

WATER ENVIRONMENT FEDERATION

Nutrient Symposium

2019

Nutrient Removal and Recovery Draft Technical Program

(Updated July 3, 2019)

July 23 - 25, 2019

**Renaissance Minneapolis Hotel, The Depot
Minneapolis, Minnesota**

Pre-Conference Workshops

(Additional fees apply)

Tuesday, July 23

8:30 AM – 5:00 PM

WORKSHOP A Removal and Recovery of Phosphorus: What Does the Future Hold?

The main objective this workshop is to address needs and challenges of mainstream phosphorus removal and recovery by showcasing and debating about recent advances. There have been concerted efforts to overcome inefficiencies of conventional phosphorus removal processes. Which is also aligned with wastewater utilities embracing a new paradigm of recovery of resources from wastewater. To this end, minimization of chemicals, energy and footprint requirements for phosphorus removal/recovery has been benefited from the use of efficient biological pathways as well as innovative processes.

WORKSHOP B Fundamentals of Nutrient Removal and Recovery: Theory, Technologies, Operation Troubleshooting using Process Simulators

This short course will cover the fundamental concepts of operating an activated sludge plant to achieve nitrogen and phosphorus removal via a combination of lecture material and hands-on use of a process simulator. The program includes a series of modules with each covering a fundamental concept of biological treatment or nutrient removal that will then be followed up with attendees being led through a series of simulations to demonstrate how the concept is applied to a plant layout. State-of-the-art software SimuWorks™ used in the class is based on the program, GPS-X, developed by Hydromantis. This program is commonly used for treatment process evaluation and design but has been enhanced to serve as a platform for plant O&M manuals and operator training. This software is the basis for the simulator event included in WEFTEC Operations Challenge. Each attendee will be provided with a computer to use for simulations through the course of the course.

Opening General Session

Wednesday, July 24

8:30 AM – 12:15 PM

- 8:30 AM** **Welcome to the 2018 Conference!**
Paul Wood, *Lockwood, Andrews & Newnam, Inc., 2019 Chair*
George Wells, *Northwestern University, 2019 Vice-Chair*
- 8:40 AM** **WEF Welcome**
Lynn Broaddus, *WEF Board of Trustees, Broadview Collaborative*
- 8:45 AM** **Welcome from CSWEA**
Patrick Haney, *HDR*
- 8:50 AM** **Grand Theme in the Nutrient Journey**
Cindy Wallis-Lage, *Black & Veatch*
- 9:25 AM** **Where Have we Come From?**
Peter Dold, *EnviroSim Associates Ltd.*
- 10:00 AM** **Networking Break**
- 10:45 AM** **Where are we Going?**
Belinda Sturm, *University of Kansas*
- 11:00 AM** **Where are we going? From treatment and disposal to processing and recovery through source separation**
Bilsen Beler Baykail, *Istanbul Technical University*
- 11:20 AM** **How are we going to get there?**
Lori Schectel, *Central Contra Costa Sanitary District*; Sandeep Sathyamoorthy, *Black & Veatch*;
Michael Falk, *HDR*
- 11:45 AM** **How are we going to get there? LIFT**
John Norton, *Great Lakes Water Authority*
- 12:05 AM** **Panel and Q&A**
- 12:15pm** **Session Adjourns for Luncheon**

