  
CARIBBEAN WATER AND  
WASTEWATER ASSOCIATION THE CAYMAN ISLANDS  
**3 - 8 OCTOBER 2021**

**2021  
CONFERENCE  
BOOKLET**





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# CWWA PRESIDENT MESSAGE

Dear Patron,

You are currently viewing our 2021 CWWA Conference Booklet, which seeks to provide a basic overview of what is to be unfolded during this year's conference and exhibition. It highlights some of our major exhibitors and sponsors, as well as the products and/services they have to offer and a portfolio of the presenters.

Since our last virtual conference and exhibition, we've been adamant in ensuring a smooth flow of every aspect of the event via the Whova App. This is evident in our preparatory works, which include but are not limited to ensuring the adequate bandwidth for online streaming, formulating affordable costs for individuals, groups and sponsor packages, multiple avenues for advertising and one on one access to persons of interest via the App.

In this booklet, you will also have access to the abstracts of the technical papers presented at this year's conference. The full papers would be later uploaded to the website for our members to access. Other information shared over the Whova App will also be available months after the conclusion of the event.

I trust that my few words give you an insight into the magnitude of work undertaken by the Cayman Islands' Organising Committee, CWWA Secretariat and Executive Council to realize an online conference and exhibition that is beneficial to you.

This year, as the CWWA celebrates its 30th anniversary, we could not be happier to share this milestone with you. We are proud to be able to equip ourselves with the requisite tools and adjust to maintain the continuity of this annual event in the midst of a pandemic for two consecutive years and to maintain our 30-year streak of conferences. With that said, I welcome you to the 30th Annual Conference and Exhibition.

Warmest Regards,  
Ms. Sara-Jade Govia  
President  
CWWA



# LOCAL ORGANISING COMMITTEE CHAIR MESSAGE

Dear Attendee,

Welcome to the 30th Annual CWWA Conference and Exhibition! We are thrilled to have you.

The theme for the conference is "Innovation and Smart Technologies: Building Resilience in the Water and Waste Industries". It's a theme that holds relevance for the region still dealing with the impacts of the pandemic and natural disasters. The conference brings the Caribbean together during challenging times. More than ever, this is the time to share stories and experiences on applied research, case studies, and lessons learnt in the water, wastewater and solid waste sector. The Local Organising Committee hopes that the information and ideas shared over the conference will be beneficial and will lead to innovative policies and practices that utilise technology to build resiliency and strengthen the sector to serve our Caribbean people better.

In addition to being informative, we hope you've enjoyed this virtual conference experience. The conference virtual platform, Whova, offers robust networking and opportunities to share ideas and make meaningful connections, no matter where in the world you are. We invite you to utilise its features to connect with fellow attendees, speakers, sponsors and exhibitors.

We are very pleased to be celebrating the 30th Anniversary of the CWWA at this year's event. We are also looking forward to sharing the culture of the Cayman Islands throughout the conference. While we are disappointed we were unable to welcome you to our shores this year, and we hope that you feel our 'CaymanKind' spirit throughout the week.

Warmest Regards,

Dr Gelia Frederick-van Genderen  
Local Organising Committee, Chair  
Water Authority - Cayman, Director



# ABOUT THE CARIBBEAN WATER AND WASTEWATER ASSOCIATION

The Caribbean Water and Wastewater Association (CWWA) is a regional non-governmental organization established by an Act of Parliament in Trinidad & Tobago in 1991. The CWWA is a grouping of water, wastewater and solid waste professionals in the public and private sectors.



## **AIMS AND OBJECTIVES**

To facilitate research and development and the use of appropriate technologies;

- to identify emerging needs and providing value-adding opportunities for our members;
- to Promote the professional development of our members, by providing access to accredited education and certified training opportunities;
- to Facilitate the sharing of members' knowledge and experience by providing an efficient support network;
- to build alliances and partnerships to strengthen the development of our members and member institutions;
- to advocate on critical issues affecting the water, wastewater and solid waste industries and our membership.

## **VISION**

To be the preeminent Association for professionals and practitioners for water and waste sectors in the Caribbean.

## **MISSION**

To advance the science and practice of water supply, wastewater disposal and solid waste management, for the sustainable development of Caribbean people.

## **MEMBERSHIP**

The CWWA membership is open to individuals who work in the water, waste, solid waste, and environmental sectors. Companies and utilities that operate in those sectors are also eligible.



# 30



CARIBBEAN WATER AND  
WASTEWATER ASSOCIATION

**ANNIVERSARY**

1991-2021

CELEBRATING 30 YEARS OF SERVICE TO THE  
CARIBBEAN WATER AND WASTE INDUSTRY.

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# CONFERENCE SCHEDULE

## Friday, 1 October 2021

AGENDA IN GMT-5 TIMEZONE

10:00 am-12:00 pm

Pre-Conference Workshop: Building Water Quality

**Pre-Conference Workshop**

- Hendrik van Genderen, Water Resources Engineer, Water Authority - Cayman
- Jen Clancy, Ph.D., Chief Scientist, ESPRI
- Sheldon Masters, Ph.D., Assistant Professor, University of Colorado - Boulder

# CONFERENCE SCHEDULE

## Monday, 4 October 2021

AGENDA IN GMT-5 TIMEZONE

9:00 am-11:30 am

Opening Plenary & Keynote Speech

Opening Ceremony

12:00 pm-12:30 pm

Technical Session #1: Non-Revenue Water Technologies

Technical Session

- Karlene Singh, Business Development - Project Engineer, Consolidated Water Co. Ltd.
- Paul Fanner, Director, Fanner & Associates Ltd.

1:00 pm-2:00 pm

Special Session #1: Artificial Intelligence and Desalination Efficiency

Special Session

- Ahmed Elsheshtawy, Engineer - Water Production, Water Authority - Cayman
- Mike Dixon, CEO and Founder, Synauta

2:30 pm-3:15 pm

Technical Session #2: Drafting Project Specifications for SWRO Facilities: Best Practices and Lessons Learned

Technical Session

- Karlene Singh, Business Development - Project Engineer, Consolidated Water Co. Ltd.
- Ahmed Elsheshtawy, Engineer - Water Production, Water Authority - Cayman

# CONFERENCE SCHEDULE

## Tuesday, 5 October 2021

### AGENDA IN GMT-5 TIMEZONE

- 9:00 am-10:00 am      **Special Session #2: Climate Change Resilience**  
**Special Session**
- 10:30 am-12:00 pm      **Technical Session #3: Building Resilience in the Water Sector**  
**Technical Session**
- Wayne Williams, Executive Director, CWWA
  - Kevin Carter, Assistant to the Director, Broward County (Florida) Water and Wastewater Services
  - Candice Santana, Secretary, Executive Council, Caribbean Water and Wastewater Association
  - Eugenio Barrios, Consultant, UNEP
- 12:15 pm-1:15 pm      **Non-Revenue Water Case Study with MIYA Water**  
**Sponsored Session**
- 1:30 pm-2:30 pm      **Technical Session #4: Adaptation to Climate Change**  
**Technical Session**
- Chris Corbin, Programme Officer, Pollution and Communications Sub-Programmes, UN Environment
  - Sandy Nettles, President, N. S. Nettles & Associates Inc./Ocean earth Technologies
  - Lilly Loe, UWI
- 3:00 pm-4:00 pm      **CWWA 30th Anniversary: Looking Back...Looking Forward**  
**Special Session**

# CONFERENCE SCHEDULE

## Wednesday, 6 October 2021

### AGENDA IN GMT-5 TIMEZONE

9:00 am-10:30 am

**Special Session #3: Utility Capacity Building - OWB Case Studies Within the Caribbean**

**Special Session**

- Valerie Jenkinson, Chair, Operators Without Borders
- Ton Vlugman, Advisory Committee Member, Operators Without Borders
- Greg Solecki, Operators Without Borders
- Ignatius Jean, Executive Director, CAWASA

11:00 am-12:30 pm

**Technical Session #5: Landfill Alternatives: Achieving Behavioral Change Through Innovative Technologies**

**Technical Session**

- Mike Haworth, Assistant Director, Solid Waste, Cayman Islands Department of Environmental Health (DEH)
- Yashoda Singh, Director, Cashew Gardens Community Council
- Jelicia Barrett, Student, University of the West Indies Mona, Jamaica
- Delena Indar, Director, Central Pathfinders Environmental Foundation
- Renaldo Lewis, Director, Central Pathfinders Environmental Foundation

