

Student Design Competition 2023



October 1st, Sunday
McCormick Place,
Chicago, IL



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Welcome to the 2023 WEF Student Design Competitions!



The WEF Student Design Competitions were developed to provide a forum to showcase top students who will be future water quality professionals. The competitions provide university students with an opportunity to highlight their skills and share their enthusiasm for the water environment while addressing real world design challenges. A list of this year's participating teams and each team's abstract are included in this program.

We encourage you to engage with these motivated students during breaks and at the **SYP Networking Reception at 8 pm (CST) on Monday, Oct. 2 at Hubbard Inn** (110 W Hubbard St, Chicago, IL 60654). The Networking Reception will be a great opportunity for further small group interaction with these bright students. There will also be a **Networking and Career Fair with a professional headshot booth in Hall B, Booth 6770 between 1-4 pm Monday, Oct. 2.**

On behalf of WEF and the WEF Students and Young Professionals Committee, we would like to thank: the sponsors of this year's

competition - **Tetra Tech, Arcadis, Black & Veatch, Vaughan, CDM Smith, and GHD** for their support of this event; the judges for their time and personal contributions; and the WEF Board of Trustees for their support of the Students and Young Professionals Programs. Howard Carter, 2023-2024 WEF Vice President, will announce this year's winners of the Student Design Competitions. Thank you to the students and their advisors for their motivation and enthusiasm.

The Student Design Competition Sub-Committee supports the design competition at the Member Association (MA) level as well as the national level. Each MA is encouraged to develop their own Student Design Competition based on a chosen design problem or allow student teams to develop their own problems and solutions. The winner of each MA competition will be invited to compete at WEFTEC in that year. If only one school is willing to participate within the MA, that team may compete at WEFTEC assuming they meet the guidelines.

It is at the discretion of each MA to adopt or change the competition guidelines developed by the WEF Sub-Committee in order to have a successful competition. The guidelines established by WEF shall be followed during the WEFTEC competition. The competitions are designed to emphasize both high quality written and oral technical presentations. Scoring is determined through an evaluation of the teams' written and oral presentation skills,

along with the technical content of the design solution. Teams have submitted a design report for review by the judges. At WEFTEC, the teams are required to give an oral presentation of their design project followed by a question and answer period during which only the judges may ask questions. Teams will receive scores based on their design report, presentation, and responses to judges' questions.

We are excited to welcome 27 teams from 25 schools representing 20 member associations and 3 countries who are participating in the water environment and wastewater competitions.

Please contact the SDC sub-committee if your MA is interested in participating in the future!



For more information, please contact:

WEF SYPC Sub-Committee Co-Chair:

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WEF Students & Young Professionals Committee

The mission of the WEF Students and Young Professionals Committee (SYPC) is to encourage and facilitate student and young professional involvement in WEF and the Member Associations through professional development and leadership opportunities. One of WEF's strategic initiatives is to encourage the involvement of students and young professionals in the organization. The following programs have been developed to provide opportunities for students and young professionals:

- Student chapters in colleges and universities
- Reduced student and YP membership rates
- Free registration for WEF Student Members attending WEFTEC, WEF conferences, and webcasts
- WEFTEC Student and Young Professionals Career Fair, Student Lounge, Students & Young Professionals Meeting, and Student Design Competition
- WEF Community Service Project and Water Palooza
- YP Summit, a professional development event
- Midyear Springboard Program
- Technical workshop development opportunities
- Stockholm Junior Water Prize
- WEF Canham Graduate Studies Scholarship

The SYPC is made up of students, young professionals, academics, and water quality professionals. We welcome your participation in the WEF SYPC and/or on a student activities or young professional committee at your local member association.

The SYPC and WEF encourage you to take advantage of WEF membership benefits. For more information contact Brad Lovett, WEF Manager, Association Engagement for Students and Young Professionals, at (703) 684-2455 or email: BLovett@wef.org.

Past WEF SDC Winners

Year	Water Environment Competition	Wastewater Competition
2022	University of Waterloo	University of Texas—Austin
2021	California State Polytechnic University, Pomona	Clemson University
2020	University of Guelph	Colorado School of Mines
2019	University of British Columbia	University of Colorado - Boulder
2018	University of British Columbia	University of Colorado - Boulder
2017	University of Guelph	University of Colorado - Boulder
2016	University of Minnesota, Twin Cities	Southern Methodist University
2015	North Dakota State University	Southern Methodist University
2014	University of British Columbia and University of North British Columbia	University of South Florida
2013	University of British Columbia	University of South Florida
2012	University of South Florida	University of Colorado - Boulder
2011	University of Florida	University of Wyoming
2010	University of Florida	Southern Methodist University
2009	University of Florida	University of Colorado - Boulder
Year	Combined Competition	
2008	University of Florida	
2007	University of Florida & North Dakota State University (tie)	
2006	University of Florida	
2005	University of South Florida	
2004	University of Washington	
2003	University of Central Florida	
2002	University of New York at Buffalo	

