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ClearWaters

**Humanitarian Assistance –
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**Also Inside:
Highlights from Spring Technical
Conference & Exhibition**





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nywea.org



Clear Waters

New York Water Environment Association, Inc.

President's Message 4
Robert Wither

Executive Director's Message 5
Patricia Cerro-Reehil

Highlights from the Spring Technical Conference & Exhibition 6-7, 51

Water Views: We All Live in a Watershed 9
James Tierney

Focus on Safety: Should I Stay or Should I Go? 9
Eileen M. Reynolds

Not Clear Water Everywhere 10
Robert E. Adamski

Volunteerism Helps End the Global Water Crisis 14
Dana de Andres

Humanitarian Engineering: Education and Application 16
Douglas Daley and Grace Anderson

Engineers Without Borders: Getting Involved 22
Taylor Brown

Taking Care of Communities: American Red Cross 26
Rosie Taravella

Navigating Foreign Terrain in La Laguna, Nicaragua 30
Rosaleen B. Nogle

AguaClara: Empowering Communities Through Safe Water 36
Serena Takada

Community Water Supply: A Case Study in Machakos County, Kenya 39
Eric R. Lehan

Community Perspectives 45
Festus Kavita Ndolo

Lessons Learned for Community-Based Design and Usage of Household Latrines 47
Walter A. Walker and Melissa Montgomery

The Importance of Utility Knowledge-Sharing and Mentorship: New York City, Fiji and Samoa Tackle Climate Change 52
Mikael Amar, Pamela Elardo, Jane Gajwani, Nate Kimball and Dennis J. Stanford

Reducing Poverty Through Economic Growth: MCC's Water Investment in Mongolia 57
Shajan Joykutty and Kumar Ranganathan

Reduce Energy Costs by More Than 5 Percent: Building Interest in Strategic Energy Management at New York's WRRFs 60
Kathleen M. O'Connor

Operator's Quiz: Process Troubleshooting 61

In Memory: John Sansalone 62

Cover: Children collecting household water at a surface water impoundment, Machakos County, Kenya. Weiling Xu, Engineers Without Borders-NY

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Welcome to the summer issue of *Clear Waters*, where we explore some of the various forms of humanitarian assistance currently underway to address water quality issues throughout the world.

Humanitarian Assistance

Bob Adamski has been leading NYWEA's efforts as chair of the Humanitarian Assistance Committee. The humanitarian efforts highlighted in these articles clearly

demonstrate advantages we have living in New York. New Yorkers often take the availability of clean water for granted. Because of this our WRRFs rarely receive the credit they deserve for protecting our health. More than 2 billion people worldwide do not have these same benefits. Wastewater is discharged into the environment without proper treatment and children are dying daily from diarrheal diseases attributed to consumption of contaminated water. Not only do communities lack clean water, but they lack the training, knowledge, and resources to build the systems necessary to maintain clean water for drinking, cooking, bathing and environmental health. Read the articles and be grateful for what we have, but take the time to consider where we may offer assistance.

2019 Spring Technical Conference

My writing in this issue follows a successful Spring Technical Conference in Saratoga Springs, New York. Our attendees had the opportunity to participate in an open panel discussion on Workforce Sustainability. During the Opening Session, we had Dan Rourke from Saratoga County Sewer District, Mark Crandall from the City of Watertown, Kenya Lewis from NYCDEP and Water Ambassador Mike Garland from Monroe County discuss their approaches to developing a more sustainable workforce. The Public Outreach Committee held an educational outreach session for 61 elementary school students from two schools. Over pizza, these students were all willing to share their excitement over watching the microorganisms that are present in an aeration tank.

During the Spring Technical Conference, I had the pleasure of assisting with the Operations Challenge through the Process Control event. This year was quite a successful event with seven New York teams and two New Jersey teams participating. Congratulations to the Rockaway Sludge Hustlers for winning overall. They, along with second-place team Brown Tide and third-place team Watershed Warriors, all qualified to demonstrate their skills at the National Competition held during WEFTEC in Chicago, Illinois, Sept. 21-25, 2019.

Operator Workforce Sustainability

We are continuing to look for ways to increase awareness of the career opportunities that exist in the wastewater field. Opportunities to develop interest begin with the school children that visited during the Spring Technical Conference. These children learned about what happens when they flush, how wastewater is treated, and the microorganisms that do the work. Participating in the workshop was SUNY-ESF graduate student Tianna Tyler. Tianna is working to develop a wastewater curriculum to educate elementary students (Grades 3-5) as part of her Practicum. As

these students demonstrated, their enthusiasm for learning is boundless. They simply need the exposure followed by encouragement to continue developing that enthusiasm.

The Syracuse City School District (SCSD) has programs to allow students to experience many different career opportunities. Their Career and Technical Education (CTE) Program includes career pathway training programs that introduce students to career opportunities, beginning with an introduction in eighth grade and expanding in high school, by providing educational opportunities that include internships, apprenticeships, industry credentials and college credits. SCSD is very interested in incorporating the water resource career opportunities into their Natural Resources career pathway. Our plan is to continue working with SCSD such that NYWEA is participating in SCSD's career day programs for eighth-graders in the September/October timeframe. The beauty of the CTE program is that it is approved by the New York State Education Department and is available throughout the state, either as an approved program delivered by a school district or as a BOCES program. As we develop experience with SCSD, we will hopefully be able to use that experience to bring water resource recovery to other CTE Natural Resources Programs in the state.

The workforce sustainability and humanitarian efforts by NYWEA members exemplify why this organization and its members lead the way in sustaining clean water quality.

NYWEA's Loss

It is sad news that NYWEA has lost a long standing and very supportive member in John Sansalone. I had the pleasure of working with John both as a fellow NYSDEC employee and on several NYWEA committees. John's absence was felt during the Operations Challenge where he served as a judge for many years. John had a passion for protection of the environment and that passion was evident in his commitment to participating in chapter and state-level NYWEA committees and boards. John's dedication to the mission of NYWEA will be missed. (See tribute on page 62.)



Robert Wither, PE, NYWEA President



SUNY-ESF graduate student Tianna Tyler, center, is developing a wastewater curriculum to educate elementary school students.



As our cover so poignantly reflects, millions of people all over the world still do not have access to reliably clean water sources. One of the things that we can do to help bring attention to that problem is to start the education process at a younger age.

To that end, we recently invited students from two schools in Saratoga Springs – Malta Montessori and St. Clement's – to our Spring Technical Conference. When I told these children that we have the privilege of turning on the faucet and having water come out, and many people in the world do not have this luxury, the children asked the question, "Why can't everyone have clean water?" It can get complicated to explain this so an 8-year-old can understand. As adults, we know climate, politics, affordability and availability are just a few of the moving parts to this difficult question. This is one of the big challenges, for each one of us working in the water sector!

A Call to Action

Bob Adamski, chair of NYWEA's Humanitarian Assistance Committee, not only helped in the coordination of this issue of *Clear Waters*, he also crafted the article on pages 10-12. Bob's dream is to see more NYWEA members give what they can to the organizations in need, and in his article he gives us a menu of the great organizations doing work in water, sanitation and hygiene (WASH). There are many ways to give, not just financially (although money makes a difference!). Share what you know, either speaking to a classroom or going on a trip to make a difference in another country. NYWEA is 2,700 members strong. If each member spoke to one third-grade class of 25 students, our impact would amplify! Let NYWEA be a resource; we have some tools to help you to make a half-hour presentation. Together we can all make a difference.

Many thanks to the members of the Publications Committee, including Rosie Nogle, for their assistance in coordinating the articles for this issue. Bob Adamski also hit a home run for NYWEA



Children at a nearly dry rainwater tank at Misuuni Primary School, Machakos County, Kenya. *Eric R. Lehan*

by organizing a Humanitarian Assistance session at our Spring Technical Conference in June, with presentations by representatives from AguaClara Reach; Bjorn Von Euler regarding corporate responsibility in Water and Sanitation; rainwater harvesting; and New York City Department of Environmental Protection's Water Operators Partnership on Climate Resiliency. It is wonderful to have these organizations involved in NYWEA activities.

Student Chapter News

With several of our scholarship winners attending Cornell University, I asked Madison Quinn, NYWEA's Communications Manager and Scholarship Administrator, to reach out to the students to gauge their interest in getting a NYWEA Student Chapter started there. Vice President Lauren Livermore, Madison and I made a trip to the campus and met with the students. Hats off to Ben DeMoras, Arjun Hausner and Lydia LaGorga who stepped up to make it happen! The NYWEA Board of Directors unanimously approved the creation of the Cornell University Student Chapter that is now also recognized by the Water Environment Federation.

Congratulations to our Student Chapter members from Manhattan College and SUNY Environmental Science and Forestry who will compete in the Water Environment Federation (WEF) Student Design Competition. This competition is intended to promote "real world" design experience for students interested in pursuing an education and/or career in water/wastewater engineering and sciences. The competition promotes interest and skills that will prove to be extremely valuable as students enter the professional world. If you attend WEFTEC, please come and support the two New York teams from SUNY-ESF and Manhattan College as they compete in the largest Student Design Competition in WEF's history! You are sure to be impressed and amazed at what they do, how they innovate and conduct themselves professionally.

Tis the Season for Award Submissions

Do you know a deserving individual, municipality or company who has gone above and beyond the call of duty in their water quality work? Submit your nominations and let us help you to celebrate their achievements. (See "Membership" at nywea.org.) An award from NYWEA can motivate individuals on their career path and give them recognition among their environmental peers at NYWEA's 92nd Annual Meeting in New York City in February 2020.

Congratulations!

Speaking of recognition, for those of you who call the office, Maggie Hoose is someone you've spoken to likely more than once! We are celebrating her 25th year working for NYWEA. Her dedication and commitment to this organization is noteworthy. Working with her for the past 25 years has been a privilege! Here's to you, Maggie!



Margaret "Maggie" Hoose

Patricia Cerro-Reehil
Patricia Cerro-Reehil, pcr@nywea.org

NYWEA Spring Technical Conference & Exhibition “Developing a Sustainable Operator Workforce”

Over 250 people attended NYWEA’s Spring Technical Conference & Exhibition held at the Saratoga Hilton & City Center, June 10-12. Meeting attendees selected from 10 sessions covering different topics. Thirty exhibitors filled the City Center where the 2019 Operations Challenge also took place. Many thanks to Dave Barnes and the members of the Conference Management Committee, Program Committee, speakers, moderators, advertisers, sponsors, exhibitors, Operations Challenge teams, judges and coordinators and, most importantly, the attendees for making the meeting a success!



NYWEA President Robert Wither leads the Opening Session panel discussion. On the dais with him are (center) Kenya Lewis, NYC Department of Environmental Protection, and (right) Mark Crandall, City of Watertown, who talked about that city’s succession plan.



Walt Walker talks about the multiple benefits of a Master Plan.



Mike Garland from Monroe County talks about the challenges of creating a sustainable operator workforce.



Mike Amar of NYCDEP addresses the members about climate change and resiliency.



Lisa Derrigan, NYWEA’s Program Committee Chair, introduces a speaker.



During the Opening Session, Dan Rourke from the Saratoga County Sewer District talks about collection system wins and woes.



Taylor Bottar of Barton & Loguidice addresses UV Disinfection.



Vijesh Karatt Vellatt, Vice Chair of NYWEA’s Program Committee.



John Esler talks about ... what else? Clarifier problems and solutions!



Magdalini Kathehis addresses the members on the topic of sludge management from waste to resource recovery.



Gregg Palmer of Koester Associates.



Bjorn Von Euler addresses NYWEA members on corporate social responsibility in water and sanitation.



Robert Kukenberger talks about engineering ethics.

Left to right: Mike Coley and Water Ambassadors Keneck Skibinski and Anthony Della Valle.





President Robert Wither and First Lady Susan Wither at the Casino in Saratoga Springs.



Anthony Della Valle and Joyette Tyler Della Valle.



Joe and Ann Massaro.



Water Ambassador Steve Fangman and Lucia Fangman.



Lauren Livermore, NYWEA's Vice President and Kathryn Serra.



L-r: J. Kirk Rowland inducts Madison Quinn, Rosaleen Nogle and Mike Quinn into the Golden Manhole Society with NYWEA President Bob Wither.



Dale Grudier and Donna Bee, NYWEA's Operator Representative to the Board.



Water Ambassador J. Kirk Rowland speaks during the Public Outreach activities.



Madison Quinn teaches students about the water cycle using an Enviroscape as a tool.



Subhani Katugampala (left) of AguaClara Reach and Yitzy Rosenberg of Cornell University.



Steve Sanders and Patricia Cerro-Reehil.



Adam Baker from Cues shares what good work the Cues cameras do inside pipes!

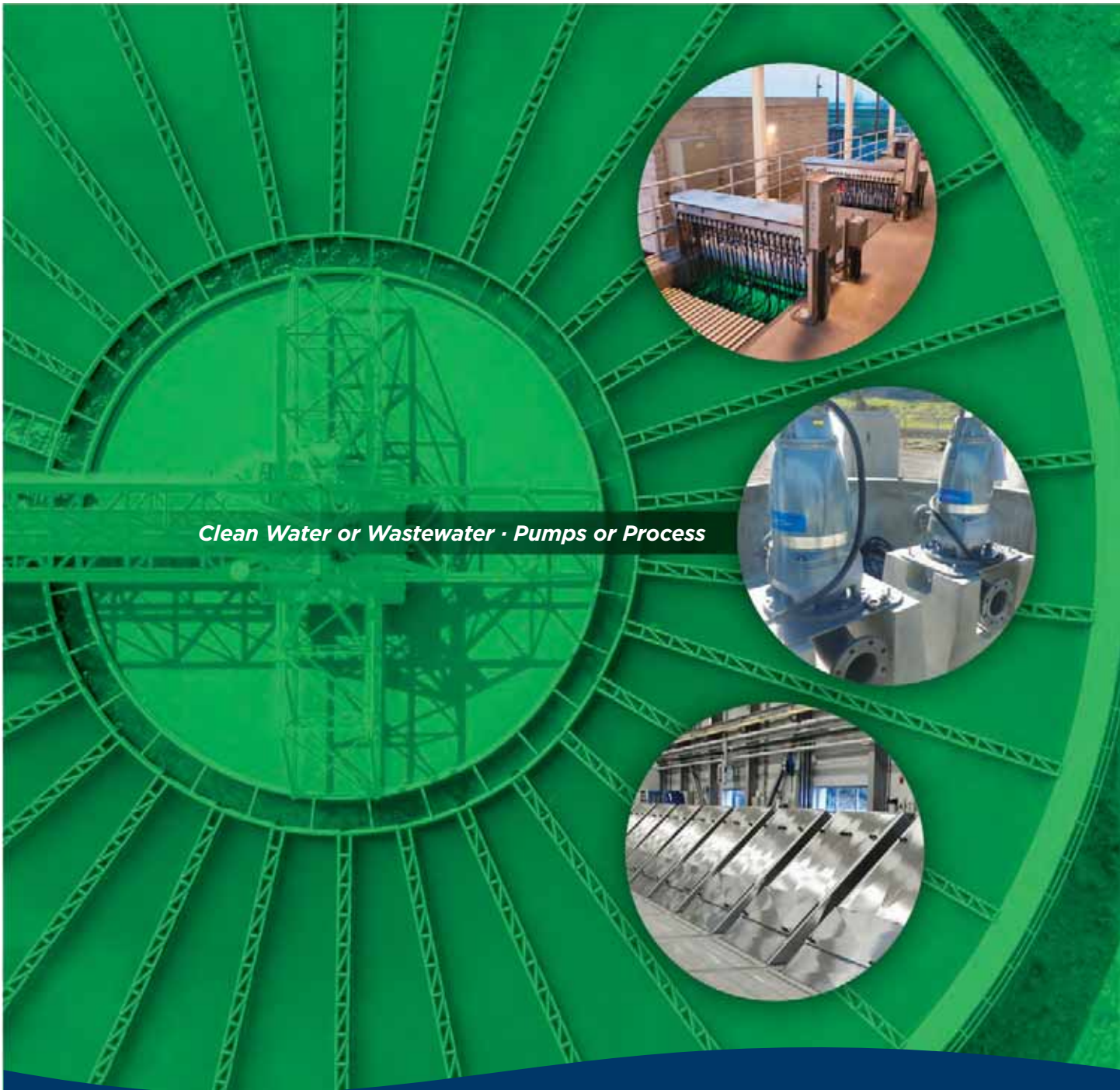


The children from St. Clement's School are intrigued.



Julie Barown (center) and Christina Chiappetta teach students from the Malta Montessori and St. Clement's schools about microbes.

continued on page 51



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We All Live in a Watershed

A watershed approach to planning and management is an important part of water protection and restoration.

New York has numerous watershed and basin programs, many managed by NYSDEC in collaboration with partners. The following programs implement an interdisciplinary approach to watershed management, considering water ecology, habitat and resiliency.

- The **Finger Lakes Watershed Hub**, established in 2017 by Governor Cuomo and the state's Water Quality Rapid Response Team, aims to better understand, protect and address water quality issues confronting the Finger Lakes, particularly harmful algal blooms.
- The **Long Island Sound Study Program** is a USEPA, New York, Connecticut and local partnership to restore and protect the Sound's water quality and habitat health, guided by the Comprehensive Conservation and Management Plan. (<http://longislandsoundstudy.net/>)
- Guided by the Great Lakes Action Agenda, the **Great Lakes Basin Program** provides a watershed-based focus to protect, restore, conserve and enhance the ecosystem health of the Great Lakes waters and water-dependent resources across 43 percent of our state. (<https://www.dec.ny.gov/lands/25562.html>)
- The **Hudson River Estuary Program** uses a collaborative approach guided by the Hudson River Estuary Action Agenda to help people enjoy, protect and revitalize the Hudson River and its valley from the Troy Dam to upper New York Harbor. (<http://www.dec.ny.gov/lands/4920.html>)

- The **Mohawk River Basin Program** promotes ecosystem-based management that fosters partnerships regionwide to manage, protect and sustain the natural resources of the river and its watershed. (<https://www.dec.ny.gov/lands/58571.html>)
- NYSDEC is an active partner in the **New York City Watershed Management Program**, helping to protect the largest unfiltered drinking water supply in the nation through technical support, coordination, and regulatory and nonregulatory oversight. (<https://www.dec.ny.gov/lands/58529.html>)
- The **Long Island Nitrogen Action Plan (LINAP)** is a multiyear initiative to reduce nitrogen in Long Island's surface and ground waters by NYSDEC, the Long Island Regional Planning Council, and Suffolk and Nassau counties, with input from partners and stakeholders. (<https://www.dec.ny.gov/lands/103654.html>)
- NYSDEC's **Chesapeake Bay Program** focuses on implementing total maximum daily load requirements for New York's portion of the Chesapeake Bay watershed, which encompasses the Susquehanna and Chemung watersheds. (<https://www.dec.ny.gov/lands/33279.html>)
- NYSDEC is a partner in the **Lake Champlain Basin Program**, a Congressionally designated bi-state, bi-national initiative to coordinate and fund efforts benefiting the basin's water quality, fisheries, wetlands, wildlife, recreation and cultural resources. (<http://www.lcbp.org/>)

The watersheds we live in can be large or small, and our actions affect everyone downstream and around us. Get involved and take ownership of your watershed. Learn more at <https://www.dec.ny.gov/chemical/74997.html>.

– James Tierney, Deputy Commissioner for Water Resources
NYS Department of Environmental Conservation



Should I Stay or Should I Go?

We all have technical skills in our fields that sometimes are needed in another part of the U.S., or even abroad. When we are asked for help, we need to make an informed decision in reasonable time. "Should I stay, or should I go?" aren't just song lyrics.

International travel is a lot different from domestic travel. If your international destination is on the edge of your comfort zone, then you have additional concerns to think about. Fortunately, helpful resources are available through either government agencies (U.S. Department of State, Centers for Disease Control and Prevention, Peace Corps) or private non-governmental organizations (World Vision). Understanding both the potential risks and the potential benefits is key to making an appropriate decision for your circumstances.

Whether the assignment is here or abroad, certain commonalities exist for a traveler or project worker. Your personal conduct and your personal awareness of any situation are key. Think about how you will likely react or interact with others. This will require you to know yourself, your strengths and your limitations. Become familiar with your environment and be aware of, if not alert to, your surroundings. Be understanding, or at least accepting, of dif-

ferent customs, perceptions and risks. Be aware that how you dress, speak, interact with others and present yourself will influence how the host community reacts to you. Be mindful that how you behave may affect your safety and the safety of others. Your travel assignment is not your adult spring break; avoid drinking to excess, hooking up or hanging from the chandelier. At all times, you must remember that you are a representative of your organization. You have the skills that others are depending on. The host community is likely stressed by the very circumstances that brought you there, so be at your professional best.

All this is not to worry anyone into a frenzy. I have traveled for business to some areas where I would not have ordinarily chosen to travel. I went prepared and looked at the assignment as an opportunity. The work was usually hot, dirty and tiring, but there was progress day by day and satisfaction at the end of the assignment. I was pegged as an Easterner when traveling out West, and as an American the moment I opened my mouth when traveling overseas. My hosts were charming, bending over backward to help our team do its work, and then welcoming us into their homes. Although travel is inconvenient – I had to remember not to have ice in a drink, and I couldn't wander off by myself to explore – I wouldn't have missed it for anything.

Should I stay or should I go? You bet I went!

– Eileen M. Reynolds, Certified Safety Professional
Owner, Coracle Safety Management

Not Clear Water Everywhere

by Robert E. Adamski

While the value of water is taken for granted in much of the U.S., in low and middle income (e.g., developing) countries water is a cherished resource.

The United Nations International Decade for Action “Water for Life” ended in 2015. The United Nations had several stated goals that came from this 10-year program:

- Promote efforts to fulfill international commitments in the water sphere.
- Raise the profile of water in the global agenda.
- Focus the world’s attention on the ground-breaking, life-saving and empowering work done by those implementing water programs and projects.
- Be a bridge to further cooperation between governments and other stakeholders; between nations and diverse communities; between economic interests and the needs of ecosystems and the poor.
- Promote efforts to ensure the participation of women in water and sanitation.

