

ERIC AUERBACH, PE

ENERGY FLOW MODELING



EDUCATION

MS Energy Engineering
University of Illinois at Chicago
June 2013

MS Environmental Engineering
University of Wisconsin-
Madison June 2005

BS Biological and Environmental
Engineering Cornell University
June 2003

YEARS OF EXPERIENCE

Total – 15

PROFESSIONAL REGISTRATIONS

Professional Engineer – NY, IL,
UT

Construction Documents
Technologist

ENV SP

PROFESSIONAL ASSOCIATIONS

Water Environment Federation
(WEF) Residuals and
Biosolids Committee

Mr. Auerbach is a design engineer with specialized expertise in biogas utilization, combined heat and power (CHP) and resource recovery from wastewater with a focus on thermal and electrical energy. He has spent over ten years developing solids and energy flow modeling tools to help track and optimize energy utilization strategies at WWTPs across the country, including some of the largest plants in the world, including the Chicago Metropolitan Water Reclamation District. He also performs design of CHP systems allowing him to bring practical technical design knowledge into the planning process for biogas to energy alternatives. He is an active member of the WEF Residuals and Biosolids Committee where he stays abreast of the current cutting-edge resource recovery technologies and trends.

Project Experience

Jackson Pike WWTP CHP Feasibility Study and Design, City of Columbus Division of Sewerage and Drainage, Columbus, OH. Technical lead for CHP feasibility study at two 100-mgd WWTPs, including CHP engines, gas treatment, electrical distribution and heat recovery systems. Based on feasibility study findings, the City moved ahead with design of CHP. Arcadis is now designing the Jackson Pike CHP system with Eric as the lead mechanical design. *Study – January 2017, Design – December 2020*

Energy Use Optimization and CHP Assessment, Evansville Water and Sewer Utility, Evansville, IN. Developed a solids and energy flow model for two 25 MGD plants utilizing interplant sludge transfers and centralized dewatering. The study identified process optimizations to best use energy resources and the addition of energy enhancements. Study looked at installing the Evoqua Captivator system for enhanced primary sludge capture and increased digestion outputs while reducing aeration loads. *May 2019*

Albany and Saratoga Regional Biosolids Facility, Albany Water Purification District and Saratoga County Sewer District, Albany, NY. Lead role in developing a facility plan to consolidate the solids operations of three different WWTPs operated by two sewer districts in two counties near Albany, NY. A centralized regional facility will be located onsite at the Albany North plant which treats an average influent flow of 25 mgd. Two additional plants operated by the founding utilities will bring in undigested, dewatered cake by truck. Additional material from throughout the region is also being targeted, including cake from other utilities, FOG, organic food waste, and industrial high strength waste. To develop the process for the new regional facility, the utilities engaged Arcadis in a comprehensive system modeling and upgrade planning effort which considered a wide range of solids treatment and energy recovery processes. The project is currently in design with Mr. Auerbach as a technical lead. *Study – March 2018, Design – Currently in Progress*

Bird Island WWTP CHP Feasibility Analysis and Design, Buffalo Sewer Authority, Buffalo, NY. Conducted a study at Bird Island WWTP (180 mgd) to estimate energy available from multiple-hearth incinerators to power a 2-MW extraction steam turbine CHP system. Used an energy flow model to analyze performance based on varying conditions, including incinerator solids feed quantities and solids feed characteristics. Conducted a holistic energy analysis of the entire plant to examine and recommend the most optimal allocation of energy resources such as routing of sludge and biogas. *March 2013*

Solids and Energy Systems Planning and Design, Capital Region Water, Harrisburg, PA. Lead role in developing a Solids and Energy Flow Model based facility plan and lead designer to implement advanced solids processing and energy recovery enhancements to the 22 MGD Advanced Water Treatment Facility. The project, currently in design, includes implementation of a new solids conditioning building with two GBT units. Thickened WAS (TWAS) will be pumped directly to an adjacent lysis system using a thermal-chemical technology that increases digestibility and reduces viscosity to allow for better pumping. Heated and lyzed TWAS is then blended in-line with primary sludge and imported high strength waste (HSW) before injection into two existing digesters. *Study – Feb 2019, Design – Currently in Progress*

Digester Gas Utilization Study and Concept Design, Metropolitan Water Reclamation District, Chicago, IL. Developed a comprehensive biogas utilization plan and conceptual designs for Stickney WRP and Calumet WRP operated by Chicago MWRD. A broad range of utilization technologies and biogas cleaning systems were evaluated. Developed an energy flow model to analyze the optimal digester gas utilization schemes for the complex energy systems at Stickney and Calumet WRPs. *Feb 2012*

Integrated State of Good Repair/Energy Conservation Measure Plan, NYC Department of Environmental Protection, New York City Arcadis project lead to investigate all aspects of operations, capital upgrade needs, and potential energy saving projects at five different NYCDEP plants. Worked closely with pertinent personnel such as current Facility Manager, former Plant Chief, Process Engineer, and current plant Chief to determine plant system operational practices and areas of capital upgrade needs. Also analyzed 2 years' worth of plant operating data to evaluate energy efficiency, liquid process performance, and solids system mass flows to inform ECM recommendations. Provided conceptual level design for proposed upgrades to pre-digestion solids thickening systems as part of the project. *July 2017*

Organics Diversion to Digestion and Renewable Natural Gas, City of Mesa, Mesa, AZ Project lead for an evaluation of the technical, operational, and financial feasibility of a implementing a comprehensive program in Mesa, AZ to extract the organic constituents out of various municipal solids waste (MSW) streams and then injecting the resulting organic slurry into plant digesters. Arcadis also developed concept level designs for organic waste collection, screening, and slurring infrastructure to be installed at a transfer station buildout, as well as the receiving and digester injection infrastructure at the WWTP. Biogas end use options including CHP and renewable natural gas/RINs were also investigated and incorporated into a full system mass and energy model that included financial and environmental analysis capabilities. Arcadis is currently designing phase 1 of the recommended organics diversion and biogas utilization system developed under the study. *Study – September 2019, Design – Currently in Progress*

Juliet Ohemeng-Ntiamoah, Ph.D.

Wastewater Project Professional, Nashville Office, TN.

Wastewater Project Professional at Jacobs Engineering Group with over eight years of experience spanning bioenergy, water and wastewater treatment design and operation, biological process modelling, stormwater management, environmental, health and safety.