Competition Schedule

Start Time	Wastewater Competition (Room S102b)	Water Environment Competition (Room S103b)
7:30	<i>Teams Arrive for Check-In and Breakfast</i>	
8:00	<i>Opening Welcome (Rooms TBD & TBD)</i>	
8:15	University of California, Riverside	Northeastern University (Small Solutions for Big Pollution: Bench-scale Bioremediation of 1,4-dioxane contaminated groundwater)
8:40	University of Florida	Old Dominion University
9:05	Iowa State University	Georgia Institute of Technology
9:30	<i>Break</i>	
9:40	University of Nevada, Las Vegas	SUNY: College of Environmental Science and Forestry
10:05	Milwaukee School of Engineering	University of Tennessee, Knoxville
10:30	Manhattan College	University of British Columbia
10:55	<i>Break</i>	
11:05	Universidad de Costa Rica	University of South Florida
11:30	Washington University in St. Louis	Utah State University
11:55	University of Colorado Boulder	<i>Lunch</i>
12:20	<i>Lunch</i>	John Hopkins University
12:50	Texas Tech University	California State Polytechnic University, Pomona
1:15	Old Dominion University	Northeastern University (Rosie's Commons: Design for a Sustainable Mixed-Use Land Development in the City of Salem, CA)
1:40	University of Guelph	<i>Break</i>
2:05	<i>Break</i>	University of Wisconsin, Madison
2:15	North Carolina State University	Illinois Institute of Technology
2:40	Carnegie Mellon University	<i>Break</i>
3:05	<i>Break</i>	
3:15	<i>Process Challenge (Room TBD)</i>	
4:45	<i>Networking Dessert Reception & Team Photos (Room TBD)</i>	
5:15	<i>WEF Address & Awards Ceremony (Room TBD)</i>	

California State Polytechnic University, Pomona

COMPETITION: Water Environment

Environmental Remediation of Surface Water Bodies in California



TEAM MEMBERS:

Oliver Reynolds

Paula Morales

Amparo Medina

Christie Jolie Carino

FACULTY ADVISOR:

Monica Palomo, PhD, PE, BCEE

MA CONTACT:

Megan Barillo, California Water Environment Association

ABSTRACT:

The design aims to develop an integrated design to remediate impaired surface water bodies in California, utilizing natural processes. Puddingstone Reservoir, a 250-acre body of water in Southern California, is hyper-eutrophic with high levels of nitrate and phosphorus. The proposed design includes floating islands and bio-detention basins, incorporating cattails (*Typha angustifolia*) to remove contaminants. Floating islands, constructed with redwood frames, will target contaminants in stagnant waterways. Each octagonal

island will occupy 309 sq.ft and utilize phytoremediation through cattails to absorb contaminants. Bio-detention basins, located in the parking area, will collect runoff from populated areas. Water will be filtered through cattail vegetation and soil media before returning to the reservoir. The design consists of 160 floating islands in two southwest sites and three bio-detention basins. The expected uptake of phosphorus for cattails is 0.007 g/(m²*yr.). Remediation of the water body is estimated to take around 20 years, assuming

no additional contaminants enter while the bioretention basins will limit the accumulation of phosphorous. The integrated design aims to harness nature's processes for the remediation of impaired water bodies, protecting human and environmental health. Long-term monitoring and maintenance will be essential for sustained water quality improvement in Puddingstone Reservoir.

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Carnegie Mellon University, Pittsburgh

COMPETITION: Wastewater

Optimizing F/M Ratio in Wastewater Treatment Plants: Developing Adaptive Strategies to Manage Sludge, Substrate, and Treatment Efficiency



TEAM MEMBERS:

Megan Johnston

Labdi Kagdi

Victoria Kurker

Fiza Jalees

FACULTY ADVISOR:

Joe Moore, PhD

MA CONTACT:

Vishal Vaidyanathan, Pennsylvania Water Environment Association

ABSTRACT:

Wastewater inputs vary throughout the year both in quantity and composition. The food microorganism ratio (F/M) balance must adjust accordingly to sustain effective wastewater treatment. Ineffective settling and formation of pin flocs in the secondary treatment basin generates turbid effluent leading to poor wastewater treatment. The ALCOSAN Wastewater Treatment Facility is currently undergoing an expansion process, from a capacity of 250 MGD to 600 MGD, to treat more water, particularly rainwater with

low substrate levels. ALCOSAN currently faces persistent issues when trying to maintain their microorganism population; their F/M ratio is consistently small. This project aims to help ALCOSAN balance their F/M ratio by modeling the current inputs and outputs, assessing sources of additional food, and reimagining their facility protocols as they expand. To address the feasibility of different alternatives studied, we developed a Life Cycle Assessment (LCA) utilizing “cradle to gate” analysis to determine the

best wastewater treatment solution in terms of global warming, eutrophication potential, coupled with cost analysis. This project aims to explore these concepts further to help ALCOSAN and other wastewater treatment facilities identify the most sustainable approach to reach F/M equilibrium.

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Georgia Institute of Technology

COMPETITION: Water Environment

Green Stormwater Infrastructure Retrofit Design for Duluth Middle School



TEAM MEMBERS:

Makaela Edmonds

Lucy Bricker

Olivia Verret

Isabella Hernandez

FACULTY ADVISOR:

Sharon Just, PE

MA CONTACT:

Susana Lanier, Georgia Association of Water Professionals

ABSTRACT:

A design was prepared for the Gwinnett County Department of Water Resources to reduce and treat stormwater runoff at Duluth Middle School, a public school in Georgia. The design prioritizes runoff reduction, water quality improvement, and public visibility. GIS database information and as-built site drawings were reviewed, and a site visit was conducted after a storm event. A total of 27 best management practices (BMPs) were initially reviewed, and five alternatives were selected for an iterative design process.

