

CENTRAL STATES WATER

The Official Magazine of the Central States Water Environment Association, Inc.

91st Annual Meeting *Recap*

PLANT PROFILE:

**Carol Stream Water Reclamation
Center, Carol Stream, IL**



PLUS:

- Radebaugh Winner: A Simple and Energy Efficient Approach to Cleaning Biogas
- My Water Legacy: The Streichers
- Biological Phosphorus Removal at St. Charles WWTF

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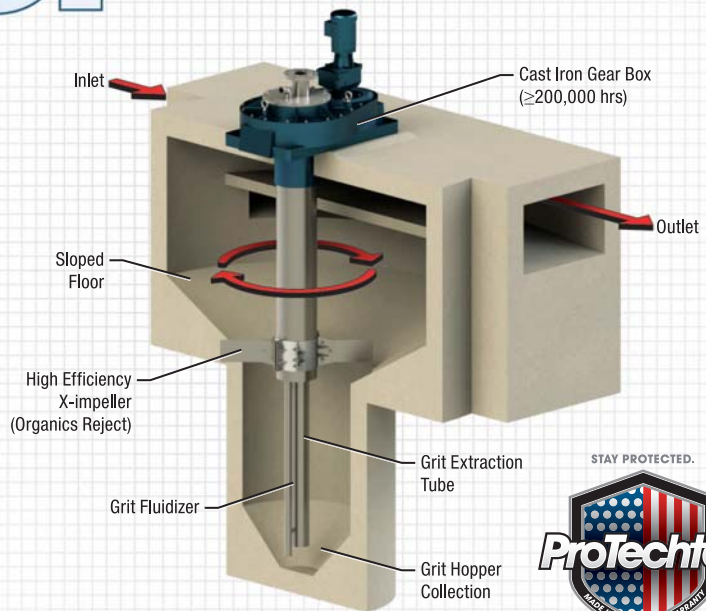
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Cover photo of Summer in Gooseberry Falls State Park © Jacob Boomsma

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Be Proud to Be Part of CSWEA

By David Arnott



As I start my year to serve as your President, I am honored and humbled. CSWEA is such a high-quality organization. We have so many hardworking members who put their heart and soul into improving our water environment. I truly think that there are amazing things that happen every day in Illinois, Wisconsin and Minnesota. We are all so busy, we sometimes forget to take a step back and reflect on all the things we make happen. From the utility improvements in energy, nutrient recovery and processes, to the exciting new products our manufacturers and manufacturer representatives offer us, to the many State Section and Association seminars that are put on, to the advanced research academia provides, the great designs our consultants offer, there is no shortage of amazing things happening. We should all reflect on this and take time to truly appreciate this. Thank you for all you do everyday to support the Association and make us thrive!

It struck me as I sat down to write this article that I am proud to be a member of CSWEA. We should all be proud of our activity and accomplishments. As I stated at the Award Banquet at the Annual Meeting, CSWEA has a special thing going. We should never take this for granted. In addition to being proud, we should be excited about the future opportunities in the clean water environment arena and the challenges and hard work that lay before us. Some of those challenges include more stringent effluent limits in particular for phosphorus, increased pressure for energy efficiency and nutrient recovery, working on a watershed level with new stakeholders to address TMDLs and the facility permit

conditions, and the pace of new product development, and research. Based on my experience working in the Association the last 17 years, we will address these issues head on with a positive attitude and a smile on our face.

without any fanfare; however it was very important. We now have a new YP that hopefully will be with GWS for the long term and likely will grow into a larger role with GWS and CSWEA in the future. It is this 'transaction,' that we need to multiply

“I look forward to getting to know you better this upcoming year and serving as your President. Our Association has a great thing going; let's build on our 91-year-old legacy and help it continue to thrive!”

As President, I want to work with our WEF delegates to bring the resources of WEF closer to the Association. Programs such as Leadership Innovation Forum for Technology (LIFT), and the Green Infrastructure Certification Program are exciting new WEF and WERF initiatives that our Association can benefit from. The Association has several committees that are closely aligned with these initiatives.

In addition, I would like to work to get YPs more involved with the Association. I encourage you to look for ways to get YPs involved with the part of CSWEA that you are involved with. I sense that YPs are hungry to get involved and to make a difference in a new way through service to the less fortunate. A recent example of volunteer 'transaction' happened with the Global Water Stewardship Committee at the Annual Meeting in May. Several YPs who had not been involved with GWS previously, attended the meeting to see what the group was all about. One YP volunteered to help Matt Streicher with Treasurer duties. This happened

in many different ways throughout the Association and state sections. The YPs are the lifeblood of our Association.

We have all worked hard to make networks. Part of the reason we joined CSWEA was to create our networks. Our networks likely spread to WEF and WERF as well, they have great resources. I encourage you to use your network within CSWEA and WEF to make your life easier in some way. Maybe it is vetting a new piece of equipment and talking with a reference that has used the equipment before; perhaps it is sharing a piece of research that would be valuable to others in the Association; it could be operator to operator sharing strategies on reduced energy usage at their facility; lastly, perhaps it is the manufacturers group getting together and planning the next networking event.

I look forward to getting to know you better this upcoming year and serving as your President. Our Association has a great thing going; let's build on our 91-year-old legacy and help it continue to thrive! **CS**

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WEF Delegate's Report

By Eric Lynne and Derek Wold



Eric Lynne



Derek Wold

Many members may not realize that amidst the hustle and bustle of the May Annual Conference, some of the Member Association leaders sneak away to WEFMAX (which stands for: WEF Member Association eXchange) which is similar to our CSX, but on a national level and mostly focused on the House of Delegates. Typically, about 40 delegates and leaders attend each of the four locations available. Prior to transitioning out of the Delegate role, Mark Eddington attended the Indiana WEA's event held in Indianapolis. Looking for some warmth, Eric Lynne attended the North Carolina event.

Several structured discussions, as well as open forums, are held to encourage the MA leaders to share their programs that work and those that struggle in an effort to continue improving the industry. The following are some highlights from the WEFMAX discussions:

WEF AND HOD UPDATE

- The House of Delegates has a steering committee that ensures WEF's actions

are in alignment with the Missions listed on the right. These provide the building blocks for most of the initiatives from WEF, and can also be a guide for MA actions. Rest assured that CSWEA is in strong compliance with these.

- Watch for a relaunch of Water's Worth It at WEFTEC. Dig up those 2012 era shirts and buttons!
- A new dashboard has been created to expedite committee rosters, meeting agendas, notes, and track deliverables.
- WEF continues to be financially stable, with approximately 50% coverage in reserve.
- Working to develop a Delegate Selection Criteria for use by each MA's nominating committee to explain the role of a Delegate and some preferred characteristics of a Delegate.

WEF/WE&RF

- WE&RF merging with Water Research Foundation (WRF) fully in 2019.
- Of the 45 member associations in North America, CSWEA is one of five cutting edge associations that have

WEF MISSION:

- Connect water professionals
- Enrich the expertise of water professionals
- Increase the awareness of the impact and value of water
- Provide a platform for water sector innovation

brought the LIFT Affiliate status to their membership. Contact Jeremy Cramer, chair of the Innovation and Technology Committee for additional information.

MA EXCHANGE TIDBITS

As mentioned above, the concept behind WEFMAX is to disseminate those tidbits to the membership, so we've summarized a list of relevant items that other Associations are doing that could make our organization better. If you see something that motivates you – let's find a way to implement it!

- Mentoring program that the Pacific Northwest Clean Water Association

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utilizes, as seen here (<https://pncwa.memberclicks.net/mentoring-program>)

- WEF has developed a Grassroots Guide & Toolkit for Fly-In attendees to increase the effectiveness of everyone's visits with legislators.

Annual Meeting Enhancements:

- Allocate timeslot for academic (MS/PhD) presentations of research
- YP Speaker Challenge (S&YP Session/Tract) reviewed and

awarded to top 3 or so, monetary (or consider conf. attendance.)

- WEF has recently developed a great public outreach water palooza toolkit for educational events with young kids. This would be a great way to boost CSWEA's connection with the next generation of water professionals.

Membership Enhancements:

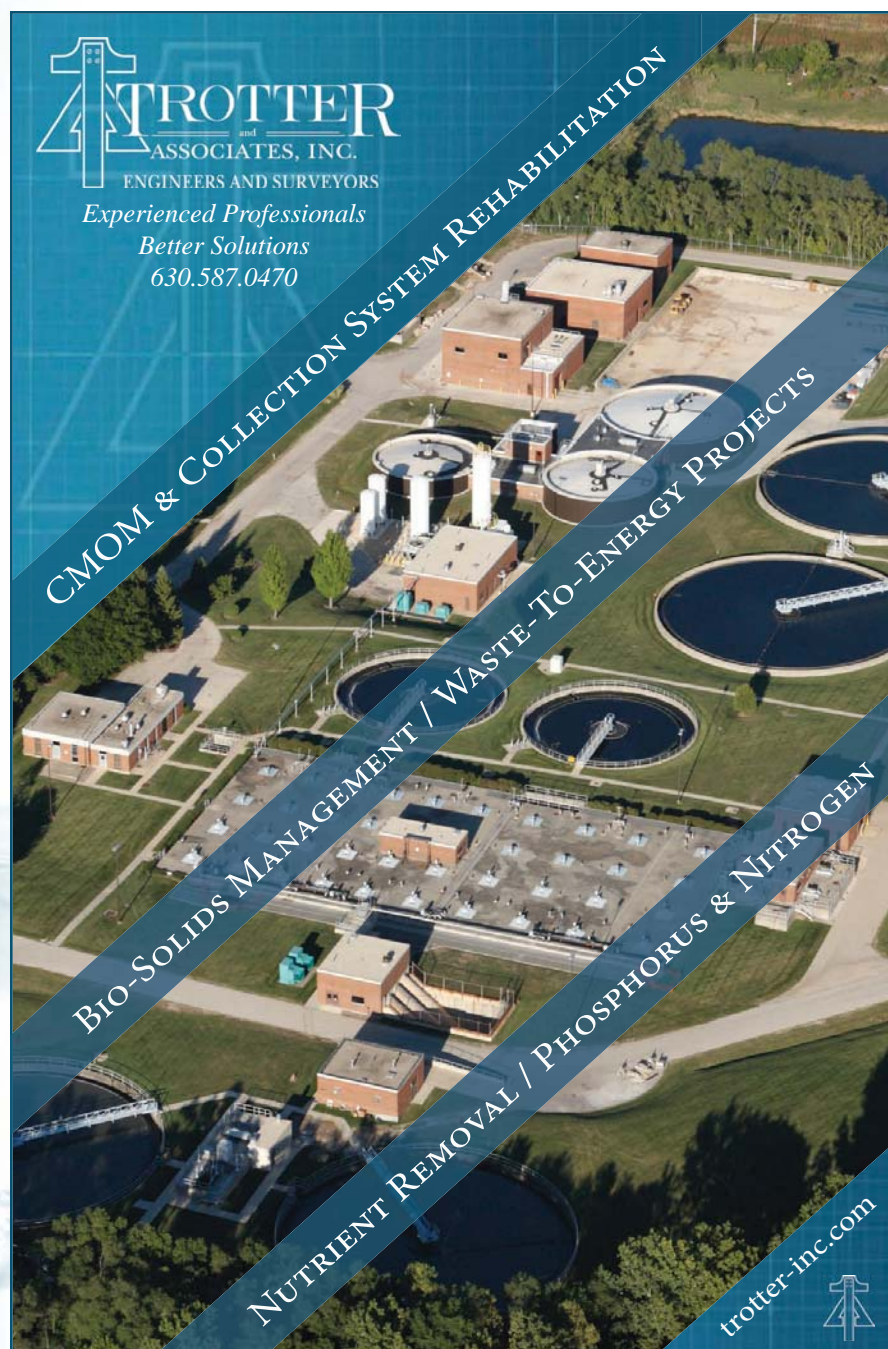
- No dues increase planned.
- Reciprocity Initiative (CSWEA gave

free MA only memberships, as a thank you WEF is providing a similar amount of free WEF memberships), 37 to be exact. This program will repeat again, but may be discontinued beyond 2019.

- MAs can request a code from WEF to give away free association only memberships. This may allow WEF to capture all our membership in one useful database.
- Some MAs offer a retired member package: this consists of a free conference membership that allows a retiree to attend the event, but offers up a portion of their time as a volunteer (photographer, registration, mentor, etc.).
- NEWEA indicated they are scheduled to perform 12 YP Poo & Brew tours this year, each with decent attendance.
- Reach out to the regional veterans workforce development groups as NEWEA has found veteran "Water Warriors" are a good fit for our industry.

Operator Enhancements:

- Some clusters of MAs are hosting regional Operations Challenges to improve existing teams and drum up interest in the program from other operators.
- 34 California utilities have developed a regional consortium, BAYWORK, to identify and enhance the workforce for wastewater operators. All their materials are open-source and available online: <http://baywork.org>. One item that would be impactful to high school graduates is a brochure regarding why and how to get into the water industry.
- The OnDemand Waste Water Library (OWWL) (<https://www.wef.org/resources/publications/owwls>) is continually being updated... check it out! If a topic is missing, voice your concern and we'll try to get it prioritized.
- WEF will be releasing a new set of operator training materials this year. It will start with a beginner level (now available for pre-sale, \$99). Next the focus will be towards offering an online course and a solids volume in 2019.
- NEWEA, RMWEA, and Baltimore shared example utility training events (operator exchange training, a leadership certificate course, and mentoring). All have had great success and are worth considering for our region. [CS](#)



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Looking Back, Looking Ahead



By Chris Marschinke

Another successful Annual Conference in the rearview mirror, and opportunities dotting the horizon. It never ceases to amaze me the level of dedication and passion surrounding us in this unique organization. A decade ago the prospect of organizing 500-plus attendees for a conference seemed an impossible task to my younger, spryer self. Today I understand how it happens – through the tremendous effort and commitment of a multitude of people. It requires fearless (or at least appearing!) Local Arrangements, Technical Program, and Executive Committees working in unison.

One of those dedicated people is my predecessor as IL Section Chair, Zach Matyja of RJN Group. A year ago Zach set clear goals to increase committee involvement and to expand our reach to encompass the entire state. To that end we've been able to bring new blood onto the committee rosters, and successfully held the first Collection Systems and Operations Conference in Bloomington this past October. The event saw more than 50 registrants, including a contingent of students from Bradley University, to participate in the nine workshop sessions. It was a successful first year to build on as we continue to develop and expand our technical impact and professional networks.

I would also be remiss if I didn't recognize the contributions of our now Past-President, Sue Baert. Sue has been a role



model for volunteerism, especially for me and the other Illinois YP's. Her contagious laugh reminds us all to take a step back, and first and foremost have fun. Overseeing some significant changes in the Annual Conference format, Sue never wavered in her leadership.

One of those changes was a concept near to my heart (and Scott's checkbook) – the Service Project. Following the format held for more than a decade at WEFTEC led by the WEF SYP Committee, the inaugural CSWEA Annual Conference Service Project

was equally successful. Natalie Cook of Donahue & Associates spearheaded the effort to bring this international endeavor into our backyard. The WEF Service Project aims to create a water legacy in the WEFTEC host city by educating the next generation of water stewards. And the CSWEA Service Project is a fantastic example of that legacy – It was spurred on by a fifth grader at Skinner North Classical school in Chicago who saw the 2017 WEF project, and wanted to replicate it at her own school. Volunteers from CSWEA, teachers and students from the school, and the neighborhood all worked to build a rain garden in the middle of a paved expanse. Student classes were brought out during the construction and learned about infiltration, runoff, pollutants, and the importance of water. Thank you to everyone who made the inaugural year a success!

With one great conference behind us, there lay a number ahead to fill our summer and fall. On June 13th the Illinois Section in partnership with the Illinois Association of Wastewater Agencies and the APWA Chicago Metro Chapter held the 11th Collection System Conference at NIU's Naperville Campus. Following the Collections System Conference, the joint CSWEA / IWEA LIFT Tour of the Aqua Aerobics Research and Technology Center took place on June 29 at the Rock River WRD. The Operations Seminar will be held at Wheaton Sanitary District's facility this year on August 2 with topics covering tertiary filtration, and a walkthrough of Wheaton's in-progress disc filter conversion and Glenbard Wastewater Authority's recently completed conversion. Rounding out the mid-summer events is of course CSWEA's CSX conference on July 26-27 – all active volunteers and committee chairs are invited to attend and share ideas for the future of our organization!

And with that, I close my first message as your Illinois Section Chair. I am proud to represent our section and excited to build on the tremendous base laid by past leadership. I encourage anyone reading who is interested in becoming more involved to reach out to me or another member of the section leadership – I assure you that you will be as thankful for it as I have been. **CS**



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It Is Whatever You Make It

By Troy Larson

In looking around Central States it's hard not to be impressed with how an organization with a defined charter and well-established culture can also promote such great individuality.

Sometimes people focus on ways to contribute that perfectly uses their respective skills and other times people use the organization to develop skills such as public speaking or leadership. Some people enjoy the conference seminars and workshops to stay connected with old friends and others use them to network and create new connections. At the 91st Annual Conference you couldn't help but be impressed with those who developed and continue to grow Global Water Stewardship. This is an initiative that was born in the minds of a few individuals and with their effort and the support of a strong organization, Global Water Stewardship has become a fantastic component of the organization.



"I am suggesting members look for opportunities within the WI Section that meets their sensibilities and professional passions and they get involved and put their own personal stamp on the growth and sustainment of this terrific organization."

I am not suggesting we should all do something as grand as Global Water Stewardship, it would be hard to sustain too many initiatives as ambitious as it is. I am, however, suggesting members look for opportunities within the WI Section that meets their sensibilities and professional passions and they get involved and put their own personal stamp on the growth and sustainment of this terrific organization. Examples of people who are doing this are easy to find. Review the roster of committee members involved with putting on any seminar, workshop, or other activity that provides networking and educational opportunities for our membership. Within the collection system seminar, for example, you will find people with a strong desire to further the education of professionals responsible for the maintenance, operation, and design of our collection systems. For me, the committee that has been most influential has been the Wisconsin Section Operations Committee. I joined the committee that at that time, was chaired by Dave Arnott. Dave invested much of his time in getting the committee stronger with new members and improving coordination with initiatives like

the operations teams. When I took over the committee, CSWEA was looking to hold seminars to discuss digester foaming and the Wisconsin Section Operations Committee was asked to conduct these seminars. This evolved into seminars addressing fundamental troubleshooting of common processes like activated sludge. Fundamentals, training, and troubleshooting all are important to me so as Committee Chair. I enjoyed and benefited from leading a committee that focused on these attributes. Now Jeremy Cramer is the WI Section Operations Chair, and he has held true to

the committee's foundation while placing an emphasis on innovation and resource recovery. If I did not replace Dave, he might not have had the time to proceed with other endeavors and eventually become this year's CSWEA President. If Jeremy did not succeed me, I would not have had time to become the WI Section Chair, an honor that I am thrilled to have. Someday, someone with ideas and talents that we have not considered previously will replace Jeremy allowing growth and change.

To me, this illustrates how individuals can insert their own style and passion into similar projects and create uniquely different outcomes. It also demonstrates the importance of having succession plans so we cycle through many different people who can bring unique perspectives to broaden our organization. I ask each of you to find a committee that you can invest some of your valuable time into and build on what has been built. Be confident and secure in what you have to offer and be generous with your skills and perspectives.

Note that in addition to our typical calendar of events the WI Section led by the Operations Committee, is hosting the EPA for a management workshop that will be held on July 26 in Oshkosh. Please look for information in e-mail blasts for this one-time opportunity.

I welcome Rachel Lee as the incoming WI Vice-Chair and Samantha (Sam) Austin as the incoming Secretary. Both Rachel and Sam have roots within the organization in the young professional committee and their perspectives growing the membership will undoubtedly bring value. Succession and change allowed them to take on their new roles, their previous accomplishments left their successors in great position to succeed.