EDUCATION

Tennessee Technological University| Cookeville, TN **May 2020**

Degree: Ph.D. Engineering (Civil & Environmental Engineering)

Kwame Nkrumah University of Science and Technology| Ghana **Aug 2012**

Degree: BSc. Environmental Science (*First Class Honors, eqv. Summa Cum laude*)

PROFESSIONAL EXPERIENCE

Wastewater Project Professional, Jacobs Engineering Group, Nashville, TN. **2019-present**

Primary responsibilities include assessing water and wastewater treatment facilities and providing recommended improvements, data review and analysis, conducting biological process simulations, writing and reviewing technical reports and general project coordination.

Graduate Research Assistant, Tennessee Technological University, Cookeville, TN. **2014-2019**

Main responsibilities included designing, installing and operating lab-scale bioreactors, conducting laboratory experiments, developing rapid analytical methods, literature review, scientific writing and publications.

Environmental Advisor, Tullow Ghana Limited, Accra, Ghana. **2013-2014**

Main responsibilities included conducting environmental audits, monitoring and reporting environmental key performance indicators such as greenhouse gas emissions and establishing procedures for wastewater monitoring and treatment to meet Ghana EPA requirements.

Environmental, Health and Safety Engineer, Technip Ghana Limited, Accra, Ghana. **2012-2013**

Main responsibilities included organizing environmental, health and safety meetings and workshops, conducting field assessments and writing reports.

MAJOR PROJECTS AT JACOBS

Harrison County Utility Authority Project Sewer and Water Resources Project; Harrison County, MS; October 2019 to present

Wastewater Engineer; Assisting to develop master plan update for ten different wastewater treatment facilities (WWTF) belonging to the Harrison County Utility Authority (HCUA), MS. The ten facilities have average flow rates ranging from 0.5-MGD to 11.7-MGD. The ten facilities have varied needs and are grouped into Tier 1 and Tier 2, with the former comprising six WWTFs that are older and require major improvement needs. Part of the team that conducted site visits to all ten facilities and assessed existing conditions of the unit processes at each facility. Responsible for developing technical memorandum for each facility that will include data review and analysis, flow projections, detailed evaluation of existing plant capacity and processes, identification of project improvement needs and recommendations.

Jackson Pike Wastewater Treatment Plant; City of Columbus, OH; December 2020 to present

Wastewater Process Engineer; Evaluating existing conditions and processes of six mesophilic anaerobic digesters and developing treatment alternatives for achieving Class A and Class B biosolids. Responsibilities include reviewing current federal, state, and local regulatory requirements, evaluating existing digester feed system, evaluating sludge thickening and mixing systems to provide recommendations for improvement.

Portland Wastewater Treatment Plant; City of Portland, TN; June 2020

Wastewater Process Engineer; Reviewed and analyzed three-year wastewater data to determine current and projected maximum month loadings to provide useful information for the facility's biological process model. Simulated biological process model based on projected influent loadings and determined the required sequencing batch reactor (SBR) expansion capacity needed for the biological process to meet permitted nutrient limits. The data analysis and simulation results informed the client that three SBRs were sufficient to handle the projected loadings, which will also result in major cost savings since the client was initially considering four SBRs.

Fayetteville Biosolids Project; City of Fayetteville, AR; March 2020 to August 2020.

Wastewater Engineer; Assisted in the preparation of cost estimates of biosolids treatment alternatives for a combined biosolids management facility that serves the 12.6-MGD Noland WWTF and the 10-MGD West Side WWTF in the City of Fayetteville. The biosolids treatment alternatives included conventional mesophilic anaerobic digestion (MAD), thermal hydrolysis pretreatment with MAD and pyrolysis. Reviewed biosolids pyrolysis processes and provided additional information on the potential uses and markets of the biochar produced. The additional information enabled the client to make an informed decision on the biosolids treatment alternatives involving pyrolysis.

South Truckee Meadows Water Reclamation Facility 2020 Expansion Project; Washoe County; Reno, NV; September 2019 to 2020

Wastewater Engineer; Reviewed the solids data to provide useful information for the facility's biological process model. Assisted in developing a calibrated biological process model for the facility and performed the process model validation exercise. The effluent quality of the validation model closely aligned with the plant's performance data. Developed a technical memorandum that detailed the process model calibration and validation process. The calibrated model was used to evaluate the performance of four expansion alternatives for the facility.

Sewage Commission- Oroville Region; City of Oroville; CA; February 2020

Wastewater Engineer; Revised the biological process model and developed preliminary design details of blower sizes required for 15-MGD peak conditions at Oroville WWTP.

Five Mile Creek Wastewater Treatment Plant, Jefferson County; AL; November 2019

Wastewater Engineer; Assisted in developing design details for chemical phosphorous removal project at the Five Mile Creek WWTP. Revised process model and determined the alum dosage, required storage, solids retention time and pump capacity needed for an average flow conditions of 19.8-MGD and permitted peak flow conditions of 30-MGD.

Moccasin Bend WWTP; City of Chattanooga; Chattanooga, TN; September 2019

Wastewater Engineer; Assisted in evaluating the solids train processes at the 65 MGD Moccasin Bend WWTP. Developed a technical memorandum which contained details of the causes of the high-water content biosolids generated at the facility and included recommendations towards improving the solids train management at the facility. Recommendations included a target minimum percent solids sludge to be pumped from the primary clarifiers, a target minimum thickener sludge blanket to aid in solids compaction to improve the performance of the dewatering units. Additional recommendations towards improving the

performance of the anaerobic digesters at the facility were included. Some of the specific anaerobic digester-related recommendations included increasing the organic loading and maintaining a constant effective volume of the digesters to improve solids destruction and biogas production.

MAJOR PROJECTS IN GHANA (Jubilee Project)

As Environmental Advisor at Tullow Ghana Limited

- Development of environmental key performance indicators such as greenhouse gas emissions, for monitoring the impacts of Jubilee Oilfield project.
- Implementation of the company's Environmental Management System to retain ISO 14001 certification for Jubilee Oilfield project.
- Worked as part of a team to initiate stakeholder engagement meetings. Engaged 15 community leaders, 6 NGOs and 3 media houses about the company's environmental impact mitigation advancements.
- Established procedures for quarterly wastewater monitoring and treatment to meet EPA requirements.