The runoff was modeled, and the BMPs were sized to capture the first 1" of rainfall, treat runoff for 85% of annual storms, and decrease TSS concentrations by 80%. The designs included (i) a bioretention basin at the bus loop, (ii) pervious pavement in the carpool lot, (iii) StormTrees™ in the carpool lot islands, (iv) a dry-enhanced swale in the greenspace along the entrance drive, and (v) stormwater planters fed by disconnected roof downspouts. Based on the client's goals and budget, the bioretention basin, dry-

enhanced swale and stormwater planters were recommended for implementation with an opinion of probable cost of \$477,000 with contingency. Public outreach was incorporated into the project, to provide for public education on the importance of protecting local watersheds.

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Illinois Institute of Technology

COMPETITION: Water Environment

PFAS Management within Fox River Water Reclamation District West Plant



TEAM MEMBERS:

Kyra Kucirka

Ryan Clemens

Brian Bustos

FACULTY ADVISOR:

David Lampert, PhD

MA CONTACT:

Mwende Lefler, Illinois Water Environment Association

ABSTRACT:

An unregulated pollutant lurks in America's public waterways and endures typical wastewater treatments. Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are forever chemicals, a group notorious for their long half-lives and high accumulations. PFAS are a growing concern due to health and environmental hazards. The Environmental Protection Agency (EPA) is expected to create federal guidelines soon. Federal, state, and international regulations will be analyzed to determine an estimate of future EPA WRF effluent concentration limits. The Fox River Water Reclamation District (FRWRD) treats and releases water from domestic intake (sewer influent) and leachate (landfill runoff influent). FRWRD's West Water Reclamation Facility (W WRF) releases produced effluent into the Fox River. FRWRD faces inevitable legislation and must adapt. FRWRD requires that any PFAS removal process must seamlessly blend into typical plant operation. There are a multitude of existing methods that can remove PFAS from water; however, each removal technique has its advantages and disadvantages. PFAS removal technologies will be assessed for their application to W WRF focusing on our proposed design: lead-lag configuration of organoclay in series with lead-lag G.A.C units. The capital and operational cost, projected maintenance needs, removal efficiency, and contaminant removal efficiency will be examined for all design solutions.

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Iowa State University

COMPETITION: Wastewater

Implementing Nutrient Reduction in a Rural Iowa Treatment Plant



TEAM MEMBERS:

Jacob Dunn Oluwatuyi Olowoyeye
Daria Dilparic Edson Lopez
Revanth Mamidala
Lois Arku

FACULTY ADVISOR:

Say Kee Ong, PhD

MA CONTACT:

Jason Kenyon, Iowa Water Environment Association

ABSTRACT:

A small city in Western Iowa is facing an urgent need to update its currently existing wastewater treatment facility due to a growing population and the implementation of the Iowa Nutrient Reduction Strategy. The utility's National Pollutant Discharge Elimination System (NPDES) permit is being renewed with the addition of more stringent limits, particularly with effluent ammonia. This will require an upgrade to the wastewater plant to include nitrification at different levels. Additionally, the city would like to plan ahead for the Nutrient Reduction Strategy and accommodate removal of nitrogen and phosphorus in order to meet the effluent limits that will be set in the future. The Water Professionals Student Chapter has composed a design team to explore upgrade designs, provide alternatives, and recommend an option that best satisfies the municipality's needs.

Johns Hopkins University

COMPETITION: Water Environment

Coastal and Climate Resilience Alternatives Assessment for Culvert Crossings: Aberdeen Proving Ground



TEAM MEMBERS:

Dorothy Thompson

Ashley Choy

Kevin Sommer

Elmer Henandez

FACULTY ADVISOR:

Ciaran Harman, PhD

MA CONTACT:

Tom Howard, Chesapeake Water Environment Association

ABSTRACT:

Sustaining resilient coastal environments under the growing threat of climate change is a worldwide and interdisciplinary challenge, and the Coastal Resilience Senior Design Team within the Environmental Health and Engineering department at Johns Hopkins University analyzed this issue through their assessment of tidal crossings facing intensifying inundation due to prolonged and periodic flooding at Aberdeen Proving Ground (APG) in the Upper

Chesapeake Bay. The team has evaluated the hazards of the rising sea level, storm surge, and wave action, and modeled their effects in this wetland ecosystem to propose nature-based solutions to protect APG operations, communities, and ecosystems. Hydrologic and hydraulic modeling of the crossings using on-site measurements and relative sea level rise predictions for 2050 were used to understand how adaptations in the wetland ecosystem

could serve as a flood management system. The designs proposed to professional partners at EA Engineering, Science, and Technology to support their ongoing projects at APG prioritize natural adaptation while considering the use of traditional engineering solutions and a management plan to respond to evolving sea level rise predictions.

Manhattan college

COMPETITION: Wastewater



Newtown Creek WRRF Odor Control

TEAM MEMBERS:

Sofia Rivera	Patrick Gaudet
Vincent Carway	Federico Cipriani
Christopher Farrington	Antonio Argudo
Gianna Gervino	

FACULTY ADVISOR:

Jeanette Brown, PE

MA CONTACT:

Stephanie Castro-Sanchez, New York Water Environment Association

ABSTRACT:

In this work, we present the design of an odor control system for use at the Newtown Creek Water Resource Recovery Facility (WRRF). The objectives of this project were to determine the odorous compounds that required treatment, select an appropriate odor removal technology, and design a system to adequately treat

the present odors. Newtown Creek data was acquired and analyzed to determine that the primary odorous compound of concern was hydrogen sulfide. Four different treatment technologies were considered for hydrogen sulfide odor control: chemical scrubbing, biotowers, biofilters and activated carbon adsorbers. A decision matrix was

developed to determine the optimal technology was dual bed activated carbon adsorbers. A full-scale design for odor control at Newtown Creek WRRF is presented.