Thank you to Veronica Loete for your service as Section Secretary and the great advice regarding the transition. Thank you to Alan Grooms for your pragmatic and practical service to the WI Section as you roll off as the now Past-Past Chair. Congratulations to Jay Kemp on completion of your duties as WI Section Chair and thank you for your guidance and assistance as I prepare for the year ahead.

As stated at the beginning, "It is whatever you make it". Let's make it a wonderful year! **CS**

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The Evolution of CSWEA

By Peter Daniels

I wanted to use my first message as the Minnesota Section Chair as a reason to do a little historical research about CSWEA. I have been active in the organization for about 10 years or so and know the organization has existed for over 90 years, but I was curious about some of the details. So, in just a few bullet points, here are some highlights about the evolution of CSWEA.

- The Central States Sewage Works Association was formed in 1927 and included Illinois, Indiana, and Wisconsin. There were 20 members the first year.
- The formation of a national federation coincided with the formation of the Central States organization. Several members from Central States were involved in the formation of the national federation.
- Minnesota joined the Central States Sewage Works Association in 1934.
- Individual membership dues were \$3.00 in 1942.
- Indiana separated from the organization in 1958.
- Government affairs committees at the Central States and national levels have had significant impact on environmental policies and funding programs through the years.
- The organization adopted the name Central States Water Environment Association in 1993.
- Current CSWEA membership is about 1,500.



I am interested in this because I have recently been reminded in several ways of the significance of the work that has been completed by others before us, in whatever field we are in.

I recently attended the funeral for Jim Miller, our colleague from CSWEA and a co-worker of mine for the past four years. As I looked around the room during the service, I couldn't help but think about all the knowledge and years of experience that were present with all of Jim's friends and colleagues. Jim had been in the wastewater industry for 46 years and

had an experience and story for most questions I could ever ask him. Many of the others attending the service had similar levels of experience. During my relatively short career, I have benefited from the experience of Jim and others present at his service. I have been able to make better decisions and avoid (some) mistakes as a wastewater engineer because of what I have learned from them.

The other reason I thought about this topic is something my brother is doing. While I write this, he is at the Johnson Space Center in Houston participating in a project for NASA. He is living in a capsule for 45 days with three other scientists, for the sake of data collection that NASA will use to further their understanding of how humans are affected by long distance space travel (he will be out of the capsule when this article is published). Each day he and his teammates work on tasks related to their simulation of traveling to an asteroid. They also talk with psychologists, are connected to monitors that continuously record biometric data, provide blood samples, and are generally under a very watchful eye. Although I know he misses not being able to go outside, he is enjoying his unique contribution to science.

His experience has piqued my interest in space travel. I recently watched the movie *The Right Stuff*, which tells the story of Air Force and Navy test pilots who became NASA's first astronauts. Accomplishments by that group and NASA scientists in the 1960's paved the way for future expeditions and led to improvements in technologies and processes. The work NASA has done and continues to do, including the study my brother is involved with, will help push the limits of future space exploration.

Although space travel and wastewater collection and treatment seemingly don't have much in common, current practitioners in each industry benefit from the work and accomplishments by those who came before us. I consider myself relatively early in my career – I have less than one-third of the experience of Jim Miller's 46 years – and I know that I have a lot yet to learn. I am thankful for the many wonderful teachers and mentors within CSWEA that work every day to make our industry, communities, and organization successful. Throughout CSWEA's 91-year history, our organization has benefited from the leadership of individuals passionate about water quality and the environment. [CS](#)

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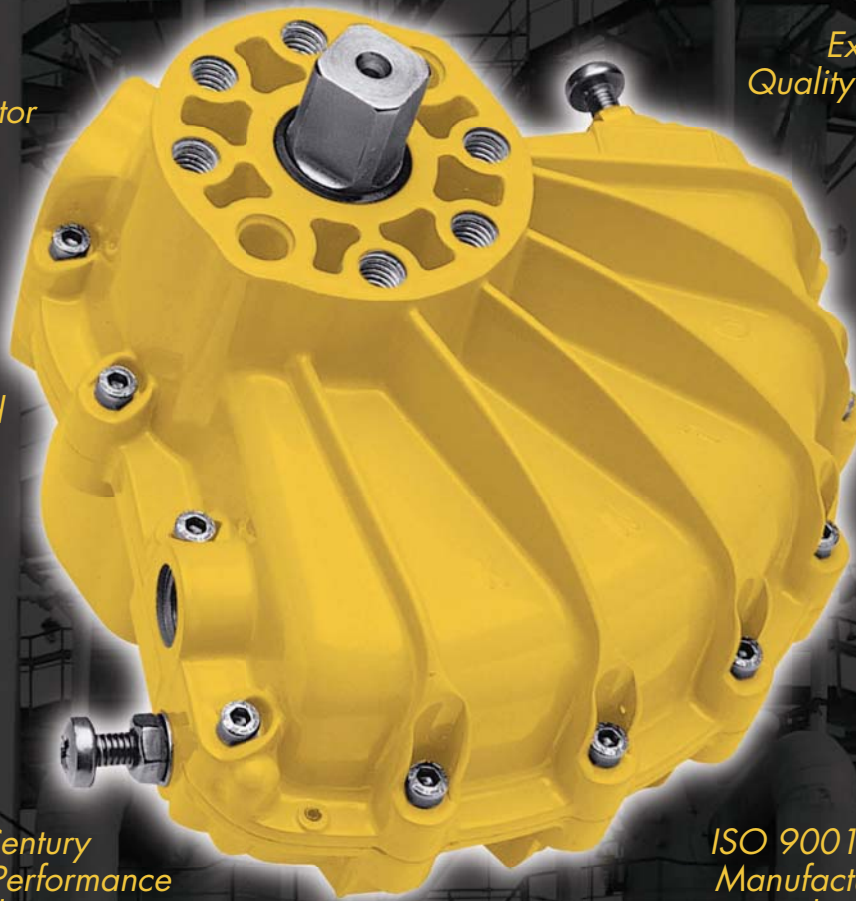
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President's WrapUp



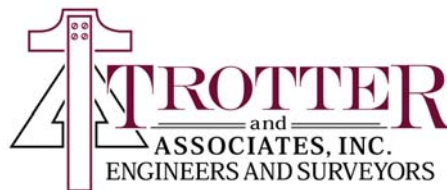
The 91st CSWEA annual meeting was a success-Whew! The meeting's focus was on Water: Educate Advocate and Learn held at Drury Lane in Oakbrook IL from May 14-16th. Monday offered many options for our members. We held two excellent workshops-Leadership and Watershed. Both held very informative discussions. Also offered was our ever-popular golf outing at Maple Meadows golf course in Wooddale, a storm water tour at Joliet followed by beverages, a Yorkville-Bristol plant tour with the new membrane aerated bioreactor technology and newly added community service project held at Skinner North Classical Elementary School in Chicago, IL. The social was held at Pinstripes –trivia anyone. The vendor show took place Tuesday and Wednesday, with breakout sessions offered for them to promote their products. Thank you everyone- I sat in a few and they were very informative. The technical program on Tuesday and Wednesday featured papers on Resource Recovery/Phosphorus Removal, Solids/Biogas/Energy, Innovation in Treatment, Industry Advancement, Instrumentation/Controls/Data, Utility Innovation,

Nutrient Removal, Major Facility Upgrades, Ethics, and new this year operator training courses given by Paul Burris. Also included were poster sessions. Tuesday's luncheon offered inductions to 7's and Golden Manhole societies, Peter Vanrolleghem our WEF visitor gave an inspiring presentation on WEF's goals for the future and great table talk and comradery. Tuesday evening the annual awards banquet took place. CS gives many awards... how wonderful to have a group with so much talent. The student involvement has really taken off; design projects for Global Water have aided this along with many active collegiate professors. A huge thank you to Jillian Kiss-local arrangement chair and the rest of the crew-Amanda Heller, Dan Rogers, Liz Bohne, Amy Underwood, Dean Wiebenga, Tim Tack, Matt Streicher, Mike Holland, Joe Kosteci, Natalie Cook, Rich Hussey, Tim Juskiewicz, Paul Siegfried, Mark Eddington and Derek Wold. The technical program committee Mark Eddington, Mandy Sheposh, Jeremy Cramer, Matt Sieb, Emma Larson, and Andy Bradshaw. Executive directors Mohammed Haque and Amy Haque. In addition, a special thank you to Dean Wiebenga, Scott Trotter, Aaron Berry and Chris Marschinke for all your help with the Tuesday evening festivities. In closing: So long, farewell, auf wiedersehen, adieu – GOODBYE.



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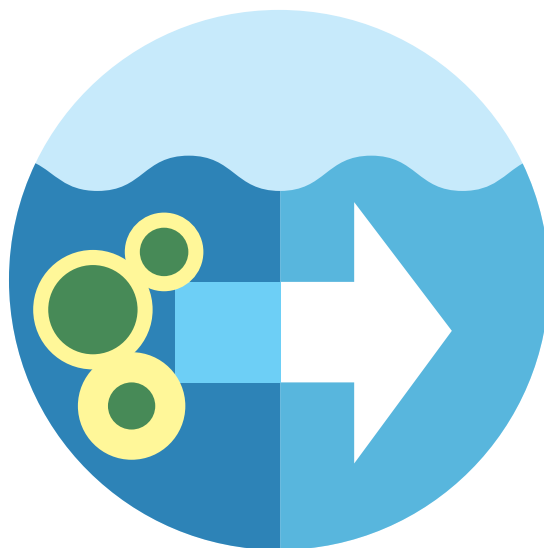
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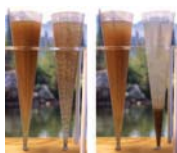
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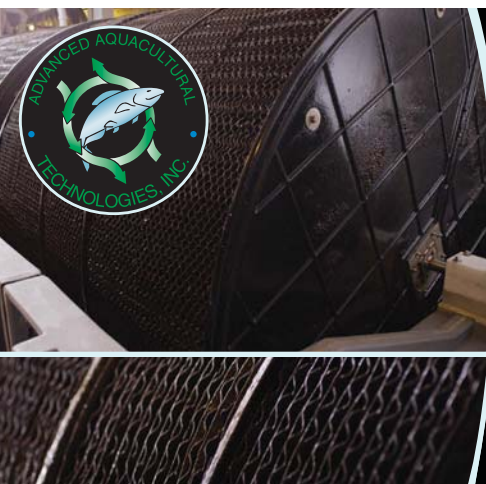
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5K Run

By Amanada Heller



The CSWEA 5k-ers were up bright and early after a fun time at the Monday Night Social! Mother Nature had her fun the night before, too, and provided enough rain to swell the River over the last 0.7 miles of the 5k course! Rather than making the event a duathlon through the raging, flooded, Salt Creek, the course was shortened to a quick 2.5 mile run – with a LOT of puddles. While a few participants were unsure how their times would come in for a shorter distance, two outstanding participants really knew their pace! Glen Tranowski (Strand) finished seven seconds from his estimated time, while Jean Warp (Sam Warp, Coty of Marshfield) finished within one second of her estimated time! Congrats to Glen and Jean for outstanding performances and being able to predict their time so closely on a shortened course! It was another great event for the 5k crew, and we are already looking forward to next year in Wisconsin.



Golf Outing

By Tim Tack

We had 39 registered golfers and it turned out to be a beautiful day for golf. The course was certainly soggy but a good time was had by all. We all played scramble golf and

prizes were awarded for two closest to the pins, long drive, low total score and highest score. A big thank you to all our sponsors.

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Plant Tour - The Yorkville-Bristol Sanitary District (YBSD)

By Amy Underwood



The Yorkville-Bristol Sanitary District (YBSD) was pleased to host a tour for approximately 25 attendees of the CSWEA 91st Annual Meeting at their wastewater treatment plant in Yorkville, IL on May 14, 2018.



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The tour started in the YBSD Administration Building with a brief presentation on the plant's major unit processes. While touring the 3.62 MGD facility, attendees visited the plant's mechanical bar screens, raw sewage pumps, 1-mm wedge wire drum screens, activated sludge plant, UV disinfection, gravity belt thickener, auto-thermal thermophilic aerobic digestion (ATAD), and dewatering centrifuge.

The highlight of the tour was the 2017 modifications to the activated sludge process. The YBSD activated sludge plant has two batteries of aeration tanks. Biological Phosphorus Removal (BPR) was implemented by converting the first aeration tank in each battery to an anaerobic tank by adding mechanical mixers. SUEZ's ZeeLung Membrane Aerated Biofilm Reactor (MABR) technology was installed in the second tank of one battery.

In addition to converting the plant to a BPR plant, the recent modifications to the plant will eventually enable the plant to increase the rated organic or biological oxygen demand (BOD) capacity by more than 45%. The MABR process employs an

innovative gas transfer membrane to deliver oxygen to a biofilm that is attached to the membrane surface. Immersing ZeeLung membrane cassettes into mixed liquor increases the inventory of the biomass in a treatment system thereby intensifying the biological treatment process and enabling increased organic load to be treated within the existing biological reactors. The YBSD will complete a one-year Performance Test on the installed MABR. Upon successful completion of the Performance Test, the YBSD intends to install ZeeLung membrane cassettes in the second aeration tank battery in order to rerate the organic capacity of the plant.

In addition to seeing the membrane cassette installation, the attendees toured the new MABR Building which houses the ZeeLung process air blowers and control panel.

After touring the facility, the attendees reconvened in the Administration Building for a presentation given by Jeff Peeters of SUEZ on the MABR technology. Attendees were very interested in the new process, spending approximately 45 minutes discussing the process with Mr. Peeters.

Stormwater Tour

By Timothy Juskiewicz

The City of Joliet is currently constructing Phase 3 of 5 of the City's Long Term Control Plan (LTCP) to reduce the occurrence of CSO discharges from any specific outfall to twenty or less during a five-year period. In 2016, the City completed Phase 2 of the LTCP, a \$21.4 million dollar project to construct two 24-inch dry weather siphons and a 60-inch wet weather pipe in a 9-foot 3-inch diameter 835-ft long tunnel under the Des Plaines River to convey combined sewage from the west side of the river to the soon to be completed Wet Weather Treatment Facility (WWTF) on the east side of the river. In 2017, the City began construction of their \$34 million dollar WWTF that will store and treat combined sewage from the west and east side basins. The facility will have 4 million gallons of first flush storage and a treatment capacity of 90 MGD when completed in 2019.

The CSWEA annual meeting included a tour with the City during the construction of the WWTF. On Monday, May 14, approximately 15 people were able to participate in a tour of the facility while it was under construction. Allison

Swisher, Interim Director of Public Utilities for the City of Joliet, welcomed the tour attendees with a presentation giving an overview of the City's LTCP, including the WWTF and the recent tunnel project. Representatives from the City's lead consultant on the project, Strand Associates Inc., assisted Allison in the presentation to provide an overview of the capabilities and individual treatment processes that make up the new WWTF.

After the presentation, and donned with proper personal protective equipment, the attendees were given a guided tour to see the WWTF at its current stage in the construction process. Many of the structures were already built but not yet online, which provided a fantastic perspective of seeing the scale and magnitude of the WWTF. Attendees even had the unique opportunity to walk through a 72-inch diameter pipe into the first flush storage tanks and see the project from the inside out. After the



tour, the attendees stopped at a local restaurant to enjoy drinks and appetizers and discuss the tour before returning to the conference.

Thanks to the City, and their contractor, Williams Brothers Construction Inc., for offering this great opportunity to the members of Central States.

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CSWEA Annual Conference Service Project



The new Young Professionals are looking younger and younger every year - but this year took an impressive jump. Central States Water Environment Association volunteers were joined by elementary school students from Chicago's Skinner North Classical School for the CSWEA Annual Conference Service Project, sharing shovels, wheel barrows, and learning about raingardens.

"According to calculations by Skinner students, the 250 square foot raingarden will divert approximately 25 bathtubs worth of water from each storm from the Chicago storm sewer, while keeping the playground dry."

This year was the first for the CSWEA Service Project, where eight CSWEA volunteers spent their Monday turning a flooding low point in the Skinner school playground into a raingarden. Volunteers began the day by filling the raingarden with a layer of gravel to act as underground stormwater storage. This was then covered by a layer of soil, and wet/dry tolerant raingarden plantings. The raingarden overflows into a city stormdrain,

diverting the initial rainfall of each storm away from the city stormwater system and into the soil.

Volunteers also taught Skinner students about stormwater design, green infrastructure, and infiltration measurement. Skinner students – and several experienced water professionals – learned to use and interpret measurements from a double disk infiltrometer. According to calculations by Skinner students (and checked by CSWEA engineers), the 250 square foot raingarden will divert approximately 25 bathtubs worth of water from each storm from the Chicago storm sewer, while keeping the playground dry.

In the afternoon, volunteers were joined by MWRD Vice President Barbara McGowan, who joined in on the hard work and gifted the school with a rain barrel.

Volunteers finished at the site late Monday afternoon and managed to get the last plants in the ground just in time for CSWEA's first service project to experience its first rainstorm.

The raingarden was made possible by donations from Chicago's Department of Water Management, the Metropolitan Water Reclamation District of Greater Chicago, Chicago Department of Streets & Sanitation Bureau of Forestry, The Spirited Gardener, Midwest Trading, Midwest Groundcover, Donohue & Associates, Inc., Carollo Engineers, Ostara Nutrient Recovery Technologies Inc, Scott Byron & Co, and several individual donors.

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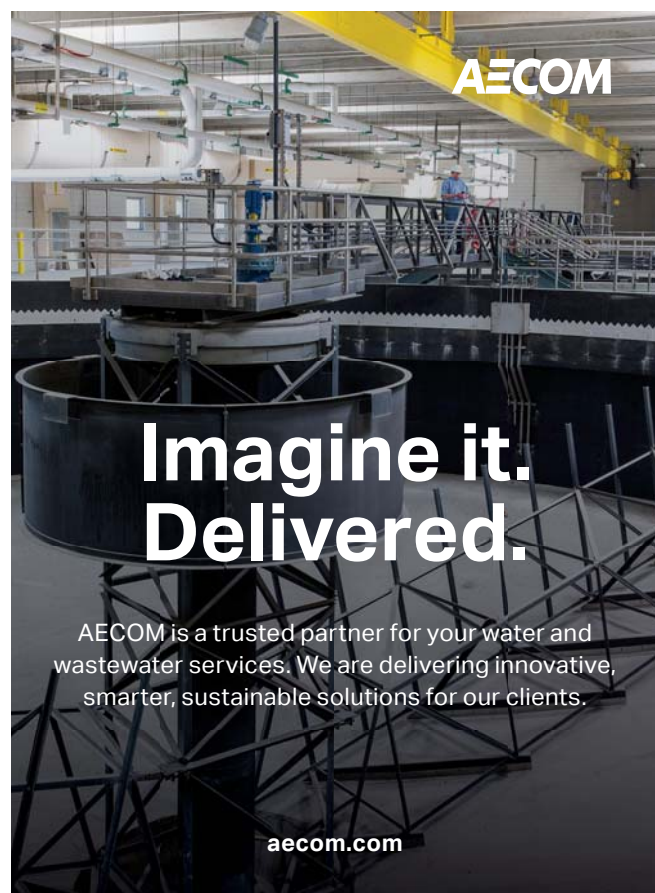
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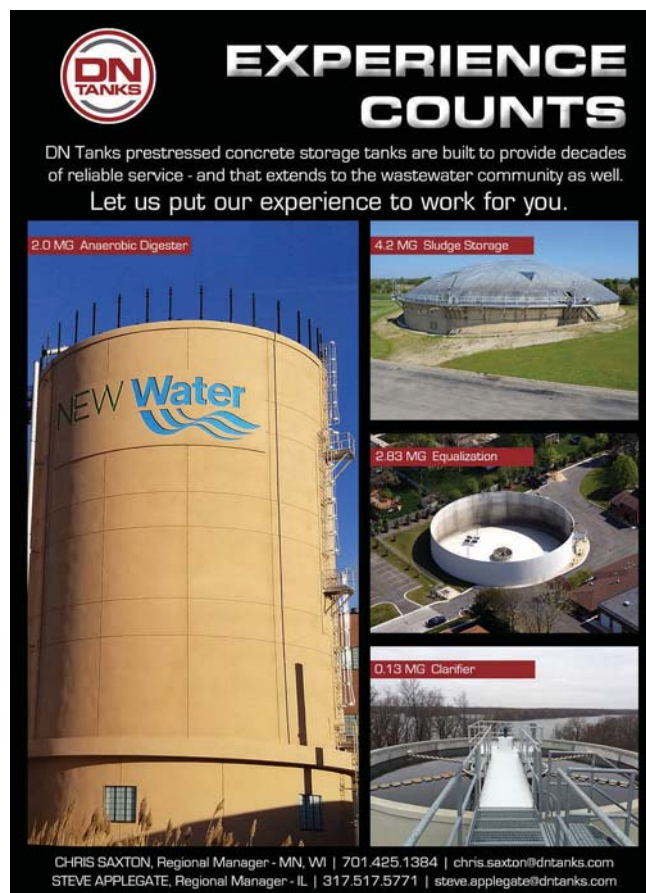


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WRC HISTORY

The Carol Stream Water Reclamation Center (WRC) is a conventional activated sludge plant permitted by the Illinois Environmental Protection Agency (IEPA) to treat a design average flow of 6.5 million gallons per day (mgd). The average daily

flow is currently 4.87 mgd, or 74 percent of the permitted capacity. The designed maximum flow of the plant is 13 mgd.

