The Clarifier is the publication of the Wisconsin Wastewater Operators' Association and is intended to inform and educate the membership on issues related to the treatment and control of wastewater. The Clarifier is produced five (5) times each year: February, April, June, September, and December. All members are encouraged to contribute to the mission of the Clarifier.

The Wisconsin Wastewater Operators' Association is a non-profit organization dedicated to educating, informing, and advancing the wastewater profession. WWOA has approximately 2,000 members divided throughout six regions: Southeast, Southern, Lake Michigan, North Central, Northwest, and West Central.
Presidents message: What’s in your skill set toolbox?

Wow. The year builds to the crescendo of our annual conference, and now it’s over, yet already time to start focusing on 2022 and Green Bay. I was so excited to be back “live” this year and enjoyed this year’s conference as I hope you all did. There are always venue-specific issues that arise, but we did our best to put on an excellent conference. Know also that we value your surveys post-conference. The Board is currently reviewing surveys to see what we did well, what we could improve on, and determine if there’s anything we need to consider for next year. Thanks for filling them out!

I am truly honored to serve as President of this incredible organization. It’s an intimidating chair filled by many incredible folks before me, but I’ll work hard to fill that seat. Who would have believed that a “DNR guy”, as one of my fellow Board members constantly needles me, would ever serve in this capacity? I’ll give you my two cents for an answer, and that is…because this organization is so open and accepting, that’s why! In my 21 years as a WWOA member, I recall the early days of being a “new guy”, who knew a scant few members, to quickly being welcomed into this huge family. I felt so appreciated by this organization, that I wanted to submit a presentation to conduct a workshop at each annual conference to help provide training and education for lab folks as well as help generate revenue for WWOA. It wasn’t much, but it was what I could do to help out.

I think it boils down to skill sets. Each of us has a unique set of strengths and weaknesses that combine to make up our skill set “toolbox”. None of us has a complete toolbox, so we work collectively as teams to bring people together that, combined, bring the sum total of skill sets necessary for any particular task. Consider the Operator’s Competition as a small-scale example. You assemble a 3-person team to compete in challenges involving collection systems, maintenance, laboratory, and process control. Only a select few operators are versatile in all these areas, so you put together your team ensuring that each of your members is particularly adept in one or more areas of the challenge. That is a recipe for a winning team.

Most of you probably know that I am not a certified Operator. I considered getting that certification many times, but life just got in the way. Do I have a grasp of wastewater operations? Absolutely. Through coursework with Dr. Aga Razvi at Stevens Point and learning from the multitude of plants I audited, I have a base knowledge. Plus, building knowledge is my thing. But you probably don’t want me to help you in a plant emergency. I always claim that I can take anything apart, but getting it back together, or building something, just isn’t in my wheelhouse. Heck, my wife usually has me hold the tools as she completes a particular task! The important thing is that I know my limitations and what knowledge I need to build on.

Borrowing a character line from one of my favorite movies, though: “Hey…I’m not without skills!” I may not be an operator, but I can and have helped many labs improve their operations through my understanding of wastewater chemistry. I also have a pretty good grasp of financial information and organization. Therefore, my mission has been to ensure that all Board members have a clear understanding of WWOA’s financial picture and that we have an updated set of policies that follow our ByLaws, and that policies, Bylaws, and website information all agree. I also want to be sure that we honor the traditions established by past Boards. These are the tools I can offer, and a solid team requires these tools as well as many others.

continued on page 4
As we move towards the holidays and the winter lull, I encourage each of you to take an objective inventory of your own skill sets. Do you have the necessary skills/knowledge to achieve your career goals? If not, identify someone that does, and see if you can team with them to build your weaknesses into strengths. Perhaps you have a strength that happens to be a particular weakness of theirs. If we all work together, we can use our collective strengths to help others work on their weaknesses, while we can utilize their strengths to help us build on our own weaknesses. That’s what teamwork is all about.

In the course of my career, I’ve had the distinct displeasure of working with a few individuals who believed that knowledge is power, and therefore one should not share their knowledge or risk “losing their power”. On the contrary, I have always subscribed to the philosophy of Dr. Koby Crabtree, who believed so strongly in sharing his knowledge that the WWOA named a major award after him. Dr. Crabtree saw knowledge as indeed power, but power to be openly shared so that everyone has the keys to personal and career development. I encourage you all to share the wealth of knowledge you have attained with your colleagues. The WWOA is not about power mongers, but rather about the value of sharing knowledge to ensure that all our members have access to the complete education they need.

I truly value the trust that you have placed in me to lead this amazing organization. I am also proud to be a part of a talented and inspiring Board of Directors. I’ve developed strong bonds with Board members I served with including, but not limited to, Juice Simpson, Jeff Bratz, and now Jeff Smudde. Five years ago, my good friend, Past President Kevin Freber, encouraged me to run for the Board of Directors and insisted that Board members will become a close-knit family of brothers and sisters. And he hit that nail squarely on the head. Together, through the past five years, we had the necessary skill set to move us past a financial crisis, a change in approach to the traditional Executive Secretary role, the pandemic, and into the “new” normal. It’s been particularly rough for Board members that came on since October 2019, as (prior to this past August) the Board had not met in person since December 2019. In-person meetings are critical to building knowledge, confidence, and team rapport. I applaud those board members for their patience and perseverance in the absence of the ability to connect personally as a team. There are always challenges ahead, but I am confident that this team will meet any challenges encountered head on and serve you well.

Strive to keep your skill set toolbox full, and share the “wealth” of knowledge you acquire along the way! Stay safe, stay well, and I wish you all a very happy holiday season!

Rick Mealy

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**Clarifier deadlines 2022**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>February</td>
<td>January 14</td>
</tr>
<tr>
<td>April</td>
<td>March 11</td>
</tr>
<tr>
<td>June</td>
<td>May 13</td>
</tr>
<tr>
<td>September</td>
<td>August 12</td>
</tr>
<tr>
<td>December</td>
<td>November 12</td>
</tr>
</tbody>
</table>
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City of Monroe Wastewater Treatment Plant

By Mike Kennison, Utility Supervisor and Jeff Klopfenstein, Lead Operator

The City of Monroe is known as the “Swiss Cheese Capital of the USA.” Nestled in the rolling hills of Green County with a population of about 11,000, the scenic City is home to an attractive downtown Square that centers around the historic courthouse. Monroe’s Swiss heritage and cheese making roots are still present in its landmarks. Industries in Monroe focus on cheesemaking, manufacturing and mail order gift production and distribution. The City also has a thriving brewery that’s been in operation since the 1800s.

The Monroe Wastewater Treatment Plant (WWTP) has sat on more than 10 acres on the City’s west side for more than 50 years. It has a long history of operators who stay for decades and are notoriously knowledgeable about the plant, history and required processes and limits.