Milwaukee School of Engineering

COMPETITION: Wastewater

Analysis of Biosolids Management Options at South Shore Water Reclamation Facility



TEAM MEMBERS:

Molly Stewart

FACULTY ADVISOR:

William Krill, PE

MA CONTACT:

Joe Lapastora, Central States Water Environment Association

ABSTRACT:

This study evaluates alternatives for expanding biosolids management and Milorganite production at the South Shore Water Reclamation Facility (SSWRF) of the Milwaukee Metropolitan Sewerage District (MMSD). MMSD's Biosolids Advanced Facilities Plan (BAFP) recommends implementing a biosolids processing system at SSWRF to increase Milorganite capacity. The first alternative, identified as Alternative 1, proposes constructing a new building for dewatering and drying equipment, with a capital cost of \$152,640,000 and maintenance cost of \$8,600,000 per year. Alternative 2 explores retrofitting existing buildings, estimating a capital cost of \$148,255,000 and equivalent maintenance to Alternative 1. Alternative 3 investigates the feasibility of a solar drying facility, with an estimated capital cost of \$103,683,000 and annual maintenance cost of \$2,270,000. Using a weighted criterion matrix, the alternatives were evaluated on a scale of 1 to 10. Alternative 1 scored 5.5, Alternative 2 scored 5.6, and Alternative 3 scored 7.8. The findings indicate that solar drying offers a practical and cost-effective solution for biosolids management at SSWRF, aligning with MMSD's sustainability goals and providing significant savings in capital and maintenance expenses. Further research is recommended to assess long-term sustainability. These insights inform MMSD's decision-making process for expanding biosolids processing at SSWRF.

North Carolina State University

COMPETITION: Wastewater

Manchester Creek Wastewater Treatment Plant Biosolids Infrastructure Expansion



TEAM MEMBERS:

Sydney Crisanti

Mitch Edney

Elizabeth Bates

Hailee Sicknick

FACULTY ADVISOR:

F. De Los Reyes, PhD

MA CONTACT:

Michael Wang, North Carolina AWWA-
WEA

ABSTRACT:

The City of Rock Hill, South Carolina has experienced steady population growth in recent years. The city desires to expand their biosolids handling infrastructure at the Manchester Creek Wastewater Treatment Plant (MCWWTP), with a focus on implementing thermal drying and meeting Class A biosolids standards. MCWWTP influent and effluent data were used to determine the plant's solids production rate. Additionally, research was conducted based on client and operator preferences, similar existing plants, thermal dryer markets, biosolid outlet markets, and biosolid regulations. Sizing appropriate biosolids handling equipment for MCWWTP's expected capacities was completed via mass balance and examination of current plant schematics. The result was a suggested conjoined dewatering and thermal drying building, visualized in a 3D Revit model. The suggested biosolids handling infrastructure includes new belt filter presses, Komline-Sanderson model 16W-3000 paddle dryers, pelletizers, polymer storage tanks and feed facility, and a storage silo. Timeline of the project was developed through a construction sequence based on a design-build method. A cost analysis and ENVISION rating calculation was conducted. The design solution is under budget and considered sustainable. The suggested design solution allows MCWWTP's biosolids treatment infrastructure to handle the city's growth and gain independence in biosolids handling operations.

Northeastern University

COMPETITION: Water Environment

Small Solutions for Big Pollution: Bench-scale Bioremediation of 1,4-Dioxane Contaminated Groundwater



TEAM MEMBERS:

Katie Moloney

Anna LeClair

Shannon Butler

Geonho (Justin) Seo

FACULTY ADVISOR:

Annalisa Onnis-Hayden, PhD

MA CONTACT:

Joanna Sullivan, New England Water Environment Association

ABSTRACT:

1,4-dioxane (dioxane) is a common drinking and groundwater chemical contaminant that has been classified as a likely human carcinogen by the United States Environmental Protection Agency (EPA) (Pollitt et. al. 2019). An estimated 90 million people in the United States are exposed to dioxane via drinking water due to its improper storage and disposal (Zhang et.al. 2017). Current treatment methods for dioxane are ineffective at

reaching the EPA's health advisory level (HAL) of 0.35 $\mu\text{g/L}$ in drinking water (Pollitt et.al. 2019, Zhang et.al. 2017). Recent research, however, has demonstrated the potential for dioxane degradation below the HAL by a microbe (company proprietary). Bench-scale reactor testing was performed to determine the impact of reactor and media type, hydraulic residence time (HRT), aeration rate and method, and temperature on dioxane

removal efficiency utilizing this microbe. Following commissioning and operation of two bench-scale bioreactors, a dioxane degradation rate of 45% was observed utilizing a continuously stirred tank reactor (CSTR). Further bench-scale testing is necessary with recommendations given including altering nutrient supplementation and increasing the commissioning period length.