Although accessibility to water and sanitation improved over the decade, the United Nations noted:

“The Water for Life logo users and the partnerships which the decade has helped boost and create will respond to the challenge of the 2030 Sustainable Development Agenda of the need to be transformative and to bring about change. ... Their work is necessary because 663 million people still drew water from an unimproved source in 2015, and for these people the statistics mean nothing. From 1990 to 2015, 2.1 billion people gained access to a latrine, flush toilet or other improved sanitation facilities, helping to comprise a total of 68 percent of the global population. Yet we missed the Millennium Development Goal (MDG) target for sanitation by 9 percentage points. We have to keep working.” (*United Nations 2015*).

As a result, the United Nations General Assembly declared 2018-2028 as the International Decade for Action on Water for Sustainable Development. This Water Action Decade commenced on World Water Day, March 22, 2018, and will end on World Water Day, March 22, 2028.

In 2005, water was one portion of Millennium Development Goal 7 “Ensure Environmental Sustainability.” The water portion of this goal reads: “Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation.” (*United Nations 2015*). In 2016, the General Assembly agreed on a stand-alone water goal as part of the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (*United*

Nations 2018). Sustainable Development Goal No. 6 reads: “Ensure access to water and sanitation for all” (*United Nations 2016*). This reflects that water and sanitation have become key priorities for member states.

Getting Involved – Nongovernmental Organizations

While government agencies are expected to meet these goals, given their history of failure the nongovernmental organizations (NGOs) have been working to “pick up the slack.” There are thousands of NGOs working worldwide on “watsan” (water and sanitation) or WASH (water, sanitation and hygiene). They range from large organizations like World Vision (over \$1 billion a year in revenues) to small ones like El Porvenir (over \$1 million a year in revenues). They are supported by grants, church offerings, corporate and individual gifts and in-kind services. Many of these organizations were founded in response to President John F. Kennedy’s call, “ask what you can do for your country,” and are aging and dealing with succession planning.

How can you get involved? Decide what it is you want to do. Donate? Fundraise? Volunteer? Go overseas and help?

To Donate

Given the number of worthwhile (and some not so worthwhile) organizations, how do you decide where to direct your donations? I suggest two websites you can check:

- An organization rating site, like Charity Navigator (www.charitynavigator.org), which rates charities based on a set of metrics.
- Check an organization’s exempt status at the Internal Revenue Service website (www.irs.gov).

To Volunteer

Look for an organization focused on sustainability that teaches residents how to do projects. See if they have a system of monitoring and evaluation and have projects that still work after five years. Many well-intentioned volunteer organizations have “flown in,” built a system and left without any technology transfer or buy-in from the users. These projects typically don’t last.

NYWEA has a Humanitarian Assistance Committee whose mission is advocating for NYWEA’s involvement in increasing awareness and supporting the need for safe water and proper sanitation in developing countries around the world, as well as helping others in time of need such as recovering from natural disaster. By joining the Humanitarian Assistance Committee, you will get to network with NYWEA members who are involved in various organizations working around the world.

Other professional organizations like the American Society of Civil Engineers (ASCE), and the American Water Works Association (AWWA) have similar committees that support organizations like Water For People and Engineers Without Borders.

Take Action

Help inspire action to achieve the United Nations’ 2030 Agenda for Sustainable Development (*United Nations 2018*) by joining thousands of other people on World Water Day March 22 (*United Nations 2019a*) and World Toilet Day Nov. 19 (*United Nations 2019b*) to raise awareness of the water and sanitation crises and exert public

Facts & Figures

- 2.1 billion people lack access to safely managed drinking water services. (*World Health Organization/UNICEF 2017*)
- 4.5 billion people lack safely managed sanitation services. (*World Health Organization/UNICEF 2017*)
- Water scarcity already affects four out of every 10 people. (*World Health Organization 2018*)
- 90 percent of natural disasters are water related. (*UNISDR 2016*)
- Globally, 80 percent of wastewater flows back into the ecosystem without being treated or reused. (*UNESCO 2017*)

pressure for change.

Following is a list of some small to medium-sized nonprofit organizations that I know of who could use our support. Many offer opportunities for NYWEA members to apply their knowledge, skills and experience to solve real problems for communities both in the U.S. and abroad.

charity:water

charity:water is a nonprofit organization bringing clean and safe drinking water to people in developing countries. It has \$36.5 million in revenue, and funded 38,113 water projects for 9.6 million people around the world. (www.charitywater.org)

Community Engineering Corps

Community Engineering Corps is an alliance between ASCE, AWWA and Engineers Without Borders U.S.A. (EWB-USA). The organization uses the expertise of volunteer engineers to help underserved communities in the U.S. that do not have the resources to access engineering services meet their infrastructure needs and improve each community member's quality of life.

(www.communityengineeringcorps.org).

El Porvenir

El Porvenir (EP) assists people in rural communities in Nicaragua to improve their living standards through sustainable development in clean water, sanitation, health education and watershed management. EP has 25 years of experience helping rural Nicaraguan communities build appropriate technology (wells, latrines, community washing stations and fuel-efficient stoves), as well as providing communities with the tools they need to manage their water, sanitation and forestry resources. Service groups spend most of their time (one to two weeks) working alongside villagers on sustainable development projects. It has \$1.4 million in annual revenue. (www.elporvenir.org)

Engineering Ministries International

Engineering Ministries International (EMI) is a Christian-based development organization that designs facilities that serve the poor in developing countries, including hospitals, orphanages, schools and clean water projects. To produce its designs, EMI blends its team of in-house project managers with volunteer architects, engineers, land surveyors, and construction managers recruited from around the world. Volunteers donate their time and travel costs. Since 1982, EMI has worked on more than 1,000 relief and development projects in more than 90 countries. It has \$5.8 million in annual revenue. (<https://emiworld.org/us>)

Engineers Without Borders

Engineers Without Borders (EWB) partners with the ASCE and developing communities worldwide to improve their quality of life. This partnership involves implementation of sustainable engineering projects while involving and training internationally responsible engineers and engineering students. EWB-USA, with more than 14,700 members, is involved in water, renewable energy and sanitation projects in 43 developing countries. These projects are completed in partnership with local communities and NGOs. It has less than \$1 million in annual revenue. (www.ewb-usa.org)

Global Water

Global Water is a volunteer-based, international humanitarian

organization focused on providing safe water supplies, sanitation and hygiene facilities, and related health programs for rural villagers in developing countries. Global Water's Rural Outreach Water Supply Program works with local NGOs in a developing country to identify suitable water projects and to provide specialty water-related equipment, technical expertise and partial funding. Global Water may assemble Water and Technical Emergency Response (WATER) Teams to perform project work during emergency events such as natural disasters. It has less than \$1 million in annual revenue. (www.globalwater.org)

Healing Waters International

Healing Waters International is on a mission to end the global water crisis. The organization builds holistic clean water solutions in at-risk communities around the world, empowering people not just to survive, but also to thrive physically, socially and spiritually. It has about \$2 million in annual revenue. (www.healingwaters.org).

Lifewater International

Lifewater International is a Christian-based development organization that works in Africa and Asia to eliminate water-borne disease and inadequate access to water. With a focus on sustainability, Lifewater helps communities gain safe water, adequate sanitation, effective hygiene, and the skills they need to pass on these resources to future generations. It has \$6.1 million in annual revenue. (www.lifewater.org)

Living Waters for the World

Living Waters for the World (LWW) is an ecumenical global mission providing sustainable clean water and fostering long-term, mutually beneficial relationships between volunteers and communities in need. LWW trains volunteers to establish and lead water mission teams that partner with international communities on the implementation and operation of sustainable water purification systems and health education programs. LWW water teams focus activities with international networks established in Cuba, the Dominican Republic, El Salvador, Ghana, Guatemala, Haiti, Honduras, Nicaragua, Peru, Southeast Mexico and Yucatan Mexico. It has less than \$1 million in annual revenue. (www.livingwatersfortheworld.org)

Pure Water for the World

Pure Water for the World provides sustainable safe drinking water filtration systems, latrines, and hygiene education to families and communities in developing countries. Pure Water is currently active in Honduras and Haiti. Its program includes educating people about what it takes to protect clean, safe drinking water so that it does not become contaminated and then implementing the purification method that best meets the needs of the people or community. It has about \$1 million in annual revenue. (www.purewaterfortheworld.org).

Water For People

Water For People assists people in developing countries to improve quality of life by supporting development of locally sustainable drinking water resources, sanitation facilities and hygiene education programs. Water For People has been designated by the AWWA as its charity of choice and is endorsed by the Water Environment Federation, the Water Quality Association, the

continued on page 12

continued from page 11

National Association of Water Companies, the National Association of Clean Water Agencies, the Association of Metropolitan Water Agencies, and other sectors of the North American water community, including manufacturing and consulting engineering companies.

The World Water Corps is Water For People's volunteer program. World Water Corps volunteers engage in activities such as mapping to provide baseline data for development, monitoring the functionality of past projects, and evaluating overall program effectiveness. It has \$21.7 million in annual revenue. (www.waterforpeople.org)

Water Mission

Water Mission is a Christian-based engineering ministry providing sustainable safe water solutions to people in developing countries and disaster areas with in-country programs and permanent staff members around the world. Water Mission International (WMI) designs and customizes sustainable safe water and sanitation solutions to meet the needs of individual communities. It also partners with the recipient community throughout the process of implementing a project. Following installation and implementation, WMI staff monitor and evaluate the project and follow-up with the community to ensure projects' sustainability and success. It has \$17.8 million in annual revenue. (www.watermission.org)

water.org

water.org solutions focus on empowerment through access to affordable financing. For millions around the world, lack of access to funds stands between them and safe water in their home. Their solutions focus on breaking down this financial barrier and bringing hope and opportunity to those in need. It has \$27.7 million in annual revenue including cause-related marketing with Stella Artois and Matt Damon. (water.org)

Do You Want to Help? Taking That First Step

NYWEA has several members who have stepped up and traveled to remote third-world areas across the globe to make a difference. Perhaps this idea appeals to you? If so, start with the list of organizations in this article, or reach out to the Executive Office to get connected to one of our incredible volunteers who have made a difference in the lives of people in developing nations.

Are You Already Involved? Let Us Know!

One of the goals of NYWEA's Humanitarian Assistance Committee is to recognize members who have worked on WASH and to connect them. If you have or are working on WASH, please let me know. We are hoping to inspire the next generation of NYWEA members who want to make a difference by sharing their water passion and expertise.

Robert E. Adamski, PE, BCEE is chair of NYWEA's Humanitarian Assistance Committee. He may be reached at gatorbob85@gmail.com.

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Volunteerism Helps End the Global Water Crisis

by Dana de Andres

Water For People is a nonprofit that promotes high-quality water and sanitation services. We call our model of providing universal, sustainable water services Everyone Forever. “Everyone” means that every single family, clinic and school, even the hardest to reach, the most vulnerable and the marginalized, has access to safe water and sanitation services. But it’s not enough to just reach Everyone. We want to make sure water and sanitation services are sustainable for communities in the long term. “Forever” to us means working from both the ground up and the top down, empowering communities and governments so that Water For People won’t be needed in the future, because the water and sanitation services will be in place and operating under local control.

We have already seen the success of the Everyone Forever model around the world. The district of San Pedro, Bolivia has reached Everyone with sustainable services. Two more districts in Bolivia are set to reach this same milestone in 2019. Water For People will maintain an oversight-only role in these districts before exiting completely, once we are confident that water will flow Forever.

Water For People works in 35 districts across nine countries in Latin America, Africa and India. To date, 3.3 million people have been reached with reliable water services. Looking ahead, this number stands to grow. With a focus on empowering other nongovernmental organizations (NGOs) and local and national governments to replicate the Everyone Forever model, millions more will be reached.

Across North America, Water For People committees and volunteers help advance this critical work.

“It’s our job to give back. It’s crazy if we don’t,” shares Mark Taylor, a Water For People volunteer.

Mark has been volunteering his skills as a water and wastewater

engineer for a decade through Water For People’s technical volunteer arm, the World Water Corps. These projects have included desk studies and trips to the countries where Water For People works, where Mark has been impressed with Water For People’s model.

“Water For People really spends the time to train people and design something that is operational and functional for the resources that exist, so it can be maintained for a long time,” Mark explains.

Sami Carroccio leads a Water For People volunteer committee, where she passionately spreads the word about ending the global water crisis.

“It’s such a great cause and an important mission,” Sami shares. “Water For People is different because they get communities involved. They educate the people they serve and help them build a sustainable future, instead of just doing the work for them.”

Sami and her committee meet monthly to learn about Water For People’s work and share it with new members. Outside of their meetings, they plan five events a year that raise money for Water For People, including a 5k run, golf tournament, wine and beer tastings, and a bike ride as part of the Tour de Tucson. The committee’s all-time fundraising totals over \$760,000!

Committees are important partners in promoting safe water and sanitation services alongside Water For People. To date, the over 50 committees across North America have not only raised incredible amounts of awareness but have raised nearly \$18 million to help end the global water crisis.

To invest in Water For People’s work, visit waterforpeople.org, and to volunteer email volunteers@waterforpeople.org.

Dana de Andres is a writer and Content Manager for Water For People.



Aisha lives in rural Uganda. Her community water point was recently fixed, with support from Water For People. She now leads the community water point committee, which helps maintain the well. She is a champion for sanitation, hygiene and health in her village.

Water For People / Tony Adams



Last year, Valentine’s community in rural Rwanda got a new, reliable water source. This saves her and her family hours each day they used to spend walking to fetch water, and it has reduced waterborne diseases in her village.

Water For People / Tony Adams



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Humanitarian Engineering: Education and Application

by Douglas Daley and Grace Anderson

The emerging practice of humanitarian engineering is rapidly growing and taking shape as scholars, teachers and practitioners of engineering recognize the need for transdisciplinary approaches in solving modern engineering problems. The challenges of population growth, resource stress and climate change, along with increasing globalization and reliance on technology, demand that engineers acknowledge and interrogate persistent social inequalities. Our work must strive to empower the poorest people by improving their access to clean water, sanitation, food security, electricity or other vital resources for life or livelihood.

This article presents our understanding of humanitarian engineering as engineering for social justice, which requires a rethinking of engineering education to incorporate cross-cultural communication and interdisciplinary collaboration, critical theory, and understanding of the interconnectedness of society, technology and the environment. We will briefly:

- Describe the basis of humanitarian engineering.
- Provide examples of how we have incorporated humanitarian engineering into our environmental resources engineering curriculum at the State University of New York College of Environmental Science and Forestry (SUNY-ESF).
- Present a basis for humanitarian engineering curriculum development at SUNY-ESF to address sustainable development across local and regional scales in our state, national and global communities.

Background

Climate change and unprecedented population growth are causing global resource stress on fresh water, clean air and fertile soils. Poverty and inequity persist despite global attempts, such as the U.N.'s Millennium Development Goals campaign, to mitigate these problems. While billions of dollars were spent on foreign aid, the eight Millennium Development Goals were drastically underfulfilled by the deadline of 2015 (*World Bank 2019*).

The internet and social media have undoubtedly ushered in an era of unparalleled interconnectedness and awareness of environmental and political issues around the globe. Contemporary university engineering students, who grew up in a postcolonial, post-development world, are aware of poverty and inequality in the U.S. as well as in underdeveloped countries.

For engineers, development in the 21st century is more complex than just temporarily loaning our expertise to poor communities for water supply and sanitation projects. Scholars are acknowledging that the traditional way of “doing development” is not working. Former senior official of the U.N., High Commissioner for Refugees Paul B. Spiegel, has critiqued the global humanitarian aid system, saying that “Affected persons and communities must be at the core of the humanitarian system and part of the decision-making process; unfortunately, this is often stated, but not acted upon. The humanitarian system was not designed to address the types of complex conflicts that are happening at present; it is not simply overstretched; it is no longer fit for purpose” (*Spiegel 2017*). Economist William Easterly has documented the shortcomings of Western aid and the failure of technocratic solutions alone, such as mosquito nets and latrines, to end poverty and improve the rights of the poor around the world (*Easterly 2014*). Director of the International Development Engineering Program at the University of South Florida, James R. Mihelcic, put it this way:

Despite the great promise of engineering, engineering projects do not always have their intended effects on people's lives. The world is littered with broken-down wells and unused latrines. Large-scale dam projects have displaced hundreds of thousands of people, with devastating environmental and societal effects. These projects may be constructed with the best of intentions, but nontechnical considerations are not always taken into account. ...Often, community preferences and habits are ignored, and communities have only a token role in decision-making processes. In other situations, initial funds for construction are provided by outside agencies, but no realistic plans for paying for operation and maintenance are put into place. The technology chosen might be beyond the capabilities of the communities to repair when needed, with replacement parts not easily obtainable. Issues of governance and financing are thus as important as technology (*Mihelcic, et al. 2009*).

Sustainable development requires a multidisciplinary and multi-scalar approach, working with groups that have varying social, economic and aid-focused missions. Engineering technologies and designs, when applied appropriately in context and with a systems-based perspective toward sustainability, can address climate change, empower disenfranchised or marginalized communities, and promote social justice.

Humanitarian engineering has emerged as a practice to respond to the 21st century's demand for a different kind of engineering approach. For some, the terms “humanitarian” and “sustainable development” automatically evoke images of a poor village in the developing world, somewhere in Latin America or Africa and far from New York. We argue that humanitarian engineering is not simply “engineering for international development,” but instead “engineering for social justice.” A humanitarian engineering approach is as relevant for communities in New York as well as the poorest nations in the Global South.

Education of the Humanitarian Engineer

The practice of humanitarian engineering is not strictly limited to any of the conventional engineering disciplines. Rather, it is the practice of engineers incorporating collaborative community engagement, cross-cultural and interdisciplinary communication, and social justice in their decision-making and design process. Students of humanitarian engineering must broaden their studies to include fields considered outside of the traditional engineering curriculum, including:

- Social justice.
- Communication and collaboration.
- Service learning.
- Social sciences and humanities.
- Humanitarian engineering courses.

Social Justice

Humanitarian engineering is not “engineering for charity,” which glorifies the role of the engineer and maintains the traditional engineer-client relationship. This approach has repeatedly been demonstrated as problematic in a developing community (*Easterly 2006; Easterly 2014*). Humanitarian engineering must also consider social justice. This requires understanding the socio-economic, cultural and political contexts, as well as the usual factors

of project-based environmental, financial and organizational constraints.

Poverty and inequity are often driven by lack of clean water, inadequate sanitation, food insecurity, lack of electricity or lack access to information. Engineering technology can solve any of these impediments. However, imposing a technical solution that ignores social justice will not be sustainable. An engineering project that ignores sociopolitical hierarchies, power dynamics, and structural inequalities in a community might introduce or promote technology that “widens the socioeconomic gap between the higher- and lower-socioeconomic status segments,” further harming marginalized populations (Rogers 1983). This is why “social justice is a goal, constraint and integral component of the process of sustainable development,” and therefore of humanitarian engineering (Passino 2016).

Universities in the U.S. and around the world have recognized the need for sustainability and social justice in engineering. Humanitarian engineering (and similarly named) programs are being developed worldwide to educate contemporary engineering students interested in engineering for social justice and/or sustainable development.

Communication and Collaboration

The Accreditation Board for Engineering and Technology, Inc. (ABET) and the National Academy of Engineering (NAE) both identify communication as an essential skill for any engineer. The NAE’s “Engineer of 2020” report makes this claim based on the increasingly diverse, global and interdisciplinary nature of teams that engineers find themselves a part of (*National Academy of Engineering 2004*). The American Society of Civil Engineers (ASCE) similarly notes communication skills as a priority for today’s engineers, stating that they must be able to effectively communicate to “technical and nontechnical audiences in a variety of settings” (*ASCE 2017*).

Humanitarian engineers need to be able to work effectively on transdisciplinary teams and be able to understand and value perspectives different from their own. A humanitarian engineer will often need to collaborate with stakeholders from different cultural, economic and educational backgrounds, as well as diverse areas of knowledge and expertise. Not only will they work with the typical stakeholders of government officials, informed and engaged citizens, scientists and other engineers; they will need to communicate and collaborate with communities. They must be able to incorporate local and indigenous knowledge of community members and cultural leaders, who are often from a background or perspective foreign to the engineer.

Edgar Schein’s notion of “humble inquiry” is a useful framework for communication in humanitarian engineering. Schein defines humble inquiry as “the fine art of drawing someone out, of asking questions to which you do not already know the answer, of building a relationship based on curiosity and interest in the other person” (*Schein 2013*). Schein argues that “good communication requires building a trusting relationship,” which is essential for effective engineering in a community context (*Schein 2013*). He also argues that asking questions of a person, instead of “telling” or “informing” them, will temporarily empower the person; this empowerment is often touted as a goal of sustainable development. Humble inquiry by the engineer is a way to empower the community and establish an equal partnership at the onset of a project.

Service Learning

Almost all humanitarian engineering university programs incorporate service learning as a vital and integral component of the

program. Service learning may include:

- Courses with an international component.
- Independent engineering design projects for community development.
- Study abroad.
- Participation in an Engineers Without Borders project or similar extracurricular service-based programs.

Service learning is a core component of humanitarian engineering programs because hands-on experience can bridge the gap between education and career, requiring students to apply their skills in a real-world setting.

Grace Anderson, co-author of this article, gained valuable experience as a core member of an Engineers Without Borders project; as leader of a local service project in Syracuse; and as a research aide for SUNY’s Sustainable Village and Learning Community development project in Haiti. She found these experiences vital components of her education as she transfers classroom theory to practice.

The experience gained from dealing with project shortcomings can teach a humanitarian engineer better than lecture-based discussion. Pennsylvania State University’s “Humanitarian Engineering and Social Entrepreneurship in Africa” program has a for-credit requirement of reflection and dissemination of research and results after completing a service project. This reflection is a critical component of humanitarian engineering education. It calls for students to synthesize what they learned and why it is important, as well as to reflect on their successes and failures in the service-learning project.

Social Sciences and Humanities

Humanitarian engineering requires an expansion of the traditional engineer-client relationship. Communities are not a single, homogeneous client. Rather, they are highly heterogeneous organisms with complex histories, cultures, demographic makeups and socioeconomic dynamics. Humanitarian engineering requires a relationship between the engineer who designs the solution and the community that will own and utilize the engineered solution. James R. Mihelcic writes in his review of humanitarian engineering:

Having an awareness of social and economic issues will improve engineers’ abilities to interact with organizations from other sectors and to assume leadership roles in alliances formed. Engineers of the future will need to be able to partner effectively with major groups, such as women, farmers, the scientific and technological community, children and youth, indigenous peoples and their communities, workers and trade unions, business and industry, nongovernmental organizations and local authorities” (*Mihelcic, et al. 2009*).