The WWTP reached its capacity around 2011 with many pieces of the facility at the end of useful life and no room for accidental discharges. At that time, the Department of Natural Resources (DNR) changed ammonia limit requirements, and biosolid storage and phosphorous limits were becoming stricter. Updating the WWTP included removing the plant’s administrative building and replacing it with a building to house administration and a garage for the City’s water and wastewater departments to work together. The $25 million plant updates took years and included a new headworks system, two new aeration tanks, expanded aeration tanks and a methane gas collection system.

continued on page 8
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When the upgraded plant went online in 2015, operators discovered inefficiencies, including malfunctioning heat exchangers. The plant’s two digester temperatures were running too low for the host bacteria to break down solid waste. The heat exchangers were changed to spiral heat to effectively break down the sewage.

Another design flaw was an odor problem that plagued the City’s west side for years. After complaints, operators learned the equalization tank was creating an unpleasant odor. In 2019, the City addressed the issue by adding a biofilter system using bacteria growth on natural components – in Monroe’s case, those are tree roots and wood chips. The bacteria use sulfur as an energy source in oxidation, and it off-gasses underground, nullifying odor caused by hydrogen sulfide. The system works well, and little maintenance is required.

Monroe’s treatment plant capacity requirement is unique because wet industries like beer, cheese, and whey production in the City contribute about 80% of the plant load, which is unusually high for most municipal plants.

continued on page 10
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The facility processes up to 2 million gallons of wastewater per day and has five aeration tanks in operation. There is a large containment warehouse for cake storage. The cake, also called biosolids or sludge, is dried and stored to be spread as fertilizer on a dozen local farm fields.

Over the last year, many local businesses have increased production. Although it’s been positive economically, the additional load has caused issues. Industrial overloading has been a challenge the plant has overcome by optimizing process management and having a process control consultant from Fehr Graham Engineering & Environmental assist with any issues.

The brewery and whey processing plant waste byproduct diverts directly into the WWTP. Despite upgrades seven years ago to handle 10,000 pounds of Biochemical Oxygen Demand (BOD) per day for domestic waste, depending on the...
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production, the plant now sometimes sees around 20,000 pounds of daily BOD.

Unlike typical WWTPs, Monroe deals with spike loadings. The operators work diligently to keep numbers within regulation. They face challenges with big swings from weekends to weekdays but stay on top of them by consistently testing and adjusting what’s needed to keep the system healthy.

Keeping phosphorous at bay
Monroe works to stay compliant with phosphorous limits. The Department of Natural Resources requires limits within .88 milligrams per liter, and restrictions will drop to 0.092 milligrams per liter in July 2022. With twice the amount of loading, it’s difficult to sustain the biological processes, so the plant uses chemical assistance to keep up with the current loading and will use water quality trading credits to meet the 2022 limit.

A Water Quality Plan is being created to keep levels more balanced to reinforce eroding stream banks and angle them back for more stability. These improvements will allow the

continued from page 10

When the industries shut down on weekends, BOD numbers drop to around 300 mg per liter – but on weekdays, those numbers can reach more than 1,000.

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continued on page 14
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City water quality credits to help keep phosphorous limits compliant.

The City uses biological phosphorous removal to reduce soluble reactive phosphorous to keep phosphorus levels under control.

Previously, the high level was killing the nitrification biology outside ammonia limits. The operators used commercial

continued from page 12
continued on page 16
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bacteria to inoculate the plant to bring numbers within compliance. This worked well in removing ammonia and its byproducts by using the bacteria.

The future of wastewater in Monroe
Because of the industries in Monroe, the plant treats waste for a population of 90,000. The unique industrial load makes it understandable that an expansion could be necessary.

The City is proud of its industries and will likely look to expand its plant as industry norms settle. Officials will also consider Monroe’s future growth, including an anticipated industrial park, and look at how businesses could expand and develop. The dedicated plant staff and operators ensure things run properly. When things aren’t right, they work to get quick results and stay on task. Despite challenges, the WWTP is still functioning well because of its devoted operators.

The Monroe Wastewater Treatment Plant team is pictured, from left: Jeff Klopfenstein, Lead Operator; Garrett Grossen, Operator in Training; Jim Sinkule, Senior Lab Technician; Chad Ringhand, Advanced Operator; Dan Neuenschwander, Lead Maintenance; and Mike Kennison, Utility Supervisor.
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Bowler WWTP hosts August Lake Michigan district meeting

The August 19th Lake Michigan District meeting at the Bowler WWTP was well attended meeting for being our first in person meeting since the COVID pandemic with 30 operators, along with 7 equipment and process vendors, and 9 students from NWTC. A special thanks to Strand Associates, Inc. and Robert E. Lee & Associates, Inc. for sponsoring the facility rental fee and the treats during the morning breaks.

The first presentation of the day was given by Randy Langer of Strand, who spoke on Pumping Station Assessment and Rehabilitation/Preparing Your Stations for Future Operations. Randy began his presentation with a general overview of how lift stations work, the common components in different types of lift stations, and discussed how vital proper maintenance is to the lifetime of lift stations. Randy then provided a breakdown explaining how spending small amounts focused on maintaining lift stations can prevent municipalities from needing to spend large amounts to replace lift stations that have not been maintained adequately. After that, Randy provided a general cost percentage that municipalities need to spend on lift stations compared to WWTPs. The percentage illustrated that large sums of money are spent on lift stations relative to WWTPs, but it is not widely thought about because of the numerous lift stations many municipalities have.

Next on the agenda was Tom Dumbaugh from WesTech. Tom’s presentation was titled Tertiary Phosphorus Basic and Treatment Options. Tom began the presentation by providing an introduction of phosphorus, which included a flow chart of the typical cycle of phosphorus. Tom then went on to explain what eutrophication is and the challenges WWTPs face to reduce to low levels. After that, Tom walked the group through various treatment processes for reducing phosphorus levels. Tom finished his presentation by discussing numerous case studies.

The third presentation of the day was by Joe Gadbois of Hawkins Chemical. Joe’s presentation was titled Chlorination and Dechlorination Technologies – Pros and Cons. Joe first identified why we disinfect wastewater. Then, Joe provided a list of different methods of disinfecting and then expanded on different options to chlorinate. This led Joe into discussing the properties of the different forms of chlorine, including the governmental regulations and the associated pros and cons. Next, Joe went over methods of dechlorination. Joe ended his presentation by discussing the safety equipment operators should use when working chlorination and dechlorination chemicals.