As Environmental, Health and Safety Engineer at Technip Ghana Limited

- Promotion of behavior-based safety programs which resulted in the company recording 584,000 man-hours without lost time injury on Jubilee phase 1A project.
- Development of environmental, health and safety (EHS) procedures for Jubilee phase 1A project which improved the company's reputation and was named among the top three oil and gas companies with best practices in Ghana.

COMPUTER SKILLS

ArcGIS | Microsoft Office Suit | SUMO by Dynamita™ | Pro2D | Google Earth Pro

PEER-REVIEWED JOURNAL PUBLICATIONS (Total Citations:36)

Ohemeng-Ntiamoah, J. and Datta, T., 2018. "Evaluating analytical methods for the characterization of lipids, proteins and carbohydrates in organic substrates for anaerobic co-digestion". *Bioresource Technology*, 247, pp.697-704. Cited by 25.

Ohemeng-Ntiamoah, J. and Datta, T., 2019. "Variabilities in Biomethane Potential Test Methodologies for Anaerobic Digestion: A Review of Studies Published Between 2007 and 2018". *Science of The Total Environment*. 664, pp.1052-1062. Cited by 11.

CONFERENCE PROCEEDINGS AND PRESENTATIONS

Ohemeng-Ntiamoah J. and Datta T. 2019. "Anaerobic Co-digestion of Wastewater Residuals with Food waste and FOG: Effects on Digester Performance and Microbial Community Structure". Proceedings of the Water Environment Federation Technical Exhibition and Conference (WEFTEC); 2019 September 24; Chicago, IL. (WEFTEC is highly competitive and the largest water quality conference in North America with over 20,000 attendees).

Ohemeng-Ntiamoah J. and Datta T. 2019. "Optimizing Renewable Energy Recovery from Organic Waste Substrates Using Anaerobic Co-digestion". Presented at Association of Environmental Engineering & Science Professors (AEESP) Research and Outreach Conference; 2019 May 15; Arizona State University, Tempe, AZ.

Ohemeng-Ntiamoah J. and Datta T. “Exploring Renewable Energy Recovery for Sustainable Wastewater Treatment”. Presented at 28th Tennessee Water Resources Symposium; April 12, 2019. Burns, TN.

Ohemeng-Ntiamoah J. and Datta T. “Water, Energy and Climate Nexus: The Role of Underutilized Renewable Energy”. Presented at Water Professionals Students Conference; 2018 March 26. Tennessee Tech University; Cookeville, TN. (Best Presentation Award)

Ohemeng-Ntiamoah J. and Datta T. “Correlation between Key Organic Substrate Characteristics and Biogas Production”. Proceedings of Student Research and Creative Inquiry Day. Tennessee Technological University; 2017 April 6; Cookeville, TN.

Ohemeng-Ntiamoah J. and Datta T. “Water, Energy and Climate Nexus: The Role of Underutilized Renewable Energy”. Presented at 25th Water Smart Innovations Conference and Exposition; 2016 October 5-7; Las Vegas, NV. (I was among the only two students out of over 200 applicants selected across the United States to speak at this conference, the world’s largest urban water conference).

Ohemeng-Ntiamoah J. “Energy Recovery from organic waste via anaerobic co-digestion” Presented at American Society of Civil Engineers, Nashville Professional Branch meeting; 2015 November, Cookeville, TN.

POSTER PRESENTATIONS

Ohemeng-Ntiamoah J. and Datta T. “Assessment of the Effects of Lipids, Proteins and Carbohydrates on the Biomethane Potential of Organic Substrates”. Poster presented at Kentucky/Tennessee Water Professionals Conference; 2017 July, Lexington, KY. (2nd Place Poster Winner)

Ohemeng-Ntiamoah J. and Datta T. “Effects of Lipids, Proteins and Carbohydrates on Biomethane Potential of Organic Substrates”. Poster presented at Association of Environmental Engineering & Science Professors (AEESP) Research and Outreach Conference; 2017 June; University of Michigan, Ann Arbor, MI.

Ohemeng-Ntiamoah J. and Datta T. “Evaluation of Analytical Methods for determination of carbohydrates, proteins and lipids in wastewater”. Poster presented at 25th Tennessee Water Resources Symposium (TWRS); 2016 April 13-15; Montgomery, TN. (Best Graduate/Doctoral Poster)

Ohemeng-Ntiamoah J., Moffet M. and Datta T. “Evaluation of Analytical Methods for determination of carbohydrates, proteins and lipids in wastewater”. Poster presented at 11th Student Research Day, Tennessee Technological University; 2016 April 6; Cookeville, TN. (Best Student Poster)

Ohemeng-Ntiamoah J. Moffet M. and Datta T. “Linking complex organic feedstock characteristics to microbial metabolic activities in anaerobic co-digesters”. Poster presented at Association of Environmental Engineering & Science Professors (AEESP) Research and Outreach Conference; 2015 June; Yale University, CT.

PROFESSIONAL ORGANIZATIONS/AFFILIATIONS

- Water Environment Federation (WEF, Bioenergy Subcommittee member and Anaerobic Co-digestion Taskforce member)
- Association of Environmental Engineering & Science Professors (AEESP)
- American Society of Civil Engineers (ASCE)
- Clean Water Professionals of Kentucky/Tennessee



CAMERON COLBY, P.E.

ENVIRONMENTAL ENGINEER

EDUCATION AND CERTIFICATIONS

Master of Science, Environmental Engineering
Clemson University, 2020

Licensed Professional Engineer
South Carolina

Bachelor of Science, Civil and Environmental Engineering
University of South Carolina, 2010

SKILLS

Environmental Engineering

Risk assessment, ground and surface water modeling and remediation, wastewater treatment, stormwater management, permitting

Frameworks and Regulations

Clean Water Act, NPDES, RCRA, TSCA, ISO 14001 (Lead Auditor), OSHA, DOT

Project Management

Due diligence, gap assessment, budget planning and management, risk management, strategic planning, Lean Six Sigma Green Belt

Modeling

Aquaveo GMS MODFLOW, BioWin, GoldSim, PHREEQC, Visual Basic, Google Data Studio

Leadership

Collaborative, creative, strategic, compassionate, goal oriented

CONTACT

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Mobile: 864-918-1606

Email: cameronc@re-wa.org / cameronwcolby@gmail.com

Address: 419 Abby Circle Greenville, SC 29607

LinkedIn: <https://www.linkedin.com/in/cameroncolby/>

CAREER EXPERIENCE

Water Quality and Sustainability Leader

Renewable Water Resources | January 2021 to present

- Organizes and implements compliance, process control, biosolids, and operations administrative support programs
- Provides professional-level technical assessment, analysis, and support for treatment processes to ensure efficient and effective operations and facility compliance
- Utilizes data analytics and drives software integration for process optimization and preparing for future state challenges
- Leads research endeavors for new and emerging contaminants, nutrient removal, and energy recovery technologies
- Drives long-term strategic planning and community sustainability efforts