For this reason, coursework from the social sciences and humanities is an essential part of any humanitarian engineering certification, minor or concentration.

A brief review of humanitarian engineering and similarly named programs at universities in the U.S. revealed some common themes for social sciences. Within the liberal arts curriculum, thematic electives are offered from the categories such as cultural diversity, social processes, contemporary global issues, and science, technology and society (*Mitcham and Munoz 2010*). Context-specific courses focus on the culture, history, politics, and/or conflicts of a specific region, country or community that affect development. Social entrepreneurship, the practice of integrating business with social change through innovative startups, is another avenue for humanitarian engineers, such as Pennsylvania State University’s “Humanitarian

continued on page 19



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continued from page 17

Engineering and Social Entrepreneurship in Africa” program (Mitcham and Munoz 2010).

Humanitarian Engineering-specific Courses

University humanitarian engineering programs require focused courses that cover the basics of humanitarian engineering, engineering and social justice, and engineering and sustainable community development, along with other core courses in applied technologies. For example, Ohio State University offers “Computational Humanitarianism,” which teaches computational modeling to assess the social impact of humanitarian technologies and “feedback control for computer automation of helping to meet social justice objectives” (Passino 2016). Many programs address appropriate or applied technologies that put engineering technology into the context of low-capacity communities.

Science and sustainability communication courses are also offered. For example, the University of Texas requires “Communicating Sustainability” and “Communication and Social Engineering,” while Colorado School of Mines requires “Engineers Engaging Communities” and “Intercultural Communication” (Repp 2012; Leydens and Lucena 2018).

Humanitarian Engineering at SUNY-ESF

Over a decade ago, the Environmental Resources Engineering (ERE) program at SUNY-ESF responded to the changing tides of engineering education and our students’ interest in and awareness of global poverty and social justice. While we do not offer a specifically named program or certificate in humanitarian engineering, we have a rich history of faculty and student engagement in humanitarian engineering. Our efforts have principally focused on the extracurricular, including Engineers Without Borders (EWB) and our SUNY-ESF club Engineers for a Sustainable Society (ESS). Along with extracurricular opportunities, elective courses are offered in:

- Applied Technology for Humanitarian Engineers.
- Humanitarian Engineering in Developing Countries.
- Ecological Engineering in the Tropics.

The common thread through these experiences is a hands-on,

service-learning style, with small-project analysis and design experiences for developing communities.

Applied Technologies for Humanitarian Engineers

The course “Applied Technologies for Humanitarian Engineers” was developed by author and associate professor Douglas Daley with assistance from co-author and research project assistant Grace Anderson. The course is geared to students interested in exploring, in a collaborative context, the ins and outs of humanitarian engineering.

We begin by asking students the basic questions of “what is humanitarian engineering?” and “who does it?” These questions turn out to be harder to answer than they seem. To find the answers, we explore the nuances of humanitarian engineering and sustainable development as well as appropriate technologies, field sampling, and participatory engagement methods in a lab setting. This course covers the basics of project management and planning for humanitarian engineering projects and explores how this approach differs from traditional engineering project management.

Humanitarian Engineering in Developing Countries (HEDC)

HEDC is taught by a former Peace Corps member. It combines theory and practice for humanitarian engineering in a relief and development context, with a focus on engineering applications to solve the 17 U.N. Sustainable Development Goals (United Nations 2018). The HEDC course covers culture and communication in humanitarian engineering projects, personality traits and attitudes of an effective humanitarian engineer, and literature related to humanitarian engineering and appropriate technologies for development settings. Also discussed in a laboratory setting are multiple individual-appropriate technologies such as stoves, water storage and treatment, and latrines. Students complete a semester project involving all steps of the engineering project process for a typical humanitarian engineering project including assessment, planning, design, implementation and program evaluation.

continued on page 21



Small impoundments store stormwater runoff captured from surrounding hillsides to be used for agricultural irrigation during the subsequent dry season, Akaye, Haiti.

Douglas Daley

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Ecological Engineering in the Tropics

“Ecological Engineering in the Tropics” features a trip over spring break to the sustainability education center and permaculture farm Rancho Mastatal in Costa Rica. Before the trip, students study ecological engineering and develop designs for appropriate technologies based in permaculture and ecological engineering principles. This course develops students’ abilities to apply engineering skills in a context-specific, sustainable, innovative and creative way, as well as skills in interdisciplinary teamwork and communication, trip planning, and appropriate technology designs as part of an existing system.

Extracurricular Opportunities

The EWB chapter at SUNY-ESF has an active membership of about 45 students, or about 30 percent of our student body, demonstrative of the deep passion and stewardship for sustainable development amongst the ERE students. EWB and ESS have completed projects for water supply and distribution, sanitation (e.g., latrines and sewage treatment), and food security in Honduras, Guatemala, Haiti, Mexico and Peru.

Closer to home, in Central New York, ESS has completed several community projects, including:

- Collaborating with the Syracuse Department of Public Works to reduce water waste in local parks.
- Constructing rain gardens for homes in the community.
- Assisting sustainability efforts at SUNY-ESF and Syracuse University.
- Working with the nonprofit Nine Mile Creek Conservation Council to measure and mitigate pollutants of concern in Nine Mile Creek from nonpoint runoff and sewage overflows.

An Eye to the Future

SUNY-ESF’s ERE program has arrived at a point where we are evaluating how we can: further improve our students’ humanitarian engineering education; attract students of all experiences interested in humanitarian engineering and engineering for social justice; and create a model for adoption of humanitarian engineering practices in our local and global communities. The growth of the humanitarian engineering program must also adhere to the philosophy expressed in the fundamental canons of the Engineer’s Code of Ethics, which is to “perform services only in areas of their competence” (ASCE 2017).

As engineers take more prominent roles in global development initiatives, there is not only a need but a responsibility for educational programs to train engineers to be effective in the developing world. Any person with technical rigor in engineering skills and applied sciences can become educated and practiced in the communication and collaboration skills, social sciences methods and awareness, systems thinking toward triple-bottom-line sustainability, and social justice framework that are required of a humanitarian engineer. To study humanitarian engineering is to rethink the way engineers apply their technical knowledge, and to become more aware of whose perspectives and voices are represented in the process.

The need for, and application of, humanitarian engineering principles is clear-cut, even in our modern, developed society in New York and the U.S., especially in the context of the water environment. Our communities need an increased understanding and appreciation for engineering and its role in creating a sustainable and equitable society. Citizens at all levels should be engaged and educated in the work that engineers do in our water environment, which is often invisible. Water supply and recovery, for example, are often misunderstood by the public, if thought about at all.

A humanitarian engineering approach increases the visibility of engineers’ work and enhances community relationships throughout the planning and design process.

Global climate change and unprecedented resource stress demand more sustainable infrastructure and technology if we are to ensure availability of energy, clean water, food and other material resources for future generations. Communities that are not engaged in the planning, design and operation of technical solutions, even in the U.S. today, are often disenfranchised, feel ignored, and ultimately distrust the culture surrounding the technical experts. Employing a humanitarian engineering approach will address some of these structural problems that are common across both developed and developing communities around the globe.

Douglas Daley is an Associate Professor in Environmental Resources Engineering at SUNY-ESF, and may be reached at djdaley@esf.edu. Grace Anderson is Research Project Assistant in Environmental Resources Engineering at SUNY-ESF and may be reached at gjand100@syr.edu.

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Engineers Without Borders: Getting Involved

by Taylor Brown

Many Americans have heard of Doctors Without Borders, but Engineers Without Borders (EWB) is not yet a household name. My journey with EWB started in 2013 while I was a student at the State University of New York College of Environmental Science and Forestry (SUNY-ESF). Since I started volunteering with EWB, I have traveled all over the world to work with incredible people on low-tech, high-impact projects. EWB has shaped my character in more ways than one and made me a better water professional.



Taylor standing on a water storage tank in Buena Vista, Honduras. SUNY-ESF's EWB college student chapter partnered with the community to design and build a gravity-fed water supply system. *Theodore Endreny*

EWB-USA

The founder of EWB-USA, Dr. Bernard Amadei, saw the need for professional and student engineers to assist the world's most underserved communities. In 2000, Dr. Amadei met a community of Mayan Indians in the Belize jungle that had to collect their water from miles away. The children in the community had the responsibility of collecting the water, so they did not attend school because they had to spend their time trekking back and forth to get water. The community had the natural resources and motivation to build a reliable water supply system, but they lacked the technical skills to design a sustainable solution. Dr. Amadei went back home to the U.S. to develop a plan and then returned to Belize with 14 of his students to install a clean water supply for the community. This was the first EWB-USA project, and the organization was officially founded in 2002.

Since this first project, there have been hundreds of other projects completed and hundreds more currently underway. Most of these projects have been water projects, but there are also agriculture, structures, civil works, energy, sanitation, information systems and disaster response projects.

Mission, Approach and Sectors

The mission of EWB-USA is "to build a better world through engineering projects that empower communities to meet their basic human needs and equip leaders to solve the world's most

pressing challenges." EWB-USA's vision is "a world in which every community has the capacity to sustainably meet their basic human needs" (*EWB-USA 2019a*).

EWB-USA's approach to development is more sustainable than similar nonprofits. They believe in community-driven development where the communities are the most effective agents for lasting, positive change. The communities that EWB-USA works with must first request assistance from EWB-USA, rather than the organization identifying the communities they want to work with. Unfortunately, it is often the case in development projects that assumptions are made about what a community needs rather than asking the community what they need. Many organizations also assume that a solution that worked for one community will also work for another, when in reality every community has their own unique issues that need to be fully understood. Sometimes, an engineering solution isn't the best solution to a community's problem, which is why a needs assessment is done for every potential EWB project. There are 275 EWB-USA chapters (college students and professionals) across the U.S. that partner directly with communities to meet their self-identified needs (*EWB-USA 2019b*).

There are three sectors of EWB-USA: International Community Program, Engineering Service Corps and Community Engineering Corps.

International Community Program

EWB-USA's International Community Program includes 600 projects in 40 countries. These programs are partnerships of at least five years between a community and an EWB-USA chapter. A program can include one or more projects depending on the needs of a community. The phases of the project process include assessment, alternatives analysis, implementation, and monitoring and evaluation. This project process was designed to ensure that after something is built, the community can maintain it themselves. The community members are also expected to provide cash contribution for 5 percent of the project costs and have an operation and maintenance plan in place (*EWB-USA 2019c*).

Engineering Service Corps

The Engineering Service Corps connects more seasoned engineering professionals with requests for project support from governments, international NGOs, United Nations agencies, local communities and other institutions who lack access to technical resources. These requests vary greatly in scale and duration, but volunteers with several years of both professional and international experience can assist some of the world's most vulnerable populations (*EWB-USA 2019d*).

You can apply to join the Engineering Service Corps Standing Roster to be connected to opportunities as they become available (*EWB-USA 2019e*).

Community Engineering Corps

The Community Engineering Corps was formed in 2014 and is an alliance of EWB-USA, the American Society of Civil Engineers, and the American Water Works Association (*Community Engineering Corps 2017*). Community Engineering Corps works with communities

continued on page 24



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continued from page 22

across the U.S. that are unable to easily retain or afford traditional engineering services. Volunteers work with community associations, nonprofits and municipalities in both rural and urban areas. Professional Liability Insurance is provided for the program's volunteer professionals.

A community in the U.S. is considered underserved if they meet at least one of the following criteria (EWB-USA 2019f):

1. The community must have a Median Household Income (MHI) that is equal to or less than 80 percent of the state's MHI.
2. The community must have a poverty rate that is equal to or greater than the national poverty rate.
3. The annual drinking water rates are higher than 2.5 percent of the community MHI.
4. The annual wastewater rates are higher than 2.0 percent of the community MHI.
5. The combined annual water/sewer rates are higher than 4.5 percent of the community MHI.

How to Get Involved

It costs \$35 annually to be an EWB-USA member. Membership gives you exclusive access to Volunteer Village, an online platform where you can personalize a volunteer profile to share your interests and talents, connect with peers and work on projects. When you fill out your volunteer profile (EWB-USA 2019g), EWB-USA will be able to better connect you with volunteer opportunities that align with your skills.

You can also check out the Volunteer Opportunities Board. If you are a more experienced professional, you will find opportunities here for mentorship, design and technical review committees. There is also a constant need for retired professionals that are available to travel with student chapters for projects (EWB-USA 2019h).

If you would like to get involved with an EWB professionals' chapter to work on projects, here is a list of the professionals' chapters in New York. These chapters welcome engineers of all ages and disciplines, as well as nonengineers.

- New York City Professionals Chapter (<https://ewbnyc.org/>).
- Syracuse Professionals Chapter (<http://www.ewbsyracuse.org/>).
- Buffalo Professionals Chapter (ewbbuffaloprofessionals@gmail.com).

National Conference

The EWB-USA 2019 National Conference will be in Pittsburgh, Pennsylvania, from Nov. 7 through 9 at the Omni William Penn Hotel. Members and nonmembers alike are welcome to attend and learn about complex global challenges, both technical and nontechnical. It is also a great networking opportunity with other people interested in sustainable development. Early bird registration ends Sept. 14 (EWB-USA 2019i).

Taylor Brown is a Junior Sanitary Engineer with the Buffalo Sewer Authority and may be reached at tbrown@buffalosewer.org.

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The advertisement features a background image of a wastewater treatment plant with circular tanks and walkways. At the top, the text reads "TREATMENT SOLUTIONS YOU CAN TRUST FOR THE LIFE OF YOUR COMMUNITY". In the center, the company logo "H2M architects + engineers" is displayed, with "H" in a green square, "2" in a grey square, and "M" in a blue square. A circular seal on the right side of the image says "Best Firms To Work For". At the bottom, the text "comprehensive wastewater engineering" is followed by a list of locations: "albany | melville | new york city | riverhead | suffern | westchester, ny | parsippany | wall township, nj". At the very bottom, there are three buttons: a phone icon with the number "866.870.6535", a globe icon with "h2m.com", and social media icons for Facebook, LinkedIn, Instagram, Twitter, and Pinterest.



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Taking Care of Communities: American Red Cross

by Rosie Taravella

In spring of 2012, I joined the American Red Cross as chief executive of the newly formed Central New York Region. My background was in executive management of arts and education institutions, so heading up a regional unit of an internationally known humanitarian organization was an honor that was destined to be a learning experience.

Like many people, I believed that American Red Cross disaster response was affiliated with, and possibly even funded by, government. Indeed, the Red Cross is chartered by Congress to provide relief to survivors of disasters and it helps people prevent, prepare for and respond to emergencies. But funding is supplied by the generosity of people.

So, What Is the Red Cross?

The American Red Cross is part of the National Response Framework (NRF). The NRF designates the Red Cross as a support element to several of Federal Emergency Management Agency's (FEMA) Emergency Support Functions and the delivery of multiple core capabilities, with a special focus on mass care. In addition to mass care, the NRF includes 14 other core capabilities, including:

- Planning.
- Public information and warning.
- Operational coordination.
- Critical transportation.
- Environmental response/health and safety.
- Fatality management services.
- Fire management and suppression.
- Infrastructure systems.
- Logistics and supply chain management.
- Mass search and rescue operations.
- On-scene security, protection and law enforcement.
- Operational communications.
- Public health, health care and emergency medical services.
- Situational assessment.

Government funding is not attached to the powerful duty bestowed upon the Red Cross by the U.S. Congress to support disaster victims. Instead, the charter spells out a call to action for the American people to support Red Cross efforts with their donations, which is our primary income source for humanitarian services.

Mohawk River Valley Flooding

Shortly after my tenure began, I learned about what it means to provide mass care. In June 2013, the Mohawk River and its tributaries overflowed their banks and flooded 1,100 homes and businesses across the Mohawk Valley section of New York. More than 2,400 people from the city of Oneida and the counties of Herkimer, Oneida and Montgomery needed to leave their homes. The Red Cross of Central New York provided health and mental health services, shelter and meals to those who were displaced, and distributed meals and relief items throughout affected neighborhoods. Volunteers also provided a fair number of hugs to people who were facing the terrible circumstance of having lost so much.

Taking care of a community after a large disaster goes far beyond immediate mass care. Long-term recovery may be provided for months and years, depending upon the amount of loss and the resiliency of the institutions providing support. The Red Cross,



Hurricane Michael, October 16, 2018, Panama City, Florida. Jenna and son Leo receive hot chicken fajita meals, snacks and water from a Red Cross feeding vehicle on day five after landfall of Hurricane Michael. Leo was especially pleased with the snack and shouted with delight when he saw his neighbor coming to receive the same.

Daniel Cima/American Red Cross

businesses, faith-based groups, government organizations, other nonprofits, funders and community advocates work together to address the unmet needs of residents in affected communities. The partnerships that are formed gather and identify needs, provide information to support their planning, and facilitate coordination with established organizations like Volunteer Organizations Active in Disaster (VOAD), long-term recovery group, and other disaster-recovery organizations.

While recovery is planned for individuals, state governments request federal public assistance aid for both individuals and infrastructure. Three weeks after the Mohawk Valley floods of 2013, FEMA approved Governor Andrew Cuomo's request for federal public assistance aid for the counties that endured flooding. In that case, the money granted was intended for emergency work to repair and/or replace public facilities that sustained damage. Subsequently, Cuomo provided \$16 million in state aid through the 2013 Upstate Flood Recovery Program, which provided much-needed funds for qualifying individuals to repair their homes.

Hurricane Michael, Florida

Throughout the Mohawk Valley flooding disaster, residents had access to clean drinking water from the public water supply. Not all who experience large disasters are so lucky. In October of 2018, several counties in Florida that were affected by the strong winds and massive debris scattered by Hurricane Michael were advised for several weeks to boil water as a precautionary measure. Anheuser-Busch continued its 30-year tradition of providing water to the Red Cross to distribute after disasters, and issued 300,000 cans for relief workers to provide to families in Florida. This was a stopgap

measure while public works agencies labored to assure safe drinking water. The Department of Environmental Conservation worked to quickly clear debris from water sources, while the Army Corps of Engineers managed dams in the impacted area to make as much water storage available as possible.

Having been a Red Crosser for more than six years when



Hurricane Michael, October 13, 2018, Mexico Beach, Florida. Hurricane Michael inflicted a monstrous amount of damage to this beach-side community as it slammed into the Florida Panhandle with almost 150 mile per hour winds. Boats were tumbled every which way on the shore along harbor areas and even well inland. Homes were blown completely off foundations and tossed many yards away, and in many cases, homes were reduced to construction rubble. Almost every building suffered severe damage. The damage was so extensive the curiosity was the very few homes or businesses that did not have observable severe damage instead of the norm of devastation. *Daniel Cima/American Red Cross*



Hurricane Michael, October 13, 2018, at the Bozeman High School Red Cross operated shelter in Panama City, Florida. Danielle's daughter Harper turned six months old the day Hurricane Michael made landfall. Her family evacuated on October 9, 2018 and had not returned home yet to assess the damage. This was the third hurricane her family experienced in three years: first in Jacksonville in 2016 and again in Georgia in 2017. "This is way worse," says Danielle. "But it's a lot easier now that we have somewhere to sleep." As Red Cross shelter workers bring more jars of baby food to her family's gathering of cots, she turned to her 3-year old daughter Makinzy and said, "I hope your school's ok." *Daniel Cima/American Red Cross*

Hurricane Michael hit, I was no longer the naive arts executive who joined this humanitarian effort back in 2012. I eagerly deployed to Tallahassee to assist with Hurricane Michael relief efforts, as I had done a year before when I went to Houston in the wake of Hurricane Harvey.

As I'd come to expect, the people affected by disasters are surprisingly resilient and often too proud to ask for help. During a visit to a shelter set up at a school in Gadsden County, I saw a young woman peering into the shelter with her two young daughters. I invited her in and learned that her name was Fantasia. She had been without power in her nearby home for five days, and her air conditioner could no longer relieve her or her daughters from the stifling humidity and heat. She had become so light-headed that it had become difficult to cook, and so she wondered if she and her girls might have a little something to eat, even though they weren't staying there. We soon convinced her that the shelter and meals were available to all affected by the storm. Shortly thereafter, while her daughters eagerly filled up on a hot meal, shelter workers brought her a cart full of cleaning and comfort supplies. Ultimately, at our urging, she agreed to stay at the shelter.

As I got up to leave, Fantasia's eyes grew wide. "You're leaving?" she asked. I assured her that I was leaving her in good hands and that the other shelter workers were as interested in her well-being as I was. It was then I realized that the Red Cross shirt I was wearing had immediately established trust between this woman and me, a perfect stranger. Of course, I gave her a hug.

Thank You!

I'm proud to share my experience in this issue of *Clear Waters* and wish to thank environmental engineers, scientists, consultants and operators who also provide humanitarian assistance whenever they work to restore a community following a disaster.

Rosie Taravella is the Regional Chief Executive Officer of the American Red Cross of New Jersey. She relocated from the Western and Central New York Region in June 2018, where she served for six years as Regional CEO. She may be reached at rosie.taravella@redcross.org.