Matt Schmidt called the WWOA-LMD business meeting to order. Last quarter's minutes and treasurer's report were presented and approved. Following the treasurer's report an explanation was given detailing why there was an interest in switching the Lake Michigan District’s financial institutions from Wells Fargo to Associated Bank. The motion to switch financial institutions was approved with no objections. The next item on the agenda was the WDNR update by Laura Gerold. First off, for the WDNR update, Lisa Lumley is no longer the permit drafter and Dave Gerdman is no longer with the WDNR. The second item is that urgent-need basis exams will be offered in Plover on September 14th and October 26th. There are no exams scheduled after October because the WDNR is working to move to online exams. The fourth item is that PFAS rules are still in development and a list of labs approved for testing is available on the WDNR's website. The sixth and final item is that come fall, sanitary sewer overflow forms are moving to an electronic submittals process via switchboard.

continued on page 19
Following the WDNR update, Matt Schmidt gave the state WWOA Board of Director’s update on their behalf. First item was a reminder for everyone that scholarships are available for the upcoming year. Three $1,000 scholarships are awarded each year for full-time students currently enrolled in an accredited college. North Central Laboratories (NCL) generously offers a $5,000 two-year scholarship each year to a student enrolled in a wastewater related field. The student receives $2,500 each for their junior and senior year for a total award of $5,000. The second item is tuition aid is available to members to further your education. Next, was a reminder everyone to start thinking about who to nominate for the various awards; more information is provided on the WWOA website. The WWOA update was finished by noting last year there was 8 operator competition teams. There is a cash reward for the winning teams. Also, the Annual Conference is from October 5-8th.

The last presentation of the day was by Rick Treleven, BCR. Rick’s presentation was titled: Significantly Improved Biosolids Management with CleanB. Rick started off by providing an overview of the CleanB biosolids treatment process, which creates Class B sludge. Rick then went into detail, explaining how the CleanB process is different from other biosolids treatment processes typically found at WWTPs in the Midwest. Lastly, Rick finished the presentation by describing the cost saving advantages of using the CleanB process.

Aaron Gutt, Village of Bowler Director of Public Works, gave an introduction of the WWTP by describing the flows, loadings, treatment processes, and a history of the plant upgrades. Self-guided plant tours followed the plant introduction.

The next meeting date is December 9th, 2021 at the Clintonville WWTP. Thanks to Aaron Gutt, the one and only operator at Bowler, for hosting the meeting and answering everyone’s questions during the tour.

Reminder, meeting presentations, if allowed by the presenter, can be found on the WWOA website on the Lake Michigan District region’s page.

Minutes submitted by Josh Steffeck, Lake Michigan District Secretary/Treasurer
2021 WWOA conference La Crosse Convention Center
55th annual conference WWOA awards 2021

The Awards Banquet is one of the highlights of the annual conference, as it provides that opportunity for individuals to be recognized for their commitment to WWOA and career achievements before their peers. There are always concerns that the banquet takes too long, and this year posed an additional challenge, as the Board was committed to bringing up 2020 award recipients who never received recognition before their peers due to the virtual conference. Yes, it took a little longer, but the Board helped mitigate that by taking photos of past award recipients, past Presidents, and Lifetime members during the Social Hour. We understand that it takes a bit of time, but this is the 2 hours each year that deserving individuals get to be recognized for their accomplishments.

Honorary Member Award
The highlight of this year’s awards banquet was the presentation, by Jeff Bratz, of an Honorary Membership to Gary Hanson. WWOA has bestowed Honorary Membership on only seven individuals to date, with the last awarded in 2011. While there is no requirement to award this honor according to any timeline, the Board of Directors feels that it is important to bestow this honor on deserving members before they head off into their retirement twilight. This year was especially meaningful as we celebrated a return to a semblance of normalcy, and we had such a deserving candidate in Gary Hanson. Honorary Membership is the only award that requires not just Board approval but ratification by a majority of the membership present at the annual business meeting. Some clever wrangling had to be done to keep Gary away from that meeting so that he remained unaware of his coming honor. Gary’s accomplishments would take several Clarifier pages to list, but to sum his qualifications, he is a dedicated member and contributor, Past President, and has received every major WWOA award, one of only three individuals to do so. Congratulations, Gary!

Albers-Templeton Service Award
The 2021 Albers-Templeton Service award recipient was Jeff Bratz, a lifetime member, Past President, and a guy who has been heavily involved in the Operator Competition and the WWOA website. One of the nominations for Jeff included the following,

“Jeff has selflessly gone far beyond any expectations in giving back to WWOA. He helped build and keep the operator competition alive, as well as handled the website. As president he helped us get through the cyber-crime incident in 2018, and enabled WWOA to manage the conference without an Executive Secretary. He was instrumental in helping WWOA to re-think the Executive Secretary position and opt to hire a management firm.

Even after moving off the board of directors, Jeff has continued to contribute to keeping WWOA running smoothly.” Thanks to Tom Mulcahy for his very warm presentation.

Koby Crabtree Research & Education Award
The 2021 Koby Crabtree Research & Education award recipient was Dan Tomaro, who unfortunately was not able to be with us, as he is dealing with some health issues. Dan has been a fixture in operator training and education for the past 15-20 years. Arguably, Dan has helped virtually every certified operator in the state to pass DNR certification courses through his training sessions.

Dan’s nomination includes the following, “Dan is responsible for training hundreds of operators in the state from people entering the profession on throughout their

continued on page 22
continued from page 21

career. Operators also contact him for assistance with their operational, regulatory, and data issues among other things, and he freely offers assistance. He has also met with operators in restaurants, conferences, and at his home to offer assistance. He is one of the most respected trainers in the state, and operators frequently quote his training facts and refer to his training materials. Dan has devoted most of his professional years developing exceptional operators in Wisconsin. In my travels, I am always able to tell if a new operator has attended Dan's classes, as they have a good understanding of all aspects of wastewater treatment and have usually passed their state exams. “Thanks to Kay Curtin for her personal reminiscences in her presentation.

George F. Bernauer Award
The 2021 George F. Bernauer award, presented by Harry Mathos, was awarded to Bill Marten. An excerpt from his nomination states, “By every measure, Bill has been instrumental in the success of several facilities in the State of Wisconsin by virtue of his engineering and process control expertise. His attention to detail and operator-friendly design enhancements creates an environment for optimal facility operation. However, what sets Bill apart from most is his ability to elevate and inspire others to bigger and better things.” Thanks to Harry Mathos, for wanting to be in La Crosse to present the award to Bill.