12:30 pm-2:00 pm

**Live Exhibitor Showcase**

**Sponsored Session**

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# CONFERENCE SCHEDULE

## Wednesday, 6 October 2021

AGENDA IN GMT-5 TIMEZONE

2:00 pm-2:30 pm

### Technical Session #6: Recycling and Energy Recovery Technologies

#### Technical Session

- Ronald Roach, Ronald Roach Waste Management Consultant
- Martin Edelenbos, CEng, PEng, Engineering Coordinator - Waste Management, DART

2:45 pm-3:45 pm

### Technical Session #7: Nature-Based Solutions for Water and Land Management

#### Technical Session

- Hendrik van Genderen, Water Resources Engineer, Water Authority - Cayman
- Halla Sahely, Project Coordinator, IWeco St. Kitts and Nevis
- Amrita Mahabir, Conservation Community Specialist, The Nature Conservancy (TNC)
- Adam Snyder, The Nature Conservancy (TNC)

# CONFERENCE SCHEDULE

## Thursday, 7 October 2021

AGENDA IN GMT-5 TIMEZONE

9:00 am-10:00 am

**Special Session #4: Disaster Preparation and Recovery**

**Special Session**

- Ignatius Jean, Executive Director, CAWASA
- Danielle Coleman, Director, Hazard Management Cayman Islands (HMCI)
- Richard Hew, CEO , Caribbean Utilities Company, Ltd. (CUC)

10:30 am-11:30 am

**Technical Session #8: Technologies in Quality Monitoring**

**Technical Session**

- Antoinette Johnson, Department Of Environmental Health, Cayman Islands
- Marcela Martinez Ebanks, Laboratory Manager, Water Authority - Cayman
- Kodie Scott, Senior Development Control Technologist, Water Authority Cayman

12:15 pm-1:15 pm

**Waste to Energy: Getting Started**

**Special Session**

- Bob Griesbach, Director, Energy Consulting, Hatch

# CONFERENCE SCHEDULE

## Thursday, 7 October 2021

AGENDA IN GMT-5 TIMEZONE

1:30 pm-2:30 pm

Technical Session #9: Wastewater Management:  
The Cayman Islands Perspective

**Technical Session**

- Tom van Zanten, Deputy Director, Water Authority - Cayman
- Hendrik van Genderen, Water Resources Engineer, Water Authority - Cayman
- Breandan McDonnell, Water Authority Cayman

3:00 pm-4:30 pm

CWWA Annual General Meeting

**CWWA AGM**

# CONFERENCE SCHEDULE

## Friday, 8 October 2021

AGENDA IN GMT-5 TIMEZONE

10:00 am-11:30 am

Technical Session #10: Innovation in Wastewater Collection and Treatment

**Technical Session**

- Wayne Williams, Executive Director, CWWA
- Bumsoo Han, Radiation Chemist, International Atomic Energy Agency
- Alphonsus Daniel, M.Sc., Managing Director, Daniel and Daniel Engineering Inc

12:30 pm-1:30 pm

Closing Ceremony

**Closing Ceremony**

1:30 pm-2:30 pm

Virtual Mixer

**Networking and Virtual Mixer**

# CWWA

## CELEBRATING

# 30

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# 2021 FUNDERS



# 2021 EXHIBITORS





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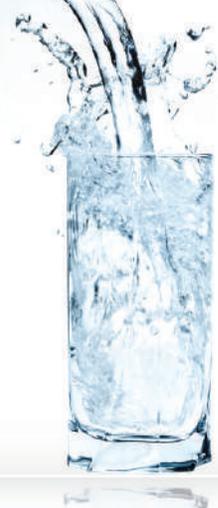
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Established in 1973, Consolidated Water Co. Ltd. is an international water solutions company, supplying potable water, treating water for reuse, and manufacturing and providing water-related products and services to customers in the Cayman Islands, The Bahamas, the United States, and the British Virgin Islands. We offer creative Design-Build-Operate services with financing options to help meet your water needs. Contact us at info@cwco.com.



ReGen

## Turning trash into electricity to power our homes and businesses.

ReGen, Cayman's Energy & Recycling Centre, is a multimillion-dollar public-private partnership between the Cayman Islands Government and Dart to turn the George Town Landfill site into a green space and build state-of-the-art infrastructure to improve recycling and turn remaining trash into electricity.

5 Interesting facts about ReGen



ReGen includes nine, integrated facilities that have the capacity to divert up to 95% of our waste from being landfilled.



Remediating the existing landfill will reduce greenhouse gas emissions by more than 23,000 tonnes a year, equivalent to removing more than 5,000 cars from our roads annually.



Cayman's trash will be used to generate approximately 9 megawatts of electricity, enough to power over 2,000 homes and businesses in Grand Cayman.



ReGen is expected to generate 300 construction jobs and up to 60 long-term, skilled jobs throughout the life of the project.



Globally, landfills are the top source of methane emissions, a powerful greenhouse gas that is 28 to 36 times more effective than carbon dioxide at trapping heat in the atmosphere.



DART  
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# High Level Forum 17 (Water) 13 - 14 October, 2021

## Wednesday, 13 October 2021

9:00 am	Official Opening
9:30 am	Ministerial Address
9:45 am	Review of Forum Agenda
10:00 am	RSAP 2021 Implementation Plan Publication - The Caribbean Water Study
11:05 am	Reporting on Country Action Plans of COVID- 19
12:00 pm	Setting the Agenda for Wastewater Treatment and Monitoring in the Caribbean

## Thursday, 14 October 2021

9:00 am	Welcome
9:15 am	Synopsis of Day 1
9:30 am	Digitization and Smart Technologies
10:15am	Caribbean Water Utility Insurance Company: Recent Developments
11:05 am	Presentation of CDB Water and Sanitation Policy Options
11:35 am	Summary of HLF and HLF Water 17 Declaration
12:05 pm	Wrap Up and Vote of Thanks

# High Level Forum 5 (Waste) 20-21 October, 2021

## Wednesday, 20 October 2021

- |          |   |
|----------|---|
| 9:00 am  | Official Opening  |
| 9:20 am  | Ministerial Address   |
| 9:35 am  | Background and Context of the HLF for Waste Management/Objectives of Meetings     |
| 9:45 am  | Review of Forum Agenda  |
| 10:00 am | CWMAP 2021 Implementation Plan  |
| 10:35 am | Support to the Effective & Sustainable Management of Solid Waste in the Caribbean |
| 11:15 am | Regional Collaboration Building on CWMAP 2021 Implementation Plan                 |

## Thursday, 21 October 2021

- |          |   |
|----------|---|
| 9:00 am  | Welcome   |
| 9:10 am  | Synopsis of Day 1   |
| 9:20 am  | Reporting on Country Action Plans of COVID-19   |
| 10:10 am | Circular Economy  |
| 10:45 am | Sustainable Plastic Management and Hazardous Chemical and Waste Management in the Caribbean |
| 11:15 am | Marine Litter (Plastics)  |
| 11:45 am | Summary of HLF and HLF 5 Waste Declaration  |
| 12:15 pm | Wrap Up and Vote of Thanks  |

**CONFERENCE  
ABSTRACTS AND  
PRESENTER  
PROFILES**



**NAME:** Paul Fanner

**COUNTRY:** United Kingdom

**PROFESSION:** Director, Fanner & Associates Ltd.

**BIOGRAPHY:** Paul Fanner is a chartered UK civil engineer and a leading Non-Revenue Water (NRW) expert with broad experience gained over 43 years in the industry. He has extensive water utility experience from working for both Thames Water and Bristol Water in a wide range of roles. Paul also has extensive international experience, having worked in Nigeria, India, Malaysia, Trinidad and Tobago, Russia, Vietnam, Philippines, Barbados, USA, Bahamas, Jamaica and Canada. Since 2001 he has worked full time as an international consultant specializing in NRW reduction. Paul is currently working as Project Director for Miya on Caribbean performance based NRW Reduction projects in the Bahamas and Jamaica. He is also leading a project to develop the NRW reduction strategy for the City of Toronto. Paul is a Fellow of the IWA, member of the IWA Waterloss Specialist Group and Regional Representative of the WSG for the Caribbean and Central America.