The plant was originally designed as a package plant in 1958 and has undergone major improvements in the 1990s and in 2002. The WRC provides wastewater treatment for approximately 40,000 residents and commercial industries within the Village of Carol Stream.

TREATMENT PROCESS

Influent wastewater enters the bottom of three primary screw pumps from the four interceptor lines and lifts the raw sewage

29 feet into the aerated grit tank. Each screw pump can pump 9,725 gallons per minute or 10 mgd. The grit removal system is aerated to provide for settling of heavy particles such as rocks, sand, pebbles, and coffee ground. The grit tank is 24 x 24 x 14 with a capacity of 60,000 gallons. Wastewater is sent through a finer screening process consisting of three rotating Hycor drum screens. These drum screens remove rags and floatable debris that remain suspended. These screenings are discharged to a dumpster and disposed of at a landfill.

Secondary screw pumps lift the wastewater an additional 14 feet to flow through aeration basins. The plant has

six aeration basins: three measure 40 x 130 x 22 with a capacity of 840,000 gallons each, and three measure 40 x 200 x 22 with a capacity of 1,300,000 gallons each. This is where the activated sludge process occurs.

Multi-stage centrifugal and high-efficiency turbo blowers force air through piping and membrane-type diffusers resulting in fine air bubbles at the bottom of the tanks. This provides mixing and oxygen to the biological process.

“We pride ourselves on our preventive maintenance as well as ability to perform corrective maintenance when necessary to keep equipment operating properly.”

Following aeration, the water flows into any of four secondary clarifiers. Each clarifier is 85 feet in diameter and 12 feet deep holding 500,000 gallons. The clarifiers allow the suspended solids from the aeration basins to settle to the bottom by gravity. The clear effluent on the top leaves the clarifiers over the weirs, and proceeds to tertiary sand filters. The solids on the bottom are removed by pumping to the digester for further treatment, or back to the aeration basin to keep the organism population strong for treating the wastewater that is always entering the plant.

The solids that go to the digester concentrate and thicken – the organisms keep feeding off any nutrients and each other until the sludge is stable.

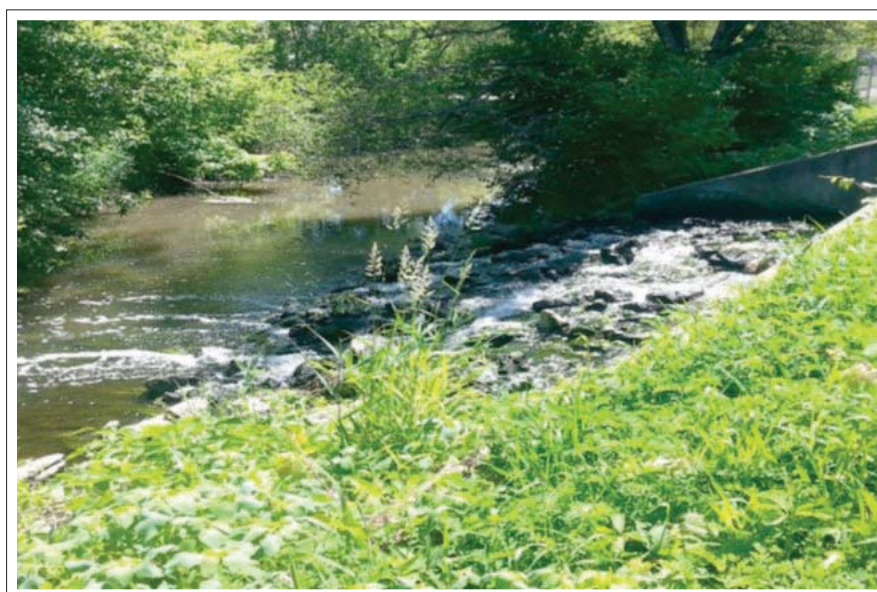
This is then pumped to the belt presses. A polymer is added to the mixture to enhance separation of the remaining water from the solids. The sludge-polymer mixture then enters one of two belt presses which dewater the sludge and return the water back to the head of the plant to go through treatment again. The sludge that has been pressed resembles soil, and is removed daily to offsite landfill for disposal. The belt presses operate 3-5 days per week.

The water from the clarifiers flow into sand filters for the removal of remaining floatable solids. The sand filters were installed in 1991 and are a traveling bridge type with approximately 11 inches of sand media supported on a plate-type underdrain system. The water is injected with a 15 percent solution of sodium hypochlorite (chlorine bleach) and enters the filters where it drains through the sand and flows to the contact basins.

MAINTENANCE

Maintenance is performed on all equipment within the plant by the

Carol Stream team. We pride ourselves on our preventive maintenance as well as ability to perform corrective maintenance when necessary to keep equipment operating properly.





An extensive Condition Assessment was performed by the maintenance staff. This included using infrared thermography, vibration analyzers, temperature probes, and power/ampere meters. This data is tracked to aid the prediction of possible equipment problems and to help identify projects for upcoming capital improvement.

By taking a proactive maintenance approach, we can prevent breakdowns

or the loss of major components. For example, infrared scanners allow us to detect hot spots in electrical equipment that can result from frayed wiring, loose connections, corroded connections, or failing parts. Detecting and repairing these problems, usually at a slight cost, can prevent the total failure of an expensive electrical device. Vibration analyzers allow us to detect and record vibration histories for high speed pumps and motors.

This condition assessment process provides a picture (a snapshot in time) of asset health, provides asset remaining life values, and helps determine maintenance priority.

Coupled with the condition assessment procedure, is a risk analysis. This helps determine asset criticality and is a basis for selecting maintenance strategies and for determining condition assessment focus and frequencies.

COMMUNITY INVOLVEMENT

Our goal is to continue our growth in the Village of Carol Stream as a civic-minded organization, sensitive to the needs of our community. Our concept is to support local projects and embrace the community as it has so graciously embraced us. Our activities include:

- Annual Open House in October for residents. The open house includes guided plant tours, hay rides, touch-a-truck, exhibits from the Conservation Foundation and the Carol Stream Public Library, and free pumpkins for children.
- Teaching our future generations the importance of our valuable resource, water. Students learn about the WRC with tours, Earth Day activities, and stream water testing. [CS](#)

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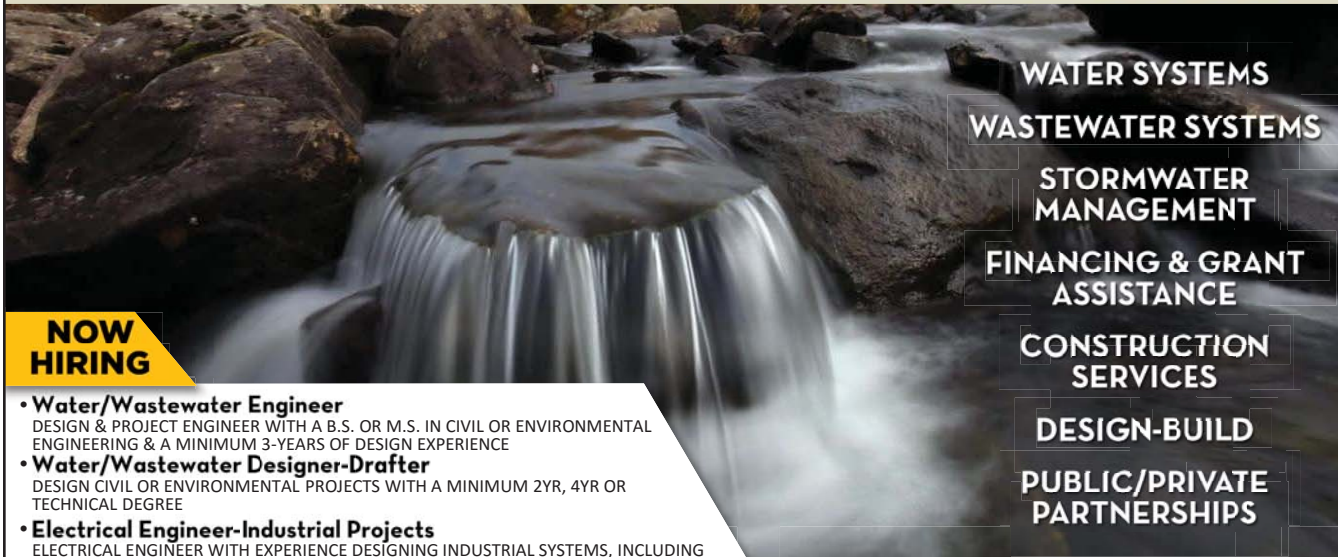
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Implementation of Biological Phosphorus Removal at the City of St. Charles WWTF

By Jerry Ruth, P.E. and Elizabeth Bohne, E.I.T., Trotter and Associates



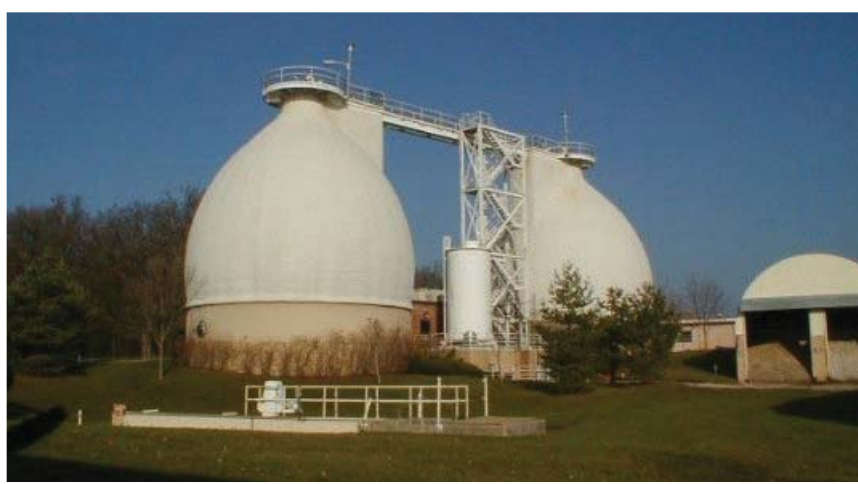
CITY OF
ST. CHARLES



The City of St. Charles, Illinois is located along the Fox River in central Kane County approximately 35 miles west of downtown Chicago. The City of St. Charles' original wastewater treatment facility was located along the banks of the Fox River near the Riverside Lift Station. In the early 1930's, a new plant was constructed up the hill on what is now the wastewater treatment facility site. The first plant on this site consisted of an Imhoff tank. Shortly after construction of the first structure, a new sludge management process was introduced and referred to as the Putnam Process. At that time, the first section of the existing sludge handling building was constructed in addition to several sludge storage tanks, two of which remain in service today. The Putnam Process was abandoned during later expansions, but the building that housed it was incorporated into the Sludge Handling Building.

The City's Main WWTF infrastructure is of varying age and condition. The Main WWTF plant has a design average treatment capacity of 9.0 million gallons per day (MGD). The facility generally serves the east side of the community's wastewater needs.

In 1989, the Main WWTF Sludge Handling and Excess Flow Improvements were prompted by the USEPA 503 Regulations, which were pending at that time, and applicable excess flow treatment requirements. The sludge handling facilities improvements included construction of an egg-shaped anaerobic digestion complex, the second of its kind in Illinois. The improvements also included sludge pumping and storage modifications. The existing first flush tanks were converted to waste activated sludge holding, while one of the excess flow clarifiers was converted to first flush holding. The project was completed in 1991. These



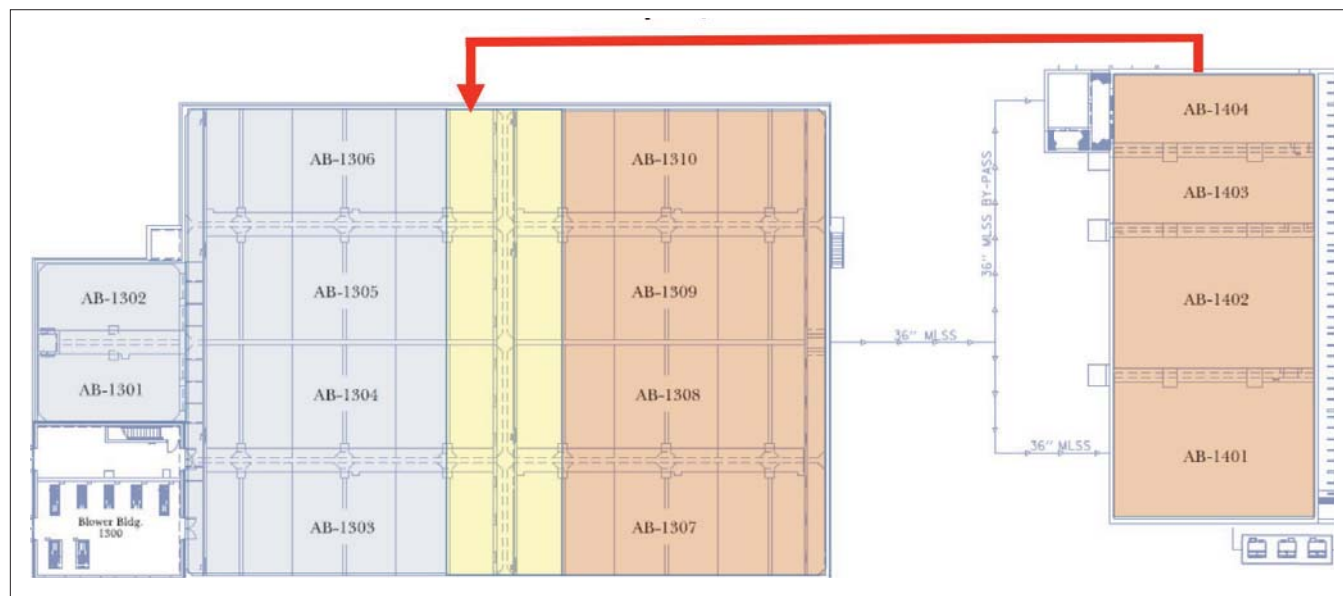
digesters are about 79 ft tall constructed of carbon steel and until 2017, had not been improved or rehabilitated on a large scale since their construction.

The City of St. Charles proceeded with replacement of the Main Sludge Handling Building in 2011, which included a Facility Plan Update. The improvements were designed in such a configuration that future treatment processes or sludge stabilization upgrades were not negatively impacted. Furthermore, the City evaluated several centrifuge manufacturers

and selected two to perform on-site pilot testing of their equipment. Both manufacturers demonstrated the capability to meet the City's performance requirements. In addition, the existing infrastructure needed to remain in service during construction. The project therefore included construction of the new building in two phases.

The first phase included electrical/control, sludge thickening and dewatering facilities. The waste activated sludge improvements included WAS holding, sludge feed pumps, polymer unit,

EXHIBIT 1 | A²/O PROCESS



Blue = Anaerobic, Yellow = Anoxic, Red = Aerobic (i.e. "Oxic")

gravity belt thickener, TWAS holding and pumping systems. The sludge dewatering improvements included sludge feed pumps, polymer units, two centrifuges and a conveyor in a loading dock. The second phase included construction of an operations building that contains an office, break room, locker room, inventory, and maintenance garage. The Facility Plan Update was submitted in July 2011 and the project was funded through the Illinois State Revolving Fund (SRF) program. Design was completed in December 2011, and construction was completed in the fall of 2014.

The Main WWTF discharges to the Fox River. According to the Illinois EPA Clean Water Act Section 303(d) List, the Fox River does not meet water quality standards for its intended use in the majority of the segments, including the segments immediately downstream of the Main WWTF. The impairment on the river for aquatic life is based on a low dissolved oxygen concentration. This low dissolved oxygen content is due to algal growth and exacerbated by the presence of pools upstream of the low head dams along the river.

The City of St. Charles received a final NPDES permit on December 1st, 2014. The Main WWTF's NPDES permit includes a special condition that states that the facility must comply with a 1.0 mg/L annual average phosphorus limit. It is likely that the Facility will need to achieve lower phosphorus effluent limits prior to

2030. The special condition requires that the City of St. Charles study, design and construct improvements which will allow the plant to achieve a 1.0 mg/L effluent phosphorus limit within 54 months after issuance of the permit, or June 1st, 2019.

The City conducted a Phosphorus Removal Feasibility Study to determine the best method to reach 1.0 mg/L. During this study, biological phosphorus removal, chemical phosphorus removal, and a combination of both were evaluated.

For the consideration of a BNR alternative, the overall system was modeled to identify potential operational issues and boundary conditions. The use of these models has become standard industry practice for evaluation and design of biological treatment plant processes, especially in phosphorus removal applications. The model was developed utilizing existing dimensions of the biological process basins, and was calibrated by data obtained during an intensive sampling and lab testing process.

During the study, BioWin™ was utilized to model the existing plant and alternative process configurations for phosphorus and nitrogen removal. The alternatives modeled only utilized the existing upper and lower aeration basins. The models were based on a design average flow rate of 9 MGD. Based on site-specific data, it was determined that the model should utilize a MLSS temperature of 9°C

and an influent rbCOD concentration of 78 mg/L. Other parameters included the maximum monthly average CBOD₅ (239 mg/L), ammonia (26 mg/L) and TKN (40 mg/L) concentrations. The model was calibrated and validated by comparing the results to existing flows and loads. Once calibrated, four BNR alternatives were evaluated. These included the A/O process, Modified Johannesburg Process, Five-stage Bardenpho Process and A²/O Process.

The evaluation included a life cycle cost analysis. After further evaluation of costs and efficiency, it was determined that the A²/O process would be the best suited BNR process for the facility. This is because no additional basins will need to be constructed, and total nitrogen is also reduced. The A/O reduces phosphorus only, not TN and the other methods would require either additional tankage or a change in process method such as an IFAS in order to meet nitrification limits. It was concluded that the A²/O configuration was the simplest and most stable process for biological nutrient removal.

The A²/O configuration of the biological process utilizes three zones. The head of the process is an anaerobic zone, followed by an anoxic and an aerobic zone. An internal recycle of approximately two times the design flow from the end of the aerobic zones is conveyed to the head of the anoxic

zones. This internal recycle will denitrify approximately 66% of the flow.