Newcomer of the Year Award
The 2021 Newcomer of the Year award, presented by Rick Mealy, was awarded to Ethan Perrine of the Village of Spencer. Due to staffing needs, Chris Helgestad was unable to make the presentation. Excerpts of the lengthy list of accomplishments cited in Chris’ nomination of Ethan include the following,

“This fall Ethan will become one of the first graduates of the State of Wisconsin’s Wastewater Apprenticeship program and will have successfully completed all of the wastewater exams offered by the DNR, several not even required by our facility. He has also completed the water exams required to operate Spencer’s water system. With the knowledge, education, and work experience he has gained in a few short years, Ethan would be an invaluable operator at any wastewater system in the state. It is a privilege to co-operate the Spencer system with him and I hope that he will stay with us for many years. I can’t imagine anyone more suited to be recognized by the Newcomer of the Year Award.”

Membership Award
The 2021 Membership Award, presented to the WWOA member credited with the most new member applications was Matt Schmidt of NEW Water.
continued from page 22

**Lifetime Membership**
Members receiving recognition for having 25 yrs of membership with WWOA in 2021 were the following:

James Birch  
Bruce Bottko  
Todd Fischer  
Craig Hendrickson  
Rodney Knoble  
John Stoeger  
Anthony Weinzirl  
Brad Zautcke

**Region of the Year**
The 2021 Region of the Year was awarded to the Southern Region.

**Regional operators of the Year**
Lake Michigan: Jenny Pagel, Clintonville Wastewater Utility

**Josh Voigt (Presenter),**  
**McKala Kiessling** and **Alex Krause (Award Recipients)**

**Matt Schmidt (Presenter),**  
**Jenny Pagel (Award Recipient)**

continued on page 24
continued from page 23

North Central: Andy Heise,
Rib Mountain MSD

Northwest: Brooke Klingbeil,
Medford WWTF

Southern: Rob Minnema,
Beaver Dam Wastewater Utility

Southeast: Bob Biedrzycki,
Lyons Sanitary District #2

continued on page 25
continued from page 24

West Central:  Dennis Eaton, Village of Prescott WWTP

2020 scholarship recipient

WWOA scholarship

Katie Jo Jerzak (Presenter), Dennis Eaton (Award Recipient)

Jenny Pagel (Presenter), Gage Hirdler (Award Recipient)

2021 scholarship recipients

WWOA scholarship

No pictures available for the WWOA scholarship award winners

Jenny Pagel (Presenter), Emma Loucks (Award Recipient)

Jenny Pagel (Presenter), Bella Serrano (Award Recipient)

NCL scholarship

Mark Mahooney (Presenter), Trevor Hefter (Award Recipient)

Mark Mahooney (Presenter), Tyler Luebke (Award Recipient)
**WWOA lifetime members**

Back row (l to r): Gary Hanson, Randy Herwig, John Bond, Don Litner, Bill Marten, Michael Humcke, Mike Penkwitz, Mary Dierker, Harry Mathos

Middle row (l to r): Jerry Kiteinger, Gary Newton, Dale Neis, Tom Mulchay, LaMont Albers, Robert Moger, Roy Lembcke, Dan Markart, Rusty Schroedel

Front row (l to r): Lisa Waigelt, Kay Curtin, Juice Simpson, Jeff Bratz, Jeff Mayou, Kevin Freber, Brian Helminger

**Past George F. Bernauer**

Gary Hanson, Rusty Schroedel, LaMont Albers, Harry Mathos

**Past Kolby Crabtree**

Gary Hanson, Rick Mcaly, Michael Humcke, Kay Curtin, Troy Larson, Roy Lembcke, Bill Marten

**Past service members**

Gary Hanson, Randy Herwig, Kay Curtin, LaMont Albers, Tom Mulcahy, Kevin Freber
Lab of the year – Plymouth

Back row: Nate Tillis, Marc Stephanie, Josh Voigt, Ben Brooks, Jenny Pagel
Front row: Courtney Harris, Jeremy Cramer, Rick Mealy, Don Lintner, Jeff Smudde

Past presidents

Back row: Gary Hanson, Randy Herwig, John Bond, Lyle Lutz, Jeff Schmudder, Don Litner
Front row: Dale Neis, Kay Curtin, Juice Simpson, Jeff Bratz, Kevin Freber, LaMont Albers

2022 board of directors

Back row: Nate Tillis, Marc Stephanie, Josh Voigt, Ben Brooks, Jenny Pagel
Front row: Courtney Harris, Jeremy Cramer, Rick Mealy, Don Lintner, Jeff Smudde
The following pictures represent 2020 award winners that were not printed in previous Clarifier issues.

### 2020 operators of the year award

**Southern region**
- Jeff Smudde (Presenter),
  Steve Schramm (Award Recipient)

**West Central region**
- Jeff Smudde (Presenter),
  Craig Hendrickson (Award Recipient)

### 2020 newcomer of the year

- Jeff Smudde (Presenter),
  Matt Vottlemy (Award Recipient)

### 2020 Albers-Templeton

- Jeff Smudde (Presenter),
  Kevin Freber (Award Recipient)

### 2020 region of the year

**Lake Michigan**

*Left to Right: Adam Filz, Matt Schmidt, and Jeff Smudde*
2021 WWOA annual sporting clays shoot

The Sporting Clays Shoot this year was a huge success with a record attendance of 81 shooters. The event, which was held at Sparta Rod and Gun Club on Tuesday October 5, consisted of a 50 bird sporting clay shoot at 13 different stations. After the shoot was over, everyone enjoyed grill-your-own steaks and all the fixings, along with some great camaraderie. This year the Top Gun prize for the best individual shooter went to Adam Clark with a 43 out of 50. There was a tie for the first place team this year between a team including Travis Anderson, Ben Propson, Alex Krause, and Kyle Casper, and another team with Jim Larson, Joe Lehner, Tim Riggs, and Bucky Walters.

In memory of Tom Stebbins, who was very involved in the planning and organizing of past shoots, there were several special prizes awarded this year. Midwest Chemical donated a Browning Silver 20 ga in memory of Tom. Jim Larson was the lucky winner of that prize. Bright Technologies also donated a Tri Star 12 ga in Tom’s memory. Nick Malucha won that prize. The Top Gun winner, Adam Clark, also received a special commemorative belt buckle in honor of Tom Stebbins.

Everyone that attended won a door prize. As a result of all the generous donations, there were 5 guns and several large gift cards given away, along with many other great door prizes. Special recognition goes out to the major sponsors for the event: Aquachem of America Inc., Crane Engineering, Donohue & Associates, Foth, J.F. Ahern, Jacobs Engineering, Midwest Chemical, PJ Kortens, Sebright Products, Watertech of America. Thank you also to our station sponsors: Adaptor Inc, Badger Labs, ByTec, DN Tanks, Flygt, Industrial Engine Company, Kraft Power Corporation, LW Allen LLC, MSA Professional Services, Roth Professional Services, SEH, and Visu-Sewer Inc. The committee that planned and organized the 2021 event included Bucky Walters, Josh Voigt, and Jeff Smudde. A huge thanks to Bucky for all of the time and effort he put into making this the most successful shoot yet. Another big thanks to Diane Thoune for her assistance with organizing all of the scores and determining the Lewis Class winners after the shoot.