Regulatory Services Resident

Renewable Water Resources | May 2020 to present

- Conducted emerging contaminant (PFAS) risk assessment and sampling plan for water resource recovery operations
- Integrated risk assessment results into proposed strategic actions for PFAS management
- Led SARS-CoV-2 wastewater sampling program, collaborated with academic and government entities on emerging research, and presented program to industry and non-industry audiences both nationally and locally
- Developed intranet tool for all employees to monitor wastewater and local COVID status
- Facilitated metric development and contractor accountability expectations involving a cross-functional team for future Biosolid Management contract

Risk and Environmental Programs Director

Orion Waste Solutions | February 2017 to May 2020

- Managed comprehensive risk management program for 350 employee waste collection and disposal operation across 10 locations in 7 states

- Responsible for budgeting and strategic planning for a \$10M risk program, including bonding, property and casualty, employment practices, and directors and officers insurance lines, operating compliance, and training
- Completed environmental, health, safety, DOT, insurance, and risk assessment-related due diligence and integration for new company acquisitions
- Responsible for Environmental Management System covering stormwater, spill prevention, waste collection and disposal, industrial wastewater, air quality, and hazardous waste
- Designed and responsible for project management of industrial wastewater oil-water separation system with sewer tie-in to accommodate vehicle wash operations
- Partnered with Orange County Solid Waste Division on proposed C&D transfer station resizing with cross-functional team
- Implemented Key Performance Indicator scorecard for environmental, DOT, and safety performance
- Created SWPPP and SPCC plans for multiple facilities, including management of change checklist for new leadership and training compliance calendar
- Managed Human Resources Manager and Payroll Clerk as direct reports
- Responsible for all regulatory Human Resource compliance, payroll, training, and personnel management
- Made business case for, was granted, and oversaw implementation and performance of Lytx DriveCam fleet safety management software and coaching program for 200+ vehicles
- Implemented new HRIS (Paycom) system focusing on applicant procurement and tracking, onboarding, development, performance tracking, and training components for 350 employees

Senior Environmental, Health, and Safety Consultant

Life and Safety Consultants | November 2013 to February 2017

- Managed project and consultants to turn-around account performance and fulfill all EHS requirements for Greenville Water
- Completed air emission baseline calculations to determine Title V permitting requirements, as well as chemical usage and disposition calculations for SARA compliance
- Managed project and consultants for a year-long Process Safety Management (PSM) implementation project for a large paint manufacturer
- Fostered ongoing relationships with 20+ companies, serving as site Environmental, Health, and Safety technical resource for development and implementation of regulatory programs, training, EHS management systems
- Published articles in EHS Today Magazine (A 4 step process to safety success with a temporary workforce) and South Carolina Manufacturing Magazine (Safety professional's perspective on the SC Manufacturing Environment)
- Completed multiple SARA baseline assessments, including report filing and proposed action plans for chemical manufacturing facilities
- Wrote SPCC and SWPP Plan for multiple facilities, including maintaining ongoing inspection and submission schedule and completing required inspections and reviews

- Conducted multiple full-scale baseline EPA Gap Assessments for new facility start-ups, including designing and facilitating implementation plans for compliance

Corporate Risk Manager

Human Technologies, Inc. | July 2012 to November 2013

- Built a ground-up Safety Program for a dispersed workforce of over 2,000 employees weekly
- Developed client relations to facilitate management of Environmental, Health, & Safety Programs across 45 client sites staffed by Human Technologies, Inc. as well as 200+ internal associates providing 3PL service
- Led shift in company culture and mentality from reactive safety measurement to proactive accountability
- Reduced annual worker's compensation cost by over \$400,000 over the course of one year
- Assessed potential client facilities for safety risk factors, and implemented change management process for accepting new clients
- Created and implemented client specific safety campaigns and initiatives

Operations Management Leadership Program Associate

GE Aviation | June 2010 to July 2012

- Permitted an onsite wastewater pretreatment system for a 250-person, 100,000 square foot manufacturing facility
- Created and implemented Pollution Prevention Plan including recycling program, driving decreased monthly utility cost of 5%
- Obtained regulatory disposition through ReWa on South Carolina streamlining of CFR 433 (metal finishing) resulting in a reduced sampling plan for the site
- Led site VPP audit recertification for 2012
- Managed team of 30 avionics technicians as direct reports, and was responsible for achieving established department production, quality, safety, continuous improvement, and training metrics
- Co-led Lean Event for commercial flight management systems repair group, resulting in continuous improvement actions that decreased turnaround time from 15 to 11 days and increased on time delivery by 16%.
- Supervisor of pilot teaming line of 10 military avionics technicians; became first site integrated team
- Streamlined Hearing Conservation Program leading to program enrollment reduction of 85%, overall noise reduction of 2 dB, and annual savings of \$18,000

PHILANTHROPY

Co-founder and Chairman

Michael Wayne Robbins Foundation for the Enhancement of Workplace Safety Education Scholarship Fund

Trained Citizen Participant

South Carolina Adopt-a-Stream

Volunteer

Roper Mountain Science Center

EDUCATION/QUALIFICATIONS

B.Eng. (Mechanical Engineering),
University of Sheffield, U.K.

REGISTRATIONS/ CERTIFICATIONS

Professional Engineer: Ontario

MEMBERSHIPS AND AFFILIATIONS

Water Environment Association of
Ontario – Served on the Biosolids
Committee

Air & Waste Management Association –
Held several positions as an Officer of the
Ontario Section, including Secretary, Vice
Chair, Chair and Past Chair, as well as
served on the Board of Directors

Water Environment Federation – Serves
on Biosolids and Residuals Committee,
Specialty Conference Committee

Air & Waste Management Association –
Served on Marketing Committee,
Membership Committee, Municipal
Waste Committee

Peter A.T. Burrowes

SENIOR FELLOW RESIDUALS ENGINEER

PRINCIPAL AIR QUALITY AND SAFETY MANAGEMENT ENGINEER

Peter Burrowes has 43 years of project management and engineering experience in the fields of wastewater, biosolids management, including digestion, digestion pretreatment, dewatering, thermal drying, gasification/pyrolysis, hydrothermal carbonisation/liquefaction, combustion, incineration, energy recovery, odour management, air pollution control, biogas management and solid waste management. Serving in key positions on assignments throughout Canada, the United States and internationally, Mr. Burrowes has been responsible for coordinating and supervising the planning, permitting and design of several major installations as design engineer, project manager, senior project manager and senior technical consultant. He has made presentations to clients, environmental boards, and public meetings.