The major cost of implementation for this process is the construction of the internal recycle pump station. However, this configuration can be implemented within the existing basins, requiring only the construction of baffle walls for zone

isolation and the conversion of roughly 46% of the existing aeration basins to anoxic/anaerobic basins. In addition, operation and maintenance would be simplified by having all internal recycle pumping equipment in one location.

Based on this conclusion, further analysis of the A²/O process was performed to

identify and confirm the initial findings. Specific adjustments included increasing the MLVSS concentration, optimization of basin sizing, and a review of internal recycle rates. The projected influent rbCOD concentration remained 78 mg/L and the MLVSS concentration increased to 2,300 mg/L. At these conditions, the A²/O process was able to satisfy the new NPDES permit limits. Phosphorus and ammonia effluent concentrations were projected to be 0.79 mg/L and 0.66 mg/L, respectively. In addition, total nitrogen is expected to be reduced by 47%. Under these conditions, the model predicted the concentrations throughout the biological process as shown in Figure 1.

The final output from the model describes concentrations in the secondary clarifier supernatant, prior to disinfection. The output data is shown in Table 1 below.

Based on the analysis of the Biowin™ model, it was recommended that the improvements incorporate a primary sludge fermenter for carbon augmentation. A location of the proposed primary sludge fermenter and internal recycle pump stations is shown in Exhibit 2. This fermenter will increase the volatile fatty acids available to the biological process in the anaerobic zone, improving the efficiency of the biological phosphorus removal.

Under average loading conditions, the existing process is able to meet effluent standards at and above 50°F (10°C). Under maximum day demand loading, the existing process is only able to meet effluent standards with wastewater at and above 57°F (14°C). The model indicates that additional detention time is necessary under high loading and low temperature conditions. In order to combat this, a swing zone was included. This allows the City to turn on the blowers in either or both the anaerobic zone or anoxic zone to provide additional HRT for nitrification. A chemical phosphorus removal back-up system was included in the design for times when the biological process needed additional air for nitrification and the A²/O was reverted back to an AO or single stage nitrification.

FIGURE 1 | CONCENTRATIONS THROUGH THE BIOLOGICAL PROCESS

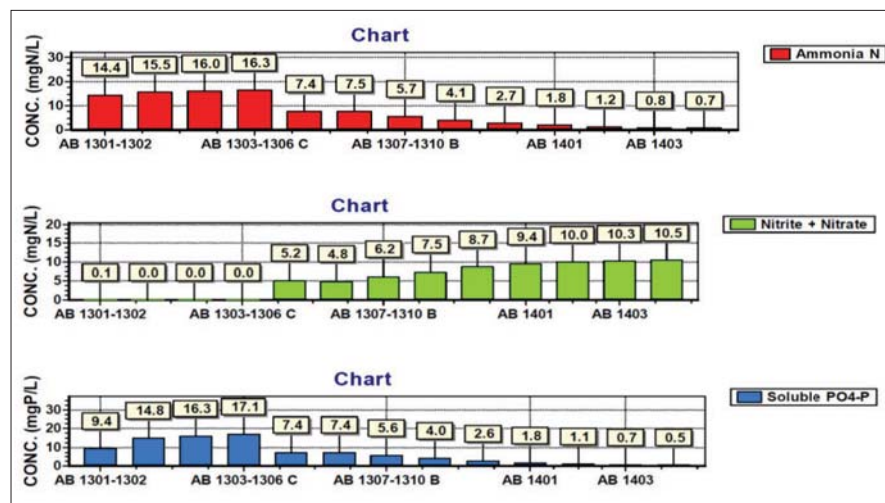


EXHIBIT 2 | PROPOSED LAYOUT FOR A²/O PROCESS



TABLE 1 | EFFLUENT CONCENTRATIONS FROM A²/O MODEL

Total COD mg/L	Total CBOD mg/L	Total P mgP/L	Soluble PO4-P mgP/L	Total N mgN/L	Ammonia N mgN/L	Nitrate N mgN/L	Nitrite N mgN/L	Total SS mgTSS/L	Volatile SS mgVSS/L
28.48	2.61	0.79	0.48	12.93	0.66	8.57	1.89	5	3.5



Implementation of the BNR process also considered the effects on downstream processes. The sludge stabilization process is anaerobic digestion. Orthophosphate tied up in PAOs from the BNR process is released under anaerobic conditions, increasing concerns regarding struvite formation. Struvite is a compound made up of magnesium, ammonium and phosphorus. Alkaline conditions increase the potential for struvite crystallization, which can attach to the mixing systems, heat exchangers, sludge recirculation pumps and sludge transfer pipes. Struvite may be controlled by minimizing the concentrations of the three main soluble ions or chemical addition to reduce the pH level. Additionally, the volatile solids destruction in the digester causes a re-release of phosphorus that was previously converted to solids in the biological process. This phosphorus is then compounded in the side stream after dewatering and returned to the head of the plant.

In order to manage the side stream impacts, implementation of a chemical buffering system and chemical storage facility was recommended. An on line pH monitoring system will dose the digestion contents with a buffering agent, such as a weak acid, to maintain pH levels between 6.5 and 7.5 and avoid struvite formation. It will also tie up the phosphorus into a fixed solid so it is not re-released due to anaerobic digestion.

The more economical choice for meeting a 1.0 mg/L phosphorus limit at the City of St. Charles Main WWTF would be to implement chemical phosphorus removal, however biological nutrient removal comes with many other benefits. The matrix on this page was developed to determine the best alternative for the City of St. Charles Main WWTF. Economic and non-economic factors were listed and weighted. The alternative that was in the best interest of the City for each factor

TABLE 2 | PHOSPHORUS REMOVAL DECISION MATRIX

Description	Weight Factor (1-18)	Bio-P	Bio-P Score	Chem-P	Chem-P
Economic Factors					
Capital	17		0	1	17
O&M	16	1	16		0
Life Cycle Cost	18	1	18	1	18
Staffing Requirements	13	1	13	1	13
Long-Term Maintenance	12	1	12		0
20-Year Residual Value	15	1	15		0
Operational Simplicity	11		0	1	11
Inflationary Risk	14	1	14		0
Non-Economic Factors					
Quality of Sludge	2	1	2		0
Dewaterability	1		0	1	1
Effluent Quality	10	1	10		0
Future Nitrogen	9	1	9		0
Future Chlorides	8	1	8		0
Training Requirements	6		0	1	6
Disruption in Operations	7		0	1	7
Public Acceptance	3	1	3		0
Environmental	4	1	4		0
Innovation	5	1	5		0
Total Score			129		73

was awarded those points, and a total score was tallied. In some instances, the factor was found to be approximately the same for both alternatives. In these cases, points were awarded to both alternatives.

From this matrix, it was decided that an A²/O with a chemical buffering back up system would be implemented. Construction for these improvements began in September 2017 and are anticipated to conclude in April 2019.

The project is being funded through an Illinois EPA SRF loan. The project was partnered with a rehabilitation of the egg-shaped anaerobic digesters and is titled the "Phosphorus Removal and Digester Improvements" project. Work in the digesters consists of cleaning and recoating the interior of the digesters, replacing and improving the interior digester piping, incorporating a boiler/

heat exchanger that is powered by digester gas to improve energy efficiency in digester heating, and new sludge piping and recirculation pumps. The main improvements that are being implemented for the phosphorus removal project are the construction of a new primary sludge fermenter, Internal Recycle pump station, baffle walls and mixers for anaerobic and anoxic zones, and chemical feed and storage systems with the ability to dose chemical to the end of the biological process, the digested sludge storage tank, and the thickened WAS prior to digestion.

This project also includes an improved process control system with online phosphorus, nitrogen, and suspended solids/turbidity monitoring to allow for advanced control and improved efficiency of the biological nutrient removal processes. [CS](#)

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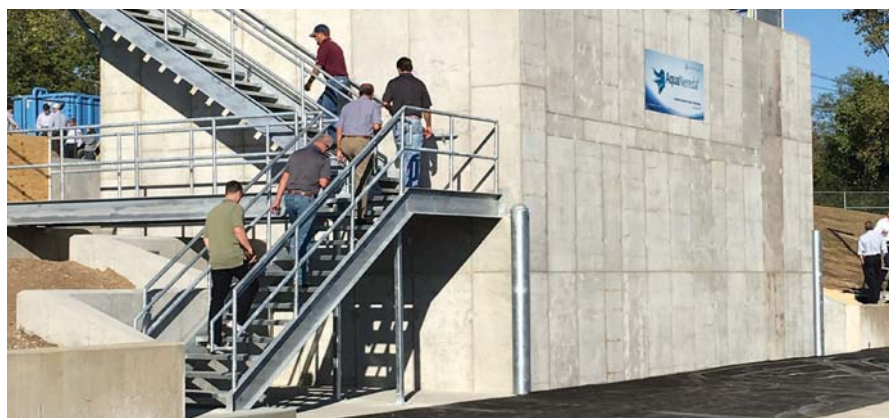
The INNOVATION & TECHNOLOGY COMMITTEE will regularly solicit articles for publication in the *Central States Water* magazine regarding new water technologies and innovation in the water field and will help promote CSWEA Leaders Innovation Forum for Technology (LIFT) engagement. This first article focuses on an innovative activated sludge process, a granular sludge process, which allows for multiple process benefits to be realized. This is one of the most followed innovative technologies in LIFT Link. LIFT Link was developed by the Water Research Foundation (WRF), then known as the Water Environment Research Foundation. LIFT Link is part of the WRF/WEF LIFT (www.werf.org/lift) program to accelerate innovation into practice. LIFT Link is an online platform which serves as a conduit of interaction among municipal and industrial water, wastewater, and stormwater agencies, technology providers, consultants, academics, investors, federal agencies, and others for advancing innovation. LIFT Link allows its users to discover new technologies and research needs; connect with others with similar needs, technology interests, and desired expertise; and collaborate on research and technology ideas, proposals, projects, demonstrations, and implementation. If interested in accessing LIFT and gaining a login please reach out to Mohammed Haque at mhaque@cswea.org. Look for more innovative articles in the near future.



The AquaNereda® Technology provides advanced secondary wastewater treatment using the unique features of aerobic granular biomass, comprised of granules. The Nereda process was created by a public-private partnership with Delft University, Dutch Water Authorities and Royal HaskoningDHV in the Netherlands. The technology has been used successfully for more than 12 years in full scale wastewater treatment facilities with over 50 plants currently in operation or under design and construction. While these plants are located around the world, just recently the technology has become available in North America due to a partnership between Aqua-Aerobic Systems, Inc. and Royal HaskoningDHV, allowing Aqua-Aerobic to be the exclusive provider of Nereda technology in the U.S. and Canada, where it is marketed under the brand AquaNereda® Aerobic Granular Sludge Technology.

The main advantages of this innovative technology include up to 75% footprint reduction, 50% energy savings and chemical savings, compared to activated sludge systems, under a wide range of influent characteristics, applications, and climates.


The AquaNereda technology provides the ideal conditions (process and mechanical) to promote granulation. Under the proper selection pressures, granules are naturally formed and maintained without the addition of carriers. The system operates in phases, in which all the treatment including clarification occur in the same tank, without the need of recycle flows. The phases include anaerobic feed, react and fast settling (and sludge wasting). Based on the sequence of operation, slow growing organisms will thrive and produce excess of Extracellular Polymeric Substances (EPS) which is the backbone of the granule. One of the most prevalent slow growing organisms found in the granule are Phosphorus accumulating organisms (PAO), making this AquaNereda system ideal biological phosphorus removal. Also, due to the diffusion gradient, the granules include aerobic conditions on the outer portion and anoxic conditions in the inner portion. This layered structure allows for promoting nitrification and denitrification to occur simultaneously, while operating the system at lower dissolved oxygen (DO) concentrations.



One of the main characteristics of aerobic granular sludge is the settling properties. Based on the density of the granules, granular biomass settles significantly faster than flocculent sludge, with SVI values of 30 to 50 ml/g. These excellent settling properties allow for design MLSS concentrations of 8,000 mg/l or higher, leading to lower volumes required for treatment.

The capability of achieving biological nutrient removal (BNR) in a single tank concept, no sludge recirculation, operating at higher MLSS concentrations, efficient use of oxygen, and fast settling, makes the AquaNereda technology ideal for secondary advanced treatment in smaller footprint with the lowest life-cycles-costs.

To introduce the technology to the North American market, Aqua-Aerobic Systems has built a 200,000 gallon per day demonstration facility at the Rock River Water Reclamation District (RRWRD)

in Rockford, IL. This fully automated system was put into operation in January 2018. The new AquaNereda demonstration facility is unique with the capability of operating at a range of water level depths, so that the distinctive advantages of AGS can be demonstrated at the various process depths often seen in retrofit applications. The demonstration facility will provide a site to grow and store seed granules for plants that need to accelerate biological nutrient removal during commissioning of new plants. Additionally, this facility will provide an easily accessible aerobic granular sludge site for engineers and plant operators to visit in North America. www.aquanereda.com 

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My Water Legacy:

The Streichers

By Elizabeth Bohne

They often say “the apple doesn’t fall far from the tree.” This could not be truer than what is seen with Matt and Lucas Streicher. Matt and Lucas are brothers, sons of Dennis Streicher. Though they each have gone down separate paths and may not get together as often as they would like anymore, they all have followed a similar passion to improve global water quality through a career dedicated to wastewater treatment.

Dennis has been involved in the wastewater field for almost 40 years. He is currently deeply involved with the DuPage River/Salt Creek Workgroup which is working to improve the water quality in DuPage County. He started his career in wastewater after he graduated from NIU with a degree in biology and was unsure where that path would take him. His then fiancé (now wife and mother to Matt and Lucas) found an ad for a chemist at the Elmhurst wastewater treatment plant. At the time, he thought it would just be a good place to start while he looked for a real job because let’s be honest, “NOBODY wants to work at a wastewater

treatment plant.” He stayed at this job for 40 years and retired as the Director of Water and Wastewater.

When asked what he feels his biggest accomplishment is, he replied that the first thing that comes to mind is his sons. Both of them have grown up to become leaders in the same field that he spent his career. They both have engineering degrees and are working to make a difference in the water/wastewater environment, continuing the Streicher Water Legacy.

Matt Streicher, the Executive Director of Glenbard Wastewater Authority says that growing up he remembers being somewhat interested in his dad’s position because he was fascinated by water towers. He says his dad was his role model, so he wanted to be just like him, though Dennis recalls that the boys never wanted to hear about his work when they were at the dinner table (who could blame them?). Matt says that he was always interested in figuring out how things work so it was natural for him to become an engineer. He says

he also thought that though smelly, the work at his dad’s wastewater treatment plant was very “cool” with all the big tanks and equipment.

Lucas Streicher, Director of Operations at the Thorn Creek Basin Sanitary District (“the largest facility any of the Streicher’s has worked at” he noted), was kind of the opposite. He says he always wanted to be an engineer as well, but like any teenager, he would tune out whenever his dad would talk about work. He says he remembers seeing his dad on television during some of the big floods in the early 90s and that piqued his interest. He says he remembers his dad always talking about the wastewater industry being great, and how it felt good to know that his career was improving the environment and making a difference. He noted that something must have gotten through to him without even realizing it at the time, because he understands that feeling now.

Even with their similarities, there is a little bit of sibling rivalry between the brothers. Matt graduated with a degree in Civil Engineering from University of Iowa,



Lucas with a degree in Materials Science Engineering from University of Illinois at Urbana-Champaign (the “real” U of I, he says). They say there is a constant battle about which “U of I” is better, but in the long-run, they both have proven to have successful careers where they can utilize their degree in a way they are passionate about. The brothers say they had a very environmentally conscious upbringing and remember their dad coming home with a sense of satisfaction knowing that he was making a positive impact on the environment. They spent a lot of time outdoors, with a back yard on the forest preserve and an awareness that wastewater treatment was helping to keep the forest preserve healthy.

Matt says that this thought made him think that his father’s job was particularly important. He says that just the exposure to wastewater at such an early age is different than most children who may not think twice about where the water goes when the pipes carry it “away.”

He also says that from plant visits and even his dad’s coat and truck, being exposed to the smells at such a young age made him feel comfortable in the wastewater world. He has developed his career and become very involved in some of the same organizations as his father, including DRSCW and CSWEA. He says that he even met his future wife (Amanda Heller, an environmental engineer for Baxter and Woodman)

through involvement in professional organizations and through their joint effort to help get CSWEA’s nonprofit group that provides wastewater solutions in the developing world, Global Water Stewardship, up and running.



Overall, the Streicher family has had an enormous impact on the wastewater industry and they’re just getting started. Dennis notes his sons accomplishments, stating that Lucas has done an incredible job automating his plant and Matt has participated in numerous committees through CSWEA, DRSCW, and IAWA which help develop and improve industry standards. He also says he is very excited to grow the Streicher wastewater legacy with Amanda!

Matt says that he thinks his dad has made the largest impact. Between his



years of experience and work to influence the regulations placed on POTW’s, he has always had the best interest of the environment in mind.

In typical engineer fashion, Lucas crunched the numbers to come to this conclusion: He has been in his position for 10 years. At an average flow of around 15MGD he says he has been directly involved in discharging nearly 55 billion gallons of clean water into the local watershed and eventually out the Gulf coast. His father, Dennis, having worked at and run a plant for over 40 years at around 10MGD would be nearly 150 billion gallons of clean water into the local watershed. Matt, in his 9 years with average flows between 8 and 12 MGD depending on the facility he was at, would be at about 30 billion gallons of clean water in the local watershed. This equates to a grand total of around **230 BILLION GALLONS** of clean water that has entered the local watershed and found its way down the Illinois and Mississippi rivers all the way to the Gulf that can be attributed to the Streicher’s in one way or another. He adds that they have a family home in Peoria where they swim on the Illinois River, where all of the plants that the three of them have worked at are eventually tributary to. They like to joke that they are swimming in their plants effluent, and take pride that it is able to be used for recreational activities! I would say that’s a win for the Streichers! [CS](#)

23RD ANNUAL CSWEA EDUCATION SEMINAR

BIOSOLIDS: Generating Value through Innovation

Presented by Central States Water Environment Association
At Monona Terrace Convention Center, Madison, Wisconsin

April 10, 2018

The 2018 CSWEA education seminar presented an exciting atmosphere to hear about the latest breakthroughs in the field. The speakers and attendees participated in high energy Q&A sessions creating a fun dynamic for learning from and with each other. The theme this year was focused on biosolids and generating value through innovation. While the seminar covered breaking research and methods, we also heard about issues that have always been common to our industry such as odors and dewaterability. Dr. Matt Higgins from Bucknell University used the case study on his research with DC Water to highlight the importance of considering social, economic, and environmental impacts when deciding which biosolids handling process to implement. The team knew that public acceptance would be huge for their final decision. Dr. Higgins revealed findings that were applicable to municipalities both big and small in all regions of the country. For example, he noted that the biodegradation of proteins in biosolids is a main culprit for odors, and that centrifuges release bioavailable proteins which increases odors relative to belt filter presses. He also addressed the phenomenon of observed regrowth of *E. coli* in biosolids through various biosolids handling processes. By employing molecular techniques, his research revealed that the gene copies of *E. coli* actually stayed high through solids handling processes but the cultivation methods used make it appear as if *E. coli* numbers are decreasing before increasing.

After hearing about odors and regrowth, Dr. Randy Wirtz (Strand Associates, Inc.) highlighted various needs and options for cleaning and utilizing biogas. He noted how digester gas was characterized as a D3 RIN (renewable identification number)



fuel, increasing its value, but that it still required cleaning before it can be blended with pipeline gas. We heard about Dubuque's drive towards sustainability lead to their efforts for natural gas recovery.