Northeastern University

COMPETITION: Water Environment

Rosie's Commons: Design for a Sustainable Mixed-Use Land Development in the City of Salem, MA



TEAM MEMBERS:

Christopher Perron

Isabella D'Ascoli

Alexandre Renaud

Christopher Meerikin

FACULTY ADVISOR:

Annalisa Onnis-Hayden, PhD

MA CONTACT:

Joanna Sullivan, New England Water Environment Association

ABSTRACT:

This project encapsulates the design efforts by ABGC Engineering for a sustainable mixed-use development in the city of Salem, MA. The site is currently an abandoned boat yard adjacent to a wetland ecosystem (Rosie's Pond) that is subject to intense flooding and urban heat island effect and bordered by environmental justice communities. The team identified various solutions for each subject of the design and narrowed to a final selection of technologies for further analysis via a robust

matrix evaluation system. ABCG Engineering proposes Rosie's Commons, a self-sufficient community driven by five overarching goals—climate resiliency, circularity, education, community integration, and affordability. The final design centers climate resiliency in the stormwater infrastructure and ecological strategies employed on site. Circularity is achieved through reduced reliance on municipal resources through closed-loop systems for energy, nutrients and waste. Educational opportunities

are woven through the site on implemented technologies with a specific emphasis on environmental interaction, stormwater management and permaculture. Site mobility prioritizes multimodal roadways and active walking paths to integrate Rosie's Commons into Salem. Through strategic use of available multi-level funding and innovative strategies, Rosie's Commons can achieve a long-term sustainable ideal of intentional living within the City of Salem.

Old Dominion University

COMPETITION: Water Environment

Aberdeen Gardens Watershed Study and Flood Mitigation



TEAM MEMBERS:

Austin Biter

Joseph Wooten

FACULTY ADVISOR:

Mujde Erten-Unal, PhD

MA CONTACT:

Justin Manzie, Virginia Water Environment Association

ABSTRACT:

This focus of this project is to provide a study of existing hydraulic conditions in the historic neighborhood of Aberdeen Gardens in Hampton, Virginia. It will investigate and quantify potential solutions to worsening flooding conditions and rising sea levels. This report and presentation will consider low infrastructure development in the form of best management practices (BMPs) that can be implemented by residents or the city of Hampton. This project includes assistance in the form of iterations from architecture students at the Hampton University. The team will provide background, identify drainage areas, showcase existing flooding extremities, analyze BMPs, suggest alternative solutions based on feasibility and effectiveness, and explore potential funding options.

Old Dominion University

COMPETITION: Wastewater

Options to Enhance Nitrogen Removal at Higher Projected Flows at the H.L. Mooney Advanced Water Reclamation Facility



TEAM MEMBERS:

David Kibbie

Ujjwal Pokharel

Francis Robinson

Madison Millsbaugh

FACULTY ADVISOR:

Gary Schafran, PhD

MA CONTACT:

Justin Manzie, Virginia Water Environment Association

ABSTRACT:

The purpose of this report is to submit and implement an upgrade to the Prince William County Service Authority's H.L. Mooney Advanced Water Reclamation Facility to enhance nitrogen removal at higher projected flows. The upgrade of the facility will consist of either a phased change to the design of the secondary process or a redesign of the operating parameters of the existing

facility. The report compares the alternatives of adding integrated fixed-film activated sludge (IFAS), operating the aeration basins at a lower dissolved oxygen (DO) concentration, and operating the basins with an ammonia-based aeration control (ABAC). This report found that a stepwise decrease in DO concentrations in the aeration basins has the potential to decrease final

effluent total nitrogen by facilitating simultaneous nitrification and denitrification with no additional cost to the facility. This report also found that implementing this change alongside a low capital ABAC upgrade would have the same benefits with the added benefit of an increased likelihood of chemical savings.

SUNY College of Environmental Science and Forestry

COMPETITION: Water Environment

Sequoit Creek Dam Removal



TEAM MEMBERS:

Jack Murtagh Daniel Mack
Lauren Henkler
Thomas Nightengale
Annie Roux

FACULTY ADVISOR:

Douglas J. Daley, PE

MA CONTACT:

Sara Igielski, New York Water Environment Association

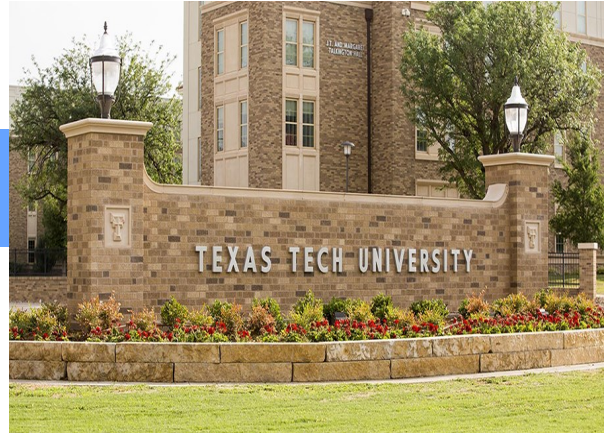
ABSTRACT:

Sauquoit Creek is a tributary to the Mohawk River in Oneida County, NY that flows north through several towns including the Town of New Hartford. Within the Town of New Hartford, Sauquoit Creek flows over a three-foot low head dam which the Department of Environmental Conservation (DEC) has determined needs to be removed since the dam impedes fish migration. In addition, Sauquoit Creek has a history of flooding during storm events and there is the opportunity for two additional floodplain storage areas north and south of the dam. The project scope focuses on the preliminary design for additional floodplain storage for Sauquoit Creek within the Town of New Hartford as well as developing a construction sequence and restoration plan for the removal of the low-head dam.