Session 01: Granular Sludge
Wednesday, July 24
1:30 PM - 5:15 PM

Moderators: Bruce Johnson, Jacobs; Paul Wood, Lockwood, Andrews & Newnam, Inc

- 1:30 PM** **Full Scale Performance of Aerobic Granular Sludge Technology in North America**
Manuel De Los Santos, Terry Reid, Brian Bates, Aaron Glauch, Aqua-Aerobic Systems Inc
- 1:50 PM** **Operation and Performance of Sidestream Aerobic Granular Sludge Nitrifying Reactor**
Maxwell Armenta, H Stensel, University of Washington; Bob Bucher, Pardi Sukapanpotharam, King County West Point; Bao Nguyen-Quoc, Mari Winkler, University of Washington
- 2:10 PM** **Utilizing Metabolic Selectors to Facilitate the Path to Densification of Activated Sludge**
Wendell Khunjar, Hazen and Sawyer
- 2:30 PM** **Technical Brief: Extracellular Polymeric Substance Composition as Bridge Between Process and Clarifier Models**
Khoa Nam Ngo, Tim Van Winckel, DC Water; Arash Massoudieh; Imre Takacs, EnviroSim Associates Ltd; Bernhard Wett, ARA Consut; Charles Bott, Hampton Roads Sanitation District; Ahmed Al-Omari; Haydee De Clippeleir, DC Water
- 2:35 PM** **Facilitated Panel Discussion**
- 3:00 PM** **Networking Break**
- 3:45 PM** **Innovative Process for Granulation of Conventional Continuous Flow Activated Sludge - A Novel Cost Effective Infra-Stretching Concept to Treat More Flow and Remove/Recover More Nutrients Without Expanding Your Plant**
Beverly Stinson, Giampiero Galvagno, Keith Sears, AECOM
- 4:05 PM** **What Did We Learn from Three Full-Scale Hydrocyclone Implementations?**
Pusker Regmi, Jose Jimenez, Brown And Caldwell; Sudhir Murthy; Bernhard Wett, ARA Consut
- 4:25 PM** **Modeling Aerobic Granular Sludge Performance in Sequencing Batch Reactor**
Rasha Faraj, Jacobs; Belinda Sturm, University of Kansas; Jose Jimenez, Brown And Caldwell; Tanush Wadhawan
- 4:45 PM** **Technical Brief: Quantifying the Benefits of Densified Activated Sludge on Secondary Clarifier Capacity**
Alonso Griborio, Hazen & Sawyer; Belinda Sturm, University of Kansas; Rasha Faraj, Jacobs; Nandita Ahuja; Wendell Khunjar, Hazen and Sawyer; Paul Pitt
- 4:50 PM** **Facilitated Panel Discussion**
- 5:15 PM** **Session Adjourns for Networking Reception**

Session 02: Carbon Management for Nutrient Removal
Wednesday, July 24
1:30 PM – 3:00 PM

Moderators: Melody White, Hach Company; Joe Husband, Arcadis

- 1:30 PM** **Onsite VFA Production to Support Simultaneous EBPR and Denitrification- Role of Novel PAOs**
Ramesh Goel, Brendan Mackey, [Sunayna Dasgupta](#), [Aditi Podder](#), University of Utah
- 1:50 PM** **Energy-Positive Wastewater Treatment Based on an Anaerobic Moving Bed Biofilm Reactor (AnMBBR) and Mainstream Anammox MBBR Process**
[Fernando Morgan-Sagastume](#), My Carlsson, Magnus Christensson, Henrique Sánchez, Anoxkaldnes-Veolia Water Technologies AB; Hong Zhao, Veolia Water Technologies/Kruger Inc
- 2:10 PM** **Redirecting Methane for Biological Nitrogen Removal: Enrichment of Nitrifying-Denitrifying Methanotrophic Mixed Culture an a Sequential Batch Reactor**
Ahmed Eldyasti, [Danelle Bishoff](#), Ahmed Fergala, Ahmed Alsayed, York University
- 2:30 PM** **Technical Brief: Primary Sludge Fermentation: Sustainable and Economic Process of Supplementing Carbon for Short Cut Nitrogen Removal**
[Priyanka Ali](#), George Washington University; Nadezhda Zalivina, University of South Florida; Tri Le, Rumana Riffat, George Washington University; Bernhard Wett, ARA Consut; Sudhir Murthy; Charles Bott, Hampton Roads Sanitation District; Sarina Ergas, University of South Florida; Salil Kharkar, Ryu Suzuki, Christine deBarbadillo, DC Water; Ahmed Al-Omari; Haydee De Clippeleir, DC Water
- 2:35 PM** **Facilitated Panel Discussion**
- 3:00 PM** **Session Adjourns for Networking Break**
- Poster:** **Piloting Mainstream Partial Nitrification-Anammox in a Two-Stage Configuration**
[Maciej Kowalski](#), University of Manitoba; Tanner Devlin, Nexom; Alessandro di Biase, Jan Oleszkiewicz, University of Manitoba