Pictured (l-r): Rosie Taravella, regional CEO, American Red Cross New Jersey Region with American Red Cross President Gail McGovern and Red Cross volunteer Scott Goodrich in Tallahassee, Florida, on October 17, 2018. Rosie and Scott were deployed to help with Hurricane Michael relief efforts. *Julie Daigle/American Red Cross*



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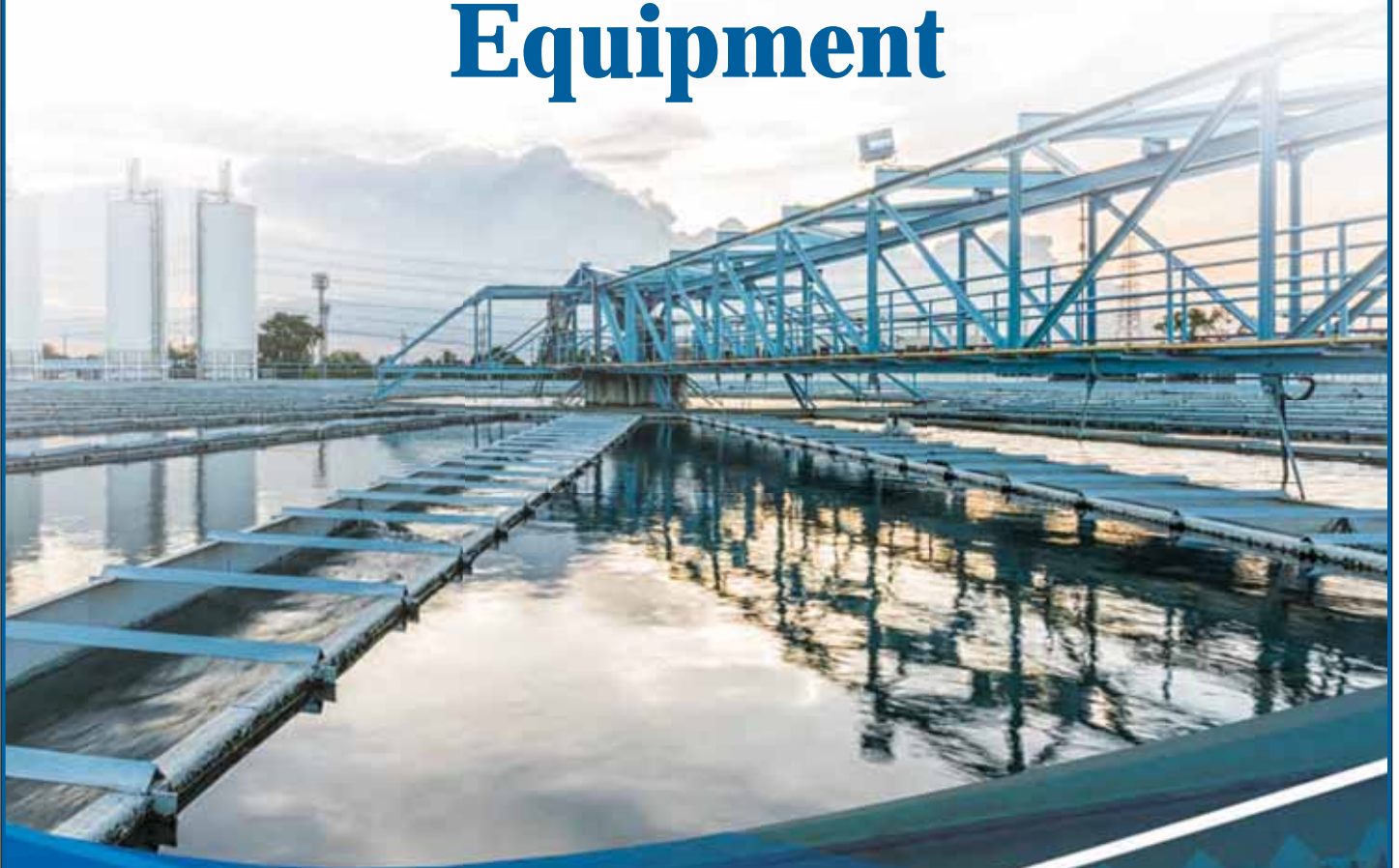
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Navigating Foreign Terrain in La Laguna, Nicaragua

by Rosaleen B. Nogle

My Introduction to Volunteerism

I attended the University of Buffalo (UB) in Buffalo, New York, while working on my B.A. in Anthropology and B.S. in Civil Engineering (2005), and M.S. in Civil Engineering (2007). While at UB, I was very active in the Newman Centers, a Roman Catholic campus ministry for students.

During each of my spring breaks, I worked with Habitat for Humanity in Buffalo and volunteered with different social welfare groups throughout the U.S. Included amongst these trips was one to New Orleans in the wake of Hurricane Katrina. This trip deeply affected me to the point that I returned to New Orleans to continue to volunteer during the summer of 2006.

The following fall, a group of undergraduate students at UB formed a chapter of Engineers Without Borders (EWB). As a graduate student, I was unable to join the chapter but I had great hope for its success. Unfortunately, the project that the students took on was too ambitious and there was a lack of support for it amongst the local professional engineering community. The project and the chapter fell apart after the students who were most involved in the project graduated from UB. What could be done differently to change this then and now?

My Public Service Career

Meanwhile, I moved on to a career as an engineer in public service. I spent much of this time as a municipal engineer for Erie County Division of Sewerage Management (DSM). In this role I performed several duties:

- Reviewed and approved new connections to the sewer system.
- Worked with internal staff to enact municipal separate storm sewer system (MS4) regulations.
- Inspected and documented the physical and functional conditions of each piece of mechanical and electrical equipment throughout the DSM system.
- Served as project manager for several smaller projects for DSM.

While applying my newly earned engineering degrees in each of these projects, I also spent a lot of time learning from the operators. I heard time and again about designed systems that were not conducive to efficient operation.

I also spent about six months as a regulatory engineer for the Erie County Health Department. In this role I inspected, regulated and, in some cases, directed the design of small water systems. I reviewed water and wastewater connections and small wastewater disposal systems. As part of this experience, I learned how to work with communities that had little to no budget for upgrades and limited understanding of how to sustainably operate and maintain their systems to keep their customers, which frequently included themselves and their families, safe.

My most recent experience has been as a municipal engineer for the Buffalo Sewer Authority. In this role I first worked to formalize regulations for connections to the systems and to provide consistent and fair reviews of those connections. I also worked as a project manager on several multimillion-dollar collection system projects. And finally, I oversaw a staff of approximately 35 collection system personnel in the performance of their work operating and maintaining the sewers of the City of Buffalo.

Each of these experiences as an engineer in the public sector

prepared me to return to my volunteer interests in a new role.

EWB-UB Responsible Engineer in Charge

In the spring of 2017, I received several emails and calls from different friends and acquaintances regarding the restart of the UB chapter of EWB, with me taking on the role of Responsible Engineer in Charge (REIC). I was both excited and a bit cautious. After some discussion with both the students and my family, I decided that it was an opportunity that I could not pass up. While I had never worked internationally before and did not speak Spanish (only Latin), my work history did provide me with a good basis for this position.

So it was that in June 2017, the UB student chapter of EWB, with me as their REIC, agreed to form a partnership with the small village of La Laguna, in the department of Matagalpa, Nicaragua, to bring a safe supply of water into the community. In accordance with EWB's standard procedures, we decided that a small group of students and I would travel to the community over winter break the following school year. In the meantime, we worked together with the community to prepare for this trip.

Preparations and Planning

To prepare for this project, we sent several electronic communications to the community, but the responses were slow in coming. Between the limited grasp of Spanish by most members of the UB team and the lack of any English from members of the community, there were some difficulties in understanding one another. What was made clear to us, though, was that there was an already identified water source located a short distance up a path above the village. We were told that the village consisted of approximately 185 individuals, including many children, and that it was located approximately 30 miles from any paved roads, somewhere in a great expanse of green on a map of Nicaragua. The community supported itself by growing coffee.

With this understanding in mind, we planned our trip to focus on physical surveying and getting to know the community we would be working with. As part of this preparation, we sought out members of the UB community with connections to Nicaragua and discovered only three individuals – one professor and two students – who met this criterion. Between discussions with these individuals and with other EWB groups, we concluded that any surveying equipment more sophisticated than a basic level with tripod and tape would likely be cost-prohibitive, confiscated by Nicaraguan customs, and may be problematic in the environment we were heading into.

We also determined that while Nicaragua was relatively stable for a Central American country, we would need to be careful during our trip; reliable health care would not be available for quite some distance away from where we would be working. This last issue, together with the memories of the Nicaraguan Civil War between the Sandinistas and the Contras, which is part of the collective consciousness of those of us over 35, led a couple of the UB students to withdraw from the trip.

On the Road

Finally, Jan. 1, 2018, at the stroke of midnight, we took off from Fort Lauderdale, Florida, to fly to Managua, the capital city of

Nicaragua. A few hours later, we touched down in the only international airport in all of Nicaragua, finding ourselves in an airport roughly the same size as that in Niagara Falls, New York. We were met at the airport by one of the two UB students with connections to Nicaragua and spent the rest of the night at his family's house in Managua.

The next morning, we woke up early for the several hour drive to the city of Matagalpa, the capital of the department of Matagalpa. For this journey, we traveled in a minivan and watched as the city of Managua gave way to greener environs higher into mountains. In the city of Matagalpa, we waited to meet with our contact from the village. When he arrived, we realized that there was only one

seat available in the pickup that we would take the rest of the way to the village. The rest of us would be sitting on the floor of the bed of the truck for the hour and a half long journey to the village of La Laguna.

The Reality of the Situation Becomes Clear

When we arrived in La Laguna, some of the confusion that we had experienced in our communications with the village was cleared up. It was here that we realized the villagers were laborers on a large coffee plantation. The owner of the plantation was our actual host for the week and the plantation manager was the driver of the pickup truck that had driven us to La Laguna. The village of La Laguna was located just outside of the gates of the plantation, and we would need to travel about a mile or so over dirt roads to get to the village. We would be staying with migrant farmworkers in barracks on the plantation.

It also became clear that the problems with the water supply were much more complex than we had been led to believe. On the one hand, the village was already receiving water from the identified source. On the other hand, the source was located about a mile away from the village up a mountain path, which had to be cut by machetes to access. Even then, the path was only a foot and a half wide with mountain on one side and a ravine on the other. The existing conveyance system consisted of a black rubber hose that had sprung multiple leaks already, was slowly disintegrating, and could not convey a consistent supply to the village. And the water source was polluted by upstream runoff. While we tried to propose to the village leaders the idea that a groundwater source may be a better solution than continuing to use this surface water source, it became apparent that this was a non-starter.

As we spent time with the villagers, we found that the "village" was not so much a village as several collections of houses spread over 9 square miles of mountain, quick sand, streams and forest. While we had hoped to be able to survey the entire village, it quickly became apparent that this would not be possible. Even trying to survey the distance from the water source to the nearest house



Rosaleen Nogle (left) and UB student Evan Supple ride in the back of a pickup on the trip to La Laguna, Nicaragua.

Gavin Amos



Jose Benito Cruz (right), from La Finca Esperanza coffee plantation, shows UB students Aaron Cheney, Gavin Amos, Evan Supple and Scott Scheers how coffee seedlings are cultivated.

Rosaleen Nogle



Gavin Amos shows off our barracks.

Rosaleen Nogle

continued on page 33



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Scott Scheers, Rosaleen Nogle, Evan Supple and Carlos Abreu survey the water source.

Gavin Amos



Scott Scheers surveys the village of La Laguna.

Rosaleen Nogle



Top, left to right: Gavin Amos, Nelson Picado (village leader), Scott Scheers, Jose Maria Maldonado (village leader) and Aaron Cheney. Bottom, left to right: Rosaleen Nogle, Carlos Abreu, Evan Supple and Juan Valdivia (village leader).

Villager from La Laguna

would not be possible with our limited time and resources. Instead the best we could hope for was to:

- Survey the distances between homes.
- Use global positioning systems (GPS) to locate the different sub-villages and the water source in relation to one another.
- Get to know the cultural issues that the community faced, in addition to the more technical issue of the water source.

As we explored the different communities, it became apparent that the population estimate of 185 that we had been provided before our travel was low and that the actual population was more than 250 people. Most of these residents were children under the age of five and the population was growing quickly. Unfortunately, it also became apparent that each spring, many of these children were sickened by the washing of contaminants into their water source by heavy rains. Even during the relatively dry season, these children faced poor sanitary conditions that resulted in frequent illnesses.

In addition to meeting with the community regarding their needs and physically surveying the villages, we also investigated the availability of conveyance and treatment technologies locally. We found that the small hardware stores in Matagalpa were the only nearby sources of these materials. Any equipment or materials from Matagalpa would need to be taken to the edges of the community by pickup trucks, then into the village by off-road vehicles and ultimately carried by hand into the final installation locations.

In our time in La Laguna, we also developed a great deal of respect for the process that produces the coffee we buy throughout the U.S. and learned quite a bit of Nicaraguan Spanish as well. By the end of the week, even those of us from Buffalo with little to no Spanish language education were able to communicate well enough with the community to go out surveying together. Overall, it was a very productive site visit.

But in the background, there was a feeling of uneasiness, of something being off socially and politically, throughout our time in Nicaragua.

Complications Arise

Within a few months of our return to the U.S., these ongoing tensions exploded into violence in the capital city of Managua, effectively cutting off our only way in and out of the country. We were asked by EWB-USA, the national level of the organization, to put any further plans for the project on temporary hold over the summer and into the fall, to see what direction the ongoing violence would take. During that time, we were not able to make any real progress on designing a solution for the community because we were not sure how it could or would be installed.

Finally, in the late fall of 2018, we were told to resume design but to plan for remote implementation of the design by members of the in-country office of EWB, members of the community and Nicaraguan contractors.

During this period of waiting, and with the change in plan to remote installation rather than hands-on work, our ability to fund-raise was reduced and there was an overall decrease in enthusiasm and morale among the students. But they have come to understand that we have made a commitment to this community and that we need to honor that commitment. We are therefore moving forward with a project, with a planned implementation schedule of winter 2020, which will:

- Provide source protection for the community.

continued on page 35

PROBLEM:

Village of Mexico, NY Public Works

The Village of Mexico's 300,000 GPD water resource recovery facility was experiencing excessive rags and debris in its primary clarifiers.

SOLUTION:

Hydro-Dyne Bull Shark Through Flow Screen

After a thorough evaluation of multiple screening technologies, plant personnel chose to install the Bull Shark Through Flow screen in the main sewage pump station feeding the plant. The setup also included the Whitetip Shark Washing Compactor.

For this setup, the front load grid type is 6mm stainless steel laced link. Flow rates are .26 MGD, 1.85 MGD max.

Since installation, the Hydro-Dyne screen has successfully eliminated the debris and ragging problem in the primary clarifiers.

Plant personnel are very happy with the performance of the screen, washer and compactor.

*Testimonial courtesy of John Power,
Superintendent of Public Works, Village of Mexico NY.*



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continued from page 33

- Replace the conveyance system with a more reliable and sanitary system.
- Provide chlorination of the water prior to consumption.

Lessons Learned

While the inability to provide direct implementation of the project has been a great disappointment for the students, this project has provided an important learning experience in addition to eventually providing clean water to the community of La Laguna. By being restricted to remote implementation, the students have learned quite a bit about working together with others and with imperfect information.

They are also learning the process of alternatives analysis. After returning home, we reconsidered the idea of using a groundwater source rather than trying to use the existing surface water source. Upon reviewing documents obtained from the Nicaraguan government, however, we determined that this was not a realistic solution. The aquifer was located several hundred feet below ground surface and getting a drilling rig to the community would not be practical.

Throughout this process, I have been working with and will continue to work with a changing cast of students as they graduate and move on to careers as engineers.

Rosaleen B. Nogle, P.E., BCEE, PMP is an Assistant Principal Engineer with the Buffalo Sewer Authority. She may be reached at rnogle@buffalo.sewer.org.

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AguaClara: Empowering Communities Through Safe Water

by Serena Takada

The Global Water Crisis

In 2017, the United Nations estimated that 2.1 billion people lacked access to safe water (*United Nations 2017*). By 2030, the United Nations expects the global population to grow by an additional 1.2 billion people (*United Nations 2015a*), further increasing the demand for clean drinking water (*Figure 1*).

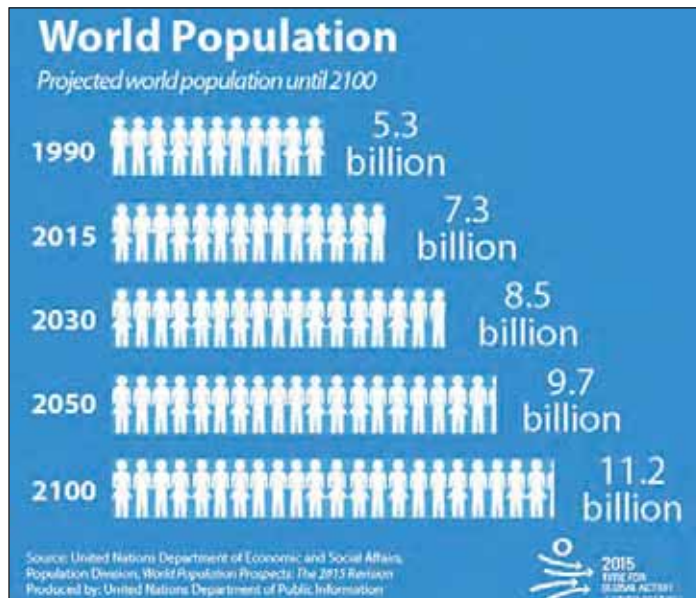


Figure 1. Projections of world population growth, 1990 through 2100.

United Nations

As a global community, we know that sufficient, safe and continuously available drinking water is imperative for human health, development and well-being (*Bartram and Cairncross 2010*). In response, the United Nations established Sustainable Development Goal (SDG) Six, Target 6.1, which calls for the “availability and sustainable management of drinking water and sanitation for all” (*United Nations 2014; United Nations 2015b*).

AguaClara is working to solve this global challenge.

Context-Specific Water Infrastructure

Electricity-powered drinking water treatment systems are economical and efficient at meeting a city like New York’s water demand. However, conventional, electricity-dependent systems at New York City’s scale and cost are not appropriate in remote low and lower-middle income communities. AguaClara offers alternative drinking water treatment systems that operate sustainably in this context (*Figure 2*).



Figure 2. Raw water before AguaClara Water Treatment (left) next to potable drinking water post-AguaClara Treatment (right). This raw water is from San Nicolás, Santa Barbra, Honduras. The AguaClara treatment plant in San Nicolás provides potable water to all 6,000 people living in the municipality of San Nicolás.

AguaClara

A Solution Amid a Global Crisis

In 2005, AguaClara was founded as a program for Cornell University students to research and develop affordable and electricity-free drinking water treatment methods. Since then, AguaClara has created next-generation water treatment technologies that are gravity-powered, cost-effective, locally built and easy to operate. With a relatively small investment, AguaClara technologies can operate in areas with intermittent electricity, making drinking water treatment accessible for communities who previously did not have access.

Today, AguaClara technologies reach the international stage through a partnership of two distinct AguaClara organizations – AguaClara Cornell and AguaClara Reach. AguaClara Cornell is the student-based team that continues to research, design and invent AguaClara technologies. AguaClara Reach is a nonprofit organization that facilitates implementation and expands global access to AguaClara technologies.

AguaClara technologies have been piloted in Honduras (18 systems), Nicaragua (2 systems) and India (5 systems) and now serve safe drinking water to 85,000 people using three treatment options: the Standard AguaClara Treatment Plant, the PF 300 and the Hydrodoser.

- Standard AguaClara Treatment Plant. This is a full service, municipal scale system that is constructed using local labor and materials. Capacity: 2,000 to 100,000 people, 0.3 to 3.0 MGD.
- The PF300 is a full-service system that serves 300 people and can be deployed in parallel to increase its capacity. The PF300 is prefabricated off-site then delivered and connected to local distribution systems. Capacity: 300 to 2,000 people, 0.03 to 0.3 MGD.
- The Hydrodoser is a disinfection system that is added to existing distribution systems. Not all treatment steps of either the Standard Treatment Plant or the PF300 are included in this system, so this system is appropriate for cleaner waters. Capacity: 300 to 100,000 people, 0.03 to 3.0 MGD.

Multistakeholder Approach

AguaClara uses a multistakeholder approach, based on a philosophy of empowerment and engagement, to develop sustainable water treatment and water management systems. Stakeholders include AguaClara Reach, AguaClara Cornell, communities with AguaClara systems, local water authorities, national governments, international NGOs, donor governments, philanthropists and academic institutions. Stakeholders openly share knowledge and collaboratively problem-solve to make AguaClara systems more resilient and reliable.

AguaClara’s expansion model is driven by local partners, such as engineering firms and NGOs. Once trained by AguaClara Reach, local partners implement AguaClara systems in communities within their region, where they understand the community’s culture and are aware of their needs. Local partners are responsible for training system operators, gaining community buy-in, and working with local water boards to establish a financial model that sustains the operations of AguaClara facilities. Financial models include sustainable water tariff payment schedules and connections with external support programs. Philanthropists and national govern-

ments assist local partners by promoting and funding AguaClara projects in their countries or areas of interest.

From construction to operation and maintenance, AguaClara Cornell works with local AguaClara treatment system operators to identify ways to improve AguaClara technologies and tailor solutions to their communities. Feedback from local operators is invaluable and drives the innovation process that will provide safe water on tap for all.

Introducing safe, reliable water supply infrastructure to a community for the first time has a transformative effect. Adults have more productive working days, and children attend school more often by avoiding waterborne illnesses. Women and girls especially are liberated from hours spent walking to collect water for the household. The benefits of having clean drinking water ripple through every aspect of life, promoting gender equality, strengthening the earning potential of communities, and enabling individuals to fulfill the future they envision for themselves.

As members of the New York water community, we ask you to join us on this journey. Learn more about how you can partner with AguaClara and create permanent change with your donation at www.aguaclearareach.org. Together, we can ensure lasting access to safe water for children and families around the world – every dollar raised helps us reach a new community with the tools to help them thrive. Please support us today.

Serena Takada, E.I.T. is a Volunteer Coordinator with AguaClara and an Assistant Engineer with Hazen and Sawyer. She can be reached at STakada@aguaclearareach.org. Contributions by Alissa Diminich, Tori Klug, Zoe Maisel, Maysoun Sharif and David Tipping.

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Kasturi Nayak (left) and Binodini Patra (right) are the two operators in Lahanda Village, Odisha, India. Here they are taking turbidity measurements. *AguaClara*



Manorma Mahanta is a Village Water and Sanitation Committee (VWSC) member in Lahanda. The VWSC is responsible for collecting water tariffs, paying operators, obtaining treatment chemicals, commissioning repairs to the water supply system, and ensuring equitable water supply for paying customers. *AguaClara*



Agua Para El Pueblo Engineer (left) and local operators (right) discussing design improvements to chemical dosing systems. *AguaClara*

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Community Water Supply: A Case Study in Machakos County, Kenya

by Eric R. Lehan

For those of us in the water and sanitation fields, it is impossible to ignore the World Health Organization's statistics:

- 844 million people still lack even a basic drinking water service.
- 263 million people spend over half an hour per round trip to collect water from an improved source.
- 159 million people still collect drinking water from a surface water source.

Of this last group, 58 percent live in sub-Saharan Africa (*World Health Organization and the United Nations Children's Fund 2017*).

This article describes one community water program in Machakos County, Republic of Kenya, which lies within the sub-Saharan region on Africa's eastern coast. This is an area that is undergoing rapid development, driven by initiatives from the Kenyan government, a variety of nongovernmental organizations (NGOs) and the communities themselves.