**CONFERENCE THEME:** Non-Revenue Water

**PAPER TITLE:** The Benefits of NB-IoT for Non-Revenue Water Reduction Implementation

**ABSTRACT:** Non-Revenue Water levels in the Caribbean are some of the highest in the world, resulting in poor levels of service to customers, high operating costs and loss of revenues for water utilities. The impacts of climate change in the Caribbean are further exacerbating these problems. It is therefore becoming increasingly important that Caribbean water utilities take effective action to reduce their high levels of NRW.

Real, physical losses normally account for the majority of these NRW volumes. Given the infrastructure materials and condition typical of Caribbean water distribution networks, an effective NRW reduction program will almost certainly include establishing pressure zones and district meter areas (DMAs). In order to use these facilities to effectively to minimise physical losses, it will be necessary to install telemetry data loggers on inlet meters, pressure logging points, PRV controllers, large customer meters, tank levels etc. Until recently, the most cost-effective solutions to meet this need have been battery powered data loggers using 2G, 3G or 4G cellular communications, however there are several drawbacks to using these technologies which the paper will detail.

In 2016, a new communication standard was agreed - NarrowBand-Internet of Things (NB-IoT), a standards-based low power wide area (LPWA) technology developed to enable a wide range of new IoT devices and services to support the development of Smart Cities.

Since agreement of this standard, adoption by mobile network operators has been rapid, with 120 operators in 64 countries already offering commercial use of NB-IoT. As a result, several of the data logger manufacturers now offer NB-IoT versions of their data loggers, which offer considerable benefits over 2G, 3G or 4G technologies for these applications. The paper will detail the important benefits of this new technology for NRW reduction programs and make the case for Caribbean mobile operators to adopt NB-IoT.



**NAME:** Ahmed Elsheshtawy

**COUNTRY:** Cayman Islands

**PROFESSION:** Engineer Water Production, Water Authority-Cayman

**BIOGRAPHY:** Ahmed is a mechanical engineer by training with over eight years of experience in the water and wastewater industry. He has experience with the design, procurement, and commissioning of water and wastewater plants, pump stations, and pipelines in the Middle East. He is currently a Water Production Engineer at the Water Authority of the Cayman Islands, where he oversees the operation of SWRO plants, provides engineering and project management support to the Authority's new works department, and manages the Authority's meter testing and replacement program. Ahmed is a licensed Professional Engineer in the state of Texas, a certified Project Management Professional, and a holder of a Reverse Osmosis Specialist III certification.

**CONFERENCE THEME:** Regulatory Compliance and Best Business Practices

**PAPER TITLE:** Drafting Project Specifications for SWRO Facilities – Best Practices and Lessons Learned

**ABSTRACT:** Effective project specifications are essential to the successful design, construction, and operation of Seawater Reverse Osmosis (SWRO) facilities. From project delivery methods to desalination technologies, there are many decisions to be made and information to be collected before the project specifications are ready to be released to potential bidders. Project owners in general, and public utilities in particular, need to strike a balance between over-specifying and under-specifying in order to ensure that they end up with a facility that provides better value for money, low Operation and Maintenance costs, and smooth transfer of operations in case of a DBOOT procurement model. This paper aims to shed light on the key aspects project owners should keep in mind while drafting their project documents to ensure their needs are met and avoid potential disputes, schedule creep, and costly add-ons. The paper draws from the experience of Water Authority – Cayman in procuring and operating SWRO facilities for more than 35 years.



**NAME:** Kevin Carter

**COUNTRY:** United States of America

**PROFESSION:** Assistant to the Director, Broward County (Florida) Water and Wastewater Services

**BIOGRAPHY:** Kevin Carter has worked with South Florida water resources for over 30 years. Since July 2015, Kevin has been the Broward County Water and Wastewater Services' Assistant to the Director with a focus on legislative and intergovernmental affairs as well as special projects like grants. He holds leadership positions in the Florida Section of the American Water Works Association, Florida Water and Environment Association, and the Florida Water and Wastewater Agency Response Network. He is also an Operators Without Borders Advisory Committee member. Previously he worked with the South Florida Water Management District for 7 years and also spent 14 years with Broward County's environmental agency. He is a CWWA member and this is his third conference presentation. He serves on the CWWA's Water Loss Specialist Group as well as the 30th Anniversary Committee. Kevin is also an adjunct professor at Broward College.

**CONFERENCE THEME:** Climate Change, Resilience, Disaster Preparedness and Recovery

**PAPER TITLE:** Water Reuse and Resiliency: From Florida to the Caribbean?

**ABSTRACT:** Water reuse conserves traditional drinking water sources and strengthens water sector resilience, especially during droughts. Drought resiliency and improved wastewater management are two important broad goals within the Regional Strategic Action Plan for the Water Sector in the Caribbean (RSAP). The United Nations Environment Programme's Caribbean Regional Fund for Wastewater Management (GEF CReW) is one important initiative working towards wastewater solutions. An optimal time to integrate water reuse systems into a utility's strategy is when new wastewater systems are being planned. As programs such as GEF CReW continue to grow, the potential for Caribbean water reuse to supplement traditional drinking water sources, desalination, and conservation appears good. Water reuse can diversify regional water supplies and provide more drought resilience to the Caribbean water sector. However, water reuse development requires scientifically sound regulations, public education, and political support.

The state of Florida's water sector utilities are national leaders in United States' water reuse production. The state set its first water reuse rules over 30 years ago and public education was critical for large scale implementation. State and local political leadership, including financial support, also contributed to water reuse growth in the state. With high population growth, Florida is now implementing potable water reuse to strengthen its water supply resilience. The author will first tell the 'Florida Water Reuse Story' and then discuss strategies to transfer knowledge and 'lessons learned' to the Caribbean water sector. With a similar climate, including droughts, and close geographic proximity, the Florida water sector could be optimal water reuse collaborators with its neighboring water sector. An opportunity to start the conversation now should provide water reuse opportunities sooner as the RSAP and programs such as GEF CReW continue to implement their important strategies.



**NAME:** Candice Santana

**COUNTRY:** Trinidad & Tobago

**PROFESSION:** Hydrological Technician III, Water and Sewerage Authority

**BIOGRAPHY:** Candice was raised in a rural village named Tabaquite on the edge of the Navet Dam in Trinidad and Tobago and found her calling in the water sector very early in life. She completed tertiary studies in Water Resources Management and Technology while engaged in academic work in the field of Agriculture, Climate Change and Rural Development and Planning. Currently, she is finishing up an MSc. Project Management. The last 17 years of her life was spent working at the Water and Sewerage Authority (WASA). She has also spent this time participating in the Water and Sanitation sector around the Caribbean region. Eventually, in 2016, she was elected to serve as the Secretary of the Executive Council at the CWWA. Through this organization, she has worked on policy development, governance, capacity building mechanisms and various other projects for the Caribbean Region in water, waste management and climate change and resilience. Outside the water sector, She has a passion for agriculture, youth development, gender equality, body positivity and Caribbean culture

**CONFERENCE THEME:** Climate Change, Resilience, Disaster Preparedness and Recovery

**PAPER TITLE:** Using a Water Security Index (WSI) approach to drive targeted projects: the Tobago Experience

**ABSTRACT:** Improving water security is a major subset of climate-proofing the water sector. Increasing uncertainties ranging from drought, flooding, financial constraints to a global pandemic such as Covid-19 can place additional strain on the water sector and impact the ability to supply potable water. In small island developing states (SIDS) such as Trinidad and Tobago, water is an economic driver, a necessity to public health and sanitation and a means for improving the standard of living.

Five (5) key dimensions: domestic, urban, economic, environmental, and resilience to water-related disasters were established to assess and monitor water security in Tobago. These key dimensions are influenced by the United Nations' Sustainable Development Goals (SDG). Hydrometeorological, hydrogeological, land use, water demand and demographic data were employed to guide the calculation of a water security index (WSI). Utilizing this approach, Tobago received a WSI of 2.8 out of 5, indicating that it is just above average on this WSI scale. The WSI approach is quantitative and can be applied to other SIDS, particularly in the Caribbean Region. The five (5) key dimensions directly reflect the cross-cutting nature of water security issues and will enable the development and implementation of targeted interventions and projects to ensure that an improved level of water security can be achieved and maintained over time.