Areas of Expertise

Residuals and Biosolids Management

- More than 43 years of experience in residuals and biosolids management planning, permitting, and designing, providing construction services, training and operations and alternative project delivery including Design-Build.
- Has managed several innovative, award-winning residuals management projects.
- Industry-recognized sewage sludge incineration expert; a principal author for the WEF Manual of Practice in Incineration Operations and Maintenance and provides senior level review of sewage sludge heat drying and incineration projects for Jacobs.
- Has a thorough understanding of the 40 CFR Part 503 Standards for the Use and Disposal of Sewage Sludge and the 40 CFR Part 60 Subparts LLLL and MMMM SSI MACT rule and 40 CFR Part 62 Subpart LLL Federal Implementation Plan. Has provided advice to clients on the interpretation of the Rules and methods of compliance. Has assisted clients with permitting.
- Developed an innovative approach to biosolids management master planning and led the development of the BMP Toolkit™ that includes a decision analysis model and process sizing and cost model. The process has provided many clients with a sustainable, transparent and publicly accepted long-term biosolids management roadmap.
- Uses a variety of techniques and tools for carrying out biosolids management assessments and designs, including wastewater process simulation and air emission dispersion modelling and several process sizing tools. Developed the HAM incineration mass and heat balance model and refined the Heat Drying Sizing Tool. Led the development of Technomics Tool which is Jacobs' biosolids process sizing and costing tool.
- More than 43 years of experience in the conditioning and utilization of biogas and energy management at wastewater treatment plants and landfills. Has managed and had hands-on involvement in projects that

included feasibility studies, planning, permitting, designing, providing construction services, training and operations assistance.

- Has presented technical papers on various aspects of residuals and biosolids management at national and international conferences, including WEFTEC, Air & Waste Management Association, and WEF residuals and biosolids management specialty conferences.
- Has served on the WEF residuals and biosolids committee and Bioenergy Technologies sub-committee, as well as the Water Environment Association of Ontario Biosolids committee.

Odour Management

- More than 43 years of experience planning, permitting, designing, providing construction support, training, and operations assistance for the control and treatment of odorous emissions from municipal collection systems and treatment plants and industrial processing facilities.
- Presented technical papers on wastewater treatment plant odour and air emissions studies at Air & Waste Management Association, IWA and WEF conferences.
- Uses a variety of techniques and tools for carrying out odour assessments and control designs, including liquid phase sampling, vapour phase sampling, vapour phase monitoring, and flow monitoring and modelling.
- Experienced in the issues, problem solving, community interactions, public workshops, and strategic planning/management associated with water reclamation facilities (WRF) and understands the balance between the WRF concerns, community, environmental groups, rate payers, and regulatory authorities regarding odour and air emissions management.

Air Quality Management

- More than 43 years of experience planning, permitting, designing, providing construction support, training, and operations assistance addressing air quality issues for a variety of industrial and municipal facilities.
- Presented technical papers on air quality management and climate change, including odour and air emissions studies at Air & Waste Management Association conferences.
- Uses a variety of techniques and tools for carrying out air and odour assessments and control designs, including liquid phase sampling, vapour phase sampling, vapour phase monitoring, flow monitoring, and source testing and modelling.
- Experienced in the issues, problem solving, community interactions, public workshops, and strategic planning/management associated with treatment plants and industrial facilities and understands the balance between facility concerns, community, environmental groups, rate payers, and regulatory authorities regarding odour and air emissions management.
- Was a member of the Air & Waste Management Association and has served in various executive positions for the Ontario section, including secretary, vice-chair, chair, and past-chair. Represents the Professional Engineers of Ontario on a committee advising the Ministry of the Environment on reform of air, water, and waste management regulations.

Biogas Utilization and Energy Management

- More than 43 years of experience in the conditioning and utilization of biogas and energy management at water reclamation facilities and landfills. Has managed and had hands-on involvement in projects that included feasibility studies, planning, permitting, designing, providing construction services, training and operations assistance.
- Familiar with Peel Region's wastewater treatment plants, through acting as the senior process specialist for the Region's Energy Security and Initiatives Strategy at the G.E. Booth and Clarkson WWTPs.
- Has evaluated many technologies for biogas treatment to prevent corrosion and damage to utilization equipment and has incorporated many of these into facility design projects.
- Biogas utilization methods successfully incorporated into projects include purification to biomethane and pipeline injection, cogeneration, fuel for boilers and incinerators, and flaring.
- Presented technical papers on biogas utilization and energy management at national conferences.

- Provided technical review of a WERF study on biogas treatment for the removal of Siloxanes.

Solid Waste Management

- More than 43 years of experience in solid waste management waste-to-energy feasibility studies, permitting, and landfill emissions assessments and gas utilization.
- Was a member of the Air & Waste Management Association and has served in various executive positions for the Ontario section, including secretary, vice-chair, and chair.

Relevant Project Experience

Incineration Projects

Mr. Burrowes has managed or participated in numerous projects involving the study, evaluation, pilot testing, planning, permitting, design, construction services, commissioning, and testing of sludge incineration programs.