Mark your calendars for Tuesday October 4, 2022 for the next annual shoot in the Green Bay Area. The planning team will be evaluating several courses to decide where it will be held. We hope you can join us.

Top Gun

First Place Teams

Salute to Tom Stebbins

Grilling steaks
**WWOA – 55th annual conference wrap-up**

The 55th Annual Conference held in La Crosse October 5th through October 8th was a successful event with close to 700 in attendance! It was wonderful to host the conference in-person once again this year after having to take a year off. The event began on Tuesday with a bike ride, golf outing, and sporting clay shoot, along with the pre-conference seminars. The golf outing and the sporting clay shoot each had great turnout, all reports indicated that fun was had by all who participated. The pre-conference seminars (WDNR Lab updates and Watershed Phosphorus work) were well attended and there was great participation by attendees. That first day was also the regional officers meeting followed by the meet and greet. It was evident from the first day that all agreed it was great to be back in-person.

On Wednesday, the day started out with WWOA President, Don Lintner welcoming Glen Daigger, the Keynote Speaker. Glen is a well-known, highly respected wastewater professional who has traveled the world, researched, and worked on several projects that have impacted the profession. Glen’s keynote address was a technical talk that shared how operators, engineers, and equipment vendors are implementing and utilizing different processes and equipment around the world. Dr. Daigger’s keynote was different than many recent WWOA keynote speakers. The focus and emphasis reflected what the organization stands for – educating our members on new processes and ideas. Wednesday and Thursday offered the opportunity for participants to attend technical sessions or to walk the exhibit hall. The exhibit hall hosted 140+ vendor booths for attendees to visit and there were over 40 technical sessions offered.

This year, the only thing missing at the conference was the Operator’s Competition, but it will be back next year bigger than ever! One new addition to the conference was a Corn Hole tournament following the Award Banquet on Thursday evening. There were 26 teams that participated in the tournament and fun was had by all who played and watched! The Awards Banquet was well attended with award winners from 2020 and 2021 being present. The conference wrapped up on Friday morning with a talk by Adrian Stocks from the Wisconsin Department of Natural Resources who provided an update on PFAS testing and activities taking place within the State.

The Conference this year was very successful due to the great participants and all of the effort put forth by many. The Annual Conference is a place for our members to learn, network, and gain insight on new equipment and processes. The Conference is a culminating event that showcases the dedication and work of many who dedicate and volunteer their time to the profession and the organization. Thank you to all that made the conference happen and thank you to all who attended to make the 55th Annual Conference successful. We look forward to next year when we welcome everyone to the Annual Conference in Green Bay!

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**Thank You!**

WWOA thanks all of you for helping make the 2021 annual conference a success.

To the exhibitors who returned to show everyone what equipment and services are available.

To the presenters who took the time to prepare technical presentations that attendees found informative.

And to the attendees who came by the hundreds to reconnect and learn.

We look forward to seeing everyone at the 2022 annual conference!
Renew your WWOA membership

The WWOA is comprised of wastewater treatment professionals who serve municipalities and industries throughout the State. Membership includes treatment plant operators, engineers, consultants, plant managers, equipment manufacturers, regulatory agencies, educators and students involved in the wastewater treatment industry. Our programs and seminars target wastewater treatment facilities in every region of the State.

The organization maintains an active web site that allows current and immediate access to many of the membership benefits. The training calender lists all wastewater and water training events in the State that have been coordinated with WWOA and other partnering agencies. Equipment sales and job postings are also popular. The “Tips & Ideas” section allows operators to exchange ideas and ask questions online. State and Regional Officer contacts are listed for your reference.

Membership Categories
ACTIVE MEMBER: Active members are dues paying members who can hold office and are eligible for all WWOA benefits.

REGIONAL MEMBER: Are members who are active in Regional affairs but are not dues paying members of the WWOA.

HONORARY MEMBER: Any active member can be elected to an Honorary Membership through special recognition and approval procedures. An Honorary Member is not required to pay dues.

LIFE MEMBER: Individuals with 25 or more years of active membership are eligible to become Life Members. All Life Members required to pay dues at a reduced rate. Any Life Member that wishes to hold elected office will have to become an Active Member paying full membership dues.

STUDENT MEMBERSHIP: Individuals currently enrolled as a full-time student in a college degree program.

Benefits
STUDENT SCHOLARSHIPS: The WWOA provides an opportunity for members and their families to receive scholarship grants toward higher education.

TUITION AID is available to WWOA members who are in the process of furthering their education by attending college classes, correspondence courses or advanced seminars.

THE “CLARIFIER” is the official educational publication of WWOA. It is published five times per year and provides educational material to the membership. It is the primary communication tool of the organization.

MEMBERSHIP DIRECTORY contains contact information on individual members and their plants.

To renew online or manually with a form go to: https://www.wwoa.org/membership/join-renew-membership

A website account allows access to additional features of the site. Use the dropdown box below to select which membership option fits your needs. After filling out the form, a confirmation email will be sent to you.

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The front cover of every issue includes the following statement:
“The Clarifier is the publication of the Wisconsin Wastewater Operator’s Association and is intended to inform and educate the membership on issues related to the treatment and control of wastewater.
All members are encouraged to contribute to the mission of the Clarifier.”

Submitting an article can be as easy as mailing a letter or sending an email. Perhaps you are not a typist or do not have access to a computer? No problem, just write your thoughts down on a piece of paper and we will do the rest. Or give me a call and we will figure something out.

Jon Butt, Clarifier Editor, c/o Symbiont 6737 W. Washington St., Suite 3440 Milwaukee, WI 53214
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Call for technical papers 2022 for the 56th annual conference

The WWOA Technical Program Committee is requesting your assistance in developing the Technical Program for our 56th Annual Conference to be held October 4 – 7, 2022. The KI Convention Center in Green Bay WI will be our conference site.

Technical papers are being solicited at this time for the Technical Program. The Committee is especially encouraging members actively involved in the day-to-day operations of a wastewater facility to prepare and present technical papers at the Conference. The following are major subject areas that presentations may cover. Papers dealing with other topics will also receive consideration by the Committee.