Session 03: Phosphorus Recovery

Wednesday, July 24

1:30 PM - 5:15 PM

Moderators: Patrick Haney, HDR; Thor Young, GHD

- 1:30 PM** **Realizing The Promise of Nutrient Recovery**
Ron Latimer, Bryan Atieh, Wendell Khunjar, Hazen & Sawyer; Kristen Wisdom, MWRD; Gayathri Ram Mohan, Gwinnett County - Department of Water Resources
- 1:50 PM** **Building upon Practice and Experience from Early Adopters of Sidestream Phosphorus Recovery**
Bryan Coday, Tanja Rauch-Williams, Carollo Engineers
- 2:10 PM** **High Efficiency Calcium Phosphate Recovery Technology at The Madison Metropolitan Sewerage District: Stability Metrics, Design Optimization, and Performance**
Menachem Tabanpour, Centrisys-CNP; Phillip Barak, Mauricio Avila, Nutrient Recovery & Upcycling; Zhongtian Li, Centrisys/CNP; Hiroko Yoshida; Gerhard Forstner, Centrisys/CNP; Leon Downing, Black & Veatch; Wendell Khunjar, Hazen and Sawyer
- 2:30 PM** **Technical Brief: Struvite Recovery through Electrochemical Phosphorus Precipitation in Side-stream. Industrial Scale Application of ePhos® at High Phosphorus Concentrations**
Iosif Mariakakis, Siegfried Egner, Fraunhofer IGB
- 2:35 PM** **Facilitated Panel Discussion**
- 3:00 PM** **Networking Break**
- 3:45 PM** **Finding the Right Solution for Phosphorus Harvesting: A Risk Based Approach to the Evaluation of Process Alternatives**
Greg Knight, Black & Veatch; Bikram Sabherwal; Lucas Botero; Leon Downing, Eric Redmond, Black & Veatch
- 4:05 PM** **Innovative Process for the Recovery of Magnesium Phosphate (Newberyite) and Ammonia from Digester Effluents**
Matias Vanotti, USDA; Patrick Dube, Water Environment Federation
- 4:25 PM** **Emergy Evaluation of Wastewater-Derived Struvite as an Alternative to Conventional Fertilizer for Crop Production**
Ranjani Theregowda, Xin Ma, Jay Garland, U.S.Environmental Protection Agency
- 4:45 PM** **Technical Brief: Determining the Dissolution Rate of Field Grown Struvite**
Sam Aguiar, University of Illinois at Urbana Champaign; Adrian Romero, CH2M; Leon Downing, Black & Veatch; Rachel Lee, Ostara Nutrient Recovery Technologies, Inc.; Tom Johnson, CH2M; Roland Cusick, University of Illinois
- 4:50 PM** **Facilitated Panel Discussion**
- 5:15 PM** **Session Adjourns for Networking Reception**
- Poster:** **Beneficial Reuse of High Strength "Waste" to Achieve Stable EBPR at Gary Sanitary District**
Anthony Giovannone, CDM Smith; Rhonda Anderson

Session 3 Posters Continued on the Next Page

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Poster: **A Case Study of Using a Revolving Algal Biofilm (RAB) Treatment System to Treat Anaerobic Digester Effluent at Pilot Scale**
Martin Gross; Xuefei Zhao, Zhiyou Wen, Max Gangestad, Gross-Wen Technologies