- **Highland Creek WWTP Incinerator Project, City of Toronto, Toronto, Ontario.** The City of Toronto owns and operates the 58-mgd (219-MLD) Highland Creek Treatment Plant. Undigested and digested primary and waste activated solids are dewatered by centrifuges and incinerated in multiple hearth incinerators (MHI). Jacobs were retained to engineer the replacement of the MHIs with 2 fluid bed incinerators (FBI). Jacobs completed pre-design, assisted the City with procurement of the FBI systems and is carrying out detailed design. Mr. Burrowes participated on the City's technical selection panel for the FBI procurement and is senior technology consultant for the project.
- **Noman M. Cole Jr. PCP Solids Processing Rehabilitation Project, Fairfax County, Virginia.** The County of Fairfax own and operate the 67-mgd (254-MLD) Noman M. Cole Jr. Pollution Control Plant in Lorton, Virginia. The facility dewateres untreated primary and waste activated solids using centrifuges and combusts the dewatered solids in multiple hearth incinerators. The County retained Jacobs to engineer their solids processing rehabilitation. The project definition report identified upgrades required to the existing incinerator facility and the incinerator equipment trains to allow them to operate for at least 2 decades and to comply with new air emission regulations and recommended installing waste heat recovery on the incinerators and heating thermal oil to produce electricity in an Organic Rankin Cycle turbogenerator. The scope of the project included replacing scrubbers with VenturiPak type scrubbers, replacing burners and afterburners and ID fans, in addition to the energy recovery/electricity generation system. Jacobs also provided permitting services to the County, including assisting permit preparation to meet SSI MACT rule and operator training and certification for the rule. Mr. Burrowes was the Senior Technology Consultant.
- **Noman M. Cole Jr. PCP Master Plan Project, Fairfax County, Virginia.** The County of Fairfax own and operate the 67-mgd (254-MLD) Noman M. Cole Jr. Pollution Control Plant in Lorton, Virginia. The facility is a conventional activated sludge plant that dewateres untreated primary and waste activated solids using centrifuges and combusts the dewatered solids in multiple hearth incinerators. The County retained Jacobs to develop a master plan and capital improvements plan to cover the next 20 years of operations. The master plan report identified upgrades required to the treatment plant and identified a list of projects and the capital investment and schedule to implement these. The projects included upgrades required to the existing incinerator facility and the incinerator equipment trains to allow them to operate for at least 2 decades and to comply with new air emission regulations and recommended installing waste heat recovery on the incinerators and heating thermal oil to produce electricity in an Organic Rankin Cycle turbogenerator. Mr. Burrowes was the Senior Technology Consultant for solids treatment.
- **Noman M. Cole Jr. PCP Solids Peer Review Project, Fairfax County, Virginia.** The County of Fairfax own and operate the 67-mgd (254-MLD) Noman M. Cole Jr. Pollution Control Plant in Lorton, Virginia. The facility dewateres untreated primary and waste activated solids using centrifuges and combusts the dewatered solids in multiple hearth incinerators. The County retained a panel of seven industry-recognized experts to evaluate the findings of a solids master plan and to recommend a path forward to cover the next 20 years of operations. The Peer Review Panel recommended continuing to use the multiple hearth furnaces for as long as possible, consider implementing energy recovery from incineration and to consider replacing the MHFs in future with fluid bed incinerators. Mr. Burrowes was a member of the panel.
- **Green Bay Facility Resource Recovery and Electrical Energy (R2E2) Project, Green Bay, Wisconsin.** The Green Bay Metropolitan Sewerage District (GBMSD) retained Jacobs to carry out engineering to implement its long-

term biosolids management strategy. GBMSD own and operate the Green Bay Facility (GBF) and the De Pere Facility (DPF). Waste activated solids is pumped from DPF to GBF and processed with primary and waste activated solids at the 40-mgd (150-MLD) GBF. The Resource Recovery and Electrical Energy (R2E2) Project replaced the existing dewatering and multiple hearth furnaces with an innovative approach to solids management. The primary and waste activated solids are combined with imported high strength organic waste and converted to biosolids in anaerobic digesters. The biogas produced powers engine/generators to produce electricity and heat for use in the plant. The biosolids is dewatered with centrifuges, pre-dried in an indirect disc dryer using heat recovered from the combustion of the biosolids and the pre-dried biosolids are combusted in a fluid bed reactor (FBR). In addition to the energy recovered from combustion, the FBR is equipped with state-of-the-art air pollution control equipment to meet the MACT SSI rule 40 CFR Part 60 subpart LLLL. Ash is decanted in repurposed ash tanks for landfilling. Mr. Burrowes led the preparation of the purchase documents for the incineration system and provided senior review for the project, as well as performance guarantee, permit compliance verification, plant commissioning and operator training.

- **Duffin Creek Wastewater Pollution Control Plant Incinerator 1 & 2 Replacement Project, Pickering, Ontario.** The Regional Municipalities of York and Durham jointly own and operate the 110-mgd (420-MLD) Duffin Creek Wastewater Pollution Control Plant. The Regions recently completed the Stage 3 expansion which provides treatment for a dry weather flow of 166 mgd (630 MLD). The Regions are now replacing and refurbishing the aging infrastructure of Stages 1 and 2. Jacobs was retained by the Regions to provide engineering services, including planning, permitting, design and construction services for the replacement of incinerator trains 1 and 2. Mr. Burrowes provided senior technical advice and review for the conceptual design including equipment train selection and sizing, a permitting plan, construction sequencing and in particular selection of mercury controls. Mr. Burrowes is providing senior advice and review for the detailed design to the project. Each incinerator train will have a design capacity of 105 dry tons per day and each train will include a hot windbox fluid bed reactor, a primary heat exchanger, a waste heat recovery steam boiler, and air pollution control system that will include state-of-the-art wet scrubber and mercury control. Recovered steam will be used to drive the fluidizing air blowers.
- **Duffin Creek Wastewater Pollution Control Plant Stage 3 Solids Expansion, Pickering, Ontario.** The Regional Municipalities of York and Durham jointly own and operate the 110-mgd (420-MLD) Duffin Creek Wastewater Pollution Control Plant. The Regions implemented the Stage 3 expansion which provides treatment for a dry weather flow of 166 mgd (630 MLD). Jacobs was retained by the Regions to prepare a Facility Plan, an Environmental Assessment and to provide engineering services for the permitting, design and construction services for the Stage 3 expansion. Mr. Burrowes was the project manager for the Facility Plan and led the technical components of solids processing. For the Environmental Assessment, Mr. Burrowes led the odour and air quality impact assessments. He led the update of the odour management plan, which included extensive odour testing and modeling. For the engineering services component of the Stage 3, Mr. Burrowes led the conceptual and preliminary designs of the solids processing systems: digestion, dewatering and incineration and was the design manager for the predesign and led the procurement of the new incineration systems. The procurement of the incinerator systems was a two-stage process that included qualification of vendors and proposals from qualified vendors. Mr. Burrowes participated in the Regions' evaluation team and led the technical evaluation. He provided support to the site engineering team during construction, provided training to plant operators and provided overview and advise during commissioning and performance verification. The completed solids processing has a processing capacity of over 270 dry tons per day from an existing capacity of 90 dry tons per day.
- **Solids Improvements Project at the Metro WWTP, St. Paul, Minnesota:** The Metropolitan Council Environmental Services in St. Paul, Minnesota owns and operates the 200-mgd (818-MLD) Metro WWTP. Jacobs was lead consultant for a solids processing facility plan that determined the preferred long-term solids management strategy for the Metro plant. The project included preparation of the air permit application. Mr. Burrowes carried out analyses and prepared the technical sections on incineration and heat drying for the plan and permit engineering. Jacobs was the lead consultant for the design and contract services for the facility, which was designed to dewater and incinerate up to 300 dry tons of solids per day. Mr. Burrowes led the pre-design of the fluidized bed combustor, waste heat boiler and state-of-the-art air-pollution-control system components, as well as the preparation of the contract documents for the design-build of the major incineration system. His role included participating in the bid evaluation and the contract negotiations with