In 2021 and beyond, the development of a successful integrated water security programme is hinged on a measurable tactic that can forecast the impacts of targeted interventions. This data-driven path is a scientific approach guiding decision makers to prioritize projects based on impact, delivery time and project cost while having an understanding of the enabling environment and current water security position.



**NAME:** J. Eugenio Barrios O.

**COUNTRY:** Mexico

**PROFESSION:** Independent Consultant, Water and Environmental Policy

**BIOGRAPHY:** Over 30 years, Eugenio has shaped a solid experience in water resource management at the national and regional level. He is a professional engineering from the University of Mexico (UNAM), and a Master of Science in Environmental Engineering from the University of Illinois Urbana-Campaign. Early in his career, he worked for the National Water Commission (Conagua) and the Institute of Engineering at UNAM. From 2004-2019, he took several positions at WWF Mexico and Latin America. He developed the National Environmental Water Reserves Program in Mexico. He was a member of the WWF Global Freshwater Practice Leadership Team, the Scientific and Technical Review Panel of the Ramsar Convention (2012-2015), the Mexico National Water Council, and President of the Mexico National Wetlands Committee (2018-19). He was Deputy Director General of Conagua and currently is an international consultant on water and environmental policies. He has worked for UNEP, World Bank, IADB, AGWA and WWF-US.

**CO-AUTHOR:** Christopher Corbin, UNEP Cartagena Convention Secretaria -Jamaica

**CONFERENCE THEME:** Climate Change, Resilience, Disaster Preparedness and Recovery

**PAPER TITLE:** An Integrated Water Resource Management Framework to Support Implementation of the Cartagena Convention

**ABSTRACT:** 20 years after the adoption of the Cartagena Convention (CC) by 28 countries of the Wider Caribbean Region (WCR) and ten years after the entry into force of its Land Based Sources of Marine Pollution (LBS) Protocol, pollution prevention and control from wastewater and agricultural runoff remains a major challenge for the region. The WCR is highly vulnerable to extreme events that impact coastal areas where most of the population resides, which is further exacerbated by climate change. This negatively impacts on economic sectors, ocean-based economies, and the prosperity and welfare of people. The CC Secretariat has developed an outline for a Regional Integrated Water Resources Management Conceptual Framework (IWRM-CF) to address existing challenges and opportunities in sector integration. The IWRM-CF proposes an approach based on common principles for both IWRM and coastal and marine resources management including ecosystem-based management, Source to Sea, sustainable consumption, natural capital, science-policy interface, resilience building, one health for all and public participation. Several IWRM actions that facilitate and promote integration and accelerated IWRM adoption and implementation are proposed. Water should be the connector for meeting Global Commitments such as the SDGs, Paris Agreement, and Sendai Framework. This IWRM-CF enables: i) CC Secretariat to support other sectors and processes such as Disaster Risk Management and Integrated Coastal Zone Management; ii) Consensus building based on common principles, goals and priorities such as the restoration/conservation of the marine ecosystems; iii) IWRM to be the central process for ensuring water security for all; iv) Recognition of the importance of water governance, supported by the Escazu Agreement; v) The development of a three-level governance model to leverage collaborative action at local, national, regional and global levels; vi) Development of climate smart and resilient ocean-based economies for the region; vii) A strong economic case to be made for more integrated and coordinated action for all sectors involved and/or impacted by water resources management.



**NAME:** N. Sandy Nettles

**COUNTRY:** United States of America

**PROFESSION:** President, N.S. Nettles & Associates, Inc./Ocean Earth Technologies

**BIOGRAPHY:** Mr. Nettles a MS degree from UF. He has been consulting in the fields of surface water and groundwater hydrology, geophysics, geotechnical evaluation, marine ecology, coastal hydrodynamics and Environmental Impact Assessments for 47 years. Mr. Nettles has performed several of the largest water resource assessments in the State of Florida as well as designing, testing, permitting and operating large coastal wellfields around the state. Additionally, Mr. Nettles has performed water resource investigations and developed fresh water and saline water supplies throughout the Caribbean islands, Mexico, Baja Mexico and Cost Rica. Mr. Nettles also has extensive experience in developing wastewater disposal alternatives including deep well injection, spray irrigation, wetland treatment and aquifer storage. Mr. Nettles is a recognized expert in Sinkhole hydrology and cavern mapping and has extensive Expert Witness experience. Mr. Nettles also modifies stressed coastal wetlands (salt ponds, salt flats) and converts them into marine lagoon or salt marsh habitats.

**CONFERENCE THEME:** Climate Change, Resilience, Disaster Preparedness and Recovery

**PAPER TITLE:** Sea Level Rise Wellfield Protection Procedures

**ABSTRACT:** Most Caribbean islands are volcanic, with a central core of volcanoes surrounded by carbonate reef and sand shorelines. Historic lava flows flowing down the sides of the volcanoes create dense rock ridges separated by valleys that occur as spokes around a wheel. Between these ridges, an accumulation of volcanic ejecta and ash fill the valleys. The valley fill is typically comprised of fine sand to boulders and is very permeable. Rainwater percolates rapidly into the valley sediments creating freshwater aquifers in each valley. All of these valleys have a freshwater storage capacity based on the rainfall recharge, aquifer Storage and Transmissivity (measured by an Aquifer Performance Test). Many of these valleys drain directly to the shoreline and are unconfined aquifers. As each valley has a defined basin (constricted laterally by the ridges) each valley aquifer has a defined volume of stored aquifer water based on rainfall recharge. It is rare that these groundwater basins have been adequately defined to determine the Valleys Safe Sustained Yield. Additionally, it is extremely rare to find a Caribbean Island wellfield that has a saltwater intrusion monitoring network installed to control the wellfield pumping schedule or to aid in predicting saltwater intrusion locations and rates. Without such a network of monitoring wells and a wellfield operating program for an unconfined aquifer, these wellfields are highly susceptible to saltwater intrusion such as occurred in the Baseterre Aquifer in 2015/2016. Mr. Nettles will present examples of how monitoring saltwater intrusion has aided wellfields in Florida and how the OET's 2009 hydrogeologic basin evaluation of the Baseterre Valley Aquifer in St. Kitts predicted the intrusion of saline water in 2015/2016. New freshwater resources were located by OET in St. Kitts at higher elevations to account for continued saltwater intrusion due to sea level rise.



**NAME:** Lilly Loe

**COUNTRY:** Jamaica

**PROFESSION:** Assistant to the Director, Broward County (Florida) Water and Wastewater Services

**CO-AUTHOR:** Dr Kwame Emmanuel,  
UWI - Jamaica

**CONFERENCE THEME:** Climate  
Change, Resilience, Disaster  
Preparedness and Recovery

**PAPER TITLE:** Climate Change and  
Rainwater Harvesting for Domestic  
Purposes in the Caribbean: The Case of  
Harmony Vale and Drumilly districts, St  
Ann, Jamaica.

**ABSTRACT:** Climate variability and change present a fundamental challenge for populations dependent on harvested rainfall for primary use. These communities are not connected to the central water utility or "off the grid", and often struggle when drought periods are long and extreme. Such are the cases of Harmony Vale and Drumilly districts located in St. Ann, Jamaica.

The research problem is the occurrence and impact of rainfall variability on everyday life in these rural communities, which are directly dependent on rainwater harvesting for primary uses.

The purpose of the study is to examine how these residents have been managing their harvested rainwater with the occurrence of changing rainfall patterns. It also involves examining how the rainfall variability has impacted residents, assessing the short-term coping strategies and long-term adaptations employed by the people.

The mixed methodology adopted involved a survey questionnaire administered to residents followed by semi-structured interviews of policy experts.

The research seeks to determine the residents' management of rainwater harvested from the unpredictable rainfall as well as the rainwater harvesting techniques used and key strategies utilized. Policy recommendations are also outlined.