Session 04: Planning and Decision Making
Wednesday, July 24
3:45 PM - 5:15 PM

Moderators: Gary Rabalais, Jones|Carter; Rob Sharp, Manhattan College

- 3:45 PM** **The Power of Principle: How One Danish Utility is Achieving Sustainable Development Goals in their Operations**
Per Henrik Nielsen, Mads Leth, Troels Kærgaard Bjerre, VCS Denmark
- 4:05 PM** **Embracing the Uncertain Allows NEW Water to Plan for their Upcoming Phosphorus TMDL**
Colin Fitzgerald, Jacobs; Thomas Sigmund, Green Bay Metro Sewerage Dist; Nathan Qualls, Philip Mentink, New Water, Green Bay Metro Sewerage Dist; William Desing, Jacobs; Brent Brown, CH2M-Jacobs Engineering Group; Leon Downing, Black & Veatch; Glen Daigger, University of Michigan
- 4:25 PM** **Tool for Estimation of Capital and Operating Costs of Nitrogen and Phosphorus Recovery from Wastewater and Agricultural Wastes**
Ankit Pathak, Kelly Landry, Wendell Khunjar, Hazen and Sawyer; Christine Radke, The Water Research Foundation
- 4:45 PM** **Facilitated Panel Discussion**
- 5:15 PM** **Session Adjourns for Networking Reception**
- Poster:** **Comprehensive Modelling of Full-Scale Nitrifying and Post-Denitrifying Biofilters**
Jialu Zhu, Université de Technologie de Compiègne; Jean Bernier, SIAAP, Direction Innovation et Environnement; Bernard Patry, Université Laval – modelEAU; Sam Azimi, SIAAP, Direction Innovation et Environnement; André Pauss, Université de Technologie de Compiègne; Vincent Rocher, SIAAP, Direction Innovation et Environnement; Peter Vanrolleghem, Université Laval – modelEAU
- Poster:** **Performance of Pilot-scale Anaerobic Ammonium Oxidation (Anammox) Reactors in Treating Ammonium Rich Wastewater for Pima County Wastewater Reclamation Facility (WRF)**
Guangbin Li, University of Maryland; Jim Field, University of Arizona; Jeff Prevatt, Pima County Wastewater Management; Mallory McMurray, University of Arizona; Jacob Smutzer, Steve King, Pima County Regional Wastewater Reclamation Department; Joleen Shiroma, Reyes Sierra-Alvarez, University of Arizona
- Poster:** **Watershed Protection through Liquid Manure Valorisation – Turning a Problem into a Commodity**
Iosif Mariakakis, Siegfried Egner, Fraunhofer IGB
- Poster:** **Simplification of Treatment Processes and Equipment Replacement Results in Energy Efficient Biological Nutrient Removal at the Bensenville, IL WWTF**
Troy Stinson, Nick Bartolerio, Strand Associates
- Poster:** **Fast Scale-Up Strategies of Pilot-Scale Single-Stage Deammonification Seeded with Conventional BNR (Biological Nutrient Removal) Sludge**
Daehee Choi, Hojin Shin, Dongeun Park, Sukhyun Cho, Jinyoung Jung, Yeungnam University

Session 05: Biological Phosphorus Removal: Main/Sidestream
Thursday, July 25
8:30 AM- 12:15 PM

Moderators: Brian Mitchell, WesTech Engineering; Kumar Upendrakumar, Veolia

- 8:30 AM** **Meeting Stringent Phosphorus and Copper Limits in BNR Processes: Challenges, Success and Lessons Learned**
Mehran Andalib, Stantec; Kristen Rolison, MWH; [Christopher Andres](#), Art Umble, Stantec
- 8:50 AM** **Integrating BioP and Shortcut Nitrogen Removal via RAS Fermentation and Partial Denitrification/Anammox**
[Stephanie Klaus](#), HRSD; Kathryn Printz, Water Environment Federation; Kester McCullough, HRSD; Varun Srinivasan, Brown and Caldwell; Dongqi Wang, Xi'an University of Technology; Peisheng He, Cornell University; Haydee De Clippeleir, DC Water; April Gu, Department of Civil and Env. Eng; Charles Bott, Hampton Roads Sanitation District
- 9:10 AM** **Elucidating the Microbial Ecology of Side-stream Enhanced Biological Phosphorus Removal (S2EBPR)**
[Varun Srinivasan](#), Brown and Caldwell; Nicholas Tooker, Northeastern University; Dongqi Wang, Xi'an University of Technology; Guangyu Li, Annalisa Onnis-Hayden, Ameet Pinto, Northeastern University; April Gu, Department of Civil and Env. Eng
- 9:30 AM** **Technical Brief: S2EBPR Case Study – Full Scale Experience at South Cary Water Reclamation Facility 20 Years of Sidestream EBPR Process Operation**
[Frederick Stroud](#), CDM Smith
- 9:35 AM** **Facilitated Panel Discussion**
- 10:00 AM** **Networking Break**
- 10:45 AM** **Insights on Bio-P Optimization Using MLSS Fermentation at the Western Wake Regional WRF**
[David Wankmuller](#), Wendell Khunjar, Katya Bilyk, Joseph Rohrbacher, Ron Latimer, Hazen & Sawyer; Damon Forney
- 11:05 AM** **Elucidating Factors for the Success or Failure of Biological Phosphorus Removal: A Comparison Between Two Lab-Scale and One Pilot/Full-Scale EBPR Processes**
[Paul Roots](#), Northwestern University; Fenghua Yang, Milwaukee Metropolitan Sewage District; Fabrizio Sabba; Alex Rosenthal; Joseph Kozak, Heng Zhang, MWRD of Greater Chicago At Cicero Stickney WTP; George Wells, Northwestern University
- 11:25 AM** **The New Nutrient! Applications of Sulphur and Redox Modeling in Phosphorus Control**
[Bruce Johnson](#), Colin Fitzgerald, Heather Stewart, Jacobs
- 11:45 AM** **Technical Brief: Organic Phosphorus Removal using an Integrated Advanced Oxidation/Ultrafiltration System and Implications for Phosphorus Recovery**
Holly Gray, Tony Powell, Purifics Water Inc.; [Scott Smith](#), Wilfrid Laurier University, Department of Chemistry; Wayne Parker, University of Waterloo
- 11:50 AM** **Facilitated Panel Discussion**
- 12:15 PM** **Session Adjourns for Lunch**
- Poster:** **Going Green: Mankato WRRF Clearas ANBR Bench Scale Testing**
[Patrick Haney](#), HDR