1. Activated Sludge
2. Biosolids Handling
3. Nutrient Removal
4. Process Control and Automation/SCADA
5. Design Concepts and Implementation
6. Staff Training and Development
7. Utility Supervisory Skills
8. Computerization & Internet
9. Industrial/High Strength Waste
10. Maintenance Practices & Methods
11. Safety & Health Issues, Personnel & Process
12. Regulations, Watershed Issues
13. Laboratory Practices
14. Plant/Process Upgrades
15. Utility Benchmarking
16. Receiving Water Quality Issues
17. Collection System O&M/Programs Management
18. Operator Ingenuity and Everyday Problem Solving

Submit your outline(s) on the 2022 Conference Submittal Form (via e-mail-preferred, or mail) by February 14, 2022: Josha Voigt, 441 Riverview Dr., Neosho WI 53059. Phone: 414-719-5567. Email: Joshua.voigt@xylem.com

(Word file for 3-submission at wwoa.org)

continued on page 35
continued from page 34

Please consider responding to this request or forwarding it on to someone who may be interested in participating.

The strength of the WWOA is in the sharing of ideas and information.
The success of this organization is dependent upon you the individual member. Please consider making a difference!

Sincerely, Joshua Voigt, Vice President 2022 Technical Program Committee Chair

56th Annual WWOA
2022 Conference Submittal Form
Oct. 4-7, 2022

Technical Presentation Subject

Author(s) / Presenter(s)

Employer / Affiliation

Address

Email Address Phone Fax

Author is actively involved in the day-to-day operation of a WWTP? Yes____ No____

Author is an active member of WWOA?  Yes____ No____

Brief Description of Presentation (please type or print clearly; attach additional pages if necessary):

________________________________________________________________________

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________________________________________________________________________

Submit your outline(s) on the 2022 Conference Submittal Form (via e-mail-preferred, or mail) by Monday, February 14, 2022.
Joshua Voigt, 441 Riverview Dr., Neosho WI 53059. Phone: 414-719-5567. Email: joshua.voigt@xylem.com
The Government Affairs Seminar planning committee is hard at work finalizing the speakers and details for the 2022 Government Affairs Seminar.

The 2022 Seminar will be virtual on February 16th and 17th, both days starting at 11:30 and ending before 4:00.

Please block your schedule for this time. Registration will open early January.

The agenda topics include:

**Wednesday, February 16, 2022**
- Resiliency in a Challenging Environment – From Environmental to Administrative
- Developing a Permit – DNR Process, Permittee Involvement, and Where is There Flexibility?
- PFAS in Wisconsin

**Thursday, February 17, 2022**
- League of Wisconsin Municipalities Update
- Phosphorus Compliance – Statewide Update and Treatment and Watershed Case Studies
- Selecting and Removing Impaired Waters, and What it Means for Your Permit
- Permit Renewal Success Story Case Study
- Operator Certification Update
- DNR Update and Operator Awards

The government Affairs Seminar is sponsored jointly by WWOA, Central States, Wis DNR and League of Municipalities.
More memories from the 2021 conference in La Crosse

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Laboratory Limelight: The death of common sense

By Rick Mealy

Recent events got me thinking back to a time about 25 years ago. I was attending one of the very first NELAC conventions because the DNR's Lab Certification Program wanted to do some due diligence and see what the potential was for a nationwide certification program. I was attending the conference with some colleagues from the State Lab of Hygiene, one of whom was an interesting curmudgeon. As we listened to the speeches, he told me (and about everybody around) that this all reminded him of a book entitled “The Death of Common Sense”. Author Phillip K. Howard noted that, “We need a new idea of how to govern. The current system is broken. Judgement is to law as water is to crops. It should not be surprising that law has become brittle, and society along with it.” Certainly, this book, and it's alluring title, has relevance in everything going on today in government, but I particularly think back to its tenets with respect to my world, the world of laboratory testing. Allow me to highlight just a few examples.

**Holding Times.** I get it. Certain analytical parameters significantly change as time passes from sample collection. However, while a number of studies have been done to show that the EPA mandated hold times can be extended for a number of parameters, the EPA does not budge. You’ll get no argument from me that keeping a bacteria sample out at room temperature past its hold time is certain to cause a significant increase in bacterial population density. But what about total phosphorus? Sure, dissolved phosphorus might be taken up by living things in a water sample, but the total phosphorus test calls for a complete digestion, using heat and strong acids, that releases ALL available phosphorus (remember: matter can neither be created or destroyed!). So, where’s the common sense in a holding time for total phosphorus, that requires analysis within 48 hours or preserve and analyze within 28 days? I can make other similar arguments, but this one underscores the point. Some of these holding times make absolutely zero sense. Yet they still are “law”.

(Continuing) **Calibration Standards MUST be analyzed first.** NR 149.446 states that, “When an initial instrument calibration is not performed on the day of analysis, the continuing validity of the initial calibration shall be verified prior to analyzing any batch quality control or environmental samples by the analysis of one or more continuing calibration verification (CCV) standards”. And boy do I have a counter argument for the qualifier term “batch quality control”, which does not even appear in NR149 rule. But let's get past that red herring.

Some labs like to analyze a blank the first thing each day, but this rule does not allow that. Why not? Well, let’s ask some questions to get some answers. What if a lab analyzes a blank first (and it passes) and then the CCV next and it passes? Both pass; so, where is the problem? And please, don’t argue that maybe the instrument was not calibrated when the blank was run. If you verify it immediately afterward, it’s fine. Don’t be one of those people that argues for the one in a billion scenario.

What if the blank is analyzed first and it fails, yet the CCV, run next, passes? Isn’t there already a specific requirement that blanks must meet criteria? And what if it is the lab’s specific criteria that the blank must pass or rerun samples? Wouldn’t that be good enough? Similarly, if the blank passes and the CCV fails, the lab is already required to take corrective action. Sure, no environmental samples or batch QC such as LCS, spikes, or duplicates should be analyzed before the calibration is verified, but can the Powers That Be open their minds to the possibility that analyzing a calibration blank immediately prior to the CCV does not invalidate an analysis, and this should be allowed?

**Refrigerator etiquette.** Most wastewater labs have been forced to purchase additional refrigerators so that samples, standards, and food can be stored separately. Look, I get the food safety issue. Personally, I’m not going to put my bologna sandwich in a refrigerator with wastewater influent samples. But that’s just me. What if Kenny (my male version of a “Karen”, based on a perfectly modeled childhood friend) doesn’t have a problem with having his bologna sandwich nuzzling up against influent or septage samples? That’s his prerogative, right?

You cannot, with a straight face, tell me that Kenny’s bologna sandwich is going to contaminate the ammonia, total phosphorus, BOD, or TSS in capped sample bottles, or standards. Solids are NOT going to jump from the calibration...
sandwich, open the capped sample bottle and contaminate the TSS! And the same is true for calibration standards. Yes, there may be more of an issue in a lab that deals with volatile organics, semi-volatile organics, or pesticides. There could be cross contamination there. But can’t we just have the common sense to admit that wastewater labs and their testing are a bit different? There’s no contamination with these tests. If Kenny wants to put his lunch in with samples, let him! If Kenny, gets sick, that’s his business. I know auditors have tried to be helpful in allowing a lab to separate lunches and samples from standards by putting them in Tupperware-like containers within the same refrigerator. Seriously? Again, that’s just added cost the municipalities don’t have. Let Kenny be Kenny.