Texas Tech University

COMPETITION: Wastewater

Austin Water Walnut Creek WWTP and Hornsby Bend Biosolids Management Plant Improvements and Expansion



TEAM MEMBERS:

Leah McDonald Mathew Rotman

Brennan Riley

Elizabeth Routon

Kieran Atkin

FACULTY ADVISOR:

Clifford Fedler, PhD, PE

MA CONTACT:

Danny Roberts, Water Environment Association of Texas

ABSTRACT:

The Walnut Creek Wastewater Treatment Plant (WWTP) is operated by Austin Water. Currently, the plant utilizes a conventional activated sludge (CAS) treatment system with a pseudo-Ludzack-Ettinger process as well as inline flow equalization basins where alkalinity adjustments are made prior to biological treatment. Due to the continued development within the City of Austin, there is a need for an upgrade and expansion of

Walnut Creek WWTP. The main objectives in developing a recommended design for the expansion to the new permitted capacity include converting the existing CAS system to biological nutrient removal (BNR), upgrading existing units as needed, and implementing a phosphorus sequestration technology at the Hornsby Bend Biosolids Management Plant to recover and remove increased phosphorus in the sludge due to the

implementation of the BNR system. The recommended A2/O design considered performance and operator preference and will ensure all units meet Texas Commission on Environmental Quality (TCEQ) requirements. An Opinion of Probable Construction Cost, an estimate for annual operation and maintenance costs, and a construction schedule of the expansion are included.

Universidad de Costa Rica

COMPETITION: Wastewater

Wastewater Recovery And Treatment Center For Bijagua, Costa Rica



TEAM MEMBERS:

Madison Arce Jimenez

Alejandro Rodriguez Vargaz

Maucio Alpizar Murillo

Sofia Abarca Rodriguez

FACULTY ADVISOR:

Erick Centeno, PhD

MA CONTACT:

Joe Lapastora, Central States Water Environment Association

ABSTRACT:

Costa Rica faces a serious sanitation problem, presenting one of the most significant challenges in the region. Therefore, investment and study in wastewater treatment plants must be a priority topic, both for environmental conservation and for the improved quality of life for its inhabitants. The importance of this work lies primarily in providing guidance for the potential decision-making process in

selecting the wastewater collection and treatment system for the Bijagua community. As part of the work, a population projection was conducted using census data and growth rates as input to determine the design flow rate. Site analysis was then carried out, selecting the land that best fits the requirements and constraints of such projects. Additionally, the layout and design of the sanitary sewer

system were developed, leading to the selection of a treatment train through a multicriteria analysis that defined the technology suitable for the area and the country's conditions. Finally, the construction, sewerage, and operation and maintenance costs were determined, which led to the establishment of a tariff per household.

The University of British Columbia

COMPETITION: Water Environment

Treatment System for Leachate Management at Glenmore Landfill: Sulphate & Sulphide Removal alongside a PFAS Pilot System



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ABSTRACT:

Leachate generated at the Glenmore Landfill facility in Kelowna, BC is discharged into the municipal sewer system without pretreatment. The leachate has been identified to contain problematically high sulfide and sulfate levels and is suspected to be causing issues downstream in the wastewater treatment plant. To reduce the sulfide concentration to acceptable levels and remove sulfates, Source Water Solutions

proposes the implementation of an upflow anaerobic sludge blanket (UASB) reactor in conjunction with sulfide precipitation methods. The UASB reactor is predicted to reduce sulfates to sulfides at a conversion percentage of 55%. The biogas created in the reactor will be passed through 3 scrubbers to reduce the hydrogen sulfide concentration below 1 ppm, and recover over 1000 pounds of sulfides. The

UASB will also generate aqueous bisulfite that will be precipitated out of solution via ferric chloride precipitation. To address emerging concerns of per- and polyfluoroalkyl substances (PFAS) in landfill leachate our group also suggests the addition of an electrochemical oxidation system to treat PFAS, which can be operated on a pilot scale.

University of California, Riverside

COMPETITION: Wastewater

Electrodialysis Reversal for Total Dissolved Solids Removal in Wastewater



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ABSTRACT:

Our team intends to analyze the impacts of water conservation on total dissolved solids (TDS) at the Western Riverside County Regional Wastewater Authority (WRCRWA). The WRCRWA is a wastewater treatment facility with a permitted capacity of 14 MGD of disinfected tertiary treated wastewater effluent. Current water usage is estimated to be 52 gallons per person per day (g/p/d) with a statewide goal to

reduce to between 42 g/p/d and 47 g/p/d under Bill 1157 while remaining under the TDS allowable standards. Water conservation efforts decrease the amount of water entering the sewage system causing an increase the concentration of influent TDS. This increase is capable of causing blockages, odors, and corrosion in pipes leading to accelerated degradation of infrastructure and increased operation and maintenance costs. Our team

will model the current treatment train utilizing Sewage Treatment Plant Modeling freeware (STOAT), evaluate the impacts of water usage reduction within residential dwellings, and make recommendations to WRCRWA to ensure the effluent concentration of TDS will be met by the WRCRWA's National Pollutant Discharge Elimination System (NPDES) permit requirement of 625 mg/L.