The final technical talk of the morning was from Curt Czarnecik and Melissa Arnot from Kenosha Water Utility about their new thermo-chemical hydrolysis process (PONDUS). Their biogas production has increased approximately 20% and they produce a cake solids of 32% total solids. The process also substantially reduces dynamic viscosity of sludge.

The final session of the morning was a fascinating round table discussion on biosolids residual programs from John Murray (Metropolitan Water Reclamation District of Greater Chicago), Matthew Magruder (Milwaukee Metropolitan Sewerage District), and Larry Rogacki (Metropolitan Council Environmental

Services). In addition to providing overviews of their programs they highlighted how they have been able to leverage collaborations with universities to fund graduate students and investigate real problems while getting deep on applied researching and leverage collaborations with industries through organizations such as the Water Equipment & Policy Center (an NSF Industry/University Cooperative Research Center). They each took the final moments to share their advice for young professionals, including to 'behold open doors', 'don't underestimate opportunities', and noting that jobs in our field are dynamic jobs that include science, math, physics, biology, economics, and policy, it's a great field.

Kicking off the afternoon Matt Higgins gave a mechanistic talk about dewaterability in anaerobic digestion sludge. Matt is best known for his pioneering work on the divalent cation theory related to dewaterability. His previous

paper indicated that, as the ratio of divalent to monovalent cations decreases, dewaterability gets worse. At this year's education seminar he revealed that this theory only applies to activated sludge and is not applicable for anaerobically digested sludge. He addressed dewaterability issues related to biosolids from bioP processes and engaged in a riveting 20 minute Q&A session on biosolids dewaterability.

The next talk was given by Dr. Leon Downing on his work in collaboration with Microbe Detectives. This work highlights how far the science has come in being able to detect and analyze the microbial community in our wastewater treatment processes. At this point we are able to detect what microbes are present after sample processing. The hope for the future is that we will someday know how our operational parameters affect the microbial community and get quick feedback from both functional parameters such as methane production as well as on which microbes are in a reactor.

Chris Hornback from NACWA provided insights into the intricacies surrounding regulations of byproducts, particularly around struvite. The current regulations do not address how valuable products recovered from wastewater treatment processes should be handled. The new administration had adopted a model of cooperative federalism and are moving toward regulatory reform. Biosolids management may see some pressure from budget cuts, the biennial Clean Water Act review, and sensitivity to new contaminants such as PFAS.

Finally, Christine Radke (Water Research Foundation) provided a great overview about all of the ways utilities, consultants, and academics can get involved with WRF to leverage funds and knowledge. WRF has a variety of relevant programs focused on energy and product recovery. They are hoping to increase the LIFT program to move innovation into practice at utilities. WRF is very excited about their merger with the Water Environment Research Foundation.

The seminar is available as a webinar and can be purchased through the CSWEA website if anyone is interested in hearing any of the presentations. We very much look forward to an exciting 2019 Education Seminar! Mark your calendars for April 10, 2019. [CS](#)



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Memories of Jim Miller

By Rick Ashling & Peter Daniels

Jim Miller began his career in the wastewater industry when he was 16, as a high school student in St. Claire, Minnesota. His career started as the assistant operator of the St. Claire wastewater treatment facility. 46 years later, he was still in the wastewater industry, and still had the smile and enthusiasm of a high schooler.

During that 46 years, Jim touched a lot of lives. Many of us know his impacts and contributions to the wastewater industry, and many of us have memories of Jim that have nothing to do with wastewater. Jim was always eager to share photos of his children and grandchildren at birthday parties or fishing trips. He and Brenda were regulars at the NHRA drag races in Las Vegas (he'll be missed at the Stratosphere, their preferred Las Vegas hotel). He could be relied upon to provide movie reviews most Monday's; he loved seeing matinees with family members. He was a concert junkie, avid rock collector (in Minnesota and Vegas), a hockey fan, and outdoorsman. His camper in Isle provided weekends of joy with family and friends on 4-wheeler and fishing trips.

Jim loved getting to know people and share his passion for his interests, especially the wastewater industry. You could count on Jim to pull groups of wastewater operators together to join him on his adventures. Sharing his love for the outdoors with others was a passion of Jim's.

Jim has been an active member of CSWEA, Minnesota Wastewater

Operators Association (MWOA), and the Wisconsin Wastewater Operators Association (WWOA) for years. He has made significant contributions to the wastewater industry during his career. On the technical side he gave countless presentations, has written technical papers, and conducted many types of training activities. Administratively, he was most recently the Secretary/Treasurer of MWOA and was involved behind the scenes assisting with the audio/video technology setup at many MWOA events. He has also served as President of CSWEA and the President of MWOA.

Jim was held in high respect by all professionals in the wastewater industry. He was always willing to help at a moment's notice, whether it was to mentor a young operator or engineer, or to give advice to a seasoned operator or lab technician. Jim always held in high esteem every operator, lab technician, collection systems operator, engineer, and maintenance personnel in his 46 years in the industry. He always encouraged people to become a professional member and join CSWEA, MWOA, or WWOA.

Jim was a pro when it came to teaching operators. He spent over 20 years coaching Operations Challenge teams at WEFTEC. He was one of two people to participate in each of the first 30 Operations Challenge events through last year and was recognized in WEF's Water Environment & Technology publication last year. He worked many long

When I moved to Minnesota in 1987 I did not know anyone in the state. The Innovative Approaches to Wastewater was the first conference I attended. Jim Miller came up to me, introduced himself and said "you must be the new kid on the block". He then proceeded to introduce me to his colleagues and saved a place for me at lunch.. I have always appreciated that show of kindness. Jim was first and foremost a devoted family man and we will remember the stories he told of his wife, kids and then grandkids, and while leading a very full and busy life always made time to lend a hand wherever it was needed. We will miss him for a long time.

Pat Oates

hours preparing for the training sessions that were held twice a year before the Operation Challenge event. He was so proud of his team's performance every year. He would provide frequent text message updates from WEFTEC to people back in Minnesota that weren't able to attend and watch. He was so proud of his CSWEA teammates that trained as a team only twice per year, compared to the other teams at WEFTEC that all came from a single sewer district and worked together every day.

Jim was proud of his industry and what it means to each of our communities. He enjoyed educating mayors, city council members, and employees at industrial facilities about what happens at the City's wastewater treatment plant. And he was so good at it! He excelled at connecting with people of all backgrounds and getting interested in wastewater, at least for a few minutes.

Jim will be greatly missed by all of his professional friends and co-workers in the wastewater field. He touched many people throughout his career and will always be remembered. [CS](#)

Jim deeply cared about the people that do these jobs. He introduced himself at my very first Minnesota Wastewater Operators Association meeting in the very early '90s and I have been friends with him since that time. When I spoke with him just a few weeks before his passing at a training session, we covered Jim's favorite subject, the "people" in our industry. The operators of the towns and cities, the vendors, the consultants, all the folks that we both interacted with, every day. The conversation would always lead back to one place. He always wanted to know how we could better prepare operators for what they were facing in a ever-changing and challenging job. He truly cared about the people, and his commitment to us blazed a trail. It's up to all of us to step up and carry on with what Jim selflessly championed for so many years...

Kelley Jones



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A Simple and Energy Efficient Approach to Cleaning Biogas

Authors: Sid Arora¹, Lindsey Busch², Sean Snyder³, Rudy Kilian²

¹ Milwaukee Metropolitan Sewerage District

² Carollo Engineers, Inc.

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ABSTRACT

One of the leading challenges to the beneficial reuse of natural biogas has always been the contaminants it carries along with it- hydrogen sulfide, carbon dioxide, and siloxanes. Newer air quality regulations and more efficient combustion processes have required that the gas produced from anaerobic digestion be cleaned before it is used in downstream equipment. Traditionally, this has been accomplished using activated carbon or iron oxide in Iron Sponge scrubbers; which rely on adsorption or reaction of the sulfide with iron oxide impregnated wood chips.

The biggest difference in our wastewater industry, compared to others that deal with cleaning biogas, is our steady supply and access to water, typically pressurized from the plant water systems. This pressurized water is being used as part of a new and simple technology for cleaning biogas. Using the water, a vacuum is generated using a Venturi that draws the raw biogas into the system, eliminating the need for pressurized gas typically required in conventional water scrubbers. The carbon dioxide and hydrogen sulfide preferentially dissolve into the water leaving behind the methane in the biogas. The gas/water mixture is then separated in a gas separator, and the cleaned gas is collected at the top in the gas separating valve.

The biogas scrubber technology was piloted at Milwaukee Metropolitan Sewerage District's (MMSD) South Shore Water Reclamation Facility (SS WRF) located in Oak Creek, Wisconsin. A pilot unit was set up in the Digester gallery of SS WRF. A small stream of raw biogas, produced in Digester 10, was fed to the pilot unit, and the treated gas leaving the unit was returned to the plant's biogas pipeline. Grab samples of biogas going in and out of the pilot unit were collected and tested for methane and carbon dioxide, total sulphur compounds, and siloxanes. The results showed close to 100% removal of hydrogen sulfide, about 30% increase in methane accompanied by about an 80% decrease in carbon dioxide, and around 65% removal of siloxanes as an added benefit.

INTRODUCTION

The Milwaukee Metropolitan Sewerage District (MMSD) owns the South Shore Water Reclamation Facility (South Shore) located in Oak Creek, Wisconsin. South Shore is a conventional activated sludge treatment plant with a treatment capacity of 300 MGD and an average daily flow of 90 MGD. South Shore has an average plant electricity load of 4.5 MW. South Shore has six active anaerobic digesters with a total effective volume of 15 MG, and produces 1.3 million cubic feet of digester gas (biogas) per day. South Shore has fueled engine-driven blowers and engine generators with biogas since the facility began secondary treatment in the 1970s.

The engine-driven blowers were decommissioned and replaced with electric-motor driven blowers. Concurrent with the replacement of the blowers, four 0.9 MW Caterpillar (CAT) engine generators were commissioned in 2009-2010 to make use of the biogas that was no longer used for the blower operation. A 1.5 MW White-Superior (WS) engine-generator operating on biogas was installed in 2000 and was recently

returned to service after undergoing a major rebuild. The engines and boilers form a combined heat and power (CHP) system that generates electricity and provides heat for the anaerobic digestion process and heat for plant buildings as shown in Figure 1.

The engines and boilers can be fueled with biogas or natural gas. Biogas contains methane which provides the fuel value. Being a byproduct of the water reclamation process, biogas is a source of renewable energy. MMSD has a goal of producing 80% of their energy needs with internal renewable sources. Utilizing biogas effectively will be important to meet the renewable energy goal. The biogas was found to contain levels of siloxane (man-made organic compounds that are used in various industries including cosmetics and coatings) that exceed the engine manufacturer's recommendations. In 2015, the concentration of siloxane was highly variable and extreme spikes for siloxanes were recorded. Damage to the engines was discovered, consistent with elevated siloxanes (increased rate

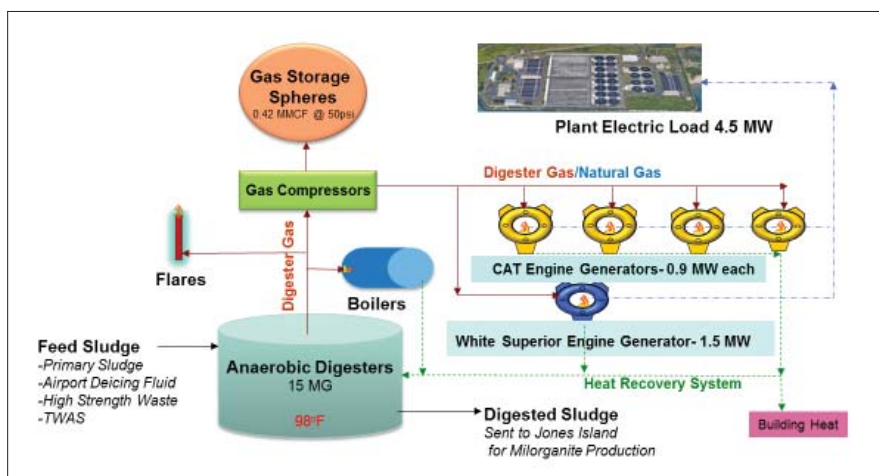


Figure 1: South Shore Digester Gas Production and Utilization

Information Item	Unit	Average	Maximum	Notes
Quantity of biogas available to be treated	SCFD	1,320,000	2,120,000	
Gas Quality:				
Methane	%	59	63	
Low Heat Value	BTU-LHV/SCF	530	565	
Carbon Dioxide	%	33.2	38	
Hydrogen Sulfide (ppm):	ppmv	21.7	34.9	Iron added to primary influent
Total Siloxanes	mgSi/Nm ³ CH ₄	22.16	320	Concentration Si in methane fraction
Total Siloxanes	mgSi/Nm ₃	13.28	202	Concentration in biogas
Notes:				
¹ Based on 2014-2016 data.				

Table 1: MMSD Plant Data(1)

of valve recession, potential cylinder scoring, and piston wear leading to more frequent and more extensive maintenance of the engines). Other corrective maintenance required is consistent with corrosive conditions caused by moisture in the biogas combined with hydrogen sulfide (H₂S), another contaminant recorded in biogas composition. Reducing the moisture content of the gas while maintaining low H₂S will prevent corrosive conditions. Accordingly, MMSD has looked into several biogas treatment options.

Biogas Collection

The biogas is collected in a gas dome on top of each anaerobic digester. The gas dome houses vertical gas collection pipes that are installed several feet above the high water elevation in each digester, to prevent foam and sludge from entering the gas piping. Gas pipes from the individual digesters are connected to a common biogas collection header. The gas collection system normally operates between 7 and 10 inches of water column (wc) pressure. Biogas from the low pressure side is sent to gas compressors and utilized in the engine generators. The excess gas is stored in the two gas spheres. Each sphere can hold 253,000 standard cubic feet (scf) of gas at 45 psig. Gas pressure in the Low pressure side is maintained by diverting gas to a flare when the biogas collection header pressure exceeds 12-in wc.

Overview of Gas Quality and Concerns

The biogas flow and the gas used by each engine-generator are recorded continuously. Methane and carbon dioxide

content of the biogas is analyzed weekly, while H₂S is analyzed monthly. The biogas was analyzed for siloxanes beginning in 2015. Table 1 shows the measured gas characteristics and contaminant concentrations from 2014 to 2016. The biogas methane concentration has been consistently averaging about 59%, indicating the gas has significant energy value and is suitable as an engine fuel.

The biogas at South Shore is minimally treated for use in the engines and boilers. Water is removed at ambient temperature through condensate traps and coalescing filters. Gas is re-heated just ahead of each engine to create separation from dew point to reduce further condensation.

The CAT engine generators have shown silica deposits on the valve and cylinder heads and an increased amount of silica measured in the engine oil. The silica levels in the oil and the occurrence of deposits can be correlated with the concentration of siloxanes in the biogas. Siloxanes are volatile and readily vaporize from the sludge to the gas phase during the anaerobic digestion process. Combustion of siloxanes in the engines deposits abrasive silica and causes an increased rate of valve recession, potential cylinder scoring, and piston wear leading to more frequent and more extensive maintenance of the engines. Combustion of siloxane in the boilers leads to accumulation of silica on the fire tubes resulting in loss of heat transfer efficiency.

Moisture and H₂S are of concern because of their corrosive effects in the gas piping and engine fuel trains, including the turbochargers and the engine exhaust systems. Biogas is considered to be saturated with moisture. The combina-

tion of liquid water condensing from the gas with H₂S creates sulfuric acid which enhances corrosiveness of the biogas.

The contaminants in the biogas increase maintenance costs and may ultimately reduce the life of the engines. Of equal or greater concern than the cost of maintenance is the cost of the downtime for the engine generators in terms of the value of lost energy production.

Table 1 contains general information on MMSD's raw biogas to be treated.

UNISON BIOGAS SCRUBBER PILOT

The Unison Biogas Scrubber takes advantage of the treatment plants' abundant supply of water to provide a convenient and effective method for cleaning biogas. As shown in Figure 2, a simple Venturi is used in combination with a gas/water separator to force contaminants into solution and produce a high-quality biogas. Hydrogen sulfide (H₂S), carbon dioxide (CO₂), and siloxanes can all be reduced or removed by this system, and, due to the relatively low solubility of methane in water, minimal methane is lost during scrubbing.

The Unison Biogas Scrubber was pilot tested for proof-of-concept at MMSD's South Shore Water Reclamation Facility (SS WRF) from November 4, 2016 through December 13, 2016. The results were excellent for removal of the aforementioned contaminants, with potential for significant benefits to MMSD's cogeneration program using internal combustion engines.

Pilot Setup and Sampling

The Unison Biogas Scrubber pilot unit consists of a gas/water contactor with a gas release valve and a Venturi. The scrubber uses the Venturi to pull a

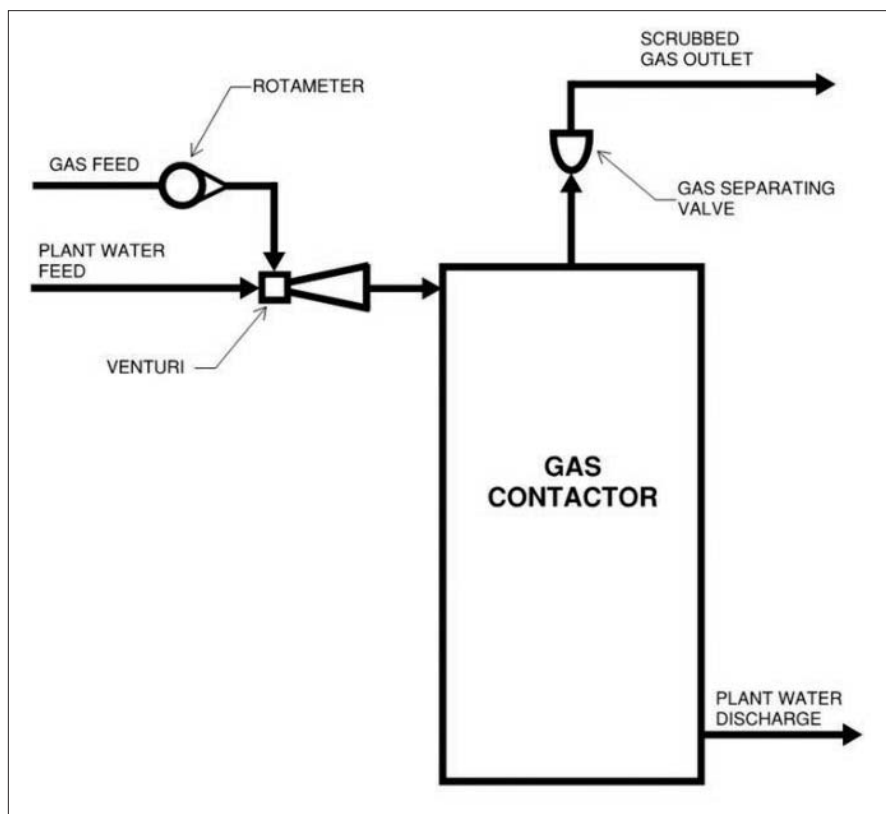


Figure 2: Biogas Scrubber Schematic

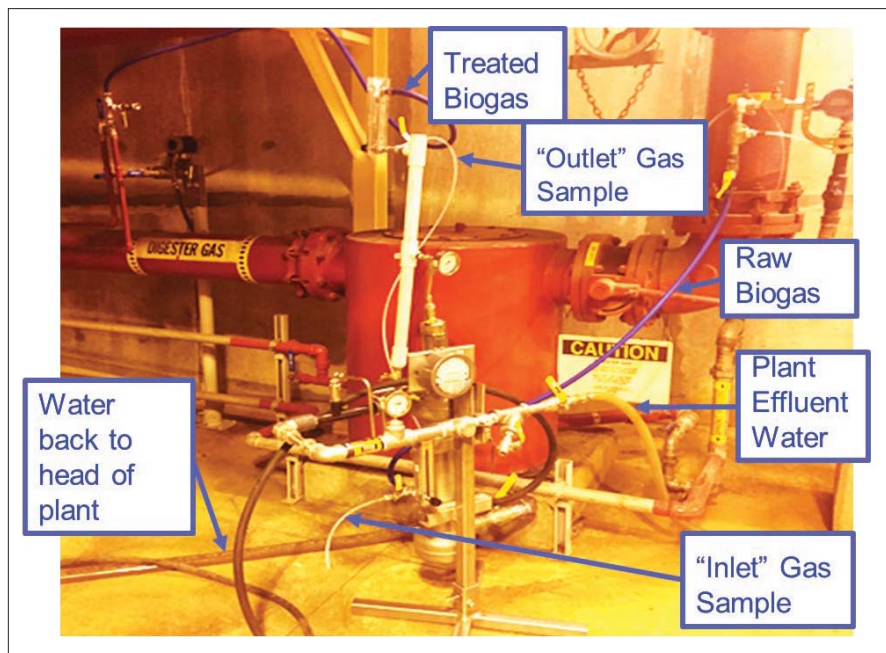


Figure 3: Pilot Setup at MMSD

vacuum and draw biogas into the system. Through pressure and water contact, contaminants that are highly soluble in water leave the biogas with the discharge water stream, and scrubbed biogas is produced with minimal remaining

contaminants. See Figure 3 for a photo of the Unison Biogas Scrubber during pilot testing at MMSD.