Program Initiation

The Misuuni Water Program is a partnership initiated by the Misuuni Development Self Help Group (MDSHG) as an online project application to Engineers Without Borders USA (EWB-USA). The stated objective was to drill a borehole (well) with the aim of improving health and preventing illness caused by water-borne disease. The estimated cost as presented in the project application was \$177,000.

The MDSHG is one of many self-help groups that have formed in East Africa to gain support for unmet community needs from wherever possible. The MDSHG's ability to fill out online applications and post project proposals to several international web-based platforms is an indication of the capacity and sophistication of this community group. MDSHG has garnered successful projects for the community in the past, including a productive borehole and water system in 2008 that was supported by the Spanish NGO Manos Unidas and a greenhouse project in 2015 that was supported by the government of Japan.

Per EWB-USA's usual process, the application for the Misuuni Water Program was reviewed, vetted and shared throughout the U.S. with EWB-USA's network of volunteer chapters. EWB-USA chapters then applied to adopt the program based on their own capabilities and preferences. The first assessment trip took place in August 2014 with an EWB student chapter. The New York City Professional Chapter (EWB-NY) adopted the program in 2016 and has continued its involvement to date.

Program Context

The Republic of Kenya is a vibrant nation of 45 million people and the economic hub of East Africa. Infrastructure improvements have been rapid across most sectors. The rates of people living in extreme poverty – less than \$1.90 per day – has declined from 43.6 percent in 2005-2006 to 35.6 percent in 2015-2016 (*World Bank Group 2018*). The educational system is good for those who can afford it. The University of Nairobi, for example, is a world-class institution with programs comparable to universities in Europe and the U.S. (*Times Higher Education 2018*).

And yet through much of the region there is a staggering lack of access to clean water. Averaged across all 47 Kenyan counties, the rate of access to an improved water source is only 66.5 percent. Only 51.8 percent of the population in Machakos County have access to clean water (*Kenya National Bureau of Statistics 2010*). Impoverished



Children hauling water from the Misuuni Dam in January 2017.

Weiling Xu, EWB-NY

people, mostly women and children, spend hours of their day hauling water to their homesteads for their domestic needs.

The Machakos County government has produced and continues to refine plans to address economic development and water. The 2015 Machakos County Development Plan, for example, lists 62 ongoing initiatives of all types, of which nine are related to irrigation water and eight related to drinking water. The plan calls for 210 new projects of all types, of which 10 are related to drinking water.

County water projects include the construction of surface water impoundments, de-silting of existing impoundments, drilling of boreholes, rehabilitation of old boreholes and construction of rainwater harvesting facilities. Notably absent is the provision of water treatment facilities. In many cases, untreated surface water impoundments are intended as all-purpose water sources, including drinking water. Water treatment is left to the end-users to manage on their own as best as possible.

Community Overview

The Misuuni Water Program area nominally covers 12 square kilometers and has a population near 4,000. It is located within the Kathiani sub-county of Machakos County, approximately 70 kilometers east of Nairobi. The project region is shown in *Figure 1*. A map of the program area is shown in *Figure 2*. The base map in *Figure 2* is outdated but nonetheless descriptive of the topography and key features. The main road runs along a high plateau where the market areas are clustered. Most of the land is farmed, and it slopes downward to intermittent streams which border the project area to the east and west.

The climate of the region is semi-arid with rainfall concentrated in two rainy seasons: the long rains (March, April, May, June) and the short rains (October, November, December). Due to the shallow basement rock, clay soils and sloping terrain, rainfall tends to run off quickly toward the intermittent streams, which drain to the Thwake River and on to the Athi River and the Indian Ocean. These same hydrologic conditions contribute to a relatively slow recharge rate for the groundwater resource, which lies beneath the overburden of clay in fractured zones of igneous rock.

continued on page 40



Figure 1: Regional map showing Kenya and the surrounding countries. The location of the Misuuni Program Project Area is marked.

Google Maps

As is typical for much of Machakos County, and Kenya overall, the main economic activity is farming. Although there are a few commercial farming operations with irrigation systems to buffer the effects of the dry seasons, most people are smallholders who survive by subsistence farming and are dependent on rainfall and a great deal of manual labor to water their crops. In a good year with adequate rainfall, a subsistence farm can sell extra produce to gain a small amount of income. In a dry year, it is a matter of bare survival. With climate change, the patterns of rainfall have become increasingly erratic, leading to regional concerns of drought and food insecurity.

Existing Water Sources

Smallholders obtain water from a variety of sources depending on the season. Surface water sources such as shallow impoundments and intermittent streams are free of charge but are unsanitary and unreliable. Groundwater sources are bacteriologically safe but somewhat mineralized and cost a moderate amount. Within the Misuuni Water Program area, one private groundwater source and one community-operated groundwater source sell water to the public.

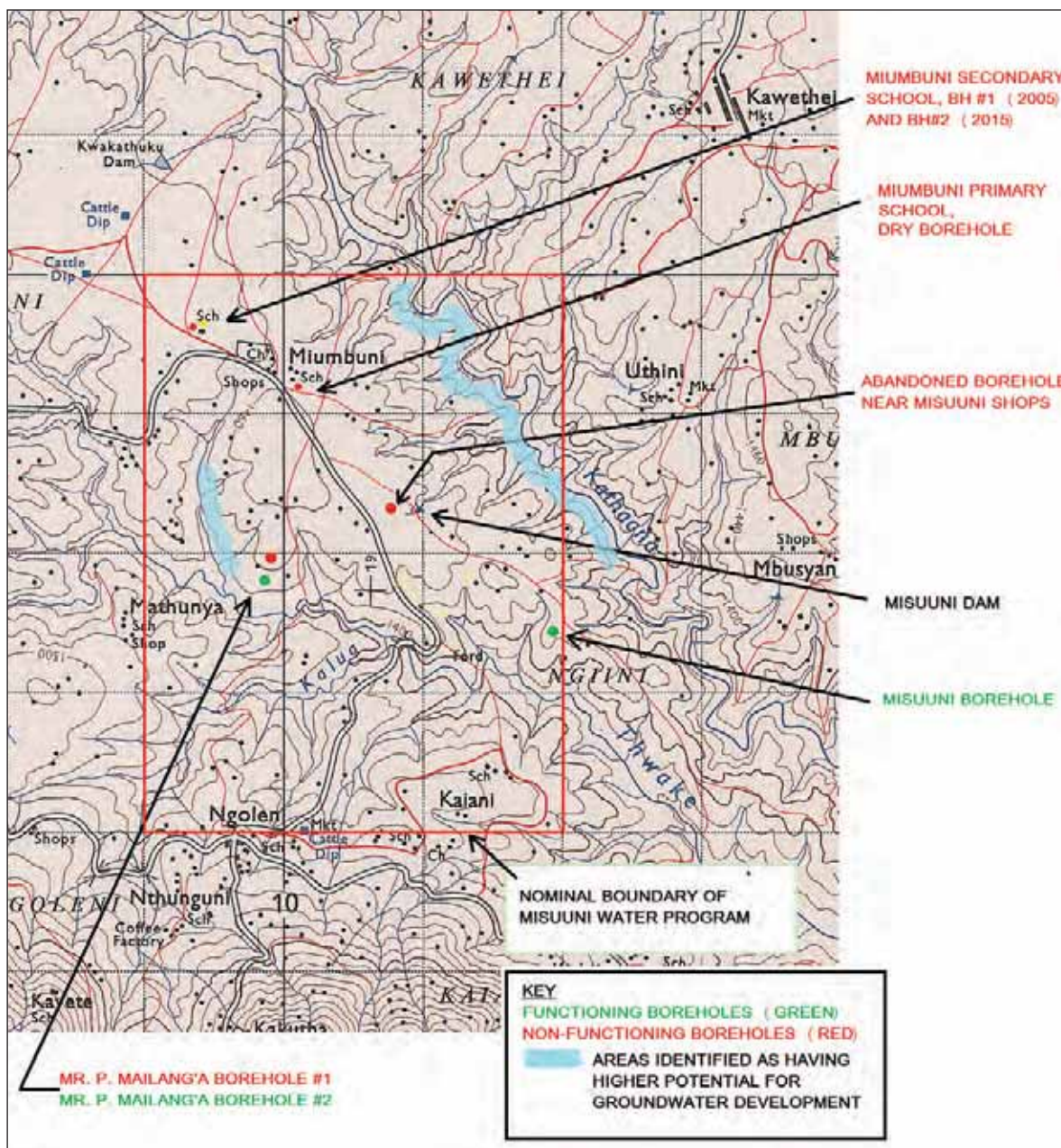


Figure 2: Map showing the Misuuni Water Program project area. The information collected from the Groundwater Availability Study (Groundwater and Technical Services, LTD 2016) is superimposed on a topographic map dating from Kenya’s colonial period and last updated in 1973. Although out-of-date and less accurate than a Google image, the topographic contours are valuable for describing the shape of the land.

Groundwater and Technical Services, Ltd / Eric Lehan

Because of its proximity and zero cost, the Misuuni Dam surface water impoundment is the local community's main all-purpose water source. Roughly half the people taking water from this pond report that they treat the water in some way before consuming it. Less than half of those treating the water boil it or disinfect it with chlorine (*EWB-USA/Polytechnic Institute of New York 2014*). The community has taken steps to improve water quality by forbidding cattle from drinking directly from the pond. However, during the dry season, the volume of water decreases or dries up completely so that contaminants become more concentrated. From a public health standpoint, the impoundment is unsanitary in the best of conditions and becomes even more so in the dry season.

The main source of potable water for the community is the Misuuni Borehole located 1 kilometer to the south of the Misuuni Dam. The Misuuni Borehole is one of the successful projects implemented by MDSHG in the past. The MDSHG now owns and operates the system. MDSHG's objective to replicate this success at another location adjacent to the Misuuni Dam is easily understood.

The system consists of a borehole some 100 meters deep, a submersible electric pump, a diesel generator for powering the pump and four 24,000-liter storage tanks that sit upon a raised concrete platform. The wellhead and water tanks are located together within a fenced lot. At some point, the ongoing rural electrification initiatives will allow the use of utility power rather than the diesel generator. Operating costs could be reduced if this transition is made, in which case the submersible pump could be run more often subject to the limitations of the well yield. However, no data are currently available to determine the safe yield of the system.

A timed test of the pumping system indicates a production rate of approximately 90 liters per minute. Static and dynamic water

level changes in the well are not known. Field testing indicates that the borehole water is free of *Escherichia coli* (*E. coli*), though it is also rather hard and corrosive. Since 2014, the demand for water has increased due to a new greenhouse initiative and expansions of the distribution system.

The available records collected in 2014 show 14,000 liters per day of water sales. The Misuuni Borehole supplies water to several institutions, farms and a water kiosk. For a smallholder hauling their water, 20 liters of water from the water kiosk will typically cost 5 Kenya shillings (approximately \$0.05). Metered water service connections to farms and institutions pay a different rate, which is not known to the author at this time.

Establishing an equitable water rate structure can be a thorny issue for any water utility. However, it is clear that this utility is paying for a skilled water system operator, fuel for the diesel generator and replacement parts. From these observations, it is fair to say that MDSHG has the technical, managerial and financial capacity to operate a water utility.

Past Project Failures

Part of any assessment is a review of past projects in the area which have failed. This is not meant to embarrass anyone or question anyone's goodwill. However, examples of nonfunctioning water infrastructure are abundant even to the casual observer. The author does not have full knowledge of the circumstances surrounding these situations. However, a pattern begins to emerge suggesting a desperate need for water but a lack of resources and sound technical guidance in the planning, design and/or construction of the facilities.

continued on page 43

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Customer at the Misuuni Borehole water kiosk in January 2017. Eric Lehan

- As shown in **Figure 2**, several previous projects involving water wells have not been successful. A Groundwater Resources Assessment (*Groundwater and Technical Services, LTD 2016*), commissioned jointly by EWB-NY and MDSHG, found that five out of seven boreholes in the project area were nonfunctioning. Data for the existing boreholes were mostly unavailable.
- At the Misuuni Primary School, several lavatory sinks lay abandoned and disconnected at the boys' and girls' privies. A sign on the privy wall indicated that the project was sponsored by the U.S. Agency for International Development. With these sinks inoperable, there was no means for hand-washing except for one faucet, which was available on an intermittent basis, located over 50 meters from the privies. This was the situation up until August 2018 when a project initiated by the Misuuni Water Program added five new water faucets and upgraded the rainwater harvesting system for the school.
- Scattered stone water kiosks for the distribution of water can be observed with no water pipeline connecting them to a water source.
- A dam on the Kathaana River – the intermittent stream on the eastern border of the project area – was constructed by a group of farmers to hold irrigation water but was washed away the following year due to unusually high river flows associated with intense rainfall.
- A girls' dormitory was constructed at a secondary school with a plan to include toilets, sinks and showers. However, an adequate water supply is unavailable, and disposal of sewage/greywater is inhibited by the shallow bedrock and perched groundwater table.
- At the Miumbuni Market Center, 1 kilometer northwest of the Misuuni Dam, the only available water kiosk flows at such a very low rate that an inordinate amount of time is required to fill water containers and the line of people waiting is long. MDSHG is not involved with the operation of this system.

Misuuni Water Program Activities

The overarching objective of the Misuuni Water Program is to make clean water more available. The improvements, if achieved, are measurable outcomes based on the location of new water distribution points and the travel time saved for people hauling water to

their homesteads. While a decrease in the incidence of waterborne disease may also be expected, measuring this impact is more complex and subject to interference from other factors. Nonetheless, the available data on disease rates from the local dispensary have been collected, along with school attendance rates, to undertake a before/after analysis and assess whether clean water availability will have a statistically significant impact on the incidence of waterborne disease.

The first actions taken by EWB-NY under the Misuuni Water Program were to apply normal due diligence to MDSHG's initial concept of drilling a borehole near the Misuuni Dam on the high plateau. Upon observing the number of nonfunctioning boreholes, EWB-NY raised concerns that this should not be repeated. For this reason, EWB-NY and MDSHG jointly commissioned a Groundwater Resources Assessment (*Groundwater and Technical Services, LTD 2016*). This hydrogeological investigation into the availability of groundwater showed that wells drilled on the local high plateau tended to hit massive bedrock with little recharge or transmissivity. Instead, the study showed that drilling on lower ground nearer the lineaments of the intermittent stream beds, where there is more fractured bedrock with greater recharge potential, would more likely yield a productive groundwater supply. As of this writing, a test well has not been drilled to demonstrate this.

To a skilled hydrogeologist, the more promising drilling locations were readily apparent. But to a small community without access to such expertise, it was not. Instead, the community picked a convenient location for a borehole and hired a hydrogeologist/technician to do the pro forma testing necessary to obtain the required drilling permit. This situation plays out across the region with a result that too many boreholes are drilled where a sustainable groundwater source does not exist.

The area where groundwater is more likely to be found is not as convenient as the initial drilling location selected by MDSHG. A pumping system and water line are needed to convey the water to the high ground near the Misuuni Dam. The well pump would need to operate against roughly 110 meters of static head plus the dynamic head loss along 1.5 kilometers of water line. However, this is technically feasible with an ordinary submersible pump and three-phase power available in the vicinity. It is also economically feasible to pay for electrical power (*Regulus 2019*) and maintain reasonable user fees. At the same time, solar power systems are rapidly becoming more economical, offering another promising alternative.

As of this writing, a project is in the planning stages to provide a borehole, pumping system, elevated storage and water distribution. The results of the Groundwater Resources Assessment have been shared with local leaders who are empowered to set government funding priorities. However, as of this writing, a funding source for this project has not yet been identified. In any case, next steps involve further data collection, community stakeholder meetings, establishment of rights of way and drilling a test well.

Interim Projects

Given the dire needs for water, the Misuuni Water Program did not wish to wait for a relatively complex planning process to conclude before taking action. One obvious need was for water and sanitation improvements at the primary schools in the area. Primary education is free in Kenya, but the schools are minimally funded. The Machakos County government is hopeful that NGOs will step in to offer support. The Misuuni Primary School, for example, has a student population near 275, pit privies and no piped water. Rainwater is collected in tanks and is used for drinking

continued on page 45



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P 315.652.5627 | randyott@jagerinc.com

continued from page 43

water and hand-washing until it runs out. The nearest faucet for hand-washing is over 50 meters from the privies.

The first interim project under the Misuuni Water Program was for rainwater harvesting improvements at the Misuuni Primary School. The number of faucets was increased from one to six. The roof area for collecting rainwater was increased from 80 square meters to 400 square meters and the storage volume was increased from 15,000 to 43,000 liters. Construction occurred in August 2018 at a capital cost of \$10,000, which is \$36 per student. All materials were purchased locally.

As of this writing, a second interim project is planned for August 2019 to address a similar situation at the Miumbuni Primary School, with a student population of 870. At the same time, data collection and other steps necessary to advance the larger groundwater development project will continue.

In the meantime, another NGO, the Africa Sand Dam Foundation (ASDF), coordinated with MDSHG to construct a sand dam on the Kathaana River, the intermittent streams on the eastern side of the program area. ASDF provided expertise and construction material while community members on both sides of the river volunteered their labor and local aggregate. ASDF has constructed several sand dams in Machakos County already. By all accounts the project was successful, providing water storage for irrigation and another potential drinking water source if a pipe gallery were to be installed in the sand bed after it accumulates sufficiently.

These interim projects fall short of providing all the water that the community needs. But something is being provided to ease the burden of poverty and disease while the community waits for better things to come.

Eric R. Lehan, P.E., M. ASCE, is an Administrative Engineer with the New York City Department of Environmental Protection (NYCDEP) Bureau of Engineering Design & Construction, and he is co-lead of the Misuuni Water Program, EWB-NY. The views expressed in this article do not necessarily reflect the views of NYCDEP. He may be reached at misuuni@ewbny.org.

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Community Water Supply – A Case Study in Machakos County, Kenya

Community Perspectives

by Festus Kavita Ndolo

Approximately 70 percent of Kenya's population lives in rural areas and most communities rely on unimproved water sources. Despite recent changes to the Water Act of 2002 to improved service delivery (*Water Services Regulatory Board 2016*), the new legislation has not translated to actual change on the ground. The new law calls for public participation in water management to ensure sustainable and equitable water use for all citizens. However, the frameworks available at the national levels are not yet devolved to the local level. Until then, local communities are forced to fend for themselves or otherwise suffer, especially during extended drought periods.

This challenge has led communities to take advantage of community-based organizations (CBOs), which by Kenyan law can both undertake projects as well as lobby for action with local governments. Organizations such as the Misuuni Development Self Help Group (MDSHG) are effective in transforming their communities by providing solutions that would otherwise take years, if not decades, to achieve through the normal government channels. By collaborating with donors and local governments, they get funding for their projects as well as local government cooperation. Whereas a foreign organization working on a project alone would go through the red tape of work permits and project approvals, partnership with communities through legally recognized CBOs provides an effective approach for humanitarian assistance. The local governments, through county governments, have been especially supportive of such endeavors, and in fact encourage them.

The work that the New York City Professional Chapter of Engineers Without Borders (EWB-NY) has been able to do thus far in partnership with MDSHG is a start to what may prove to be a great economic stimulus to the local community. Construction of rainwater harvesting systems at schools not only improves access to water but also improves the delivery of education at these schools. The connections EWB-NY brings have led to other partnerships such as the one with The Charitable Foundation (<http://www.thecharitablefoundation.org/>), which supported the construction of a new dam through the Africa Sand Dam Foundation. This has further benefited the community by providing water for agriculture and domestic use. It is such initiatives that will fill the gap between the commitment of the Kenyan government to meet development goals such as clean water access and actualization of the same.

As a local technical liaison for EWB-NY in their projects with MDSHG, I cannot fail to mention the importance of cooperation and proper coordination between foreign donor organizations and the local communities they work with. Whereas the community has needs and a perceived way to meet them, the donor organization also has pre-determined steps to their mandate. This often leads to misunderstandings between the two parties. A local third party, often technical, is advisable to work as a go-between. For instance, the work may involve the harmonization and interpretation of engineering standards, labor norms and general business practices in a way that not only works but is also understandable to all stakeholders.

Festus Kavita Ndolo received his bachelor's in civil engineering from the University of Nairobi in 2015 and serves as the in-country Technical Liaison for the Misuuni Water Program on a volunteer basis. Professionally, he is a project manager for Teejay Estates Ltd on housing and other construction throughout East Africa and can be reached at kavitandolo@gmail.com.

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Lessons Learned for Community-Based Design and Usage of Household Latrines

by Walter A. Walker and Melissa Montgomery

Vision, Approach and Mission

The vision of Engineers Without Borders USA (EWB-USA) is a world in which the communities we serve have the capacity to sustainably meet their basic human needs, and that in turn our members develop enriched global perspectives. EWB-USA collaborates on more than 360 active projects in 40 countries driven by 275 chapters across the U.S., partnering directly with communities in the U.S. and around the world to meet their self-identified needs (Figure 1). Of these types of projects, approximately 12 percent are of the sanitation discipline, primarily of the latrine type.

Our approach to development is based on more than blueprints and measurements; it's based on real relationships and a minimum five-year partnership with communities. We do more than build latrines for communities; we prepare them to build and maintain latrines for themselves. We work together to develop solutions to improve the health of communities through safe collection of human excreta, proper wastewater disposal, hygiene education and waste management training.

Our mission is not to provide access to sanitation facilities as quickly as possible. Rather, it is to make sure those implemented projects have greater sustainability, so that we move away from the longer history of failed development projects. Therefore, it is essential to acknowledge that there is no one-size-fits-all solution for a community's water, sanitation and other basic needs. The geographic, cultural and political fabric of each community we partner with is unique, which is why the engineering solutions are unique, too.

We take into consideration several specific variables to ensure the project is built to last. These are:

- Program Scope. The community's request might be for latrines but there could be other sources of waste and pollution or hygiene issues to address, such as greywater, groundwater protection, trash, lack of hand-washing, etc.