**NAME:** Roslyn Williams-George

**COUNTRY:** Trinidad & Tobago

**ORGANISATION:** Cashew Gardens Community Council

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**CO-AUTHOR:** Yashoda Singh, Cashew Gardens Community Council - Trinidad & Tobago

**CONFERENCE THEME:** Landfill Alternatives: Achieving Behavioral Change through Innovative Technologies

**PAPER TITLE:** Towards a Climate Resilient Strategy in the Waste Industry: A Case Study of the Cashew Gardens Community Council: A Model Community

**ABSTRACT:** The Cashew Gardens Community Council (CGCC) recognizes that methane gas and plastic pollutants are two of the biggest contributors to the negative impact on landfills in Trinidad and Tobago. The Council has always been concerned about pollution and ways in which we, as a community, can reduce our carbon footprint by sending less recyclable waste to the landfill. Our model is designed to educate the community about becoming more climate-resilient and to make more eco-friendly choices. In order to address our community waste, the CGCC implemented two important projects. Firstly, the Cashew Garden Community Recycling Programme, which was established in 2016. This project is still ongoing and to date, has successfully diverted over 2.5 tonnes of plastic, cans, glass and tetra packs from entering our landfills. According to our National Recycling Policy, these four waste types account for almost 40% of the waste that goes to our landfills. Additionally, the project has also evolved from two hundred households that were part of the initial study, to three other communities around us, with a total of over six hundred households now included. The items collected are sent to the Solid Waste Management Company (SWMCOL), where they are bailed and shipped to recycling facilities outside of Trinidad and Tobago. Secondly, the most recent project is the Cashew Gardens Community Composting initiative, which involves community collection and processing of organic waste to create fertilizer, which is used in the community garden. This project, which began in August 2020, is the first of its kind in the country and was introduced as a pilot project involving 16 households. On average, the project has yielded over 22 kilograms of compost material in a 3 month period. This paper aims to review the recycling activities of the Cashew Gardens community and its contribution to reducing waste in landfills. It will also explore the change in behaviour that has been ongoing over the past 5 years and how this change has positively contributed to the achievement of environmentally friendly waste management practices in this community.



**NAME:** Jelicia Barrett

**COUNTRY:** Jamaica

**PROFESSION:** Student, University of the West Indies Mona, Jamaica

**BIOGRAPHY:** Jelicia Barrett is a student at the University of the West Indies, Mona, Jamaica where she is pursuing a Master of Science Degree in Integrated Urban and Rural Environmental Management. She holds a Bachelor's Degree in Business Administration from the University of Technology, Jamaica. In 2016, she received international training in sustainable solid waste management in Okinawa Japan, sponsored by the Japan International Cooperation Agency (JICA). She works within Jamaica's Waste Management Industry where I provide Auditing Services in the areas of Finance, Operations and Compliance.

**CONFERENCE THEME:** Landfill Alternatives: Achieving Behavioral Change through Innovative Technologies

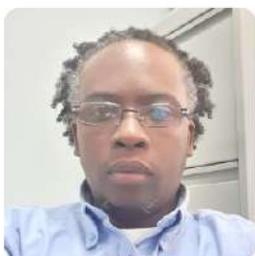
**PAPER TITLE:** An Assessment of the Viability of Adopting Composting as a Waste Management Solution Within the Vineyard Town Community, in Kingston Jamaica

**ABSTRACT:** Background: Jamaica faces several issues in solid waste management such as improper disposal of solid waste, infrequent and inadequate garbage collection and fire at disposal sites across the island as a result of uncovered garbage. The impacts of these issues range from rodent infection in communities, increase in disease-carrying vector breeding sites, increase community flooding to the increase in carbon emission from the burning of garbage. Waste characterization study conducted in 2006 disclosed that approximately 69% of the solid waste generated within Jamaica is organic in nature.

Objectives: This research aims to determine the viability of composting as a waste reduction strategy within the urban community of Vineyard Town in Jamaica. Key factors such as the level of awareness on composting by residents within the community, the willingness to separate and compost household generated organic waste as well as the most suitable approach/ method of composting for implementation within this urban setting will be assessed.

Methods: A mixed-method approach was taken to capture both quantitative and qualitative data using survey tools; questionnaires and interviews (key informant).

Results: The research seeks to uncover the level of awareness on composting within the adult population in the Vineyard Town community and the willingness to compost. The identification of the most suitable approach towards establishing a community level composting initiative fitting to the various socio-economic groups and housing solutions within the community is expected to emerge from this research.



**NAME:** Renaldo Lewis  
**COUNTRY:** Trinidad & Tobago  
**PROFESSION:** Director, CPEF

**BIOGRAPHY:** Renaldo Lewis is a founding member and a director of CPEF since 2014. Mr. Lewis has a BSc in Environmental and Natural Resource Management, an MSc in Environmental Management and an M.Phil in Environmental Management. Additionally, Mr. Lewis is a lead consultant at Sustainable Environmental and Agricultural Development. He has many years of experience in technical agricultural work, as he is currently employed at the University of the West Indies in the Department of Food Production and has also been employed at the Ministry of Agriculture and the Sugar Cane Feed Centre. Mr. Lewis is an advocate of sustainable development through responsible consumption, community empowerment and the application of innovative ideas. He aims for the achievement of sustainable business models for the benefit of both the environment and the citizens of this nation.

**CO-AUTHORS:** Delena Indar, CPEF - Trinidad & Tobago; Demitri Ramlochan; Adrian Mitchell

**CONFERENCE THEME:** Landfill Alternatives: Achieving Behavioural Change through Innovative Technologies

**PAPER TITLE:** Efficacy of the compost tumbler as a tool in organic waste management in households: A case study by a Non-Governmental Organization in Trinidad and Tobago

**ABSTRACT:** In Trinidad and Tobago, organic material comprises the largest component of municipal waste, accounting for thirty-two per cent (32%) of waste at the Beetham Landfill, according to the National Waste Recycling Policy (2015). Addressing this issue, the non-governmental organization (NGO), Central Pathfinders Environmental Foundation (CPEF), embarked on a UNDP Global Environment Facility Small Grants Programme-funded project to reduce this percentage through behavioural change towards composting. The objective of this paper is to outline the effectiveness of a locally produced enclosed composting unit as a tool for managing organic waste from urbanized households. The project commenced in October 2020 with the design and construction of twelve (12) Urbanized Composting Units (UCU), followed by blended training exercises in home composting, and distribution of the units to six (6) households to beta-test its efficacy. Temperature, humidity and pH were recorded by the testers, along with odour which was ranked on a subjective scale. Data on the inputs of high nitrogen materials ("greens") and high carbon materials ("browns") were also collected and analyzed. It was found that testers had an increased interest in composting given the convenience of UCU, though problems faced were unpleasant odours and leachate issues. Moreover, it was found that each UCU has the potential to remove up to eight kilogrammes (8kg) of organic waste from the municipal waste stream and produce ready-to-use compost with a moderate level of efficacy.



**NAME:** Martin Edelenbos, CEng, PEng

**COUNTRY:** Cayman Islands

**PROFESSION:** Engineering Coordinator - Waste Management, DART

**BIOGRAPHY:** Martin Edelenbos is a geotechnical engineer with 35 years of experience designing and operating waste management systems both in the public and private sector. Martin is a Professional Engineer in Ontario and a Chartered Engineer in the UK. He has been a SWANA qualified manager of landfill operations and waste collections systems, a USEPA Qualified Supervisor of Asbestos Abatement, and a Hazardous Waste responder. He has instructed Waste Management at Universities and regulatory agencies was a committee member in defining medical waste in Ontario and assisted in establishing Canadian Standards (CSA) for Bio-Gas and Landfill Gas utilities. Martin's 3 years experience as Assistant Director - Solid Waste with the Cayman Islands Department of Environmental Health and 5 years as Solid Waste Manager with the Government of Bermuda gives him unique experience in managing solid waste in a small island locale.