Session 06: High Strength Wastewater Treatment

Thursday, July 25

8:30 AM- 10:00 AM

Moderators: Zhongtian Li, Centrysis CNP; Nerea Uri Carreño, VCS Denmark

8:30 AM IFAS ANITA™ Mox Deammonification Process for Treating THP Reject Water: from Lab/Pilot Scale Development to Full Scale Implementation

Hong Zhao, Meg Hollowed, Romain Lemaire, Laure Graveleau, Frederic Veuillet, Veolia Water Technologies; Magnus Christensson, AnoxKaldnes AB; Brandy Nussbaum, Veolia Water Technologies

8:50 AM Treatment of Gold Mine Wastewater with Aerobic Up-Flow Submerged Attached Growth Reactor

Alessandro di Biase, Victor Wei, Maciej Kowalski, University of Manitoba; Michael Bratty, Golder; Martin Hildebrand, Nelson Environmental; Tanner Devlin, Nexom; Pouria Jabari; Jan Oleszkiewicz, University of Manitoba

9:10 AM Successful Upcycling of Residual Brewery Nutrients into an SCP Ingredient

Seth Terry, Andy Logan, Jian Hua Song, iCell Sustainable Nutrition

9:30 AM Technical Brief: Single Stage Partial Nitrification/Anammox in Treatment of Complicated Urban Waste-streams Containing High Recalcitrant Organic Matter

Aditi Podder, University of Utah; Debra Reinhart, University of Central Florida; Ramesh Goel, University of Utah

9:35 AM Facilitated Panel Discussion

10:00 AM Session Adjourns for Networking Break

Session 07: Operations Experience at Nutrient Removal Plants
Thursday, July 25
8:30 AM- 10:00 AM

Moderators: Mark Miller, Brown and Caldwell; Mehran Andalib, MWH

- 8:30 AM** **Record Rainfall and Sewer Flows Not Enough to Dampen New Denitrification Filter Startup**
Thor Young, Scott Crosswell; Peng Chen, GHD; Stona Cosner, City Of Frederick Public Works
- 8:50 AM** **Real-Time Process Controls to Meet Increasingly Stringent Effluent Limits and Improve Operational Sustainability: A Case Study of Three North Carolina Facilities**
Victoria Boschmans, Katya Bilyk, Hazen and Sawyer; Erika Bailey, City of Raleigh; Nathan Howell; John Dodson, Charles Cocker, City Of Durham
- 9:10 AM** **Full-Scale Optimization of a BNR Facility in Northwest Montana**
Rickey Schultz, HDR
- 9:30 AM** **Technical Brief: How Biological Filtration Was Used to Surpass Tough Nitrogen Limits for Long Island Sound**
Matt Edds, Kruger; Glenn Thesing, Veolia Water Technologies; Anthony Della Valle, Westchester County Department of Environmental Facilities
- 9:35 AM** **Facilitated Panel Discussion**
- 10:00 AM** **Session Adjourns for Networking Break**