the design-build contractor and technical review and oversight during the construction phase, as well as evaluation of performance testing and performance verification.

- The Puerto Nuevo Regional WWTP, owned by the Puerto Rico Aqueduct and Sewer Authority (PRASA), operated two multiple-hearth incinerators. Mr. Burrowes led a team providing technical support to PRASA on regulatory compliance issues, including preparing a compliance plan, developing a strategy for permitting replacement abatement units, as well as advising on rehabilitation requirements for the existing incinerators. Following this, he led the permitting and replacement of one of the existing multiple hearth incinerators with a fluid bed incinerator. The assignment included preparing the permit application, the pre-design and procurement documents for the replacement fluid bed, evaluating bids and providing review of the design and construction of the system by the design-build contractor. The system can process more than 63 dry tons per day of biosolids. Mr. Burrowes carried out a condition assessment of the incineration system and assisted PRASA with preparation to commission and startup of the incinerator. Mr. Burrowes has continued to provide support to PRASA in operations and permitting services. Has advised on maintenance and repairs of incinerator systems and supported compliance with the SSI MACT regulations and Title V permitting.
- The Puerto Nuevo Regional WWTP, owned by the Puerto Rico Aqueduct and Sewer Authority (PRASA), operates a fluidized bed incinerator. Jacobs was retained by PRASA to carry out a study to determine whether it was feasible to continue incinerating or whether PRASA should landfill its solids. The study recommended continuing incineration. As a follow up, Jacobs assisted PRASA with permitting the incinerator under the SSI MACT Rule. Mr. Burrowes was the Senior Technology Consultant.
- Project manager and lead engineer for the thermal oxidation facility at the Lakeview WPCP, Ontario. For this project, a firm incineration capacity of 55 tonnes (60 tons) per day dry solids was integrated into the existing thermal conditioning/dewatering system. Fluid bed incinerators with waste heat recovery boilers and venturi scrubbers were selected. The project was implemented using a design, bid, build approach, with multiple contracts. Following selection of the major equipment, demonstration burns were successfully performed. The completed facility passed all performance and regulatory testing requirements and met permit requirements. Mr. Burrowes led permitting and planning of an expansion of the incineration facility and provided senior technical review for the design, construction, commissioning, and testing.
- Project manager and lead engineer for a major program to improve the sludge incineration system at Toronto's 200-mgd (818-MLD) Ashbridges Bay Wastewater Treatment Plant. The program included installing new incinerators and waste heat boilers and scrubbers and rehabilitating existing incinerators. The purpose of the program was to provide firm incineration capacity and meet changing regulatory requirements. The projects, which included planning, permitting, design, construction services, commissioning and testing, are as follows:
 - New multiple hearth incinerator No. 8; waste heat boilers Nos. 5, 6, 7, and 8; and rehabilitation of incinerators Nos. 3, 4, 5, 6, and 7
 - Waste heat boiler and incinerator auxiliary facilities including installation of two 11-t/hr, 500-psig (3,500-kPag) high pressure steam boilers, high pressure steam piping, and boiler chemical treatment
 - Incinerator building extension: Incinerator auxiliary facility including 2,450-cfm (255,000-m³/h) combustion air blowers, ash collection and transfer system, and a 17-cfm (1,700-m³/h), 100-psig (700-kPag) compressed air system to serve the plant. The project also included dry chemical scrubbing of compressor air.
 - Report on best available technology for sludge incineration
 - Demolition of incinerators Nos. 1 and 2
 - Design of new fluid bed to replace incinerator No. 2
 - Design of upgrades to incinerators Nos. 3 through 8, including venturi scrubbers, wet electrostatic precipitators, exhaust (ID) fans, and continuous emission monitoring systems (CEMS)
- For the Buffalo Sewer Authority, Mr. Burrowes was project manager and lead engineer for preparing the Part 503 permit application for the sludge incinerators at the 610-MLD (150-mgd) Bird Island STP and installing a THC CEMS and studying improvements necessary for improving incineration. Jacobs is currently upgraded two of the existing multiple hearth incinerator trains. Mr. Burrowes was STC.

- Project manager for study of the potential energy recoverable from the combustion of municipal solid waste in Ontario, for Independent Power Producers' Society of Ontario, Toronto.
- Project manager for feasibility study of a large-scale energy-from-waste facility, Lambton Chamber of Commerce, Sarnia.
- Technical advisor for feasibility study for a 600-t/d energy from waste facility in Kingston, Jamaica, for Canadian International Development Agency.

Wastewater, Residuals and Biosolids Management

Mr. Burrowes has managed or participated in numerous projects involving the study, evaluation and planning, permitting, design and construction management of residuals and biosolids management programs for many municipal wastewater treatment systems.