The Unison Biogas Scrubber technology proof-of-concept pilot was tested at Milwaukee Metropolitan Sewerage

District's (MMSD) South Shore from November 4 to December 13, 2016.

A pilot unit was set up in the Digester gallery of South Shore. The pilot unit was installed in the low-pressure side of biogas collection system. A small stream of raw biogas produced in Digester 10 was fed to the pilot unit, and the treated gas leaving the unit was returned back to the low-pressure biogas pipeline.

During pilot testing, samples of biogas were taken at the inlet and outlet of the Unison Biogas Scrubber and sent to ALS Environmental in California for analysis. Each sample day, a 6 L Silonite Canister was collected for CO_2 , methane, and H_2S analysis from inlet and one from the outlet gas. AQL Method 111 was used for the sampling of inlet biogas and the outlet gas using a specially prepared sorbent tube.

EPA Method 3C was used for determination of Carbon Dioxide and Methane at the inlet and the outlet samples. ASTM D 5504-12 Method was used for determination of Sulfur Compounds. Siloxanes were analyzed with gas chromatograph equipped with a mass spectrometer.

Pilot Results

The results from this pilot showed that this system not only removes H_2S and CO_2 , but also significantly reduces siloxanes from biogas. It was also discovered that some oxygen contained within the plant water that was used left solution and was added to the scrubbed biogas. It is estimated this contributed to the gap in the mass balance on the outlet gas quality. The average results from the pilot testing are shown below in Table 2.

Process Water

Assuming plant water is to be used for the process, discharge water will be relatively clean with very low biochemical oxygen demand (BOD), and will contain only the additions of sulfides and CO_2 from the scrubbed biogas. Total concentrations will vary depending on the inlet gas quality, but for a full-scale system installed at South Shore, it is estimated that only about 15 pounds of sulfides per day will be added to the total loading of the plant, which represents a small fraction of total sulfides typically found at a wastewater treatment facility. If CO_2 is assumed to stay in solution, this would add approximately 57,000 pounds of CO_2 to the process water per day, but much of the CO_2 is expected to

leave solution as it is released into the biogas scrubber water recirculation tank.

There may be other impacts, such as corrosion or scaling within the system, that are currently unknown.

CONCEPTUAL FULL-SCALE DESIGN

For conceptual design of a full-scale system, the following design criteria were used:

- Design Biogas Flow: 1,804,320 SCFD.
- Total Process Water Flow (without recirculation): 12.2 mgd.
- Biogas Scrubber Inlet Water Pressure: 80 pounds per square inch gauge (psig).
- Biogas Scrubber Treated Gas Discharge Pressure: <1 psig.
- Water Recirculation Pumps (optional):
 - Flow: 3.9 MGD per pump.
 - Horsepower: 200 (hp) per pump.

A conceptual full-scale system sized to treat a maximum of 1,804,320 SCFD of biogas was designed to contain six identical biogas scrubbing modules. These six units are expected to provide sufficient turnaround capability to cover the full range of expected biogas flows.

Controls for this system can vary widely depending on the level of automation desired, but the completed high-level design included automated valves to control biogas flow and VFD's for the water recirculation pumps. Each module and the recirculation system would be controlled at a common system control panel, where all measured parameters are displayed and monitored by the PLC.

It is noted that the scrubbed biogas will impact downstream equipment such as the cogeneration engines. The projected biogas quality could require changes to the current cogeneration engine operation. The higher available British thermal unit (BTU), reduced flow, reduced CO₂, and additional oxygen in the scrubbed biogas likely would require initial adjustments to the engines for proper operation. In addition, periodic changes may be needed. These changes would be minimized if a consistent flow and quality of gas can be provided to the cogeneration engines, but further testing is needed to determine this consistency under actual operating conditions.

Similarly, engine emissions would be expected to vary from current operations, but the raw emissions and emission treatment impacts are unknown and should be determined through additional testing.

Component	Average Inlet Gas Quality ⁽¹⁾	Average Outlet Gas Quality ⁽¹⁾	Average Percent Change
Methane (CH ₄) ⁽²⁾	63%	81%	29% ± 16%
Carbon Dioxide (CO ₂) ⁽²⁾	32%	6.3%	80.3% ± 14%
Hydrogen Sulfide (H ₂ S)	90 ppmV	0.14 ppmV	99.8% ± 0.3%
Siloxanes	2.9 ppmV as Si	0.92 ppmV as Si	65% ± 13.6%

Notes:
¹ Values based on average of samples analyzed from pilot test by ALS Environmental.
² Values reported are percent by volume.

Table 2: MMSD Pilot Results Nov - Dec 2016

NEXT STEPS

Further testing is required on a small scale pilot (larger than the proof-of-concept used in this study) before design of a full scale system can be finalized. Areas that are still in need of testing include outlet water quality, water recirculation, and reduction of entrained oxygen in the inlet process water. A small scale pilot will also provide more accurate flow measurements so that a complete mass balance can be performed. Results of this testing will dictate what level of treatment will be required for water being processed by the system, total new water required and what quantities can be recirculated, and what (if any) additional treatment would be required downstream.

Gas tests have shown that certain species of siloxanes are removed at higher rates with the Unison Biogas Scrubber. In addition to the testing described above,

conducting additional siloxane testing on various biogas sources will allow for better forecasting for siloxane removal performance on full scale systems moving forward.

CONCLUSIONS

Overall, the proof of concept testing conducted at MMSD South Shore WRF demonstrated that the Unison Biogas Scrubbing technology is extremely efficient at removing not only the hydrogen sulfide, but provides fairly efficient removal of carbon dioxide as well. It also provides an additional benefit of reducing siloxanes in the product gas stream. While additional testing is still required to optimize the system and demonstrate its full benefits, the preliminary applications of this technology suggest it has a promising future in wastewater treatment resource recovery. [CS](#)

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WISCONSIN CONGRESSIONAL VISITS DURING WATER WEEK



By Brandon Koltz/ Brandon Koltz Water & Environmental Consulting LLC

WEF Water Week Fly-In activities were held April 17 and 18. WEF, in association with American Water Works, Association of Metropolitan Water Agencies, National Association of Clean Water Agencies, the US Water Alliance, WaterReuse, the Water Research Foundation, and the Water and Wastewater Equipment Manufacturers Association annually organize. This combined organizational effort allowed consolidated visits to Capitol Hill. Keith Haas (Racine), David Botts (Janesville), Nancy Quark and Mandie Smith (Green Bay Water), Martye Griffin and Jennifer Sereno (Madison MSD) and Brandon Koltz from the Wisconsin Section visited some or all the Wisconsin Representatives and two Senators. Having individuals from Representative districts helped facilitate meetings with staff or the representative. To the degree we can have individuals from district make visits, it increases interest in the discussion in each office.

Having visited offices for several years, the water infrastructure funding issue was generally well received. We met with staff and in one case Representative Gallagher (from the Green Bay District). They were generally informed and recognized the importance of water and wastewater infrastructure funding to Wisconsin. We thanked them for increasing SRF funding in the recently passed Omnibus budget bill.

The "ask" document jointly prepared by WEF and the affiliated water organizations calls on Congress to:

- Double drinking water and wastewater SRF funding,
- Reauthorize and boost funding for Water Infrastructure Finance and Innovation Act (WIFIA)
- Increase funding for national priorities water research grant program to \$20 million
- Strengthen protection of the nation's waters in the 2018 farm bill
- Increase funding for the USDA rural water/wastewater loan and grant program

- Increase funding for the Bureau of Reclamation's water recycling program to \$60 million

In addition, the WEF Stormwater Institute included informational material, noting that in 1970, 85% of impairments were from industrial and wastewater effluent discharges; by 2010 85% were from urban and agricultural runoff. EPA estimates that \$150 billion is needed for MS4 and CSO investment over the next 20 years. With this information, a further request was made to include stormwater infrastructure in the next congressional needs assessment for water and wastewater.

David Ross/Assistant Administrator Office of Water –

- Aging wastewater infrastructure has \$750 billion need
- Waters of the United States - the 2015 rule has been remanded and is being rewritten; a revised rule is expected to be out for comment late summer 2018
- Nutrient management – one size does not fit all; encourage watershed solutions including trading, encourage ag management practices such as constructed wetlands, keeping nutrients on the farm
- Rulemaking for blending will be examined to bring consistency across EPA regions and clarity to permitting.

Deborah Nagle/ Director Office of Science and Technology

- Aquatic life criteria – nutrient criteria for lakes/reference criteria are undergoing updates. The stream/response method is being re-examined
- Recreational criteria – a mycotoxin/mycrocystis proposal is expected 2nd Quarter this year
- The national nutrient survey is being conducted to examine nutrient removal with secondary treatment; it is still voluntary. The goal is to identify nutrient removal optimization methods.

Andrew Sawyer/Director Office of Wastewater Management

- Lead, CSOs asset management are continuing focus
- WIFIA - The \$25 million appropriation will leverage \$3 billion
- SRF was increased by \$300 million to \$1.7 billion in the recent Omnibus Bill
- The Water Finance Center will lead the update of the affordability discussion (the infamous 2% MHI criteria). In particular, MHI may not reflect affordability for a large number of lower income residents/ratepayers. The financial criteria will be updated from the 1997 Guidance – expect draft guidance in 2019.
- Integrated planning is encouraged – wastewater, water, stormwater.

John Goodin/Office of Wetlands, Oceans and Watersheds

- WOTUS is being jointly re-proposed by EPA & Corps of Engineers – There were 685,000 comments. States, tribes and other stakeholders are weighing in. Expect to finalize applicability 2020
- Nutrient management in watersheds: partnership needed with USDA, identify key vulnerable watersheds and apply techniques on the land for reductions

Congressional Staff also provided updates with respect to committee actions in the Senate and House. Majority and minority views on legislative activities. WRDA and the Farm Bill were the main focus of discussion.

Our congressional Representatives and Senators recognize WEF and Central States for our expertise in water issues in Wisconsin and each year there is greater recognition of the importance of funding for Wisconsin water infrastructure. When new people are elected, there is a new educational process and with changes at EPA, the eventual effect locally can be anticipated.

The WEF Government Affairs Committee provides regular updates through This Week in Washington. Subscribe through the WEF website. [CS](#)

Volunteer Spotlight and GWS Update – Amanda Heller

By Liz Bohne



In the past three years GWS has grown from an idea to a reality, all with the help of Amanda Heller. Amanda served as the first organization Chair, and held that role for 3 years. During that time, a business plan, marketing plan, and multiple committees were established. With her help, GWS has grown to a group with more 100 people interested, a regular corporate sponsors, recognition within CSWEA, and a clear path ahead to move forward with accomplishing our goal of improving sanitation in the developing world. She has helped develop relationships with important members of AyA (the

Costa Rican Water/Wastewater authority) and been an advocate for the education program that now has taught more than 1000 students about wastewater and how they can help. Though her time as chair is over, she is excited to remain involved with the organization and help us to continue to grow and improve. I spoke with her about how she got involved with GWS in the first place, and what she feels like has been the highlight of her time as chair. Read on to learn more...

LIZ: Amanda, you have basically been involved with GWS since the beginning.

Can you tell me a little bit about what motivated you to get involved?

AMANDA: Well.. A free trip to Costa Rica! I'm only half kidding.. it started shortly after graduation. I graduated from MSOE in 2013 with my Bachelor's in Architectural Engineering and my Master's in Environmental Engineering. After graduation I began working for a mechanical contractor. I received an e-mail from Doug Nelson, who was my thesis advisor for my graduate program, that had a flyer from CSWEA attached with information about Global Water Stewardship. They were looking for



AMANDA: After the trip I decided I wanted to stay involved. Mohammed referred me to a few different companies that are actively involved in CSWEA that would support my involvement and I ended up switching careers. I was hired by Baxter and Woodman at the end of 2014. This was a great career move for me as well because it is in line with my interests.

LIZ: Wow, I didn't realize you started at B&W after GWS. So what was your next move with GWS?

AMANDA: The organization was still brand new at this point. We were working on putting together the requirements for the student design competition, and getting more schools involved. We were also trying to get more people involved in general. After the first design competition we began working on establishing our business plan with long-term and short-term goals. Another important aspect of the organization that we started around that time was the education campaign. We realized on the trips that we needed both the school children and the communities to support our efforts and understand how and why these projects were being completed. I helped develop presentations for children and community members that we gave on the August 2015 trip, and have improved and continued to present every August to more schools and communities. We also began developing relationships in Costa Rica with officials who were interested in our mission and had the power and funding available to help realize our goals. We partnered with an engineering firm in Costa Rica to help us develop plans to their specific standards and regulations.

LIZ: Sounds like the first few years there was a lot of behind the scenes work being done. What do you feel is your greatest impact over the past 3 years?

AMANDA: Hmm.. that is tough. I think one of my biggest impacts was the organization I brought to the table. I helped keep everything in order and make sure that everything that we said we were going to do got done. Another big impact I think I had was growth. I worked very hard to grow the organization. We went from 4 people after the first trip to over 100 that are interested. I'm very proud

applications from people to come on a free trip to Costa Rica to help collect data for the first GWS student design competition. I had participated in the CSWEA student design competition before the GWS category had been established but I thought it would be great to be on the other side of that, especially if it meant I could go to Costa Rica. I still had my CSWEA membership since I had previously taken part in the competition, so I applied. It turns out I was actually the second choice! I only

was selected because their first choice declined... I'd like to think Mohammed (Haque) and Manuel (de los Santos) were happy to be stuck with me in the end.

LIZ: I am definitely glad they got stuck with you! That's a great story to look back on. I am sure you never imagined that you would become a leader in the organization at that point. What did you do to remain involved when you got back from your trip?

of that. Another thing I am proud of is what we have done with our education program. It's been great working with the kids and helping them to realize that they have an opportunity to help. I think the biggest impact GWS as an organization has had is the work done with AyA. The Costa Rican government was previously developing Wastewater Master Plan for the country and I think the work we are doing has really helped to move that along. It was approved in 2015 and we are partnered with them to help them realize the goals in the Master Plan by 2045.

LIZ: What do you hope to see the organization accomplish in the next 5 years?

AMANDA: I would like a regular operator training schedule like what we are planning for the August trip. I also hope the organization will get more involved the technical side of things and used as a resource to answer operator questions. I would like to see a project break ground. It has been tough for us to get this far without a project in the ground but we are learning that things work very different in Costa Rica than they do here. We also are learning the ways around a new country, but we have developed the relationships we need at this point to start seeing great progress. I also hope our education program continues to grow. I would love to work in more high schools with students who are trying to make decisions about college and careers. Another goal I have to is maybe to start some conversations in Dominican Republic. That is the next target area for GWS so I'm hoping within 5 years we will be big enough and have the resources to start making that move. If the past 5 years momentum continues, I believe it's possible.

LIZ: Has GWS helped you professionally at all?

AMANDA: Definitely. I think it has helped my management skills, my ability to balance a lot of things at once and has helped me to be better at making sure things get done right and on time. It also has changed my perspective, so I can see the broad picture better, as well as the small steps to get there.

LIZ: What is your favorite part of being involved with GWS?

AMANDA: I really feel like I can make an impact and improve lives. This is



beyond just meeting a stricter permit limit. It is the difference between cloudy grey water in the streets and clean streets with happy healthy residents. It helps remind me how important the work I am doing here is as well and makes me really appreciate the infrastructure we have here.

LIZ: Thanks so much Amanda! I look forward to working with you in the coming years to make our goals a reality.

GWS had a quarterly board meeting at the 2018 CSWEA Annual Meeting. At this meeting, our new chairs were announced for 2018-2019. Many people maintained their positions, while a few new faces joined us. The 2018-2019 committee chairs are:

- Past Chair : Amanda Heller*
- GWS Chair: Maureen Durkin*
- Vice Chair: Tim Bronn*
- 2nd Vice Chair: Liz Bohne*
- Treasurer: Matt Streicher - Chair



- Fundraising: Rich Hussey – Chair
- Marketing/Social Media:
 - Matt Castillo – Social Media Chair
 - Liz Bohne – Marketing Chair
- Student Design Competition: Zack Wallin - Chair
- QA/QC: Jennifer Svennes – Chair*
- R&D: Elizabeth Brown – Chair*

*New position

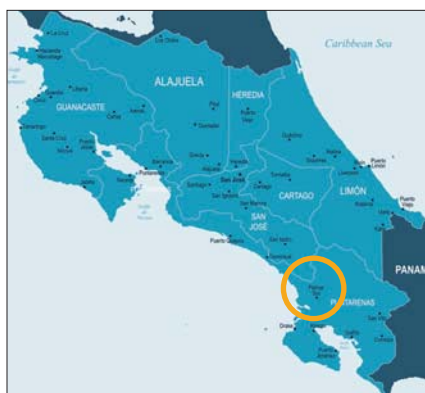
We would like to welcome our new organization chair, Maureen Durkin! Maureen Durkin is a Managing Civil Engineer at the Metropolitan Water Reclamation District of Greater Chicago. She has been an active member of Global Water Stewardship since 2015. Maureen helped to develop GWS' business plan as part of the McCloskey Business Plan Competition sponsored by the University of Notre Dame. She also played a key role in writing GWS' articles of incorporation and bylaws and helped complete the process obtaining tax exempt status. A member of WEF and of IWEA, Maureen and looks forward to helping GWS to continue its work and we are thrilled to have her!

The organization has big goals for this year. We are shifting our focus to include more operator training and involvement. We are working with AyA to plan our first operator training seminar which will take place in San Jose in August. At this seminar we will work with members of AyA and local water utilities to teach them the basics required to own and operate a wastewater treatment facility. We are using the training resources provided by Michigan WEA that will be translated to Spanish. The presentations that were selected by AyA were: Propósito y fundamentos del tratamiento de aguas residuales (Fundamentals of WWT), Fundamentos de Sistemas de Recolección (Fundamentals of Collection Systems), Fundamentos del lodo activado I (Fundamentals of Activated Sludge), Fundamentos de las prácticas de mantenimiento I (Maintenance Practices). We are hoping that this training session is a big step in preparing the country and communities for the responsibilities associated with wastewater treatment.



We also have updated our business plan to reflect what we have accomplished in the past 5 years and include our new goals. We hope our updated business plan will make us competitive for larger grant funding that will be needed to meet our goals.