University of Colorado Boulder

COMPETITION: Wastewater



Nutrient Removal for Copper Mountain Consolidated Metropolitan District

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ABSTRACT:

Copper Mountain is a mountain and ski resort located in Summit County, Colorado, about 75 miles west of Denver on Interstate 70. The wastewater plant is rated for 1.1 million gallons per day of flow and sees considerable seasonal fluctuations due to the heavy ski population in the winter and occasional plant upsets. On the liquid treatment side, the plant utilizes headworks, grit removal, equalization, treatment with aeration basins, secondary clarifiers, effluent filters, and UV disinfection. On the solids processing side, the plant currently utilizes aerobic digestion and dewatering centrifuges, then hauls the biosolids to be land applied. A key issue facing the CMCMD WWTP is meeting upcoming nutrient regulations. The plant currently utilizes aluminum sulfate (Alum) to aid with Phosphorus removal but is interested in the possibility of reducing their reliance on Alum and switching to Biological Phosphorus removal. The goal of this project is to identify process improvements for reducing Total Phosphorus levels in the plant effluent. The chosen design includes measures that aim to reduce the Total Phosphorus levels in the effluent to the upcoming Colorado Department of Public Health and Environment (CDPHE) Regulation 31 limit of 0.17 mg/L of Total Phosphorus.

University of Florida

COMPETITION: Wastewater

Rapid Co-digestion of Novel Feedstocks: Closing the Organic Waste Loop for Municipalities



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ABSTRACT:

Currently, many reusable resources are landfilled, such as organic waste like food waste and the biogenic fraction of street-sweeping residuals. To address this, we propose a design to modify existing waste management practices of these organics by integrating them within the wastewater treatment system to create a circular economy.

Our proposal suggests that rather than landfilling, wastewater, food waste, and the organic street-sweeping residuals can be fed through a rapid anaerobic digester. In this system, nutrients like

nitrogen, carbon, and phosphorus can be recycled. This process produces two major products: biogas, a renewable energy source, and struvite, a phosphate mineral. Selling biogas and struvite can return a profit for the wastewater treatment facility. The remaining solid fraction would be land applied.

These improvements could recontextualize the waste system with valuable products resulting from waste management rather than disposal.

Reproducing this system could be viable in municipalities across the country. This is a feasible solution to the current problems associated with waste streams. Additionally, this would reduce plant energy consumption, increase phosphorus and energy security, and decrease the amount of waste landfilled. Altogether, such a project would complete a circular economic model for organic waste and make waste management more sustainable.

University of Guelph

COMPETITION: Wastewater



Optimization of Side Stream Treatment at the Mid-Halton WWTP

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ABSTRACT:

The Mid-Halton WWTP is an advanced secondary plant located in the Regional Municipality of Halton. During normal plant operation, liquid waste streams with high nutrient concentrations are produced. Additionally, septage from an upstream transfer station is treated at the plant. These sidestreams are returned to the head of the plant, where they represent a significant portion of the nutrient loading. When the sidestreams are reintroduced into the influent, they cause several operational

challenges, including decreasing alkalinity and pH, increasing oxygen and energy demand, bacterial upset, vivianite formation, and ammonia bleed-through. The purpose of this project is to address these challenges through the completion of short-term and long-term design solutions. A preliminary design was completed with the goal of managing the sidestream loading for the next 1-2 years through optimizing the existing treatment processes. A conceptual design of a long-term solution was

developed, which may utilize more process additions or removals to treat the sidestreams more efficiently. Short-term solutions include: • Flow equalization of the centrate and filtrate; and • Aeration optimization to reduce populations of filamentous bacteria. Long-term solutions include: • Electrocoagulation for phosphorus removal; and • DEMON Hybrid Granular and Flocculant Activated Sludge Deammonification System for ammonia removal.

University of Nevada, Las Vegas

COMPETITION: Wastewater



Southern Nevada Supplemental Airport Wastewater Conveyance and Management Project

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ABSTRACT:

The Harry Reid International Airport, Las Vegas experienced a significant influx of 52.6 million passengers in 2022, pushing it closer to its maximum capacity with only 10 million more passengers to spare, making the need for a supplementary airport urgent. To address this, a 6,500-acre site in an underdeveloped area, 30 miles south of Las Vegas between Jean and Primm has been selected for the Southern Nevada Supplemental Airport.

However, before proceeding with the construction, it is crucial to establish a wastewater management system for the airport and the surrounding community. The project aims to find a cost-effective wastewater management solution for the new airport. Several options were considered, including constructing an onsite water resources recovery facility (WRRF), enhancing the capacity of an existing WRRF in Primm, conveying the wastewater to WRRFs in California or Arizona, or

pipng it to Las Vegas for treatment at one of four facilities in the Las Vegas Valley, then discharging it into Lake Mead. Cost analysis and a decision matrix concluded that piping wastewater to Las Vegas is the most cost-effective choice. Additionally, this option provides return flow credits from the Colorado River pact, boosting water supply resilience in the Las Vegas Valley.

University of South Florida

COMPETITION: Water Environment

Increasing Visitor Access: Flood Mitigation Alternatives for Dell Holmes Park Parking Lot



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ABSTRACT:

Dell Holmes Park is a public attraction constructed in 2007, located in southern St. Petersburg, Florida. The site borders Lake Maggiore and suffers from severe flooding during mild storm events, limiting visitor accessibility. The high water levels prevent vehicles from entering the parking lot and restrict amenity usage. The existing stormwater management system suffers from debris blockages, poor flow routing, and undersized infrastructure. This project evaluates three alternatives to alleviate flooding and

protect water quality: Alternative 1 replaces the culvert/swale system south of the parking lot; Alternative 2 implements a new drainage system into the parking lot; and Alternative 3 increases dry detention storage by lowering the dry pond bottom elevation. The alternatives are evaluated based on the following criteria: flood mitigation, feasibility, sustainability, cost, aesthetics, and pollutant loading reduction. A preliminary evaluation of each alternative led to the elimination of Alternative 3.