- Education and Training. EWB-USA chapters are encouraged to work with public health specialists, such as volunteers or mentors from the U.S. or health delegates from the community, to collect data on the diseases present in the community related to poor hygiene and lack of waste management. This information is used to create appropriate health education training programs and resources.
- Gender Approach. We consider the safety of young women in the design of sanitation facilities, such as distance from homes or schools and privacy. Women could be at risk if they must travel long distances in isolated pathways by themselves, even during the day. Women are included in all design discussions and operation and maintenance (O&M) trainings. Women will usually be the ones to clean the sanitation facilities and will be directly affected by design decisions.
- Financing Strategies for On-Site Household Systems. Different strategies can be used to help families pay for their sanitation facilities. In certain regions, microfinancing institutions might offer loans for community members looking to build or improve their sanitation systems. A revolving fund might help build more latrines in large communities. The best strategy needs to be discussed and agreed upon with the community before implementation.

Latrine Technologies

Several latrine technologies are widely deployed. Selection of the technology depends on water and materials availability, soil analysis, community practices and estimated population growth.

The three most common types of sanitation latrines are:

- Ventilated improved pit latrine.
- Pour-flush latrine.
- Composting latrine.

continued on page 48



Figure 1. EWB-USA sanitation project locations.

EWB-USA

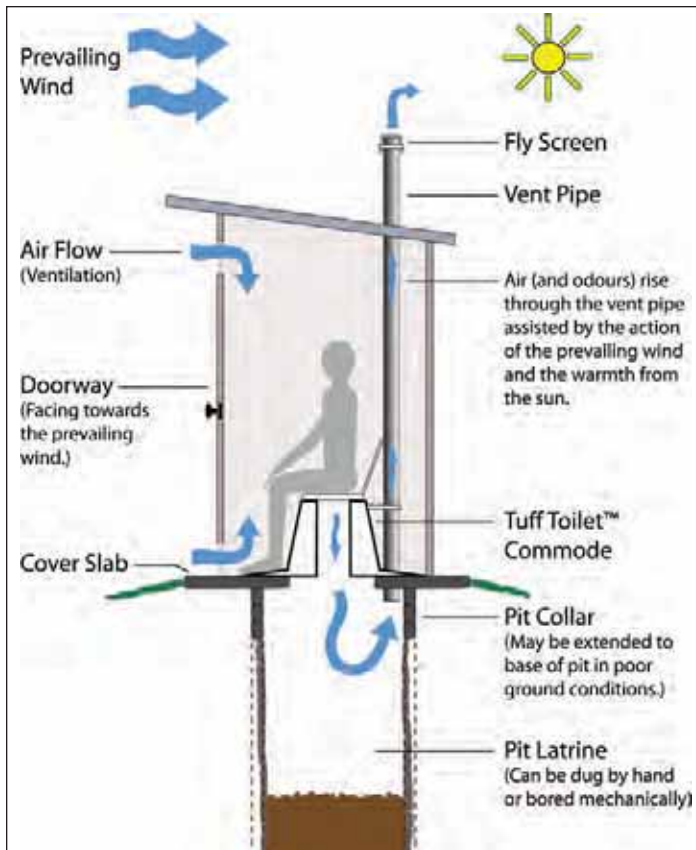


Figure 2. Ventilated improved pit latrine.
 Bellatrines Portable VIP Toilets/a SOLPONT brand
 (http://www.bellatrines.co.nz/how_it_works.html)

Ventilated Improved Pit (VIP)

The VIP system (Figure 2) produces a continuous airflow through the ventilation pipe. The airflow vents away odors, assists waste breakdown by drying action, and acts as an effective fly control mechanism. Despite their simplicity, well-designed VIPs can be completely smell-free and more pleasant to use than some other water-based technologies.

Pour-Flush Latrine

A pour-flush latrine is similar to a regular cistern flush toilet, except that the water is poured in by the user instead of coming from the cistern above. Pour-flush latrine pits often have unsealed bottoms allowing liquid to percolate down into the soil. In areas of high groundwater, these latrine pits have sealed bottoms. The additional water from flushing causes sealed pits to fill up faster. Full pour-flush pits are then emptied using the vacuum hose of a sludge pumping truck or allowed to settle before being emptied manually using a shovel.

Composting Latrine

Composting toilets use the natural processes of decomposition and evaporation to recycle human waste. Waste entering the toilets is over 90 percent water, which is evaporated and carried back to the atmosphere through the vent system. The small amount of remaining solid material is converted to useful fertilizing soil by natural decomposition.

Importance of Impact Assessment and Lessons Learned

EWB-USA’s mission is to build a better world through engineering projects that empower communities to meet their basic human needs. As such, an integral part of all EWB-USA programs is the

planning, monitoring, evaluation and learning (PMEL) framework. The PMEL framework provides the feedback we need to maximize our effectiveness and enable leaders in their fields to solve the world’s most pressing problems. This framework is embedded in the project delivery process to provide feedback and inform improvements to our overall process and delivery model. EWB-USA provides planning tools, best practice guidance and resources to aid in planning. We measure more than the project functionality. Our framework assesses quality-of-life changes from the perspectives of both successful projects and failures.

The EWB-USA PMEL framework was recently updated to align our standard project indicators with the United Nations 17 Sustainable Development Goals (SDGs) defined in the “2030 Agenda for Sustainable Development” (United Nations 2015). The project indicators are assigned by project category. This shift allows us to report uniformly on the level of impact we are having across the organization, but also provides reliable evidence for the contribution our efforts make toward both our mission and the global goals expressed in the SDGs.

EWB-USA strives to learn from past mistakes, big and small, to constantly improve our efficiency and effectiveness in delivering community-driven projects. Each project team is asked to contribute to this effort by writing helpful lessons learned, both technical and nontechnical, for future teams to utilize. In addition, it provides insight to improve our project process and identify gaps.

Methodology

EWB-USA tracks projects on three high-level metrics, each with specific indicators. These performance and quality indicators look broadly at the project design and determine if the project is meeting the relevant local and global standards, as well as best practices for quality.

- **Functionality.** These indicators will document that the project functions as designed.
- **Maintenance.** These indicators will document that the project is being maintained in a way to foster a sustainable improvement into the future.
- **Community capacity.** These indicators will document that the community can sustain the project into the future without outside assistance, and that the community members have the knowledge, financial capacity and interest to keep the system operational.

Table 1 summarizes the five sanitation project categories that EWB-USA delivers.

Table 1. EWB-USA Sanitation Project Categories.

Category	Description
Latrine and Hand-washingAny latrine project at a school. (School)
Latrine and Hand-washingAny latrine project at a clinic (Hospital) or hospital.
Latrine and Hand-washingAny latrine project not at (Community/Household) school or clinic.
Stand Alone Hand-washingHand-washing station not built as part of latrine. Facility
Other SanitationWastewater treatment, solid waste management, medical waste management, black water management, stand-alone hygiene education, showers.

Baseline data are documented during the initial assessment. Monitoring on all indicators is done on every trip into the community throughout the entire project process. A final evaluation trip is conducted at least one year after implementation has been completed. These data are reported within the Salesforce™-based

database platform, and are used to provide transparency to our work, share lessons learned through our membership and staff, and provide regular reporting on our organizational impact and overall contributions to the SDGs.

continued on page 50

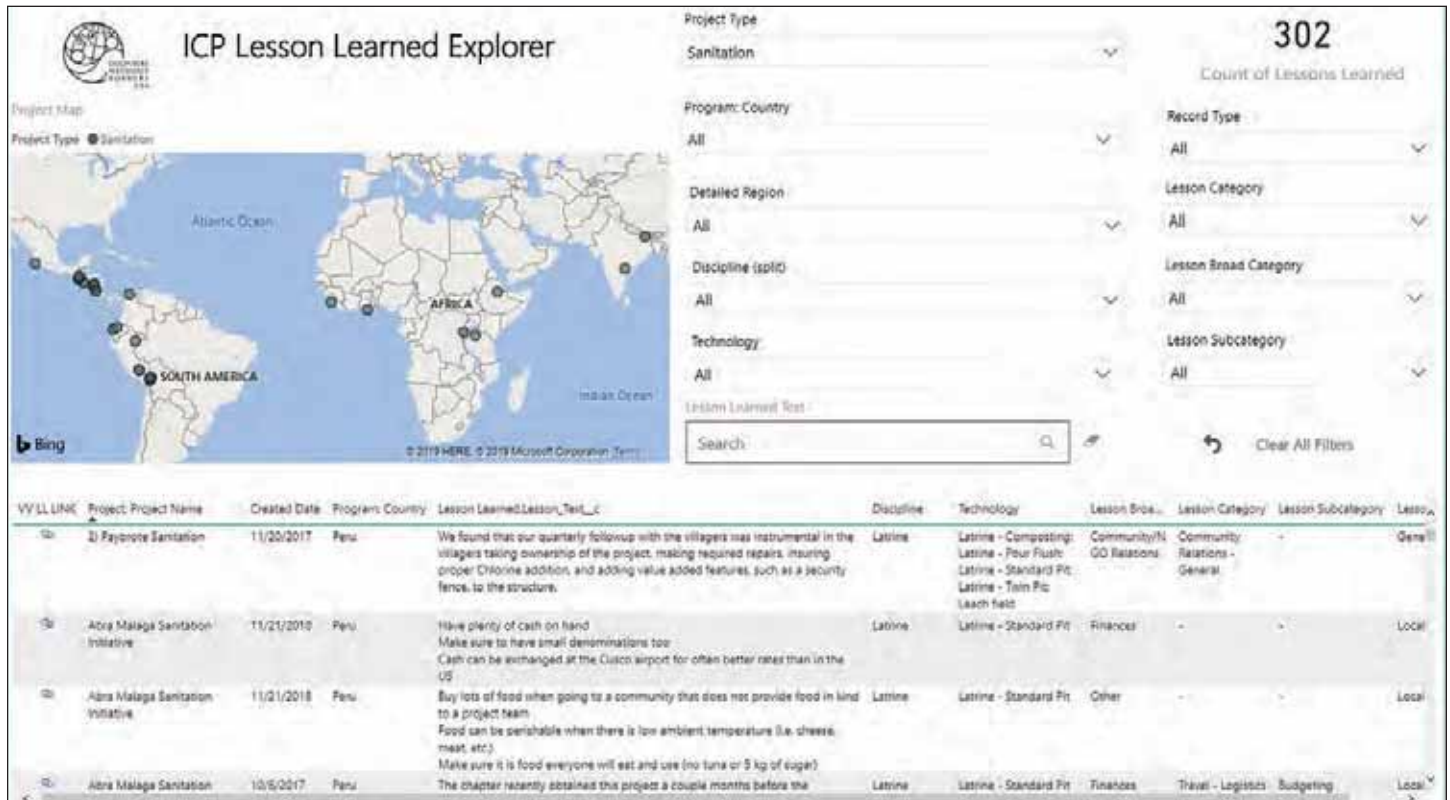


Figure 3. EWB-USA Lessons Learned Dashboard.

EWB-USA

Table 2. Examples of General Lessons Learned as Reported from the Dashboard Tool.

Community/Nongovernmental Organization (NGO) relations		
<ul style="list-style-type: none"> • Certain communities are democratic in nature; thus, choosing large groups of people to make decisions related to a project, rather than a select few, may be beneficial. • Respecting local culture may be key to the success of the project. • Define expectations and capacity of cash contributions in the assessment phase. 	<ul style="list-style-type: none"> • Importance of involving local officials (mayor, president, chief, etc.) to help gain acceptance and credibility of EWB-USA members by the community as well as provide maintenance assistance. • Effective community interviews/surveys in the early phase (assessment) of the project to confirm needs, develop a data profile, and facilitate trust and a long-term working relationship. 	<ul style="list-style-type: none"> • Importance of communicating EWB-USA's level of involvement to the community and integrating the community into the project. • Expectations of the NGO to coordinate, including when EWB-USA chapters are not present in the country.
Technical		
<ul style="list-style-type: none"> • Understanding and accounting for existing field conditions and environment risks, such as topography, ground-water, climate change. • Be prepared for the unexpected, such as ground material inconsistency, rain affecting construction progress, etc. 	<ul style="list-style-type: none"> • Understanding availability of local materials, and compromises of material strength properties in those materials. • Men in the community may tend to migrate to the inner cities for work, resulting in less manual laborers available locally. 	<ul style="list-style-type: none"> • Using metric units. • Appropriate technology for community. • Long-term operation and maintenance plan. • Consider incorporating hygiene training in conjunction, where applicable.
Logistics/Management		
<ul style="list-style-type: none"> • Construction safety (e.g., around excavations) and personal protective equipment (PPE). 	<ul style="list-style-type: none"> • Schedule planning, including general delays and delivery of materials/equipment from local manufacturer or contractor. 	<ul style="list-style-type: none"> • Common building practices in the region. • Travel and distance. • Security of materials.

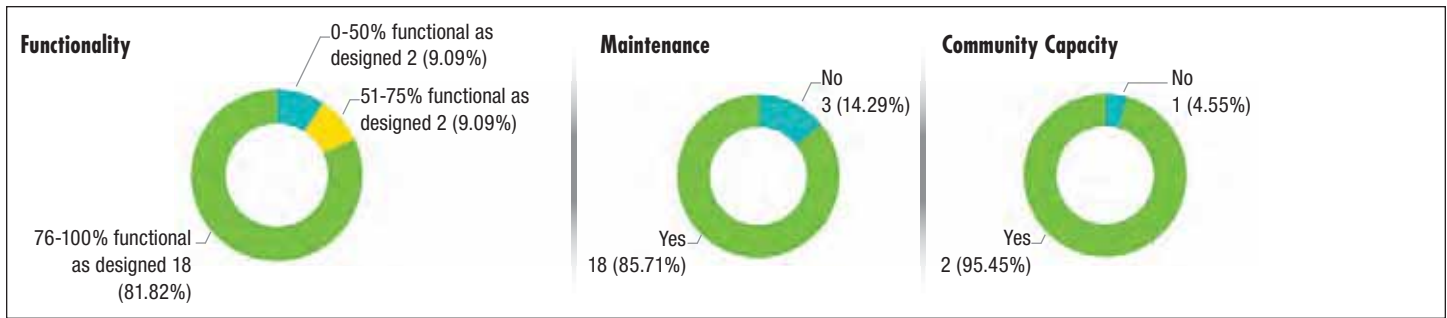


Figure 4. Reporting on high-level metrics for EWB-USA sanitation projects.

EWB-USA

Defining Success

The established indicators that speak to the higher metrics of performance and quality, maintenance and functionality, and community capacity are used to determine the overall success of an EWB-USA project. Success is not only dependent on a quality design, but also on the community’s capacity to operate and maintain the project well into the future, after the partnership has ended. The alignment of indicators across all EWB-USA projects allows for high-level reporting across all our work on an annual basis.

Lessons Learned: Factors Impacting Success

As a critical component of the learning aspect within the PMEL framework, lessons learned provide useful data to help teams set themselves up for success. These reported lessons also inform potential gaps in resources. EWB-USA has created a dashboard tool (Figure 3) to explore the lessons learned that have been reported for a given region, project type, phase or country.

Some of the most common reported lessons learned factors are community relations, construction materials and finances. This speaks to some of the bigger challenges within our projects, including:

- Importance of community engagement and buy-in. Regardless of how well-designed a project may be, the real success factor is whether the community takes ownership and responsibility. This includes cultural acceptance and the behavior/systems adjustment of the latrine usage and maintenance. As part of the collaborative mindset of the project process, opportunities can also arise for community leadership and technical skill-building.
- Construction materials. Sourcing local materials and local labor for construction increases the likelihood that the community will take on ownership and long-term maintenance.
- Finances. The financial components of any engineering project are important for timely project delivery to fulfill the commitments we have made to our community partners, as well as being responsible stewards of donor funding.

Table 2 describes more examples of the lessons learned that can be found using the dashboard tool.

As noted previously, the high-level metrics that are monitored for performance and quality include functionality, maintenance and community capacity. Figure 4 shows the current reporting on 43 active EWB-USA sanitation projects on these three metrics. This reporting is completed by project teams at least one year after implementation is completed. Highlights of the graphs include:

- Approximately 81 percent of sanitation projects are reported to be functioning as intended.
- Approximately 85 percent of sanitation projects are reported as being maintained by the community.

- Approximately 95 percent of sanitation projects are reported as the community having the financial and technical capacity to take on long-term operation and maintenance of the system.

Next Steps

As seen in the graphics, we have room to improve upon our work based on these three high-level metrics. The data show that approximately 20 percent of our implemented projects are not functioning as designed. While this is lower than the global average, we still have the responsibility to improve upon this indicator. The data also report that nearly 15 percent of sanitation projects are not being maintained. These are two areas that we will continue to improve upon.

We also intend to expand new PMEL framework to include a more direct mechanism to gather feedback directly from our local NGO and community partners. In addition, we aim to complete in-depth impact assessments and conduct more longitudinal studies with multiple evaluation trips in locations where we have country offices. As a learning organization, we embrace continuous improvement, and we have a robust system to allow us to continue to make improvements to projects for our community partners.

Walter A. Walker, PE, ENV SP, is a Project Manager and Associate with Greeley & Hansen and may be reached at wwalker@greeley-hansen.com. Melissa Montgomery is the International Community Program Director at Engineers Without Borders-USA and may be reached at melissa.montgomery@ewb-usa.org.

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Meet the Winners of 2019's Operations Challenge! Congratulations to All!



The 2019 first place winners of the Operations Challenge are the Rockaway Sludge Hustlers: (l-r) NYCDEP's Pamela Elardo, Yu-Tung Chan, Robert Ferland, Ray Antenucci, Robert Ortiz, and Ops Challenge Coordinator John Fortin.



Second place winners in the Operations Challenge are the Long Island Brown Tide: (l-r) Nick Barresi, Hector Soto, Jake Miller, Rob Jentz and James Behr.



Third place winners in the Operations Challenge are the Lower Hudson Watershed Warriors: (l-r) back, Andrew Reaves, Matt Burd, Captain Ken Taylor, Daniel Byrne; front, Coach Erik Coddington, Bruce Decker and Eric Albano.



Members of the Metropolitan Bowery Bay Coyotes: (l-r) back, Coach Howard Robinson, Anthony Quadrino, Chris Reyes; front, Dragan Pelovic and Andrew Luong.



Members of the Genesee Valley Water Recyclers: (l-r) back, Will Monier, Harley Hancy, Michelle Hess, Lucas Kasperowicz; (l-r) front, Tim Vandermeid and Tony Filer.



Michelle Hess, Team Captain of Monroe County's Genesee Valley Water Recyclers, competes in the Pump Event.



Rockaway Sludge Hustlers ably handle performing service on a KSB submersible pump.



Members of the Long Island Resource Revolutionaries: (l-r) Joseph Cappetti, Lorenzo Seijo, Nuno DaSilva, Dan Rowe, Kevin Peterson, Nick Kublbock and Bill Donovan.



Members of the Central's Mixed Liquors: (l-r) Dean Ellsworth, Casey Clark, Michael Burkett, Derrick Rawson and Dave Cunha.



William Grandner (left) and John Fortin are hard at work during the Operations Challenge event.



Operations Challenge onlookers intently watch events.



NYWEA President Robert Wither Bob gives directions for the Sludge Challenge.

The Importance of Utility Knowledge-Sharing and Mentorship: New York City, Fiji and Samoa Tackle Climate Change

by Mikael Amar, Pamela Elardo, Jane Gajwani, Nate Kimball and Dennis J. Stanford

Importance of Utility Knowledge-Sharing and Mentorship

Water and wastewater services are critical to the functioning of a healthy economy. Across the world, governments acknowledge that access to clean water forms a bedrock commitment that must be met. For that reason, water resources generally receive some level of government support.

Water utilities across the globe face many of the same challenges. Climate change, for example, represents a universal threat to water supply and wastewater infrastructure globally. Sea level rise, drought, more frequent and intense rainstorms, cyclones and heat waves represent just some of the threats to critical infrastructure.

Water utilities also have diverse mandates around the world:

- Ownership can be private or public.
- Geographic reach can be regional or local.
- Utilities can be tasked with water supply, wastewater services or both, in addition to stormwater and floodwater management.
- Revenue streams can be a mix of public subsidies and private ratepayer funds.
- Operating assets can be at vastly different scales and levels of sophistication.

Despite these differences, water utilities all face similar challenges resulting from climate change, including the need to:

- Develop operational responses to weather and climate events that have not existed in the recent past.
- Use climate projections to plan new infrastructure and renovate existing infrastructure.
- Identify critical infrastructure.
- Identify funding streams and necessary capital to make improvements to facilities.

Not all utilities have the resources to develop the tools needed to address this growing threat. In many cases, utilities can save valu-

able time and effort for their own purposes by adapting strategies that have had success elsewhere. Mentorship and coordination can help to identify pitfalls or roadblocks early in the process and lend credibility when new strategies are proposed to management and other stakeholders.

ADB Water Operators Partnership Program History

The Asian Development Bank (ADB) is an institution established in 1966 to aid economic growth and cooperation in one of the poorest regions in the world: Asia and the Pacific (Asia-Pacific). To enhance capital infrastructure investments by ensuring long-term operations and maintenance, ADB created the Water Operators Partnership Program, under which utilities across the world form peer-to-peer learning and mentoring relationships to spread expertise and best practices in the field of water utility operators. These partnerships focus on improved and sustainable water and wastewater service and have been successful in a full range of operations and maintenance needs, including planning, asset management, process improvement, safety, odor control and nonrevenue water. More recently, the ADB Partnership Program is responding to today's challenges in the changing global environment.

The Asia-Pacific region has realized that it is at a growing disadvantage due to the projections of global climate change and sea level rise. One remarkable fact in disproportional causation is that many of the countries of the Asia-Pacific region are faced with some of the most significant difficulties from climate change, while they have historically been insignificant contributors to global greenhouse gas emissions, one of the root causes of the impacts.

ADB initiated the Water Operators Partnership Program in 2007 and has engaged in 69 completed and ongoing partnerships in the Asia-Pacific region, supporting around \$2.3 billion worth of invest-



Commercial District in Downtown Suva, Fiji. Once a rare occurrence, flooding during high tide is a frequent disruption to pedestrians and businesses in

ments in water supply and sanitation. For both mentor and mentee utilities, this program provides insight to spread expertise and best practices in the field of water utility operations, which in turn further improves sustainable water and wastewater service delivery.

NYCDEP's Involvement in the Program and Incentives

In 2017, New York City Department of Environmental Protection (NYCDEP) began discussions with the ADB to participate in two partnerships: one with the Water Authority of Fiji (WAF) and another with the Samoa Water Authority (SWA). The partnerships aimed to improve WAF's and SWA's approaches to climate adaptation and were then formalized into Memorandums of Understandings (MOUs). The close work between the New York City Mayor's Office of Resiliency (MOR) and NYCDEP on climate resiliency led to additional support to these MOUs.