**Thermometer Police.** This one always killed me in my auditor days. Full disclosure: When I audited, I simply found that I had no time left to look at thermometer calibration records. Yes, I admit, that made me guilty of a different crime…auditor inconsistency… but this whole thermometer calibration thing has gotten out of hand. To avoid having to annually calibrate their thermometers (which is arguably a very flawed procedure) labs simply get a new thermometer every year and toss the old one out. Can you imagine how many of these thermometers annually are winding up in our landfills? And yet this happens because of a rule from the very agency that theoretically wants to minimize landfill waste. That makes zero sense!

Again, I get it. We need to know that temperatures are appropriate for the testing and storage of samples. But don’t we trust the morning weatherman’s temperature? The temperature on our phones or in our cars? Thermometers either work or they don’t. And if they don’t, one can usually tell. If your autosampler thermometer reads 4.0 C, but the sample feels warm, or is frozen solid, Hello! That means the thermometer is broken, and one can usually see, if one looks, a broken column in the thermometer. Common Sense is rolling over in its grave.

**PFAS- Cart Before the Horse.** Last, but certainly not least comes the PFAS quagmire. Nothing underscores the death of Common Sense more than this issue. The bullet train has left the station, regulations are being promulgated for numerous compounds, and yet there still doesn’t exist any concrete evidence that PFAS, which we have surrounded ourselves with for over 60 years, directly and unequivocally affect human health. Sure, there are some correlations, but correlation does NOT imply causation! Not one individual has died with cause of death attributed to PFAS. Individual states are scrambling to create their own path and regulate these compounds at different levels in each state. How much sense does that make? We’re all humans being, so shouldn’t there be a SINGLE standard for health risk for all (assuming one is warranted)? No one can agree on what a safe level is, so everyone does their own thing. That’s called chaos. But others are leading and so Wisconsin follows.

More to the point, regulators are not considering five very important things:

1. Unless we get rid of everything that contains PFAS (and don’t even ask how we will manage that or where all that stuff would be buried) we will continue to live with it… it’s “forever”, right?
2. People WANT their waterproof clothing, Sharpes, Sticky-Notes, stain-free carpeting and furniture. They do not want the grease from fast food to get on their clothing.
3. We worry about our drinking water, yet I haven’t heard a single “leader” raise concern about the amount of Teflon tape (a PFAS source) used in plumbing our drinking water, and how that might be impacting drinking water testing, possibly causing false positives.
4. All the PFAS testing done in anything other than drinking water has been done without using a nationally approved and tested method. How could the data generated possibly hold up to scrutiny in court?
5. Where there is a will, there is a way. Manufacturers will always be several steps ahead of regulators. Regulate Tetramethyl-X and they will create unregulated TetraMethyl-Y to serve the same function. Stop chasing ghosts.

It amazes me the amount of money (tax dollars) being spent on PFAS and yet we still have miles and miles of lead pipes in our cities. We know for a scientific fact that lead causes serious neurological problems in people, especially children. We don’t know, for certain, what PFAS does or doesn’t do. Didn’t we learn anything from the BPA bottle fiasco over 10 years ago? I’d rather spend those PFAS dollars ridding our cities of all lead pipes. PFAS has been here for 60 years; perhaps we should see how valid certified environmental health studies play out and in the interim, use PFAS dollars to curb more known health issues.

In our overzealous quest for quality control, too many regulators are not applying any Common Sense test to their regulations, instead choosing to march forward, because, “that’s what everyone else is doing”. You want to be a leader? Then do some independent thinking and forge your own path. Yes, that path many need to be cleared along the way, but at least it will be yours.

*continued on page 40*
With respect to lab testing rules, shouldn’t we just focus on the known and verified science that will affect the accuracy of testing? Auditors need to spend more time learning and understanding the intricacies of each analytical test/technology and focus on identifying and correcting things that truly impact data quality. Those that continue to cite nonsensical deficiencies just because they exist in code are nothing more than book auditors.

There are MANY silly ordinances all over the US that are ignored by law enforcement simply because…wait for it…they don’t make sense! If you want to be a leader, resurrect Common Sense and insert it into your regulations.

I pose the argument that too many of our rules exist simply because someone writing a rule saw something in another state’s rule and simply copied it. There is no Common Sense analysis. If it’s good for their rule, it should be fine for ours…right? It’s time we resurrected Common Sense. Forget the Marvel Universe. If there was ever a time for a superhero, the time is now, and that hero would be Common Sense.
Fennimore WWTP hosts September Southern district meeting

Southern District Meeting on September 15, 2021
Hosted by the City of Fennimore Wastewater Utility
Thank you to Town and Country Engineering for sponsoring the meeting.

The first speaker was Troy Larson from Strand Associates who discussed fundamentals of biological phosphorus removal (BPR) optimization. The three main fundamentals include converting dissolved phosphorus into particulate phosphorus, minimizing TSS in your effluent, and understanding the composition of your phosphorus (where it’s at). He continued to discuss ways to enhance BPR, such as extending anaerobic zones and having a good source of VFAs. This could include using a fermenter, sewer fermentation, in-line fermentation, or purchasing substrate. Troy also discussed side-stream enhanced BPR and benefits compared to conventional BPR configurations. S2EBPR allows 10-25% of RAS to ferment in an anaerobic tank to create their own VFAs prior to the anoxic zone. Benefits include a higher microbial diversity, reduced solids washout during peak flow events, and more stable performance.

The next topic was best mixing practices by Mike Zelinsky from Xylem. Mike discussed why we need to mix, mixer sizing and thrust, positioning basics, adaptive mixing, maintenance and installation tips, and the opportunity to reduce power consumption. Adequate mixing helps to

continued on page 42
prevent settling, increase detention times, and reduce short circuiting. When in the correct position, we can prevent calm zones, reduce the number of mixers needed, increase efficiency, and improve effectiveness of the mixer. He also stated the importance of considering mixer changes after upgrades or permit changes. For example, after Nine Springs WWTP improved headwork screening their mixers were able to be reduced from 7.5 HP to 2.5 HP due to reduction of grit and trash. This provided them with significant energy savings.

The following speaker was Ben Heidemann from Town and Country Engineering. Ben gave an overview of the steps taken to join the Sullivan Village WWTP and the Sullivan Sanitary District into one facility. This project took extensive planning and communication to determine overall goal, funding, design, construction, and operation/staffing. The project scope for the village included abandoning the existing processes and installing a new pump station and a 4.3 mile force main to the district. The scope for the district included new headworks, secondary treatment package plan, aerated sludge treatment, and 180 day liquid storage. A commission was created to control WWTP operations and charge the district and village for services. The five commissioners consist of two individuals from each community and one at-large. The facility merge is expected to be complete by Fall of 2022.