Session 08: Membrane Aerated Biofilm Reactors
Thursday, July 25
10:45 AM - 12:15 PM

Moderators: Phil Ackman, Sanitation Districts of Los Angeles County; Patrick Haney, HDR

- 10:45 AM** **BNR Process Intensification using Membrane Aerated Biofilm Reactors**
Sandeep Sathyamoorthy, Yueyun Tse, Kelly Gordon, Black & Veatch; Dwight Houweling; Daniel Coutts, Suez Water
- 11:05 AM** **A One Year Demonstration of Nutrient Removal with Membrane Aerated Biofilm Reactor (MABR)**
Jose Bicudo, Associated Engineering; Barry Heffernan, OxyMem; Amber Klassen, Associated Engineering; Max Rao; John McConomy, Eoin Syron, OxyMem; Leigh McDermott, Region of Waterloo
- 11:25 AM** **Going Bubbleless: Design and Start-Up of the Full-Scale MABR Demonstration at the Ejby Mølle WRRF**
Tim Constantine, Jacobs; Nerea Uri, VCS Denmark; Julian Sandino; Adrienne Willoughby, Jacobs; Per Henrik Nielsen, VCS Denmark
- 11:45 AM** **Technical Brief: Simultaneous Nitrification and Denitrification Throughout a Multi Stage Process Comprising Membrane Aerated Biofilm Reactors**
Ronen Shechter, Yedidya Heffes, Fluence
- 11:50 AM** **Facilitated Panel Discussion**
- 12:15 PM** **Session Adjourns for Lunch**

Session 09: Ultra-Low Nutrient Effluent and Reuse
Thursday, July 25
10:45 AM - 12:15 PM

Moderators: Maureen Kinyua, UC Davis; Uma Vempati, ISG

- 10:45 AM** **Maximizing TN Removal and Reliability for SWIFT Reuse with Upstream Controls**
Heather Stewart, Bruce Johnson, Tyler Nading Jacobs; Charles Bott, Michael Parsons, Hampton Roads Sanitation District
- 11:05 AM** **Technical Brief: Exeno: Removal of Micropollutants in Municipal WWTP Effluents with Moving Bed Biofilm Reactors**
Elena Torresi, Veolia Water Technologies-AnoxKaldnes; Magnus Christensson, AnoxKaldnes AB; Henrik Andersen, Kai Tang, DTU; Christina Sund, Heidi Andersen, Kruger; Hong Zhao, Veolia Water Technologies/Kruger Inc; Brandy Nussbaum, Veolia Water Technologies
- 11:25 AM** **Meeting Ultra-Low Effluent Quality Standards in Lagoons and Mechanical Plants**
Tanner Devlin, Nexom
- 11:45 AM** **Facilitated Panel Discussion**
- 12:15 PM** **Session Adjourns for Lunch**
- Poster:** **Study of Three Enhanced Nutrient Removal (ENR) Facilities Meeting Stringent Nutrient Limits in the Chesapeake Bay Watershed**
Ankit Pathak, Gregory Pace, Wendell Khunjar, Hazen and Sawyer
- Poster:** **Impact of Averaging Periods on Nutrient Discharge Load and WRRF Design**
JB Neethling, Michael Falk, Samuel Bruce, David Clark, HDR
- Poster:** **Achieving Low Effluent Nutrient Concentrations with No Chemical Addition: Results of a BNR Optimization Study at the 2.54 MGD Louisville, Colorado WWTP**
Patrick Radabaugh, Dewberry Engineers; Just Elkins, City of Louisville