We are always looking for more volunteers! As you can see, we have a TON going on right now. If you are interested in getting involved please contact Maureen at chair@globalwaterstewardship.org! [CS](#)



Global Water Stewardship - Palmar Sur, Costa Rica

By Elizabeth Ebert, Joseph Lapastora, Erik Papenfus, and Jessica Zemen

ON APRIL 9, four students from the University of Wisconsin-Platteville competed and won the CSWEA Student Design Competition at the Monona Terrace Convention Center in Madison, WI. The objective of the competition was to design and present a collection system and treatment facility for Palmar Sur, Costa Rica. The team consisted of Elizabeth Ebert, Joseph Lapastora, Erik Papenfus and Jessica Zemen, all senior level environmental engineering students. Michael Penn and Austin Polebitski served as the University of Wisconsin-Platteville engineer advisors for the project, while Mohammed Haque and Zachary Wallin served as the CSWEA engineer advisors for the project.



Pictured left to right: Jessica Zemen, Joe Lapastora, Erik Papenfus, and Liz Ebert.

Concern

Palmar Sur is a rural community in Costa Rica looking for a permanent solution to their sanitation problem. Palmar Sur's current collection and treatment system of septic tanks to leach fields does not adequately treat their wastewater. A sanitary collection and treatment system is needed for each neighborhood in Palmar Sur including: San Marcos, El Hangar, and

Zona Americana (Figure 1). The current population of these neighborhoods is 1,985 people total, with an expected growth rate of 50 people per year. An additional community, Once de Abril, will be considered for future expansion of the system with a current population of 500 people and an expected growth rate of 15 people per year. Palmar Sur desires a low maintenance, aesthetically pleasing, and natural process such as a constructed wetland or lagoon. The location of the treatment facility needs to be adequately sized for anticipated flow, future growth, and infiltration and inflow (I/I) based on an annual precipitation of 3,900 mm/yr. This design competition is sponsored by Central States Water Environment Association and Global Water Stewardship. This provides university students a chance to design a wastewater treatment system which will be brought to the host country for implementation with the help of local engineers.

Objective

The goal of this project was to design a collection system and treatment facility for anticipated flows due to future growth, and to treat to a level of 50 mg/L biochemical oxygen demand (BOD) and 50 mg/L total suspended solids (TSS) as determined by the Global Water Stewardship.

Constraints

Issues of concern for this project are centered on operations and maintenance, location, and cost. The design for the treatment facility will require minimal operations and maintenance since there is little to no training about wastewater management for an operator. Additionally, Palmar Sur receives above normal precipitation compared to the United States, which can

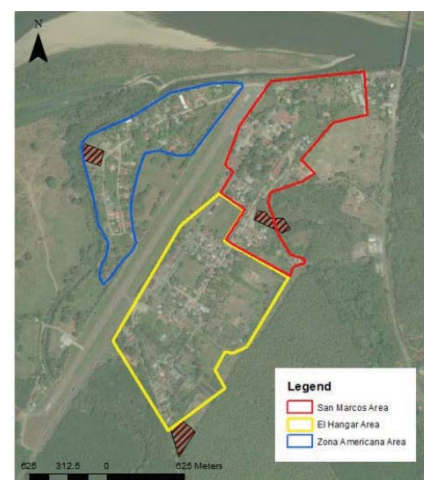


Figure 1. Areal Map of Palmar Sur Site Locations

lead to a risk of flooding. The site(s) used for the construction of the treatment facility will have to be located on high grounds to avoid flooding. Additionally, native soils are not conducive to treatment and the area has a high groundwater table of 2.5 to 5 meters deep. The final treatment system must also take into account the location of the buffer zones surrounding the drinking water wells for the community (Figure 2).

If the buffer zones were to intersect the site chosen, extra safety precautions will need to be taken into account to protect Palmar Sur's drinking water. The overall cost for this project must have a low capital and operations and maintenance cost of no more than \$8.80 per month (5,000 colones) due to the socioeconomic status of the community.

Site Locations

The Palmar Sur community is physically divided by an airport runway, with the neighborhoods of Zona Americana on the

northwest and San Marcos, El Hangar, and the community of Once de Abril on the southeast (Figure 1). The community is surrounded by plantations, estuaries, mangroves, and marshes. The community is primarily composed of residential areas, and have no plans of future industrial or commercial inputs. For the treatment site location, Palmar Sur has two publicly owned sites, with an additional privately owned site which may be available for purchase. Site 1 is located in Zona Americana and is owned by Palmar Sur ASADA, a public utility. According to the Global Water Stewardship, this site is near Zona Americana's disposal site, and is out of any protected wetland zones. After further

research using Plan Regulador Cantonal, the entire area west of the highway is considered a protected wetland zone. Site 2, located in San Marcos, and is also owned by Palmar Sur ASADA. Site 3 is located in El Hangar and is privately owned with the cost of the land unknown. This site appears to be outside of any protected wetland zones, but the acquisition of the land is uncertain at this time. The fault line that is located under the community of Palmar Sur was also taken into account when selecting the location of each treatment site(s). Both of the sites owned by Palmar Sur ASADA will be utilized in the final design, ensuring the airport runway will not be disturbed.

Evaluation of Design Flowrates

The residential flowrates were calculated for start-up and design based on the population projections and current water usage of Palmar Sur. The community has an estimated water usage of 200 L/capita/day (Lpcd), based on information provided by the Global Water Stewardship Problem Statement. The flowrate was separated into the three main neighborhoods, flowing to their corresponding treatment sites. The flows from Zona Americana will be treated at the Zona Americana site while flows for San Marcos and El Hangar will be treated at the San Marcos site.

Inflow and infiltration (I/I) are design considerations in which stormwater and groundwater can enter a sanitary collection sewer system. I/I was considered in the design due to minimal maintenance on the existing infrastructure, seismic activity and the above average rainfall. In addition, the groundwater table is relatively high with a depth of 2.5 to 5 meters below ground surface. With I/I included in the flow, treatment can be affected by changing the detention times in each treatment system and the dilution of BOD and TSS concentrations.

The design flows entering the sanitary collection and treatment system are based on residential flows as well as the I/I rates. Each system was designed to meet the BOD and TSS effluent limits. Three scenarios were selected for analysis. The three scenarios that were analyzed include start-up dry weather, design wet weather and neglecting I/I at design life. Table 1 and Table 2 provide the design flows for each system.

Process Selection

Two decision matrices were created to analyze the different treatment options for each site based on considerations from GWS and the team. The design options for the first matrix were determined by the various treatment options typical to decentralized communities. The factors taken into account included: initial cost, operations and maintenance, footprint, effectiveness, constructability, operability, aesthetics, odor, and redundancy. The treatment options analyzed include: free water surface (FWS) wetlands, subsurface flow (SF) wetlands, aerated lagoon, aerobic lagoon, anaerobic lagoon, and sequence batch reactor (SBR).

A second decision matrix was utilized to analyze the different types of treatment systems. This decision matrix was used to make the final decision for a treatment system for each site. Based on the weightings, the highest scores were assigned to aerobic lagoon to FWS wetland and aerated lagoon to

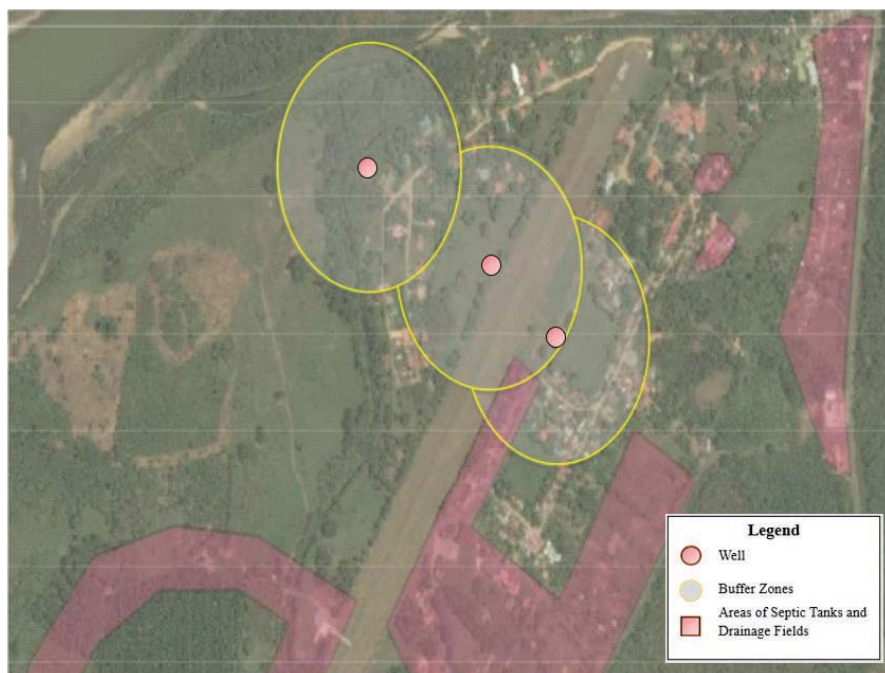


Figure 2. Buffer Zones in Palmar Sur

San Marcos and El Hangar (m ³ /day)				
	Start-up (2018)		Design (2038)	
	Dry	Wet	Dry	Wet
Residential Flow	325	325	495	495
Design Flow	785	870	1190	1375

Table 1. Zona Americana Flow Projections

Zona Americana (m ³ /day)				
	Start-up (2018)		Design (2038)	
	Dry	Wet	Dry	Wet
Residential Flow	75	75	115	115
Design Flow	180	215	280	350

Table 2. San Marcos and El Hangar Flow Projections

settling lagoon. An anaerobic lagoon was not a viable alternative due to the odor concern and SBR was not considered due to high capital cost and requirement of full-time operator.

Proposed Treatment Design for Zona Americana Site

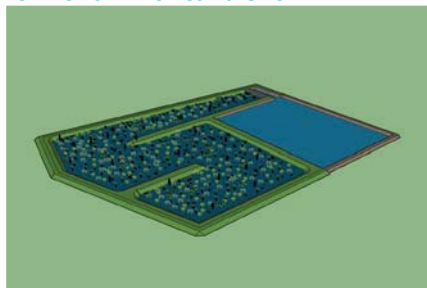


Figure 3: Proposed Treatment Site for Zona Americana Site

The first treatment site considered was the Zona Americana site (Figure 3). A new sanitary collection system was proposed to replace the existing sewer pipes due to their poor condition. The community preferred a wetland for a natural looking and aesthetically pleasing treatment system. A single constructed wetland was considered for the Zona Americana site. However, the required effluent levels could not be met with a constructed wetland as the only process due to land area requirement. Aerobic and anaerobic lagoons were considered for treatment, with the aerobic lagoon ultimately being selected over the anaerobic lagoon due to odor concerns. Since the treatment site is located in the middle of the Zona Americana community, the client expressed some concern with the suggestion of an anaerobic lagoon. Considering the client's concern, the proposed treatment system for the Zona Americana site is an aerobic lagoon where the water will then flow through a rock filter before entering the last process which is an FWS constructed wetland. The FWS wetland will act as a plug flow reactor as the wastewater flows through the wetland before exiting to the effluent pipe. The reductions for BOD and TSS are shown in Figure 4 and 5. Both figure mimic the treatment system at the Zona Americana treatment site. The treated wastewater will then be gravity fed to the storm water canal where the water will flow south of the community, and more importantly, outside of the drinking water well buffer zone. This treatment design coincides with the high-

est rated system considered in the system design matrix.

For the design of the aerobic lagoon, assumptions were made for wind speeds, detention time, depth, and typical reductions for BOD and TSS. Wind speeds are an important consideration of an aerobic lagoon as higher wind speeds are required to overturn and completely mix the lagoon. Additionally, in order to degrade organics effectively, sunlight exposure is also required.

Typical detention times are around 5 days and typical depths can range from 0.3 meters to 0.6 meters (Crites, 1998). For the proposed aerobic lagoon at the Zona Americana site, a depth of 0.6 meters was chosen while the dimensions for the lagoon are 24 meters by 48 meters. Surface area for this lagoon was 1,200 m² and the volume dimension

was 700 m³. The wastewater will have a detention time ranging from 2 to 7 days depending on the influent flow. Typical reductions of TSS range from 35% to 45% from Small and Decentralized Wastewater Management Systems. To ensure the design accounted for periods of no I/I and thus high concentrations of BOD and TSS with low wastewater flows, a conservative value of 40% reduction for TSS was chosen.

After the aerobic lagoon, the water passes through a rock filter in the form of a gabion basket that is fixed on top of an overflow weir. The canal is 0.2 meters deep which allows larger suspended solids to settle out in the aerobic lagoon. The rock filter was placed at water level to minimize suspended solids within the water passing through the rock filter. The concrete overflow weir will match the depth of the aerobic lagoon at 0.6 m so that the

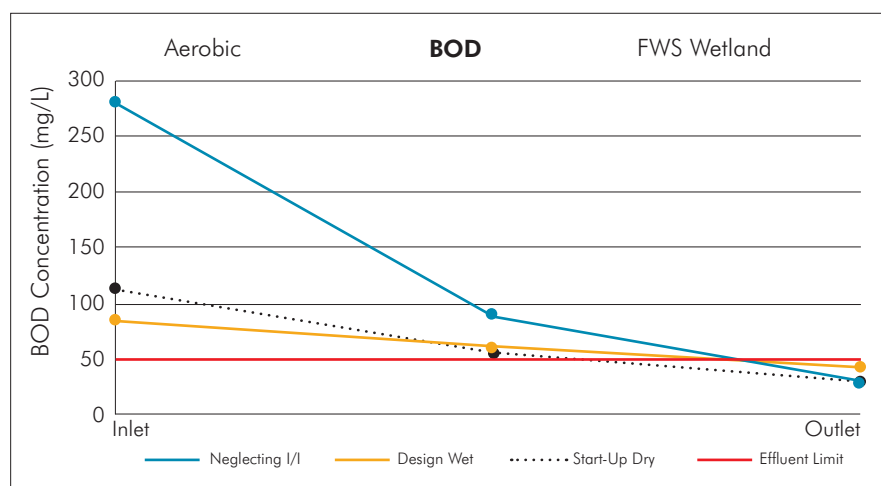


Figure 4. Zona Americana BOD Reductions

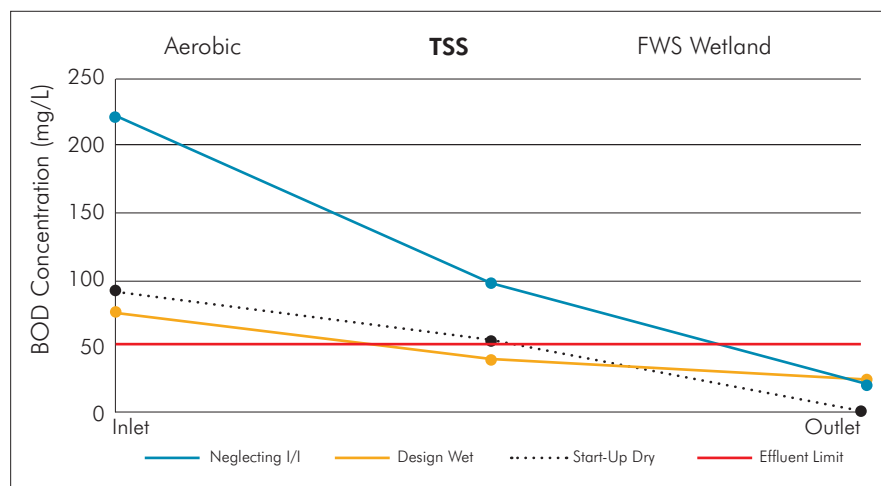


Figure 5. Zona Americana TSS Reductions

structure will not allow any water to bypass the filter. The water is then forced over the weir where algae will be removed by the rock filter, before entering the FWS wetland.

An FWS wetland was chosen over an SF wetland in order to minimize the operations and maintenance cost. Assumptions for this wetland came from by the EPA's Constructed Wetlands Treatment of Municipal Wastewaters for depth, detention times, areal loading rates (ALR), and typical reductions for BOD and TSS. Depth requirements are between 0.6 to 1.25 meters. The dimensions for the FWS wetland are as follow: depth was 0.7 meters, surface area was 2,500 m², and volume was 1,725 m³. The wastewater will have a detention time ranging from 5 to 20 days depending on the influent flow into the FWS wetland. Areal loading rates were applied to each flow scenario to determine the size of the wetland. For BOD ALR's between 45 and 60 kg/ha-d, there is a 70% reduction. Based on TSS ALR's between 30 and 50 kg/ha-d, an 80% reduction is typical. For the design, a conservative TSS reduction of 75% was assumed.

Proposed Treatment Design for San Marcos Site

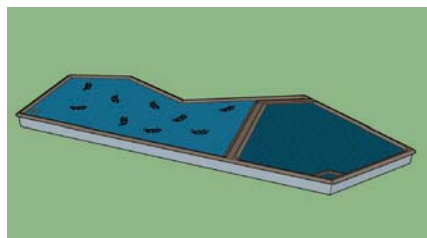


Figure 6. Proposed Treatment Site for San Marcos Site

The second treatment site considered was the San Marcos site (Figure 6). A similar treatment facility design as the Zona Americana site was considered for the San Marcos site, however, the increased flows from the population of San Marcos and El Hangar would not allow for the same design. A new sanitary collection system was proposed to replace the existing sewer pipes and septic system due to their poor condition, as was the case for the Zona Americana site. Ultimately, the proposed system for the San Marcos site includes a partially-mixed aerated lagoon where the water will flow through a rock filter before entering the last process of a settling lagoon. The treated wastewater will then

be gravity fed to the storm water canal to the south where the water will flow south of the community. The wastewater will not be able to infiltrate into the drinking water well buffer zone, as it flows away from the community. This treatment design coincides with the second highest rated system considered in the system design matrix.

Once the wastewater travels through the inlet structure, the wastewater enters the first process of treatment at the San Marcos site. The first treatment process is a partially-mixed aerated (PMA) lagoon. Typical detention times are around 5 to 20 days and typical depths can range from 2 to 6 meters (Crites, 1998). For the proposed PMA lagoon at the San Marcos site, a depth of 4 meters was chosen to ensure the lagoon would not intercept the groundwater table. The dimensions for the PMA Lagoon are as follow: surface area

was 2,765 m², and volume was 10,000 m³. The wastewater will have a hydraulic retention time ranging from 5 to 17 days depending on the influent flows entering the system. This lagoon will be subsurface aerated with a 6-horsepower pump and circular diffuser heads. The pump for the aeration system will be enclosed in a small building located west of the San Marcos treatment site. In a PMA lagoon, typical BOD reductions are 95% however, to ensure the design would operate under the same assumptions in the aerobic lagoon with periods of no I/I or high concentrations of BOD and TSS with low wastewater flows a conservative value of 60% to 85% reduction was utilized. Figure 7, shows the BOD reductions for the entire treatment system at San Marcos. Additionally, PMA lagoons can contribute to a slight reduction in TSS of 50% to 65%. In this proposed design, again

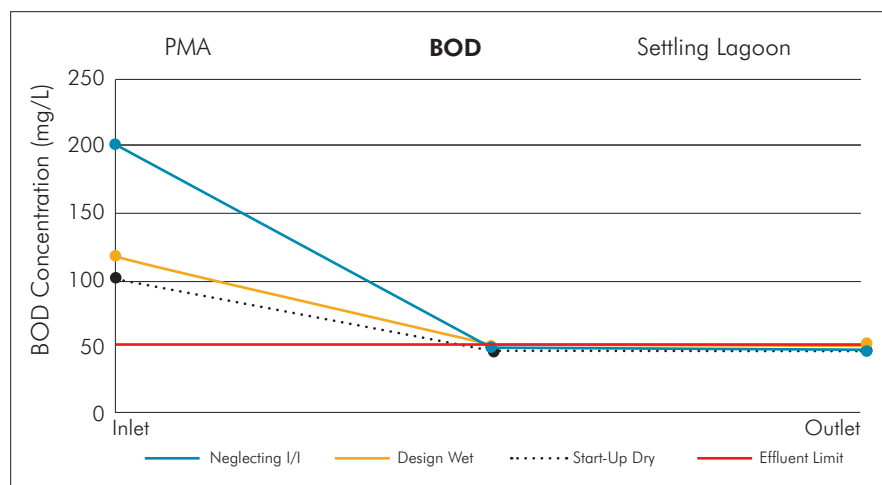


Figure 7. San Marcos BOD Reductions

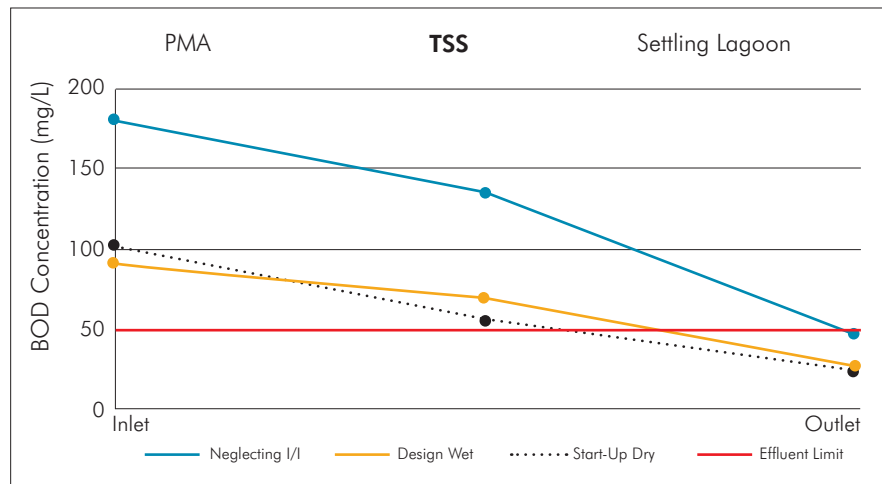


Figure 8. San Marcos TSS Reductions

a conservative value of 25% reduction of TSS was chosen. The majority of TSS will be reduced by a rock filter.