Hydrologic and hydraulic modeling for both Alternatives 1 and 2 displays an elimination of flooding. The flood mitigation evaluation proves Alternative 2 alleviates flooding most effectively. Based on pollutant loading modeling, neither alternative pose adverse impacts on water quality. A weighted sum model provides the ratings for each alternative and demonstrates that Alternative 2 is most favorable.

University of Tennessee, Knoxville

COMPETITION: Water Environment

Mobile Water Testing Strategies for Rural Panama



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ABSTRACT:

Uncharted Waters has partnered with Solea Water, a nonprofit organization dedicated to alleviating water poverty in Latin America, to propose water testing strategies for use in rural, remote settings. Indigenous communities in rural Panama need accessible water quality testing to evaluate potability of their local drinking water sources. Due to the isolated nature of the communities, Solea employees and community members must be able to

perform on-site testing without sending samples to a laboratory. To facilitate this need, a mobile water testing kit was designed by selecting the Hach DR1900 Spectrophotometer and the Aquagenx Field Testing Kit + Expansion Pack as the most suitable equipment for the project based on the identified relevant parameters, ease of use, size, and maintenance. An accompanying Standard Operating Procedure applicable to rural Panama

was created and is intended to provide an easy-to-use guide for community members to sample, test, and evaluate clean water conditions in indigenous villages. A maintenance guide was developed to present strategies for consumable monitoring, annual reviewal, and waste disposal, and estimated costs for initial and anticipated replenishing of equipment were assembled based on the proposed testing scheme.

University of Wisconsin— Madison

COMPETITION: Water Environment

Koshkonong Creek Watershed Flood Control and Recreational Lake Project



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ABSTRACT:

This project is a flood management system for the Koshkonong Creek Watershed, aiming to mitigate annual flooding, enhance environmental sustainability, and promote community well-being. The system includes a weir, an embankment, a flood basin, and a recreational park. This design alleviates flood intensities of up to 2-year floods and greatly reduces the impact of greater flood events. The 75-acre flood basin has 500 CY of flood water storage and retains 8ft of water throughout the year

for recreational use. This design is a cost-efficient, environmentally friendly solution. Existing soil on site is repurposed to create project features, and peat soil is preserved for farming use. One significant environmental benefit of the system is the reduction of phosphorus levels in Koshkonong Creek, achieved through erosion reduction and ferric chloride treatments. The integrated system facilitates the restoration and preservation of the natural habitat along the creek, which promotes

biodiversity and ecological integrity. The inclusion of a recreational park not only offers leisure opportunities, but also educates the community about watershed management and environmental conservation. By implementing this comprehensive flood management system, the Koshkonong Creek Watershed can expect significant reductions in flood damage, providing long-term economic benefits to the community and the environment.

Utah State University



COMPETITION: Water Environment

PFAS Removal at the East Canyon Water Reclamation Facility

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ABSTRACT:

The purpose of this proposal is to explore and recommend potential technologies for reducing perfluorooctanoic acid and perfluorooctane sulfonate (PFOA and PFOS) concentrations in the liquid stream at the East Canyon Water Reclamation Facility (ECWRF). The ECWRF is interested in removal technologies to reduce PFOA and PFOS effluent concentrations below 2 ng/L. In this proposal three alternatives are analyzed: do nothing, granular activated carbon (GAC), and ion exchange resin (IX). These alternatives are evaluated with regard to project cost, removal efficiency, space requirement, and overall environmental impact to recommend the best alternative. Based on the results of the analysis, the recommended technology to implement at the ECWRF is an application of ion exchange resin. The use of ion exchange resin is a proven and effective treatment process capable of removing up to 97%-99% of PFOA and PFOS contaminants, respectively. This option will reduce the PFOA and PFOS concentrations below 2 ng/L as directed with minimum space requirement and environmental impact.

Washington University in St. Louis

COMPETITION: Wastewater



Biogas Upgrading Design for Anaerobic Digestion Systems in Missouri

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ABSTRACT:

Biogas upgrading has become an emerging topic as many wastewater treatment plants (WWTPs) in Missouri have anaerobic digestion (AD) systems. AD was constructed to recover energy from the wastewater by biogas generation. Through AD process, the organic compounds in wastewater can be degraded and converted into biogas, which has potential to be utilized as an energy source. Methane (CH₄) is the major

component in biogas that serves as the energy source, while the existence of carbon dioxide (CO₂) will reduce the energy value of the biogas. Our goal is to design a system that upgrades biogas by either converting CO₂ or removing it entirely. This system will increase the concentration of CH₄ enriched in the biogas, which will improve its energy value. We intend to implement our design to AD systems in WWTPs across Missouri. A

detailed analysis of the economic and energy implications will be presented, including calculations of specific energy recovery from biogas upgrading and utilization. Through preliminary research and data analyses, the performance of our designed system will be further optimized to meet the needs of the community.

Thank you!

JUDGES:

We would like to thank our judges for volunteering their time. We are grateful for their presence and knowledge during the competition.

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