The next presentation was by Brian Hoth from Altronex Control Systems on analytical device maintenance. Whether Hach, YSI, ABB, or other sensors, they will require cleaning, calibrations, and maintenance. He stated the importance of sensor cleaning and the steps to consider when doing so. Facilities should schedule regular cleanings at least once every 90 days, but maybe more often depending on the sensor and the water stream they are in. Calibrations should be performed at least once a year, when the sensor is installed or replaced, or after cleaning and the readings are questionable. Depending on the manufacturer and specific sensor, the calibrations will vary, so it is important to become familiar with the steps listed in your manual.

During the WWOA Southern District business meeting, the Treasurer’s report was provided. Randy Langer provided upcoming WWOA events including the annual conference in Lacrosse starting October 5, 2021 and the next WWOA Southern District meeting in Mount Horeb on October 28, 2021. He also reminded Southern District members about the two $250 tuition aid scholarships available. Members were in favor of McKala Kiessling becoming the new WWOA Southern District chairperson. Thank you Randy for your commitment to this organization.

Lastly, Evan Chambers from Town and Country Engineering provided an overview of the Fennimore Wastewater Utility. Due to increased facility loadings and aging infrastructure the facility began a large upgrade project in 2017. Some of the many upgraded processes include headworks, BPR in selector basins, biosolids pumping/aerobic digestion, and sludge storage. He also described construction challenges due to working around existing equipment and layers of bedrock and how they overcame them. The project was $480,000 under budget, so they also upgraded five lift stations while being 93% grant funded. Future work may include phosphorus filtration, secondary treatment expansion, and sludge thickening.

Fennimore Wastewater Utility tour at 860 Lincoln Avenue
Fennimore, WI 53809
Trouble Shooting Corner: Why phase contrast microscopy is important for wastewater applications

By Ryan Hennessy
Principal Scientist at Ryan Hennessy Wastewater Microbiology
https://rhwastewatermicrobiology.com/

While brightfield microscopes are useful for Gram staining, Neisser staining, and viewing of protozoa and metazoan it is extremely difficult (in most opinions impossible) to conduct accurate microscopy assessments without phase contrast capabilities. The contrast is needed to accurately view floc structure, filament abundance, filamentous impact on floc structure, and for identifying filamentous bacteria morphotypes and other indicator organism phenotypes. The attached pictures demonstrate the difference between brightfield and phase contrast and why phase contrast is needed for accuracy.

How Phase Contrast Microscopy Works
Not all phase contrast microscopes are created equally. The simple explanation is each objective has a different size ring inside of it. Each objective is typically labeled with Ph1, Ph2, or Ph3. The 10x and 20x objective are Ph1, the 40x will be Ph2, and the 100x will be Ph3. The ring inside the objective must match the ring called a phase annulus which is inserted into the condenser. Once the microscope is properly aligned, and the two rings are superimposed you are “in phase.” There are three different ways to insert the phase annulus into the condenser.

1. Individual snap on pieces. This method is an economical method and is not recommended as you physically have to add / remove components from the bottom of your condenser as you change objectives. It continued on page 44
can slow you down, lead to miss alignment of the phase rings, and or breaking / losing the parts.

2. A phase slider. This method involves inserting a bar into the slot of your condenser. You slide the bar left / right to put the corresponding phase annulus in position to match the objective. The issue with this method is that some models do not have enough space to have all phase annuli on the same bar, so you will need to remove one slider and insert the other slider. The second part is that the position you are at is not visible as it is hidden under the stage, so you need to look under the stage to verify which position you are in.

3. A phase turret. This is the most expensive method, but also the most convenient. This method involves a wheel that contains the phase annuli all in one. You simply rotate the wheel as you change objectives. The position of the phase turret is clear and right in front of you. A phase turret will typically have a darkfield spot on it in addition to phase and brightfield.

IN SUMMARY THERE ARE VARIOUS WAYS TO ACHIEVE PHASE CONTRAST WITH DIFFERENTIATING QUALITY.

Alignment of Phase Rings
To be “in phase” you must superimpose the phase ring in the objective to the corresponding phase annulus inserted into the condenser. The first step is to align your microscope for kohler illumination (if applicable). Once this is done you can begin to align the phase rings. This process is made easier by a phase centering telescope. You remove an eyepiece and insert the phase centering telescope which allows you to focus on the two rings.

The phase ring in the objective does not move, you will move the phase annulus in the condenser. The individual snap on pieces typically has two thumbscrews, the phase slider is sometimes pre-aligned, and you cannot move the annulus, if not you move them with allen wrenches. The phase turret condenser most of the time will have allen wrenches that are already in built into the condenser and you simply push in and turn them. The other method is that the condenser has two dials underneath that you rotate to move the annulus. Once you complete the phase alignment the position should hold unless someone disrupts the microscope.

- https://microscopecentral.com/pages/how-to-center-for-phase-contrast
- https://microscopecentral.com/pages/how-to-center-for-kohler-illumination

*The links above are good for understanding alignment of phase rings.

Purchasing Microscopes
As described above not all phase contrast microscopes are created equally and therefore quality among phase contrast microscopes may vary considerably. This platform is not for advertisement of any brands of microscopes over others, however it is important to do the homework as well as consider the long-term impact and practicality of any purchases.
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Clarifier advertisers index

USA Blue Book.......................................................... page 5
Process Equipment Repair Services............................... page 6
Cady Aquastore........................................................... page 7
Mulcahy Shaw Water-Teledyne ISCO .......................... page 8
LW Allen....................................................................... page 9
B&M Technical Service............................................... page 10
Clearas........................................................................ page 11
Badger Labs................................................................... page 12
B&M Technical Service-Crane ....................................... page 13
Visu-Sewer................................................................. page 14
Dorner ......................................................................... page 15
Xylem-Flygt ............................................................. page 17
Strand ........................................................................ page 18
Symbiont ..................................................................... page 19
Ruekert-Mielke .......................................................... page 30
Adaptor ........................................................................ page 31
JF Ahern ..................................................................... page 32
Energenecs .................................................................. page 33
B&M Technical Service-ShinMaywa .............................. page 34
Mulcahy Shaw Water-Borger ........................................ page 37
McMahon...................................................................... page 40
Applied Technologies.................................................. page 41
MSA .............................................................................. page 42
Staab Construction ..................................................... page 43
Clark Dietz.................................................................... page 44
Crane Engineering ....................................................... page 45
Donohue ....................................................................... page 46
Energenecs-Huber ....................................................... page 47
North Central Labs ...................................................... back page
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