Both countries faced severe impacts from tropical cyclones in 2012 and 2016, making it clear that climate-adaptive infrastructure is needed in small island nations. After WAF and SWA employees attended a climate adaptation workshop in Australia, NYCDEP and MOR were called upon to help each utility take action on climate adaptation.

Since Superstorm Sandy impacted New York City in 2012, NYCDEP and MOR have been involved in recovery and long-term planning efforts to improve the resiliency of the city's water and wastewater infrastructure. In addition to improvements in building code and a comprehensive recovery program, MOR has developed Climate Resiliency Design Guidelines for capital projects, specifying design parameters to respond to the anticipated effects of climate change. New York City has also convened the New York City Panel on Climate Change to develop tailored climate projections for the region. NYCDEP developed their Wastewater Resiliency Plan in 2013, documenting vulnerabilities to their wastewater infrastructure and charting a course toward risk reduction at their facilities. NYCDEP and MOR felt that the lessons learned since Sandy are universally applicable and are useful to share with other utilities as they face similar challenges. Furthermore, the opportunity to test

NYCDEP's practices within different utility structures and within different operational constraints would provide greater insight into the limitations of these approaches.

Water Authority of Fiji (WAF)

The WAF serves a population of over 700,000 people across the 110 inhabited islands in the Fiji archipelago with water and wastewater services. This equates to approximately 31 billion gallons of drinking water provided per year. Climate change in Fiji has manifested itself through increased precipitation intensity and duration, increased frequency of cyclones, sea level rise, and increased frequency of droughts and severe heat events. As a water utility, these impacts have stressed its water supply's quality, storage volumes and distribution network. Planning and designing of capital improvements are now intertwined with WAF's long-term response to climate change.

Samoa Water Authority (SWA)

The SWA provides water services to 85 percent of the nation's 196,000 people. As a small island nation, climate change is impacting the very fabric of Samoan culture, as the population moves from coastal villages to new inland settlements. The SWA has felt impacts of increased precipitation, sea level rise and increased frequency of cyclones on its infrastructure. More recently, the nation has experienced the impacts of heat waves and drought.

Goals and Objectives for this Session (Climate Change)

After an initial diagnostic visit to WAF and SWA in 2017, NYCDEP and MOR supported each utility as they developed risk registers examining specific vulnerabilities at their facilities and to their operational protocols. Upon completion of the risk registers, WAF and SWA staff came to New York City in late 2018 and immersed themselves in NYCDEP and MOR operations, visiting both water supply and wastewater facilities and understanding how the city agencies deployed policies, engineering standards and operational

continued on page 54



downtown Suva. The Government of Fiji and WAF are working together for a comprehensive regional plan to address these occurrences.

NYCDEP



Vaturu Dam, Water Authority of Fiji. This water supply has recently experienced water quality issues outside of its normal seasonal changes. Facility staff have been monitoring higher than normal temperatures at the water intake and have expanded their monitoring equipment to better understand climate impacts on the system. (Left-right): Miteshwar Chand (WAF), Dennis J. Stanford (NYCDEP) and Nate Kimball (MOR).
NYCDEP

solutions to increase resiliency.

In early 2019, NYCDEP and MOR staff once again visited Fiji and Samoa to help each utility take actions that would reduce risks identified in their registers and make climate adaptation actionable. Specifically, the goals of the 2019 visit were to:

- Support the development of location-specific Climate Resiliency Design Guidelines based on the best available scientific projections.
- Support the development of Project Delivery Tools for the implementation of climate-adaptive design.

The Project Delivery tools included three elements:

- A project-specific risk assessment tool to identify specific climate stressors.
- A design-level risk assessment to identify resiliency interventions for each asset's components and subcomponents.



Tasitolala Drinking Water Facility, Samoa Water Authority. The 2012 Tropical Cyclone Evan changed the path of the facility's water source, requiring a reconstruction of the plant's intake and modifications to equipment.
NYCDEP



Tamavua Drinking Water Plant Intake, Water Authority of Fiji. Drinking water supplies fed by rivers have decreased in dependability for WAF as increased frequencies of rainfall, drought and heat have resulted in operation constraints. (Left-right): Seru Soderberg (WAF), Nate Kimball (MOR) and Dennis J. Stanford (NYCDEP).
NYCDEP

- A cost-benefit framework to assess the effectiveness of each intervention.

Results

While both WAF and SWA operate at significantly smaller scales than NYCDEP, the challenges remain the same. Each agency/authority:

- Has seen a large storm event directly impacting operations.
- Has seen small-scale changes in climatic conditions that have impacted operations.
- Has an ongoing understanding of the impacts of climate change data and models.
- Operates with a limited operational budget.

These common challenges allowed the partnerships to flourish and were the basis for the success in each mentorship. The New York



Alcoa Drinking Water Plant, Samoa Water Authority. This facility serves the capital of Apia and shuts down once to twice per month due to site flooding, requiring the use of more expensive alternative water supplies.
NYCDEP

City team developed early iterations of Climate Resiliency Design Guidelines and Project Delivery Tools for Climate Resiliency with both WAF and SWA. Both WAF and SWA now understand the methodologies that NYCDEP has used to set policies, design data models and develop detailed engineering and project management processes tailored to their unique infrastructure and climate.

While NYCDEP left each authority with tools intended to institutionalize climate adaptation into project planning, approaches to climate adaptation are constantly evolving, and each authority will need to adjust their approach going forward, including:

- Refining and adjusting their climate projections as the state of climate science improves, new storm events change assumptions about various climate stressors and new information is available for stressors such as drought, for which there is little data.
- Improving and adjusting operational protocols as resiliency strategies are deployed across infrastructure, to ensure that hardening infrastructure does not result in unintended consequences.
- Updating their engineering guidelines to consider location-specific needs and tailoring guidelines to specific infrastructure classes.
- Assessing the criticality and developing risk assessments for all their assets.

Conclusions and Lessons Learned

The ADB Water Operators Partnership Program has a lot of potential for smaller water utilities who may not have the tools at their disposal to fully evaluate the risks posed by climate change on their facilities. The tools that NYCDEP and MOR provided to WAF and SWA should help the utilities to streamline their capital planning process and avoid some of the unexpected costs and operational burdens that climate change will undoubtedly pose on their facilities. At the same time, scaling New York City’s resiliency solutions to small island nations provided NYCDEP with a unique opportunity to challenge the assumptions embedded within its guidelines.

Overall, partnerships such as these improve critical thinking of all who participate. The challenges faced by New York City are not unique but are indicative of the global impact of climate change.



Operations Headquarters, Samoa Water Authority. Changes in storm frequency and duration have outpaced the government’s best management practices. This image shows the results of a cloud burst and flash flooding. NYCDEP



(Left-right): Christopher Moster (ADB), Heseti Sione (SWA), Akesa Tagilala Davuiqalita (WAF), Jammie Saena (SWA), Seru Soderberg (WAF), and co-authors Pam Elardo, Mikael Amar, Jane Gajwani, and Nate Kimball visit the Rockaway Wastewater Resource Recovery Facility to learn about the devastation brought by Superstorm Sandy and the climate resiliency efforts implemented at the plant since 2012. Also pictured are Kevin McCormick, Allen Deur and George Sullivan with NYCDEP’s wastewater treatment division. NYCDEP

The need to reduce individual environmental impacts and sources of climate pollution while adapting to the effects of climate change is at the core of the policy objectives established by *OneNYC 2050*, New York City’s strategic plan. New York City has led by example on climate adaptation, and it serves us well to bring our approach to other stakeholders. Conversely, many of the takeaways from the site visits and workshops can be used when honing MOR’s and NYCDEP’s approaches to community engagement and interactions with external stakeholders.

The challenges of climate change are not unique to any specific region or utility and must be met through a unified response. By forming partnerships, sharing knowledge and broadening decision-making techniques, water professionals can have global reach.

To Learn More

- Forging Partnerships Among Water and Wastewater Operators (adb.org/publications/forging-partnerships-water-wastewater-operators)
- *OneNYC 2050* (onenyc.cityofnewyork.us)
- NYC DEP (nyc.gov/dep)
- Samoa Water Authority (waterauthority.ws)
- Water Authority of Fiji (waterauthority.com.fj)

Mikael Amar, M.S., is the Energy Liaison Officer at NYCDEP and may be reached at MAmar@dep.nyc.gov. Pamela Elardo, P.E., is the Deputy Commissioner of Wastewater Treatment at NYCDEP. The Deputy Commissioner may be reached through Kristen Molfetta at KMolfetta@dep.nyc.gov. Jane Gajwani, P.E., is the Director of Energy and Resource Recovery Programs at NYCDEP and may be reached at JGajwani@dep.nyc.gov. Nate Kimball, MBA, ENVSP, is a Senior Policy Adviser at the New York City Mayor’s Office of Resiliency and may be reached at NKimball@sustainability.nyc.gov. Dennis J. Stanford, P.E., ENVSP, is the Engineering Standards Division Chief at NYCDEP and may be reached at DStanford@dep.nyc.gov.



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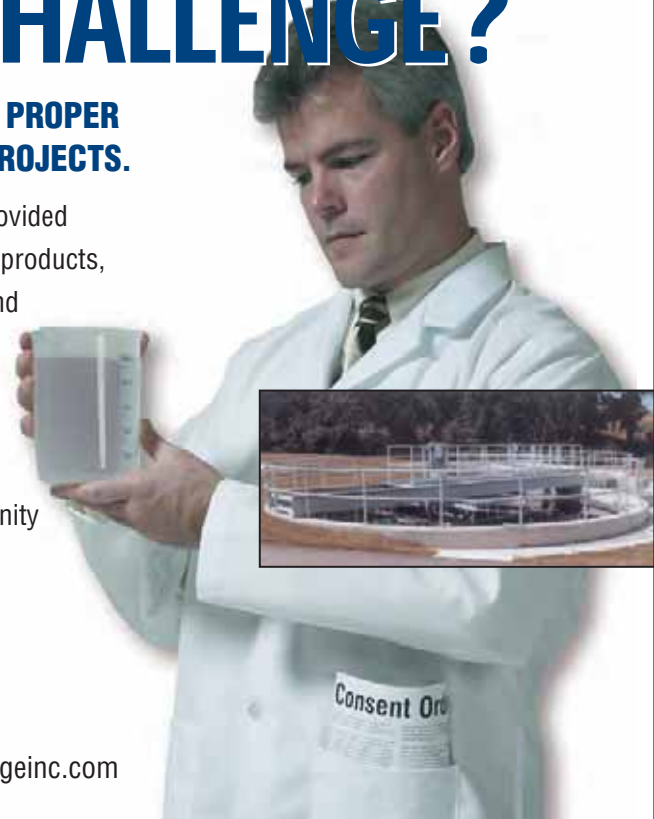
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Reducing Poverty Through Economic Growth: MCC's Water Investment in Mongolia

by Shajan Joykutty and Kumar Ranganathan

Introduction

The Millennium Challenge Corporation (MCC) is an innovative and independent foreign assistance agency under the U.S. State Department that is helping lead the fight against global poverty. Created by the U.S. Congress in January 2004 with strong bipartisan support, MCC has changed the conversation on how best to deliver smart U.S. foreign assistance by focusing on good policies, country ownership and results. MCC provides time-limited grants promoting economic growth, reducing poverty and strengthening institutions. These investments not only support stability and prosperity in partner countries but also enhance American interests. MCC forms partnerships with developing countries who are committed to good governance, economic freedom and investing in their citizens. The MCC model has been admired around the world as an effective way to render humanitarian assistance to many developing countries.

MCC's Board examines a country's performance on 20 independent and transparent policy indicators and selects countries based on policy performance. MCC requires selected countries to identify their priorities for achieving sustainable economic growth and poverty reduction. Countries develop their MCC proposals in broad consultation within their society. MCC then works in close partnership to help countries refine programs. When a country is awarded an MCC grant (Compact), it sets up a local accountable entity to manage and oversee all aspects of implementation. Monitoring of funds is rigorous, transparent and often managed through independent fiscal agents. MCC has invested more than \$13 billion in programs worldwide that support country-led projects focused on infrastructure.

Water is essential to life. Access to water is a critical element of economic growth and poverty reduction, from household drinking water and sanitation to energy generation by utilities to crop irrigation. Since its inception in 2004, MCC has invested \$2.2 billion in clean water, sanitation and natural resource improvement projects in partner countries in Africa, Asia, Europe and Latin America. Access to clean water and adequate sanitation is a fundamental pillar for improving the livelihoods and well-being of the world's poor. Water, sanitation and hygiene (WASH) investments help reduce illness from water-borne diseases. Irrigation investments support increased agricultural productivity and farmer incomes. Natural resource protection promotes long-term economic growth by providing essential natural resources like water. Natural resource protection also provides benefits that people obtain from living in healthy ecosystems, including climate regulation, clean air and water, renewable energy and genetic diversity.

MCC's Mongolia Water Compact

Ulaanbaatar, the capital city of Mongolia, faces a potential water supply shortage in the coming years. Economic booms following the collapse of the Soviet Union, rapid industrialization and the migration of nomadic people into Ulaanbaatar have stressed the current water resources to their sustainable capacity. The current bulk water demand of 77 million cubic meters per year is the estimated sustainable limit of safe yield from existing wellfields.

Much of Ulaanbaatar's municipal and industrial water supply is

withdrawn from groundwater wells located in the upper reaches of the surficial aquifer. The aquifer is recharged by the Tuul River, which flows through the city. Following human consumptive and industrial uses, much of the water is discharged as wastewater into the city's municipal sewage system to be processed at the existing Central Wastewater Treatment Plant (CWWTP). Industrial discharges have been increasing at a high rate and have contributed to the failure of the CWWTP, which currently discharges poor quality effluent into the Tuul River. Because most of the groundwater wells are located upstream of the CWWTP, the city's water supply has not yet been affected by the poor downstream river water quality.

Given the growth of its population and its economic output, Ulaanbaatar faces an urgent need for additional water. MCC is engaged with the Government of Mongolia (GoM) to implement a \$350 million Compact focused on increasing bulk water supply to Ulaanbaatar. In preparation for the Compact, the GoM appointed a Core Team, which in turn developed a Constraints Analysis and Concept Notes for MCC consideration. The former identified water supply and sanitation in Ulaanbaatar as key constraints to economic growth and poverty reduction, while the latter outlined certain interventions deemed necessary to eliminate the constraints. MCC evaluated these proposed interventions through preliminary investigations conducted in Mongolia in 2016 and further funded feasibility studies that reviewed several options for interventions for funding. Based on the feasibility studies, MCC and GoM developed the scope of projects to be funded by the Compact, which will address the identified constraint to economic growth through a single Water Supply Project. This project aims to alleviate water shortages and meet the projected demand for water in the Ulaanbaatar for residential consumers and both commercial and industrial users. The Water Supply Project consists of three closely related investment Activities:

- A. *Downstream Wells Activity* to construct new groundwater wells with attendant transmission lines and reservoirs, along with an Advanced Water Purification Plant (AWPP).
- B. *Wastewater Recycling Activity* to construct a new wastewater recycling plant and pipelines to provide high-quality treated wastewater that can be used instead of fresh water by water-intensive industries, thereby releasing fresh water for general consumption.
- C. *Water Sector Sustainability Activity* to support policy reforms, capacity building and technical assistance to improve the long-term sustainability of Ulaanbaatar's water supply.

The two proposed new wellfields in the Downstream Wells Activity, Biokombinat and Shuvuun, are located downstream of the outfall from the CWWTP. Beneficial use of water from these sources will require robust water purification facilities for the abstracted groundwater. The construction of an AWPP is included in the Compact for this purpose.

The GoM is separately pursuing a project to construct a new CWWTP in Ulaanbaatar capable of properly treating an average daily flow of 250,000 cubic meters per day of wastewater. The Compact will support a complementary Wastewater Recycling

continued on page 58

continued from page 57

Activity that includes the treatment of 50,000 cubic meters per day of effluent from the new CWWTP for use at two Combined Heating and Power (CHP) plants, the CHP-3 plant and CHP-4 plant, to reduce their reliance on groundwater and thereby increase available groundwater supply for other consumptive uses. For that purpose, the Water Supply Project includes construction of a wastewater recycling plant adjacent to the CWWTP, along with transmission mains, storage tanks and pump stations to provide recycled water to the CHP plants and piping work within the CHP plants for beneficial use of recycled water.

MCC and the GoM signed the Compact July 27, 2018. The GoM has also committed to contribute up to \$111.8 million in additional funding to ensure the completion of the three activities.

These components of the Water Supply Project are graphically presented in *Figure 1*.

Downstream Wells Activity

The Downstream Wells Activity involves the installation of 52 new wells in two new wellfields in the areas known as Biokombinat (26 wells) and Shuvuun (26 wells) on the western outskirts of Ulaanbaatar. The GoM will determine the configuration of the wells and associated infrastructure based on detailed designs that are currently underway. The new wells will provide a combined 50 million cubic meters per year of water supply to Ulaanbaatar's water supply system. Wherever possible, local collection pipelines from each well will take advantage of existing rights of way along local roads. The local collection pipelines will deposit groundwater into an equalization tank, from which it will be pumped through a steel transmission pipeline to the AWPP. The transmission pipeline will be buried 3 meters underground to protect against harsh winter temperatures. It will largely follow an abandoned railroad track along the Tuul River but will avoid several plots of privately-owned land.

Following treatment in the AWPP, the groundwater will be mixed and stored in a tank with a projected maximum capacity of 30,000 cubic meters. From there, the finished water will then flow through an 8-kilometer long pipeline that will connect to parts of the existing municipal water supply system operated by the Water Supply and Sewerage Authority of Ulaanbaatar City (USUG), the primary water utility for the city.

The AWPP (*Figure 2*) will employ multiple barriers to remove pathogens, volatile organic compounds, heavy metals and other contaminants that may be present in the groundwater. Based on a preliminary design, such barriers may include ultraviolet radiation, oxidization, air stripping, coagulation, filtration and reverse osmosis. The sludge will be pumped to sludge thickeners and drying beds or centrifuges, after which it will be disposed in a sanitary landfill. Liquid residuals requiring treatment will pass through settling and dewatering and second-stage reverse osmosis to reduce brine volume. Final liquid waste products will be disposed via a waste stream to the CWWTP via a new sewer system.

Wastewater Recycling Activity

The proposed Wastewater Recycling Activity supports the

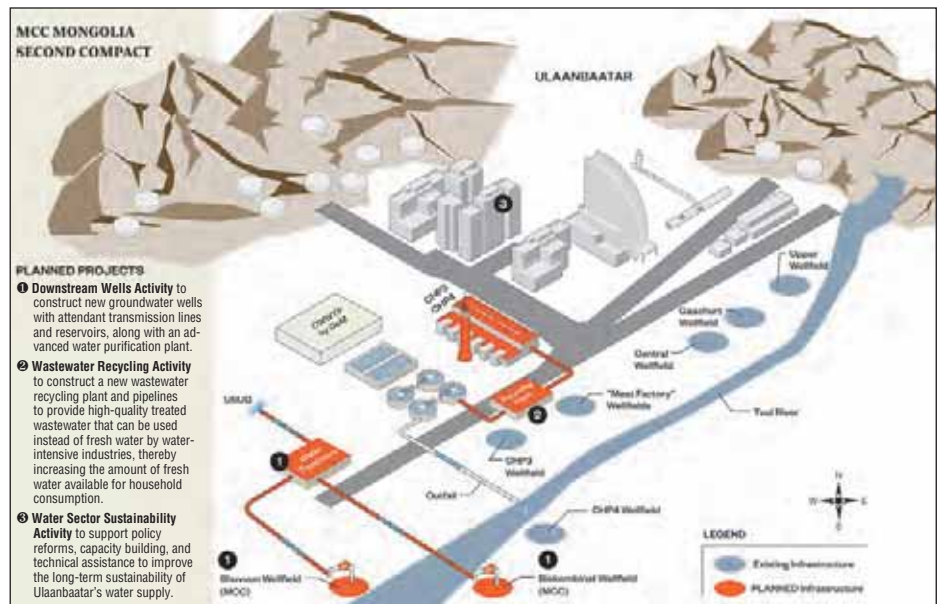


Figure 1. Elements of the MCC Mongolia Water Compact for the city of Ulaanbaatar.

Mongolia Water Compact, Millennium Challenge Corporation

recycling and reuse of wastewater effluent from the CWWTP. It is expected that the Wastewater Recycling Activity will be able to provide up to 50,000 cubic meters per day of high quality, recycled wastewater for use inside the city's two largest CHP plants, the 48 megawatt (MW) CHP-3 plant and the 570 MW CHP-4 plant, thereby suppressing their current demand for approximately 14.6 million cubic meters of fresh water per year. The wastewater recycling plant will subject the effluent to additional aeration and nitrification to remove ammonia and reduce alkalinity; coagulation and flocculation to remove phosphorus and suspended solids; granular media for further filtration to improve clarity; and chlorination to reduce the presence of *E. coli* or other possible pathogens.

The wastewater recycling plant will be located on available public land adjacent to the CWWTP. There are several reasons why that location is an optimal choice. It will help provide for efficient interconnection of controls, electrical supplies, sludge piping and disposal. It will address other operational considerations and reduce the need for resettlement. Finally, it will maintain continuity in land use within the city of Ulaanbaatar.

From the wastewater recycling plant, recycled water will flow through dedicated transmission pipelines to the CHP-3 and CHP-4 plants for use in cooling boilers and steam generators. For redundancy, the investment activity will support the construction of two pipelines to each plant to ensure a continuous supply of recycled water for critical cooling functions, as may be needed. The investment activity will also support the construction of additional storage tanks, dedicated recycled water pipelines to the cooling towers, interconnectors and control systems within the property lines of each CHP plant. Recycled water not used at the CHP plants will be returned to the CWWTP for discharge to the Tuul River.