After the PMA lagoon, the water passes through a rock filter that is designed in a similar manner to the rock filter at the Zona Americana site. The water will enter a shallow canal, which is 0.2 meters deep, to allow larger suspended solids to settle out in the PMA lagoon. Algal growth in some form is anticipated in the PMA lagoon due to high detention times. Since the PMA lagoon at the San Marcos site is deeper than the aerobic lagoon at the Zona Americana site, the depth of the concrete overflow is 4 meters deep to match the depth of the lagoon.

The second part of the proposed design at the San Marcos treatment facility is a settling lagoon. The dimensions for the settling lagoon are as follow: depth was 4 meters, surface area was 1,675 m², and volume was 7,600 m³. From the EPA's Stabilization Ponds, FWS Constructed Wetlands, and Other Aquatic Systems, a settling lagoon that follows a PMA has an estimated TSS removal efficiency of 90% to 95% depending on the amount of algal growth in the system. For this design, a conservative value of 60% to 65% TSS removal efficiency was estimated. This reduction was conservative for typical TSS reductions to ensure all scenarios will meet the effluent requirement of 50 mg/L (Figure 8).

Collection System

The sanitary sewer system was designed with consideration to NR 110 and modeled off of the existing system and will be laid

alongside the roadways. NR 110 states that a conventional gravity sewer system may not be less than 20 centimeters (8 inches) in diameter. Updating the pipe diameter will allow for the possibility of toilet paper disposal in the future. El Hangar, which was previously unconnected to the existing sewer system, will be the only neighborhood with an all new sanitary collection system. The sanitary collection system for Zona Americana, San Marcos, and El Hangar was modeled in Bentley SewerCAD. This determined whether the proposed system would be able to handle flow projections and I/I from Palmar Sur. The northwest section is composed of Zona Americana's flows which travel to the Zona Americana treatment site. The southeast section including both San Marcos and El Hangar's flows will be treated at the San Marcos treatment site. The sanitary collection system will be laid in compliance with NR 110, and will consist of PVC sewers, manholes, PVC pressure pipes, wet wells, and pumps.

All NR 110 requirements have been met, with the exception of self-cleansing velocity and pipe depth. For velocity to be considered self-cleansing, a minimum of 0.6 meters per second (m/s) must be reached in the system. However, for the collection system in Palmar Sur (Table 3), the range in velocity is between 0.1-1.3 m/s for all three neighborhoods, thus some pipes will not meet the criteria. In order to account for not meeting self-cleansing velocities, the distance of 120 meters between manholes as stated in NR 110 will be used to allow enough access to the system for periodic flushing. The slopes of

the pipes were not increased to reach self-cleansing velocity to ensure the pipe depths would not be within the groundwater table. If the pipes are located in the groundwater table, more I/I and possible contamination of the community's drinking water source could occur. Additionally, having the wastewater traveling from wet well to wet well to reach the 0.6 m/s velocity in all pipes would be economically and operationally infeasible for a small community to manage. The pipe depth requirement was not met because a frost line will not develop in warm climates.

Wastewater from the sewer mains will travel to a wet well with a submerged pump that allows the water to be pumped up to the treatment site. From the wet well, the wastewater will be pumped to the final elevation of each treatment site. Each neighborhood in Palmar Sur will have one wet well except El Hangar, which will have two. The wet well in both Zona Americana and San Marcos will pump the water to the ground surface at the corresponding treatment site. The wet well in the south section of El Hangar will pump the wastewater to the north wet well which will then be transported by PVC pressure pipe to the San Marcos wet well (Figure 9). The main reasons for having two lift stations in El Hangar was to decrease the depth, which would allow the wells to not be located in the groundwater, and to save on excavation costs.

There will be three wet well pumps utilized for this design. The corresponding flowrate, head and pump cycle of each pump utilized can be found in Table 4. The pumps used for the proposed design are provided by JKA Pump, a Costa Rican pump supplier. Zona Americana and the south section of El Hangar will use the same pump, even though the pump is oversized for Zona Americana. This will reduce the types of pumps utilized in the final design. There will also be a backup generator located by each wet well to ensure the pumps will still be able to operate during power outages.

Construction

The proposed sanitary collection system will replace the current collection system within Palmar Sur. The sanitary collection system will be excavated with a small backhoe according to the Proposed Sewer Layout (Figure 9). The bottom of the trench should be lined with 6 inches of crushed stone, and backfilled with Class I, II, III, or IV soil as described in ASTM D2321-09 for

Sewer System Location	Manhole Spacing (m)	Conduit Length (m)	Velocity (m/s)	Slope (%)	Cover (m)
Zona Americana	45-120	1230	-	0.2-1.0	0.4-1.5
El Hangar	25-120	1700	365 & 402	0.1-0.9	0.4-3.0
San Marcos	12-120	1660	-	0.2-1.3	0.5-2.8

Table 3. Sanitary Collection System Details

Sewer System Location	Wet Well Characteristics			Pump Characteristics		
	Diameter (m)	Depth (m)	Detention Time (min.)	Flowrate (m ³ /day)	Head (m)	Pump Cycle (min.)
Zona Americana	2.0	1.0	13-25	525	4.5	50
El Hangar	2.0	1.0	15-30	800	11	8
			8-15	525	4.5	7
San Marcos	2.5	2.0	15-26	1450	15	15

Table 4. Wet Well and Pump Details

flexible pipe. Backfill should be placed in 6 inch lifts for proper compaction. The backfill should be clean without debris, large clods/stones, or organic material in accordance with NR 110.

Zona Americana and San Marcos site will undergo a clearing and grubbing process, which will consist of removing all surface vegetation and existing trees. Zona Americana area will be excavated approximately 1.3 meters below the original ground surface. The bottom of the lagoons should be excavated with a 0.05% slope, sloping towards the outlet to allow for water to travel through the system. To minimize short circuiting and improve treatment efficiency, a gabion rock inlet and outlet structure will be used as a controlled weir to distribute water over the width of the aerobic and wetland basins. Between the aerobic lagoon and the wetland, an impervious concrete wall will be placed to force water to flow over the rock filter.

At San Marcos Site, the partially-mixed aerated system and settling lagoon should be excavated 3 meters below the original ground surface with a bottom slope of 0.05% to ensure the water travels to the outlet. The tops of the interior and exterior berms will be approximately 1 meter above the original ground surface with a 1-meter top width and 2:1 side slopes. Although a 3:1 side slope is required for code, land availability was a limiting factor. In discussion with the client, it was important to attempt to fit the treatment process on the designated site so the decision to reduce the side slopes was made. The client also mentioned that once more site visits occur, the availability of the surrounding land could be inquired in order to obtain a 3:1 side slope. Additionally, an aeration system will be placed at the bottom of the partially-mixed lagoon. The diffuser heads will have aeration tubing that can be laid on the bottom of the lagoon. This will allow easy removal of the diffuser heads when cleaning is required.

At both sites a double geosynthetic membrane liner will be installed under the all treatment systems to minimize leaching of untreated wastewater into the buffer zones of the wells. The membrane was considered to ensure a form of redundancy to protect the drinking water. The geosynthetic membrane material should be 30-mil PVC or high-density polyethylene (HDPE) (EPA, Constructed Wetlands Treatment of Municipal Wastewaters, 2000). Top soil that was stripped from the site should be placed over the geosynthetic liner and used as a

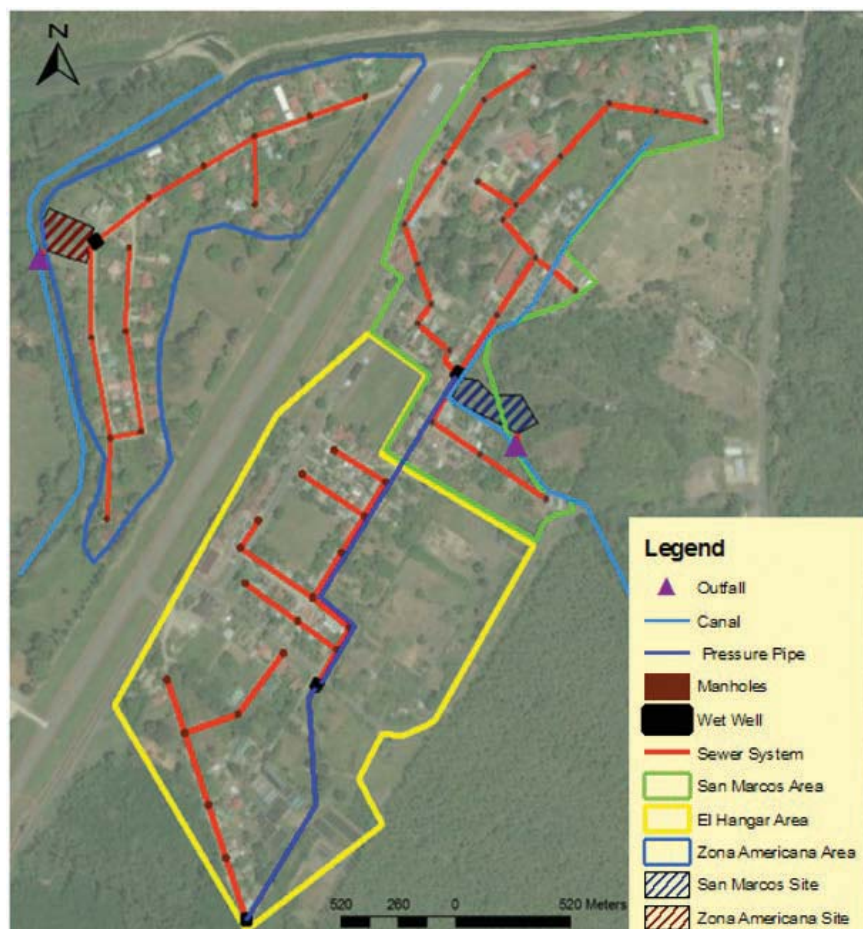


Figure 9. Proposed Sewer Layout

soil-rooting medium. The interior berms should be constructed 2 meters wide, with grassed side slopes of 3:1 to reduce erosion and increase berm stability. Exterior berms should be constructed similarly to the interior berms. The back slopes will be grassed with a slope of 3:1 for soil stability.

An inlet and outlet structure will be installed to distribute and collect water from the lagoons to prevent short circuiting.

Cost Analysis

A cost analysis was completed for a new sanitary sewer collection and treatment facility in Palmar Sur. The cost was broken down into collection system, general construction items for the treatment system, and annual operations and maintenance. Also, a cost analysis was calculated to remove all 94 septic tanks over a five year period. Global Water Stewardship provided unit cost for various materials and services.

The collection system took into account the cost of pumps, pipe, excavation,

manholes, mains, and an aerator. The treatment system accounted for excavation, labor, pipes, liner materials, plants, stones, erosion control, and fencing. Annual O&M costs included lab testing, electrical rates for pumps and aerators, and labor. The operations and maintenance calculations used net present value (NPV) to determine the present value cost over the 20-year design life with a compound interest of 5%. The monthly cost per person is \$4.00 at start-up and at the end of the design the monthly cost per person is \$3.00 from the increase population. The estimated cost for this entire project over a 20-year period is \$2.8 million. [CS](#)

References

References cited in online version.

Acknowledgments

Mohammed Haque, PE, MBA- Global Water Stewardship; Zach Wallin, EIT- SEH Michael Penn, PhD, PE; Austin Polbliski, PhD, PE; Jerry Mahun, PLS; Diane Hardyman, Department Associate

STOCKHOLM JUNIOR WATER PRIZE *Winners*

Wisconsin

This year, Hunter Bindas and Abigail Warwick, a team of seniors at Muskego High School in Muskego, was selected to be the winner of SJWP Wisconsin round. The winning project was titled 'Development of a Grass Variety as a Way to Remove Nitrogen from Water Environments.' The project was supported by Karen Lindholm-Rynkiewicz, Cheryl Schultz and Jaqi Christopher I. Horn Bros also donated grass seeds and fertilizers. Hunter has lived on Little Muskego Lake her entire life and in recent years has worked on the lake. This job made her aware of the process of eutrophication happening in the lake and made her interested in learning a way to prevent it. Abby has had a passion for the environment for many years and has taken AP Environmental Science.

The abstract of the project are as follows: Excess nitrogen from fertilizers put on residential lawns to achieve a desired grass appearance has been increasing in recently, which is harming waterways due to an abundance of algae blooms causing eutrophication. Our approach was an experiment of biology (Mycorrhiza) versus chemistry (chemical fertilizer) to see which is the most effective choice for both growing grass and saving waterways. We grew four types of grasses with Mycorrhiza, fertilizer and neither (control) to identify the best growing grass type, determined by root length, and growing speed. After four weeks, ryegrass was determined to be the best grass based on the above criteria. Next, nitrogen soil tests were performed for all three growing components added to ryegrass. The testing results were that



the ryegrass with Mycorrhiza and the control had little to no runoff. However, the results showed that ryegrass grown with the suggested amount of fertilizer (50 lbs per 12,000ft²) was above the desired amount of nitrogen in soil. These results contrasted with the desired amount of nitrogen in the soil of the ryegrass grown with Mycorrhiza or neither.



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“Avni, one of 57 state winners announced by the Water Environment Federation (WEF), will represent Minnesota in the national finals June 16 at the University of North Carolina at Charlotte, where students from 47 states and Puerto Rico will be competing.

News from MN-Stockholm Junior Water Prize 2018

By Hasibul Hasan, PE, Project Engineer, Sambatek, Inc.
State Representative - MN-Stockholm Junior Water Prize

It has been an outstanding year so far regarding the MN-Stockholm Junior Water Prize (SJWP). We have seen seventeen (17) water-related projects in the state science fair comparing to seven (7) participants last year. It is nice to see more young minds interested in the water related projects.

In our effort to support public education in Minnesota as a CSWEA member and also as the MA of the Stockholm Junior Water Prize (SJWP), Regional and state science fairs were attended by MN SJWP organizer. A graduate student of the University of Minnesota was recruited for the state science fair event. A panel of three judges selected the SJWP paper award winner.

The U.S. Stockholm Junior Water Prize is a great example of how science and innovation can impact water and water quality. We are so proud to see Avni Jain of Eden Prairie High School competing in the U.S. Stockholm Junior Water Prize! The future of clean water relies on future water leaders like Avni Jain! Congratulations and good luck!



Avni, one of 57 state winners announced by the Water Environment Federation (WEF), represented Minnesota in the national finals June 16 at the University of North Carolina at Charlotte, where

students from 47 states and Puerto Rico were competing. The winner will receive \$10,000 and an all-expenses-paid trip to Stockholm to represent the United States at the international competition during World Water Week on August 26-31.

Avni is being mentored by Dr. Caroline Ylitalo from 3M. She worked under the supervision of Dr. Min Addy, Professor, Department of Bio-products and Biosystems Engineering, at University of Minnesota throughout the summer and the fall of 2017, to conduct a series of studies.

The abstract of Avni's Paper follows below.

Wastewater Treatment: Utilizing Hydroponics to Develop a Novel and Sustainable Solution to Nutrient Pollution

By Avni Jain, Eden Prairie High School Eden Prairie, MN

ABSTRACT

Nutrient pollution is one of America's most widespread, costly, and challenging environmental problems which is caused by excess nitrogen and phosphorus in the air and water. My research focuses on converting nutrient pollution into a product of economic value through the utilization of wastewater in hydroponic systems, which will also cultivate organic produce.

Three studies were conducted over duration of twelve weeks in which *Lactuca sativa* L. (lettuce) and *Beta Vulgaris* (Swiss chard) were grown hydroponically. The

first hydroponic system, NP1, contained wastewater whereas the second system, NP2, contained commercially available nutrients. Weekly measurements were taken in order to monitor the Total Nitrogen (TN), Total Phosphorus (TP), Ammonia (NH₃), Nitrate (NO₃), and total dissolved solids (TDS).

The results indicated hydroponics to be an effective method for wastewater treatment, as a majority of the nutrients were absorbed by the plants, and hence removed from the water. Over a 28-day period, NP1 reduced the TN levels by 55.52% as compared to NP2 with a

31.06% reduction. ICP-OES analysis was performed to measure concentrations of essential macronutrients in the lettuce produced by NP1 compared to the control, NP2: 122.13% Ca, 95.59% Fe, 88.07% K, 145.15% Na, and 83.99% P, indicating a safe and nutritional output.

An Arduino-based temperature sensor was developed in order to maintain the desired temperature of the system, which acts as a proof of concept for future development and commercialization. My research opens up possibilities for sustainable, profitable, and eco-friendly options for combatting nutrient pollution. [CS](#)

CSWEA Welcomes Our New Members

Updated on July 1, 2018



March 2018

Tina Arrowood, Dow
Jacob Holbert, Veolia Water
Chris Waul, Milwaukee MSD

April 2018

Don Berry, Sherwin Williams
Matthew Buerger, KPlus
Tucker Burch, USDA
Joseph Chang, Baxter & Woodman
Katherine Despinoy, Stanley Consultants
Ryan Hanson, Sambatek
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Jaqueline Janz, Mortenson Kim
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May 2018

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June 2018

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To demonstrate our admiration and respect for the association, its members and the water industry as a whole, we have established a yearly educational scholarship of \$1,000 to be funded through a percentage of advertising sales generated in *Central States Water*.

On behalf of the publishing professionals who form part of our team, as well as our advertisers who use the pages of *Central States Water* to convey their important messages, we look forward to helping a worthy individual further their education in the water industry.

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April 11, 2017 was "Energy Independence Day," the first day the wastewater treatment facility produced 100% of its required energy and achieved Net Zero Energy status. Annually, the facility produces more than 85% of its required electricity, exceeding purchased energy reduction goals 17 years ahead of schedule. Donohue congratulates the Facility on its well-earned accolades and for making the City GREATER.