**CO-AUTHOR:** Michael Haworth, Cayman Islands Government: Department of Environmental Health - Cayman Islands

**CONFERENCE THEME:** Climate Change, Resilience, Disaster Preparedness and Recovery

**PAPER TITLE:** Case Study; PPP Project for Integrated Solid Waste Management in Cayman Islands

**ABSTRACT:** The Cayman Islands consist of three islands located in the Caribbean sea about 200 miles west of Jamaica. The largest and most populous is Grand Cayman with a land area of about 100 sq miles and a population of about 65,000. The two smaller islands; Cayman Brac and Little Cayman, are located about 90 miles east of Grand Cayman and have populations of about 1800 and 300 respectively.

Cayman relies heavily on income from tourism and the financial sector. The current waste management system includes government-owned and operated landfills on each island to dispose of the approximate 100,000 tons of waste generated annually. These sites, especially on Grand Cayman are resulting in unacceptable environmental impacts, and are generally unsustainable.

In 2014 the Government brought consultants on board to assist in developing policies, strategies, and a business case towards a sustainable waste management system. The studies suggested that an integrated waste management system that relies on the 4Rs including a waste to energy component, was the most favourable solution. Furthermore, the best way to procure this solution was through a Public-Private-Partnership.

A Request for Proposals was issued by the Government late in 2016 and in 2017 Dart was selected the preferred bidder to finance-build-own-operate the integrated facilities for 25 years. After the contract period the facilities will revert to Government.

The integrated solution includes waste reduction and recycling, household waste recovery centre, yard waste mulching and composting, construction and demolition waste recycling, scrap metal and end of life vehicle recycling, Energy Recovery Facility, bottom ash recycling, and a residual waste landfill for disposal of residual wastes and stabilized air pollution control residue. In all, the integrated system will reduce reliance on landfill by up to 95%. The new waste management system is expected to be fully commissioned in 2024.

In conjunction with developing a new waste management system, the existing landfills, will be remediated to manage any further environmental impacts.



**NAME:** Halla Sahely, Ph.D.

**COUNTRY:** St. Kitts and Nevis

**PROFESSION:** National Project Coordinator IWeco SKN

**BIOGRAPHY:** Dr. Halla Sahely is an environmental engineer with many years of experience in the area of water resources management. She is currently serving as the National Project Coordinator for the GEF IWeco project in St. Kitts and Nevis. Dr. Sahely was the first female Manager / Water Engineer of the Water Services Department in St. Kitts from 2013-2014 after having served as Assistant Water Engineer in charge of strategic planning and capital projects for over 5 years. She managed various projects including the expansion of the chlorination program, state-of-the-art mapping of the entire water system and several other projects related to integrated water resources management. She coordinated the effort to have the vulnerable well-field zone of the Basseterre Valley Aquifer declared a protected area. She received her Ph.D. in Environmental Engineering from the University of Toronto in 2006. Dr. Sahely is a licensed professional engineer in the Province of Ontario, Canada and has served on the executive board of the Caribbean Water and Wastewater Association as Vice-President from 2008-2010 and as Ordinary Member in 2019-2020.

**CONFERENCE THEME:** Nature-based solutions for Water & Land Management

**PAPER TITLE:** Making Peace with Nature - Using the IWeco Approach to Ecosystems Restoration in St. Kitts and Nevis

**ABSTRACT:** The themes of both Earth Day and World Environment Day in 2021 were focused on ecosystems restoration and the urgent need for us to make peace with nature. How can we do this? What actions can we take in small island developing states of the Caribbean to BECOME 'Generation Restoration'. The answer lies in unity, integration and collaboration. Nature-based solutions are critical to making peace with nature.

Nature-based Solutions (NbS) are defined by IUCN as "actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits."

NbS are at the core of a regional project termed the Integrating Water, Land and Ecosystems Management (IWeco) in Caribbean Small Island Developing States project. IWeco's objective is to contribute to the preservation of Caribbean ecosystems and the sustainability of livelihoods through improved fresh and coastal water resources management, sustainable land management and sustainable forest management. IWeco is an integrative approach that focuses on systems, people and values. All project activities consider whole ecosystems (such as watersheds) and focus on relationships and processes within the system. Next, the approach puts people and sustainability at the heart of environmental management and ensures intersectoral cooperation and stakeholder engagement. Finally, this approach recognizes that our environment provides us with important and valuable benefits (also called ecosystems goods and services) which support all life and seeks to enhance benefit sharing.

St. Kitts and Nevis is one of ten participating countries in the IWeco project. The overall goal of the sub-project is to reduce and reverse land degradation in St. Kitts and Nevis by an integrated water, land and ecosystems management approach. The project will strengthen the institutional capacity, improve the policy framework and facilitate pilot projects within the College Street Ghaut watershed (St. Kitts), and key quarry sites and nearby wetlands and coral reefs (Nevis).

This paper will highlight NbS in action in St. Kitts and Nevis implemented through the IWeco project. In St. Kitts, about 5 acres of land inside of a major ghaut (i.e. ravine) were restored in order to mitigate against erosion and land degradation through the installation of gabion baskets and planting of deep-rooted vetiver grass. In Nevis, restoration activities were activated over 10 acres at three separate sites including an abandoned quarry at Potworks Estate and a coastal wetland at Nelson Spring. Finally, marine-based NbS were also activated including the installation of artificial reefs modules which can also serve as coral reef nurseries.

**NAME:** Adam Snyder

**COUNTRY:** United States of America

**ORGANISATION:** The Nature Conservancy

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**CO-AUTHOR:** Anna-Cherice Ebanks-Chin, The Nature Conservancy - Jamaica; Carlos M. Garcia Cartagena, The Nature Conservancy - Dominican Republic; Amrita Mahabir, The Nature Conservancy - Grenada

**CONFERENCE THEME:** Nature-based solutions for Water & Land Management

**PAPER TITLE:** NBS for Wastewater: Opportunities and Barriers in the Caribbean

**ABSTRACT:** In coordination with United Nations Environment Programme Cartagena Convention Secretariat and support from the Swedish Ministry of Environment, The Nature Conservancy (TNC) is assessing wastewater management in four island nations—the Dominican Republic, Haiti, Jamaica, and Grenada—to understand the barriers and opportunities for addressing this issue. The assessment focuses on scientific/technological approaches; policy, legal, and institutional frameworks; the role nature-based solutions (NBS) are playing or can play; and stakeholder engagement, including public opinion research. This assessment is helping guide TNC's engagement on the issue in the region, in order to better support the prevention and reduction of pollution from untreated or inadequately treated wastewater discharges in order to sustain the region's remarkable biodiversity and to ensure human well-being. The research in this report complements the Marine Biodiversity (SPAW) and Marine Pollution (LBS) Protocols of the Cartagena Convention by focusing on the aforementioned countries and includes an analysis of existing research and interviews with subject-matter experts. Overall, we have found that the need for wastewater treatment is profound in the region, but there are common threads that hinder both traditional built infrastructure solutions and NBS from being implemented successfully to address wastewater treatment needs. Without the proper planning and design, stakeholder involvement, government policies and regulatory structures, operations and maintenance, and adequate public financing, the biodiversity and human health of the region will remain at risk no matter what types of wastewater solutions are promoted. NBS for wastewater management represent an opportunity to take a holistic "Source to Sea" approach to conservation programs, that can have the added co-benefit of providing climate adaptation. As CWWA leadership is critical to managing water for both biodiversity and human health, we hope an interactive discussion among governments, the private sector, and NGOs will lead to new thinking about NBS and shared solutions."

**NAME:** Marcela Martinez Ebanks

**COUNTRY:** Water Authority-Cayman

**PROFESSION:** Laboratory Manager, Water Authority - Cayman

**BIOGRAPHY:** Marcela Martinez Ebanks has a fascination for data. She is the Laboratory Manager for Water Authority-Cayman, and holds a BA in Chemistry from Union College, Lincoln, Nebraska, and a Ms in Leadership from Walden University. Additionally, she has a Class IV Wastewater Analyst certificate.