Water Sector Sustainability Activity

The proposed Water Sector Sustainability Activity also supports an array of interventions that address policy, legal, regulatory and institutional issues and improve the long-term sustainability of the water sector in Ulaanbaatar. Nearly three-fifths of Ulaanbaatar's population live in settlements arising out of nomadic population's

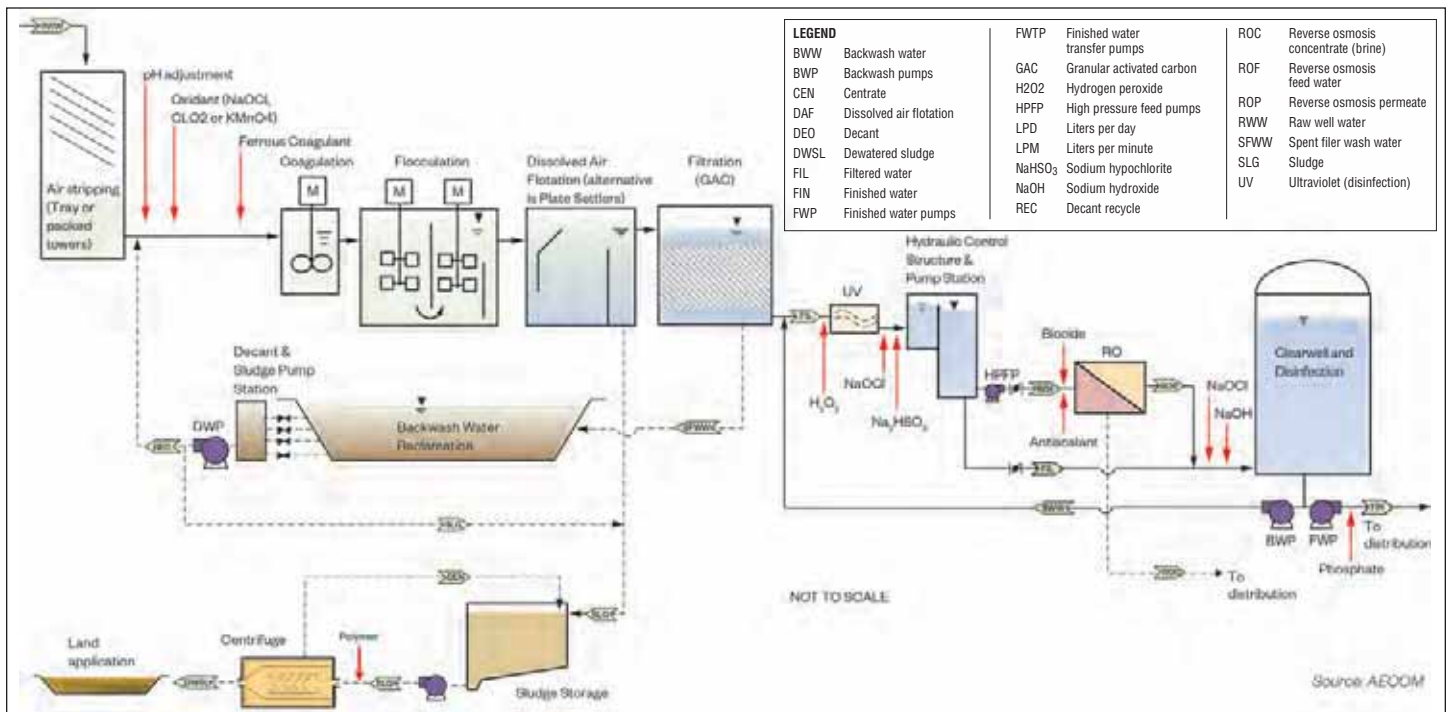


Figure 2. Conceptual Advanced Water Purification Plant (AWPP) flow diagram.

"Feasibility Studies – Bulk Water Supply for Ulaanbaatar", AECOM

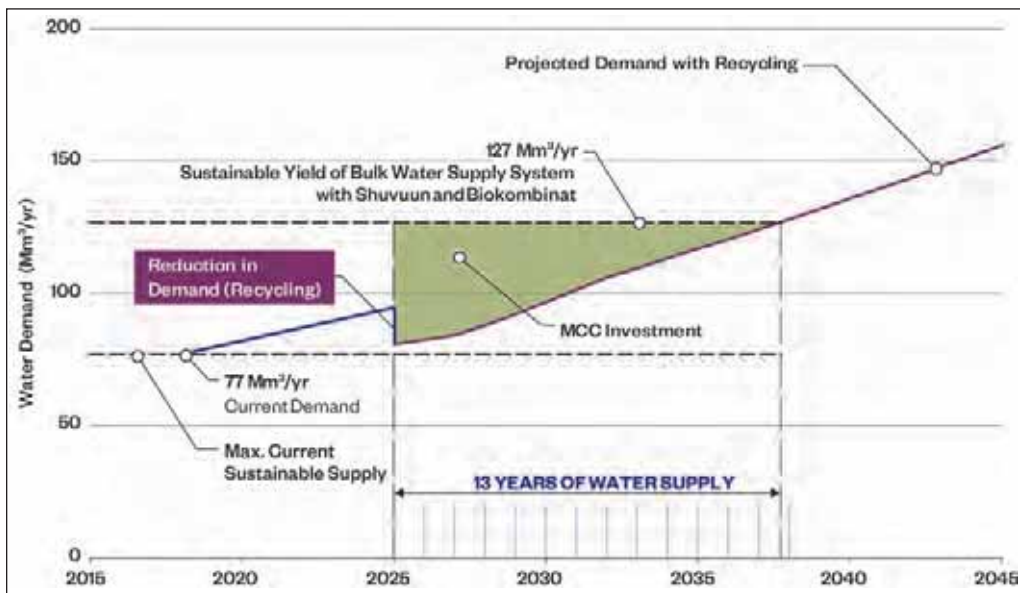


Figure 3. Anticipated net effect on Ulaanbaatar's water demand by MCC's investments. Government of Mongolia

movement into the city. These areas are identified as peri-urban "ger" areas of Ulaanbaatar.

Designed to support efforts to reduce the high costs that Ulaanbaatar's water utility, the USUG, bears for providing water through the system of water kiosks throughout these peri-urban areas, the Compact will support a variety of small-scale infrastructure works that are designed to reduce the direct costs associated with the delivery and sale of water through water kiosks. These include:

- Conversion of 504 manually operated kiosks to automatic "smart" kiosks that operate longer hours at lower cost.
- Extension of supply pipes in order to connect some water kiosks that are currently supplied by tanker truck to a continuous piped water supply.
- Construction of three tanker truck filling stations to reduce the distance traveled and time spent by USUG's fleet of tanker

trucks.

Compact Status and Expected Outcomes

GoM has completed procurements for consultants for the project. Detailed designs have commenced and are scheduled to be completed mid-2019. The GoM expects the CWWTP construction to commence in 2020. The Compact's Entry into Force is expected to follow the commencement of the CWWTP construction. Construction is expected to take four years. The Program is expected to be complete and assets are expected to be in service before 2026.

MCC pays utmost importance to the impacts of its investments on the targeted beneficiaries. The Compact

is expected to more than double the capacity of Ulaanbaatar's bulk water supply system. Based on current projections, the investments are expected to satisfy demand for approximately 13 years following start-up. **Figure 3** shows the net effect on Ulaanbaatar's water demand by MCC's investments.

Shajan Joykutty, PE is Vice President with Hazen and Sawyer and may be reached at sjoykutty@hazenandsawyer.com. Kumar Ranganathan is a Senior Director who leads the Water, Sanitation and Irrigation Practice Group at the Millennium Challenge Corporation and may be reached at ranganathannk@mcc.gov.



Reduce Energy Costs by More Than 5 Percent: Building Interest in Strategic Energy Management at New York's WRRFs

by Kathleen M. O'Connor

Strategic energy management focuses on achieving lasting energy savings through continuous energy improvement. Although all WRRF personnel make decisions that can affect plant energy consumption, only a few are held accountable for the costs incurred. A strategic energy management approach embeds energy efficiency and conservation within the WRRF's systems and processes, creating a culture where controlling energy cost is important to everyone, not just an accountable few.

The SEM Pilot Program – First Cohort

In June 2018, the New York State Energy Research and Development Authority (NYSERDA) initiated a Water Resource Recovery Facility (WRRF) Strategic Energy Management (SEM) pilot program. The first cohort (i.e., group) of participants were operators, managers, maintenance staff and other personnel from nine large municipal WRRFs located in western New York. The program included workshops, one-on-one coaching, a treasure hunt to uncover energy savings opportunities and other process improvements, other on-site activities and peer-to-peer knowledge sharing.

All activities were facilitated by coaches who have worked in the industry and demonstrate a deep understanding of wastewater systems, processes and regulations. Persuading operators and other WRRF staff to make changes, even changes that clearly garner positive results, requires credibility and trust. As such, before the first workshop, the coaches conducted energy management assessments of each WRRF and learned about each plant's systems, organizations and challenges.

250 WRRFs have participated in SEM programs. On average, these facilities have achieved savings of 9 percent, with the top quartile of participants achieving savings closer to 19 percent.

Source: Cascade Energy (<https://cascadeenergy.com/utility-energy-efficiency/water-wastewater/>)

As part of the SEM pilot program, each WRRF identified an energy champion and formed an energy team. The energy teams then:

- Established goals.
- Secured senior management commitment.
- Developed an understanding of where and how energy is used.
- Identified and evaluated energy savings opportunities.
- Completed projects (or assigned projects to others to complete) that produced measurable, sustained energy savings over time.
- Measured, tracked, and shared progress broadly across the WRRF and larger municipality.

Initial focus was placed on implementing projects identified as "Quick Wins," easy-to-achieve energy savings opportunities that allowed the WRRF to experience the value of SEM immediately. This early success helped create commitment within the WRRF and built momentum for engaging in energy and process improvements in a lasting way.

One of the most beneficial elements of a SEM program is peer-to-peer knowledge exchange, including visits to cohort-member plants and a final "Report Out and Celebration" workshop. Peer-to-peer exchange provides exposure to new best practices and ideas, and

encouragement, accountability and gentle pressure to step beyond one's comfort zone. As one may expect, the best ideas are often identified by operators and other WRRF personnel. At the final workshop in September 2019, the teams will present their accomplishments and advocate for projects and process changes they believe in. Public works directors, elected city leaders and other municipal officials are invited to the workshop specifically for the purpose of hearing success stories and building support for future efforts.

Seeking Applications for Second Cohort

NYSERDA is currently seeking applications for participation in the second cohort of the pilot program. Participation in the program is free. To be eligible, municipal WRRFs must pay into the System Benefits Charge via their electricity bill and spend a minimum of \$200,000 annually on energy (i.e., electricity, natural gas, propane and diesel). For more information, please visit Program Opportunity Notice (PON) 3844 online, or contact Kathleen O'Connor (NYSERDA) at (518) 862-1090 ext. 3422.

In addition to the SEM pilot program, NYSEDA is offering two one-day SEM "bootcamp" workshops through NYWEA's Member Education Committee training program:

- August 14, 2019, Washington County Municipal Center, Fort Edward.
- Nov. 6, 2019, hosted by the Yonkers Joint WWTP.

In addition to a mini treasure hunt at the host WRRF, workshop participants will learn the following:

- Understanding Your Energy Bill.
- Energy Basics – Rate Schedules, Consumption and Demand.
- Energy Mapping – Estimating Energy Consumption by Treatment Process.
- Measuring and Tracking Energy – Key Performance Indicators, Benchmarks and Energy Events.
- Identifying Quick Wins.
- Human Elements of Success – Securing Senior Management Commitment, Identifying an Energy Champion, Building an Energy Team and Employee Engagement.
- Prioritizing Opportunities.
- Leveraging Help – Your Local Energy Provider, DOE 50001-ready.
- Identifying and Overcoming Barriers to Success.

The municipal wastewater industry is uniquely positioned to benefit from strategic energy management. Each municipal WRRF accounts for a sizable portion of their municipality's total energy bill, and opportunities for saving energy are abundant. The wastewater community is a relatively close-knit group and, due to the public nature of the facilities, sharing of new information and ideas is encouraged. If you, your client or your friend works for a municipal WRRF in the state of New York, NYSEDA encourages you to apply to participate in the second cohort of the SEM pilot program, attend one of the upcoming "bootcamp" workshops or pass the information about these opportunities along.

Kathleen M. O'Connor, PE, is a Senior Project Manager with NYSEDA and may be reached at Kathleen.OConnor@nyserda.ny.gov.

Operator Quiz Summer 2019 – Process Troubleshooting

The following questions are designed for trainees as they prepare to take the ABC wastewater operator test. It is also designed for existing operators to test their knowledge. Each issue of *Clear Waters* will have more questions from a different section of wastewater treatment. Good luck!

1. A trickling filter plant is experiencing an increase in secondary clarifier effluent suspended solids. It is noticed that there is excessive sloughing from the trickling filter most likely due to changes in wastewater characteristics. Which of the following would not be a corrective action to resolve this issue?
 - a. Check wastewater for toxic materials, pH, temperature and BOD.
 - b. Increase clarifier sludge withdrawal rate.
 - c. Clean off trickling filter with a low dose mixture of sodium hypochlorite.
 - d. Identify and eliminate the source of wastewater causing the upset.
2. An operator is told to do the following: Increase the hydraulic loading to the trickling filter, unplug the spray orifices, and adjust orifice opening at the end of the distributor arm to spray trickling filter walls. The most appropriate reason to do these actions is:
 - a. To help remove *Psychoda* (filter flies).
 - b. To increase microbiology population.
 - c. To increase BOD removal rate.
 - d. To decrease the amount of TSS in the trickling filter effluent.
3. A primary clarifier has damaged scrapers and is experiencing excessive sludge accumulating in the tank due to a plugged withdrawal line. What scenario is the operator most likely to see due to these conditions?
 - a. Floating sludge.
 - b. Clear effluent.
 - c. Decreased scum production.
 - d. Increased TSS removal.
4. A treatment plant has been implementing the following solutions to an ongoing problem in their primary clarifier: Using available tank capacity to shave peak flows; increased and consistent pumping as well as minimizing short circuiting of the tank. The most likely reason to implement these solutions is:
 - a. To aid in poor settleable solids removal.
 - b. To aid in poor fecal coliform removal.
 - c. To aid in poor pH neutralization.
 - d. To increase the amount of flow to secondary treatment.
5. An aeration tank is showing signs of stiff, white, billowing foam. Of the following statements, which is the most accurate?
 - a. This foam is characteristic of old sludge and chlorine should be added to kill any unwanted organisms.
 - b. This foam is characteristic of old sludge and the RAS rate should be increased to help minimize the foam.
 - c. This foam is characteristic of young sludge and more air should be added to increase the DO.
 - d. This foam is characteristic of young sludge and the WAS rate should be adjusted to increase tank MLSS.
6. An aeration system has just experienced an upset with the nitrification process. After identifying the problem, which of the following is not necessary to maintain the health of the nitrifying organisms?
 - a. Monitor the influent and effluent pH, nitrate, nitrite and ammonia levels.
 - b. Decrease the pH in the aeration basin to a more acidic level.
 - c. Reduce wasting to increase the SRT to develop the nitrifying organisms.
 - d. Maintain the DO in the aeration basin at an acceptable level, usually between 2 and 3 mg/L.
7. A centrifugal pump is experiencing rapidly wearing bearings. What would be the most likely cause and solution to this problem?
 - a. There is a misalignment of the pump; resolve this by greasing the bearings.
 - b. The shaft of the pump is bent; resolve this by tightening the packing.
 - c. There is a lack of lubrication in the bearings; resolve this by properly lubricating bearings.
 - d. There is dirt in the bearings; resolve this by adding more grease to the bearings.
8. When inspecting a newly built progressive cavity pump the operator noticed there is no discharge coming from the pump. This can be caused by an unprimed pump, loose belts, closed discharge line or which of the following?
 - a. Improper rotation direction.
 - b. Open check valve.
 - c. Open seal water line.
 - d. Low discharge pressure.
9. While doing rounds the operator noticed the grit system was not recovering any grit. After further inspection it was found that the grit pump was free of clogs and the pump seals and shaft were not worn. What is the most reasonable explanation for the decrease in grit removal?
 - a. Flow through the chamber is too fast or turbulent.
 - b. Flow through the chamber is too slow.
 - c. Grit was removed by the coarse bar screens.
 - d. Grit was removed by the primary clarifier.
10. An anaerobic digester is experiencing increased foaming. After doing an investigation it is confirmed that there was an organic overload to this digester. Which of the following scenarios would be the most likely cause of the digester upset?
 - a. Consistent feeding of co-thickened raw and waste sludge.
 - b. An increase of VFAs.
 - c. Limited grease and scum inputs in digester feed.
 - d. Low mixing time schedule.

Answers on page 62.

For those who have questions concerning operator certification requirements and scheduling, please contact Tanya May Jennings at 315-422-7811 ext. 4, tmj@nywea.org, or visit www.nywea.org.

Correction: In the Spring 2019 Operator Quiz (Basic Conversion Factors, Digester Gas), there was a typographic error for the correct answer in question number 6. The question was “1 horsepower equals _____ kilowatts.” The correct answer is (a), which should have read “0.746” rather than “746.” Thanks to Angela Heintz for picking up on this error.



John Sansalone, P.E.

In Memory

It is with a heavy heart that we share the news of the passing of John Sansalone. John received his bachelor's degree in engineering from New York University and his Masters of Science in Civil/Environmental Engineering in 1975. He first joined the Water Environment Federation (WEF) and the NY

Water Environment Association (NYWEA) in 1974 and dedicated his career to environmental issues with a focus on water quality. He became a WEF Life Member in 2017. He worked for the NYS Department of Environmental Conservation for 37 years with the primary responsibility of permit drafting, inspection and compliance of water resource recovery utilities. John was a dedicated volunteer for the NYWEA, having served on the Lower Hudson Chapter Board, the NYWEA State Association Board, Utility O&M Committee, Government Affairs Committee and Awards Committee. In each one of these leadership capacities John gave 110 percent, always sharing his opinion and passion for the issue at hand. He was the recipient of several NYWEA and WEF Awards including the Arthur Sidney Bedell Award, the Golden Manhole Society and the Select Society of Sanitary Sludge Shovelers. John was recently nominated for NYWEA's Hall of Fame. He was also a supporter of NYWEA's Scholarship Program. Always interested in the good work performed by water resource recovery operators, for decades John served as a Judge on the State Operations Challenge competition. He was also a frequent moderator at the New York City Watershed Conference.

John gave mightily to other organizations besides NYWEA, serving in leadership positions with Ulster County Environmental Management Council, the Mid-Hudson branch of the American Society of Civil Engineers (ASCE), and the Town of Gardiner Environmental Conservation Commission. John was an active member of the Gardiner Fire & Rescue Department, and notably recognized as one of the top ten responders from 1997-2008. John was also passionate about history, serving as a Trustee on the Ulster County Civil War Roundtable. He was an enthusiastic historian and was sure to share his knowledge of the Dutch settlement in New York, anything about Henry Hudson and the Half Moon and General Washington's chain across the Hudson at Storm King. John loved music and also volunteered his time with the Old Songs Folk Festival and the Champlain Valley Folk Festival.

More recently he connected NYWEA with leaders of ASCE and the American Council of Engineering Companies. Known for speaking his mind, John broke the mold and took his service on the boards and committees he served on seriously, never allowing the organization to be a "rubber stamp" but rather to debate/discuss all sides on the issue. John had a gift for sharing his knowledge and could tell you much about the environmental issues facing New York state today; he was a tremendous asset on NYWEA's Government Affairs Committee. He was likely a great asset to all of the organizations with which he volunteered. Just a few days before his passing, John was scheduled to be a Judge during the NYWEA Operations Challenge on June 11, 2019, but was not able to attend due to not feeling well. He leaves behind three sisters and an extended family including several cousins. He will be greatly missed!

Patricia Cerro-Reehil

Summer 2019, Vol. 49, No. 2

Clear Waters

New York Water Environment Association, Inc.



ADVERTISER	PAGE
AECOM	38
Aftek, Inc.	Back Cover
Aqua-Aerobic Systems	44
Barton & Loguidice, D.P.C.	41
C&S Companies	35
CDM Smith	12
D & B Consulting Engineers and Architects, PC.	23
EDR.	25
Franklin Miller Inc.	32
GA Fleet	8
Gartner Equipment Co, Inc.	18
GP Jager Inc.	29, 42
Greeley & Hansen	15
H2M architects + engineers	24
Harper Control Solutions Inc.	35

ADVERTISER	PAGE
HDR	23
Holland Company, Inc.	18
Infosense	18
J. Andrew Lange Inc.	56
Jacobs	46
Koester Associates, Inc.	Inside Front Cover
Lakeside Equipment Corporation	13
Mixing Systems, Inc.	Inside Back Cover
Mott MacDonald	28
OBG, Part of Ramboll	15
PSI Process	20
Siewert Equipment Co.	34
Smith & Loveless, Inc.	56
Statewide Aquastore, Inc.	25

Answers from page 61:
1C, 2A, 3A, 4A, 5D, 6B, 7C, 8A, 9A, 10B

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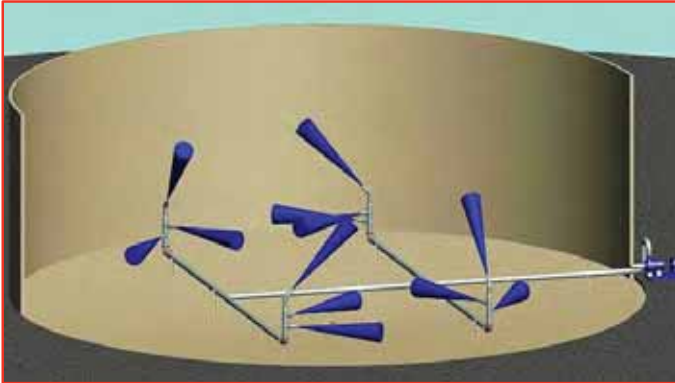
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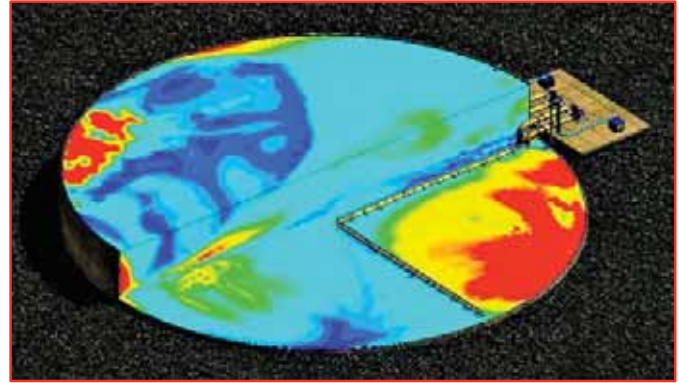
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