Session 10: Reality Check: Mainstream Shortcut Nitrogen

Thursday, July 25

1:30 PM - 5:15 PM

Moderators: Pusker Regmi, Brown and Caldwell; Weihua Peter Peng, Suez

- 1:30 PM** **AlexRenew's Experience with Aeration Controls for Shortcut Nitrogen Removal**
Paula Sanjines, Jacobs; Hari Santha, Kacey King-Mcrae, Alexandria Renew Enterprise; Timothy Constantine, Adrienne Willoughby, Jacobs
- 1:50 PM** **Concurrent Mainstream Deammonification and Phosphorus Removal Using the ANITA Mox Process: A Pilot-Scale Evaluation at the Joint Water Pollution Control Plant (JWPCP)**
Eric Krikorian, Hana Chmielewski, Thomas Knapp, Michael Liu, Nikos Melitas, LA County Sanitation District; Hong Zhao, Veolia Water Technologies/Kruger Inc; Mitchell Johnson, Kruger
- 2:10 PM** **Single-sludge Shortcut N and Biological P Removal for Sustainable Mainstream Wastewater Treatment in Temperate Climates**
Paul Roots, Northwestern University; Fabrizio Sabba; Alex Rosenthal; Yubo Wang, Northwestern University; Quan Yuan; Fenghua Yang, Milwaukee Metropolitan Sewage District; Joseph Kozak, Heng Zhang, MWRD of Greater Chicago At Cicero Stickney WTP; George Wells, Northwestern University
- 2:30 PM** **Technical Brief: Electron Competition as a Mechanism of Nitrite Accumulation in a Denitrating Culture**
Matthew Baideme, Julian van der Made, Kartik Chandran, Columbia University
- 2:35 PM** **Facilitated Panel Discussion**
- 3:00 PM** **Networking Break**
- 3:45 PM** **Exploring the Conversion of Tertiary Denitrification to Mainstream Deammonification: Pilot Scale Filter Results and Challenges**
Eric Polli, North Carolina State University; Katya Bilyk, Wendell Khunjar, Hazen and Sawyer; Erika Bailey, City of Raleigh; Tarek Aziz, Francis De Los Reyes, North Carolina State University
- 4:05 PM** **Pushing Process Intensification Limits for Biological Nitrogen Removal using Gel Entrapment Technology**
Mehran Andalib, Carla Cherchi, Art Umble, Stantec Inc.; Jacangelo; Shu Tsuda, Hiroyuki Yoguchi, Hitachi, Ltd.; Kellogg Schwab, Johns Hopkins Bloomberg School of Public Health; Bradley Schmitz, Johns Hopkins University
- 4:25 PM** **Nitrogen Removal from Water Resource Recovery Facilities Using Partial Nitrification, Denitrification-Anaerobic Ammonia Oxidation (PANDA)**
Wendell Khunjar, Hazen and Sawyer
- 4:45 PM** **Technical Brief: Lab-scale Results from a Partial Nitrification / Anammox Membrane Aerated Biofilm Reactor (MABR) for Mainstream Nitrogen Removal**
Brett Wagner, Glen Daigger, University of Michigan; Nancy Love, Virginia Tech
- 4:50 PM** **Facilitated Panel Discussion**
- 5:15 PM** **Symposium Adjourns**

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Poster: Using Sensor-Mediated Control to Achieve Energy Efficient Mainstream Nitrogen Removal with Next Generation Treatment Systems: Long Term Stability and Operating Strategies
Zerihun Bekele, University of Michigan; Charles Bott, Hampton Roads Sanitation District; Nancy Love, Virginia Tech

Poster: Stability of Partial Nitrification–Anammox Process Using Immobilized Gel Carriers For Mainstream Deammonification
Shoko Miyamae, Hitachi, Ltd.; Yuya Kimura; Shinichi YOSHIKAWA, Hitachi,Ltd