**CO-AUTHORS:** Jerry Banks, Water Authority-Cayman - Cayman Islands

**CONFERENCE THEME:** Exploring the Nexus between Water, Waste and Health

**PAPER TITLE:** Comparison of Methodologies for the Quantification of Hydrogen Sulphide Emissions at a Wastewater Treatment Plant

**ABSTRACT:** Hydrogen sulfide (H<sub>2</sub>S) is a pungent gas that can present odour and health issues in areas near sources of H<sub>2</sub>S with sufficient dispersion. The Water Authority operates a Wastewater treatment facility with a treatment capacity of 9,500m<sup>3</sup> per day. The wastewater treatment process is known to produce H<sub>2</sub>S gas. The quantification of the H<sub>2</sub>S emitted by the Authority's treatment facility is hindered as natural and man-made sources of H<sub>2</sub>S border the treatment plant. The sources include swamps primarily upwind of the treatment plant and a landfill primarily downwind of the treatment plant. To better understand the Authority's contribution to the H<sub>2</sub>S concentrations in the area, active and passive sampling methodologies were deployed to quantify levels of H<sub>2</sub>S at the wastewater plant and its surrounding areas. Active sampling used an Arizona Instruments Jerome J605, which uses gold film technology to measure H<sub>2</sub>S. The J605 provides timed grab samples over defined periods. Passive sampling used radiello® H<sub>2</sub>S air samplers which use microporous polyethylene cartridges impregnated with zinc acetate to estimate the average H<sub>2</sub>S concentration over the exposure period. The sampling data was combined with wind data to identify hotspots of H<sub>2</sub>S production and to quantify the extent of H<sub>2</sub>S dispersion from the identified hotspots at the wastewater plant.

drogen sulfide (H<sub>2</sub>S) is a pungent gas that can present odor and health issues in areas near sources of H<sub>2</sub>S with sufficient dispersion. The Water Authority operates a Wastewater treatment facility with a treatment capacity of 9,500m<sup>3</sup> per day. The wastewater treatment process is known to produce H<sub>2</sub>S gas. The quantification of the H<sub>2</sub>S emitted by the Authority's treatment facility is hindered as natural and man-made sources of H<sub>2</sub>S border the treatment plant. The sources include swamps primarily upwind of the treatment plant and a landfill primarily downwind of the treatment plant. To better understand the Authority's contribution to the H<sub>2</sub>S concentrations in the area, active and passive sampling methodologies were deployed to quantify levels of H<sub>2</sub>S at the wastewater plant and its surrounding areas. Active sampling used an Arizona Instruments Jerome J605, which uses gold film technology to measure H<sub>2</sub>S. The J605 provides timed grab samples over defined periods. Passive sampling used radiello® H<sub>2</sub>S air samplers which use microporous polyethylene cartridges impregnated with zinc acetate to estimate the average H<sub>2</sub>S concentration over the exposure period. The sampling data was combined with wind data to identify hotspots of H<sub>2</sub>S production and to quantify the extent of H<sub>2</sub>S dispersion from the identified hotspots at the wastewater plant.



**NAME:** Kodie Kelvin Scott

**COUNTRY:** Cayman Islands

**PROFESSION:** Senior Development Control Technologist,  
Water Authority Cayman

**BIOGRAPHY:** Kodie is a Senior Development Control Technologist at Water Authority Cayman. He has a strong passion for the environment and the ocean has always been a staple in this life. His credentials include a bachelor's degree in Environmental Studies with a minor in Geographical Information Systems. He also obtained a Master's Degree in Public Health with a concentration on Global Environmental Health. Kodie utilizes his educational background and experience in his daily work to ensure the Cayman Islands develops in a sustainable and environmentally conscious manner. His hobbies include football, tennis and everything water-related.

**CO-AUTHORS:** Marcela Martinez-Ebanks, Water Authority-Cayman - Cayman Islands

**CONFERENCE THEME:** Exploring the Nexus between Water, Waste and Health

**PAPER TITLE:** The chemical composition in the genus Sargassum in the coastal waters in the Cayman Islands. Safe for land use?

**ABSTRACT:** The Sargassum influx in the Caribbean region has increased massively since 2015. The Cayman Islands is not to be excluded from dealing with this invasive ocean floating organism. While limited research has been done on the various impacts on tourism, fisheries and other industries. The land use and agricultural aspect of using Sargassum has been neglected in the academia fields. The purpose of the preliminary paper is to investigate the chemical composition of the genus Sargassum in drifting on the shores of the Cayman Islands. By using the ISO 17025:2017 accredited lab of the Water Authority Cayman with a chemical digestive methodology a better scope of the makeup of this issue can be formulated. The nutrients and heavy metals that will be tested by the lab are Nitrogen, Phosphates, Ammonia, Nitrates, Copper, Zinc, Iron, Lead and Chlorides. Various farmers are contemplating the use of this organic matter to enrich their yields of various crops, however, the effects on the groundwater lens has not been considered. The potential impacts of using Sargassum as compost over areas of the freshwater lens in the Cayman Islands will be used. The results and findings of this investigation could offer a catalyst for further research and papers in the neighbouring Caribbean countries on this familiar dilemma.



**NAME:** Hendrik van Genderen

**COUNTRY:** Cayman Islands

**PROFESSION:** Water Resources Engineer, Water Authority-Cayman

**BIOGRAPHY:** Hendrik van Genderen obtained his environmental engineering degree at Wageningen University & Research in the Netherlands in the late 1980s. He has worked for the Water Authority of the Cayman Islands since 1988 in various positions. As Water Resources Engineer he manages the dynamic team of the Authority's Water Resources and Quality Control Department. Focus areas of the department are management and protection of the groundwater resources of the Cayman Islands and quality control performed by the Authority's accredited laboratory. The department is closely involved in the operations of the Authority as a water and wastewater utility. In addition, the department deals with many environmental and public health issues that impact the quality of life in the Cayman Islands.

**CO-AUTHORS:** Kodie Scott, Water Authority-Cayman - Cayman Islands; Trenton Forman, Water Authority-Cayman - Cayman Islands; Yasmin James Water Authority-Cayman - Cayman Islands

**CONFERENCE THEME:** Optimizing Onsite Wastewater Collection & Treatment

**PAPER TITLE:** Onsite Wastewater Treatment in the Cayman Islands Sharing our story: where did we come from, where are we now, and where are we going?

**ABSTRACT:** The Cayman Islands, like many other jurisdictions in the Caribbean, has a substantial proportion of its wastewater treated by onsite systems. A recent review for PAHO estimated that 23% of the population is connected to the central sewage system and 77% relies on onsite systems, consisting of aerobic treatment units (23%), septic tanks (50%) or no form of treatment (less than 1%).

The Water Authority of the Cayman Islands is tasked with the regulatory oversight of onsite wastewater treatment and disposal. The paper titled Onsite Wastewater Treatment: Here to Stay, How to Manage? presented by Catherine Crabb at the 2003 CWWA conference reviewed the challenges and opportunities of developing the Onsite Wastewater Management Programme (OWMP) in the Cayman Islands. In 2009 the same author presented a paper at the CWWA conference on the performance of onsite wastewater treatment systems.

This paper provides an update on the 2003 and 2009 presentations. The challenges and opportunities of onsite wastewater treatment in the Cayman Islands are repeated throughout the Caribbean region, with regulatory oversight being exercised by relatively small agencies with limited staff and resources. The Water Authority's OWMP has evolved recognizing that onsite wastewater treatment will remain the most practical and viable solution in many areas in the Cayman Islands for wastewater management.

The Authority continues to assess the effectiveness of its OWMP resulting in continued evolution and improvements of the programme. The OWMP relies on a strong partnership between the Authority, property owners and private sector service providers. It is supported by proprietary software that manages all data relating to onsite systems. The Authority has an accredited laboratory that conducts wastewater testing. The programme is supported by an in-house developed training and education programme for service providers, property owners and certification of wastewater technicians. Whereas the OWMP has addressed many challenging issues, there remains a need to further develop it in response to new challenges and ongoing rapid development in the Cayman Islands.



**NAME:** Breandan McDonnell

**COUNTRY:** Cayman Islands

**PROFESSION:** Civil Engineer, Water Authority-Cayman

**BIOGRAPHY:** Having received his B.Eng Honors degree in Civil Engineering in Ireland, Breandan's experience to date is as a Project engineer. I have worked in both structural and civil aspects of engineering. Prior to his arrival in Grand Cayman, he worked for a large Civil contractor in Ireland, where Horizontal Directional drilling and tunnel boring was the speciality of the contractor. His current position with Water Authority Cayman is as project engineer on the waste water collection side, where the collection system is being upgraded and rehabilitated with the use of pipe bursting and manhole replacement.