Session 11: Case Studies and Optimization
Thursday, July 25
1:30 PM - 5:15 PM

Moderators: Clint Rogers, Stantec; Jeanette Brown, Manhattan College

- 1:30 PM** **3 Million Pounds of Nitrogen Removed and Counting at the Fairfax County NCPCP**
Gregory Pace, Joseph Rohrbacher, Wendell Khunjar, Ronald Taylor, Janice Carroll, Hazen & Sawyer; Sarah Motsch; Mujahid Ali, Fairfax County Government
- 1:50 PM** **Adapting to the Unexpected: Pre-digestion Waste Activated Sludge Phosphorus Release Process Design and Optimization at St. Cloud Nutrient, Energy & Water Recovery Facility**
Derek Lycke, Ostara Nutrient Recovery Technologies Inc.; Patrick Shea, Tracy Hodel, Emma Larson, City of St Cloud; Rachel Lee, Pavan Patel, Joshua Benoit, Ostara Nutrient Recovery Technologies Inc
- 2:10 PM** **Achieving Nitrification and Nutrient Removal through Mainstream Bio-Augmentation from Parallel Plant**
Mario Benisch, Partick Young, HDR Engineering Inc; Andy Clements, City of St Joseph
- 2:30 PM** **Facilitated Panel Discussion**
- 3:00 PM** **Networking Break**
- 3:45 PM** **Optimization Strategies at Four BNR Facilities to Reduce Nutrients and Operating Costs**
David Wankmuller, Katya Bilyk, Hazen and Sawyer; Eric Polli; Damon Forney; John Dodson, Charles Cocker, City Of Durham; Jeffery Mahagan
- 4:05 PM** **Economic Analysis of Removing Orthophosphate and Improving Dewaterability of Digested Sludge by Struvite Precipitation in Digested Sludge**
Zhongtian Li, Gerhard Forstner, Menachem Tabanpour, Centrisys/CNP; Hiroko Yoshida
- 4:25 PM** **Denitrifying PAOs for Low- Carbon and Low-Energy Nutrient Removal in Cold Weather Conditions: The Ejby Mølle Case Study**
Nerea Uri, Per Henrik Nielsen, VCS Denmark; Timothy Constantine, Jacobs; Kartik Chandran, Catherine Hoar, Columbia University; Christine deBarbadillo, DC Water; George Wells, Northwestern University
- 4:45 PM** **Technical Brief: An Energy Evaluation of Nitrogen Removal Methods: Is Fancy Nitrogen Removal Worth the Effort?**
Bruce Johnson, Colin Fitzgerald, Jacobs
- 4:50 PM** **Facilitated Panel Discussion**
- 5:15 PM** **Symposium Adjourns**

Session 12: Microbial Ecology
Thursday, July 25
1:30 PM – 5:15 PM

Moderators: George Wells, Northwestern University; Guangbin Li, University of Maryland, College Park

- 1:30 PM** **Generous Orthodoxy: Understanding the Future of Dissolved Oxygen Setpoints While Acknowledging the Past**
Leon Downing, Black & Veatch; Eric Redmond; Colin Fitzgerald, Jacobs
- 1:50 PM** **Single-Cell Raman Spectroscopy-Based Phenotyping Revealed Metabolic Difference Between Side-Stream and Conventional Enhanced Biological Phosphorus Removal Systems**
Dongqi Wang, Xi'an University of Technology; Nicholas Tooker, Guangyu Li, Northeastern University; Varun Srinivasan, Brown and Caldwell; Annalisa Onnis-Hayden, Northeastern University; April Gu, Department of Civil and Env. Eng; Peisheng He, Cornell University
- 2:10 PM** **Glycerol-Driven Dissimilatory Nitrate Reduction to Ammonium (DNRA): Impact of Kinetic-Limitation on System Performance and Microbial Ecology**
Matthew Baideme, Columbia University; Luke Plante, Michael Butkus, United States Military Academy; Kartik Chandran, Columbia University
- 2:30 PM** **Facilitated Panel Discussion**
- 3:00 PM** **Session Adjourns for Networking Break**

Session 13: General Nutrient Management
Thursday, July 25
3:45 PM - 5:15 PM

Moderators: Patrick O'Donnell, INVENT Environmental Technologies, Inc.; Mark Halm, Deuchler Engineering Corp.

- 3:45 PM** **Strategies, Tools, and a Case Study for Implementing Watershed Nutrient Management**
Brent Brown, CH2M-Jacobs Engineering Group; Jeffrey Smudde, New Water, Green Bay Metro Sewerage Dist; Megan Bender, Jacobs
- 4:05 PM** **Simultaneous Organic Matter Removal and Nitrification in a Highly Loaded Aerated Lagoon Enhanced with Biofilm**
Bernard Patry, Paul Lessard, Peter Vanrolleghem, Université Laval - modelEAU
- 4:25 PM** **Comparison of a Modified and Traditional Rapid Infiltration Basin for Control of Nitrate in Reclaimed Water**
Jessica Cormier, Steven Duranceau, University of Central Florida
- 4:45 PM** **Facilitated Panel Discussion**
- 5:15 PM** **Symposium Adjourns**
- Poster:** **Coupled Anoxic Suspended Growth and Membrane Aerated Biofilm Reactor Process Options**
Avery Carlson, Glen Daiggerr, University of Michigan