**CONFERENCE THEME:** Optimizing Onsite Wastewater Collection & Treatment

**PAPER TITLE:** Pipe Bursting

**ABSTRACT:** Pipe bursting is a relatively new method of replacing pipes underground. The method of pipe bursting is cost-effective, less invasive and relatively quick in comparison with cut and fill methods of pipe replacement. The concept of pipe bursting was originally developed on the basis of pneumatic piercing. When DJ Ryan and Sons Ltd. and British Gas successfully ran one through an existing gas line in England in 1981, pipe bursting was born. Years on, it is the preferred method of pipe replacement by contractors and local authorities due to, less digging (entry & exit pit is only needed), the ability to minimally disturb the soil as new pipe is laid and its cost-effectiveness all around. This abstract examines pipe bursting from a sewerage collection system improvement point of view. In particular, the improvements made to the wastewater collection system as a direct result from Inflow/Infiltration (I&I). I&I is a huge problem for wastewater treatment systems. I&I adds clear water to sewer systems increasing the load on the system. When clear water enters sanitary sewer systems, it must be transported and treated like sanitary wastewater. WAC has been using pipe bursting technology for the past three years and it is now its main method of sewer pipe replacement. The material that currently serves our sewer network system is mostly clay pipe which is susceptible to vibration, brittleness and ultimately collapse. The main advantages of HDPE pipe are its continuity, flexibility, and versatility. The continuity, which is obtained by butt fusing together long segments in the field, allows for a smoother interior surface (relative to other pipe material) reduces the friction between the flow and the pipe wall, which allows higher flow speed and increased flow capacity. The HDPE pipe does not erode, rot, corrode, or rust; it also does not support bacteriological growth. The main challenge found with the installation of the HDPE pipe and the use of pipe bursting technology is Caymans high water table, and tidal influence.



**NAME:** BumSoo Han

**COUNTRY:** Austria

**PROFESSION:** Radiation Chemist, International Atomic Energy Agency

**BIOGRAPHY:** Mr BumSoo Han is Radiation Chemist in the IAEA. Before joining the IAEA, one of his major interests is the development of radiation processing technologies for industries and also engaged in manufacturing of industrial radiation sources including electron accelerator and X-rays. Radiation processing offers a clean and additive-free method for the preparation of value-added novel materials based on renewable, non-toxic and biodegradable natural polymers and natural polymer waste, and also the remediation of polluted water and air. Mr. Han received his B.S. in Nuclear Engineering from Seoul National University, Republic of Korea (1982) and M.S. in Material Sciences from Korea Advanced Institute of Science and Technology (KAIST) (1984) and Ph.D. in Metallurgical Engineering from the Colorado School of Mines, U.S.A. (1991). He has worked at Samsung Heavy Industries Co. and EB TECH Co., Ltd.

**CO-AUTHORS:** Celina Horak, International Atomic Energy Agency - Austria; Valeriia Starovoitova, International Atomic Energy Agency - Austria; Melissa Dencke, International Atomic Energy Agency - Austria.

**CONFERENCE THEME:** Optimizing Onsite Wastewater Collection & Treatment

**PAPER TITLE:** Wastewater Treatment by Radiation Technology

**ABSTRACT:** The problems of environmental damage and degradation of natural resources are receiving increasing attention throughout the world. The increased population, higher living standards, increased urbanization and enhanced industrial activities of humankind are all leading to significant water pollution.

Radiation technologies have been widely promoted in industry, agriculture, and researches. Ionizing radiation in the form of accelerated particles or electromagnetic waves are capable of ionising water molecules, thereby generating active radicals from the water molecule that react with the harmful organic contaminants in the wastewater. These contaminants then degrade and become simpler chemical forms and are easier to treat through traditional methods. The first studies on radiation treatment of wastes were carried out in the 1950s principally for disinfection. In the 1960s, these studies were extended to the purification of water and wastewater. After some laboratory research on industrial wastewaters and polluted groundwater in the 1970s and 1980s, several pilot plants were built for extended research in the 1990s. The first full-scale application was constructed in 2005 for the treatment of textile dyeing wastewater (10,000 m<sup>3</sup>/d) in Korea with the support of the International Atomic Energy Agency (AEA), followed by a plant in China in 2020 (30,000 m<sup>3</sup>/d) for textile industries. The results of practical applications confirmed this technology is easily and effectively utilized for treating large quantities of wastewater.

Radiation treatment can also be used to treat emerging organic pollutants in groundwater such as fertilizers, pesticides, and pharmaceutical residues that can lead to ground pollution and consequent contamination of water resources. The major advantage of radiation technology is that the reactive species are generated in-situ during the radiolysis process without the addition of any chemicals and such reactions can be carried out at a relatively low temperature, resulting in lower energy cost, less thermal damage to the system and product.



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**BIOGRAPHY:** Alphonsus Daniel has been a practicing Mechanical, Sanitary and Environmental Engineer for 35 years with a wide range of experience in planning, design, supervision and management water and waste water systems. A 1986 graduate from ISPJAM, Cuba with a B.Sc. and a Masters of Engineering in Mechanical Engineering. After graduation, experience has been developed through working with the National Water and Sewerage Authority Grenada, and later in 1994-1996 pursued a post graduate Diploma and a Master of Science Degree in Sanitary Engineering from IHE, Delft. He was the sole founder of Daniel and Daniel Engineering in 1999. Daniel and Daniel Engineering has been performing consulting services for various private and Governmental organizations in Grenada and the Caribbean. He is a Past President of the CWWA & Past President of the Grenada Institute of Professional Engineers (GIPE). He is also the President of the Rotary Club of Grenada 2021-2022.

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**CONFERENCE THEME:** Optimizing Onsite Wastewater Collection & Treatment

**PAPER TITLE:** Optioneering and design of small scale pilot greywater collection, treatment and reuse system, College Street Ghaut, St. Kitts

**ABSTRACT:** It is well recognized that climate change impacts will have serious deleterious environmental, social and economic consequences for small island developing states (SIDS). Many SIDS face severe constraints in both the quality and quantity of freshwater because of their small size and geological, topographical and climatic conditions. One major technical issue is the disposal of wastewater. In St. Kitts and Nevis, on-site disposal of wastewater (i.e. use of septic tanks, soakaway pits and pit latrines) is currently practiced. Septic tanks are used to contain blackwater whereas greywater (i.e. all household water used excluding the toilet) is sometimes transported, via open gutters lining the streets, to the nearest water body (usually the ocean). The issue of greywater entering the coastal zone untreated is especially severe in the College Street Ghaut watershed presenting a major threat to public health and to the water quality of the coastal zone. There is an urgent need to invest in the collection and disposal of wastewater to ensure the continued sustainable development of the nation and increase the resilience of the island to climate change.

St. Kitts and Nevis is one of ten participating countries in the Integrating Water, Land and Ecosystems Management in Caribbean SIDS (IWECO) project. The overall goal of the sub-project is to reduce and reverse land degradation in St. Kitts and Nevis. The project will strengthen the institutional capacity, improve the policy framework and facilitate pilot projects within the College Street Ghaut watershed (St. Kitts), and key quarry sites and nearby wetlands and coral reefs (Nevis).

This paper will describe the process of optioneering and design of a small-scale pilot system for greywater collection, treatment and reuse at a site inside the College Street Ghaut. The evaluation criteria for the optioneering process included:

**Environmental:** Nutrient recycling (P, N), organic matter recycling (COD, BOD<sub>5</sub>), occupied area, energy use, sludge and by-product production, sludge quality, eutrophication potential, disinfectant consumption.

**Public Health:** Contact risk, treated water quality, public acceptance, potential for reuse of treated effluent for irrigation or other uses.

**Financial:** Net present value, Cost benefit ratio, expected lifetime, operation and maintenance requirements.

**Technology:** Ability to adapt to fluctuations in hydraulic and pollution loading, vulnerability to natural disasters and climate change

In addition, the paper will highlight important features of the final design highlighting the implementation plan (detailed workplan, resource and budget allocation, stakeholder analysis, identification of training requirements, risk assessment / contingency plans and monitoring and evaluation).



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