- **Subject Matter Expert, Woodman Point WRRF Sludge Treatment Upgrade, Perth, Australia.** The Water Corporation owns and operates the Woodman Point Water Resource Recovery Facility (WRRF) which is currently being upgraded to 180-ML/d. During this upgrade, it was identified that the sludge treatment infrastructure requires significant upgrades to match the used water treatment capacity. Additionally, the ability to continue to produce P3 C2 biosolids suitable for direct beneficial use in agriculture is at risk due to insufficient retention time in the egg shaped digesters (ESDs). The Water Corporation retained Jacobs to carry out a conceptual design for the sludge treatment upgrade. The conceptual design reviewed existing plant bottlenecks, multiple short and long-term alternatives and prepared the final conceptual design of a thermal hydrolysis process (THP) to treat the waste activated sludge as a short-term solution, with phased implementation of the long-term solution to include upgrade to full THP, addition of an additional ESD and potentially installation of gasification/pyrolysis. Mr. Burrowes was subject matter expert for gasification/pyrolysis.
- **Casey Biosolids Preliminary Engineering Report, Clayton County, Georgia.** The W.B. Casey Water Resource Recovery Facility (WRRF) is one of three water reclamation facilities owned and operated by Clayton County Water Authority (CCWA). A new wasteload allocation was received for the W.B. Casey WRRF in October 2019 that would allow a capacity expansion from 24 to 32 mgd. As part of the subsequent capacity analysis, revised flow projections indicated a reduced urgency to expand the liquid stream facilities. However, the existing biosolids facility is operating near capacity, is at the end of its useful life, and represents safety concerns. Jacobs was retained to develop the concept for plant expansion and to prepare a preliminary engineering report for the solids expansion. The project will replace the existing dewatering and thermal drying system and include anaerobic digestion of primary sludge. A state-of-the-art rotary drum drying facility will produce Class A EQ fertilizer grade granules. Mr. Burrowes provided senior overview for the dryer and QA/QC for the preliminary engineering report.
- **Process Lead, Blue River WWTP Solids Improvements, Kansas City, Missouri.** The Water Services Department (WSD), City of Kansas, Missouri own and operate the 85-mgd (322-MLD) conventional activated sludge plant that includes primary treatment at one site and trickling filters and secondary clarifiers at a nearby site. Solids treatment includes anaerobic digestion, with liquid land application of a portion of the solids and dewatering and multiple hearth incineration (MHI) of the remainder. Solids processing is located at the same location as the primary plant. The MHIs have reached their useful life and required replacement. WSD retained Carollo and Jacobs to provide conceptual design, preliminary design and procurement documents for design build delivery of solids improvements. The solids improvements will include addition of a thermal hydrolysis process (THP) and upgrading of existing anaerobic digesters and a biogas treatment system. The solids improvements will process solids from Blue River, as well as from Westside WWTP, and Birmingham WWTP. Mr. Burrowes is leading the process design and procurement documents for THP biogas treatment.
- **Senior Technology Consultant, Wastewater Sludge Drying Plant at the Dan Region Wastewater Treatment Plant (SHAFDAN), Tel Aviv, Israel.** Mey Ezor Dan Agricultural Cooperative Water Society Ltd. (MED) owns the Dan Region Wastewater Treatment Plant (Shafdan) in the City of Rishon Letzion, Israel, approximately 10 kilometres south of Tel Aviv. The plant treats approximately 380,000 m³/d of municipal wastewater for a population equivalent of 2.2 million and is designed for biological nitrogen removal. MED retained Jacobs to

provide engineering services to develop a predesign and develop a request for qualifications/proposals for a design/build/finance/operate thermal drying plant with multiple belt dryers with total evaporation capacity of up to 23.7 kg/h. Mr. Burrowes is providing technical oversight and QA/QC for dryer section and sizing.

- **Subject Matter Expert, Solids Process and Biogas, Lulu and Iona Integrated Resource Recovery (IRR) studies; Metro Vancouver, Burnaby, British Columbia.** Metro Vancouver retained KWL and Jacobs to study integrated resource recovery (IRR) in the Lulu Island and Iona Island sewerage areas. The objectives of the studies included: identifying effective opportunities to integrate liquid and solid waste systems; reducing demands on utility infrastructure and the environment; generating resource revenues to offset utility system costs; providing renewable energy to replace fossil fuel use; and reducing greenhouse gas (GHG) emissions. Mr. Burrowes provided technical review of the IRR technical memos for the Lulu and Iona IRR studies.
- **Sewage Treatment Modernization Plan in the Metropolitan Region of Sao Paulo, Brazil.** Companhia de Saneamento Básico do Estado de São Paulo – (SABESP) own and operate five wastewater treatment plants (WWTPs) that serve the population (over 23 million) of the Metropolitan Region of Sao Paulo. SABESP retained Jacobs to develop a Sewage Treatment Modernization Plan in the Metropolitan Area of São Paulo (PLAMTE_RMSP) with a planning horizon to the year 2040, and to study alternatives for meeting the 2040 requirements at each WWTP, select preferred alternatives and to develop preliminary designs for the expansion of each of the WWTPs. Mr. Burrowes provided process and technical oversight for the solids treatment components of the project.
- **Technology Consultant, Milwaukee Metropolitan Sewerage District Effective Biosolids Energy and Utilization Management Study, Milwaukee, Wisconsin.** The Milwaukee Metropolitan Sewerage District (District) has been producing its wastewater biosolids-derived Milorganite® product since 1926, making it perhaps the most established marketed product in the industry. The District is considering alternative, innovative methods to more effectively and efficiently process biosolids and one option may be the production of biochar. The District retained Jacobs to study the feasibility of pyrolysis/gasification of its dried biosolids and production and utilization of biochar. Eleven vendors were identified that have marketed or have installed wastewater solids gasification and pyrolysis systems. A preliminary mass and energy balance for the pyrolysis process was prepared based on data collected from the vendor proposals as well as previous work performed by Marquette University. It was determined that the energy in the py-gas and bio-oil could produce enough electricity to meet the external pyrolysis input requirement. A conceptual cost estimate for a 26-dtpd pyrolysis system was developed and operations and maintenance (O&M) costs were also estimated. MSD. An economic evaluation was completed to determine if pyrolysis would be cost effective. A demonstration scale system was recommended that would allow the District to further evaluate the technology and potential product uses, which may result in the development of a full-scale system. The pilot will begin in 2018. Mr. Burrowes was the technology consultant for the pyrolysis/gasification evaluation.
- **Technical Lead, Annacis Island WWTP Biosolids Drying Feasibility Study, Metro Vancouver, Delta, British Columbia.** Responsible for leading the team in evaluating options for the dryer facility concept and developing an optimal design for the Annacis Island WWTP, as well as characterizing air emissions and evaluating pollution control technologies. Project involves reviewing feasibility of using excess heat from cogeneration engines as the primary heat source to dry biosolids produced from Metro Vancouver's five wastewater treatment plants. The study recommended installing a rotary drum dryer plant adjacent to the new Northwest Langley WWTP to process up to 75,000 wet tonnes of biosolids annually. Mr. Burrowes provided senior review and oversight.
- **Senior Technology Consultant (Solids), Honouliuli WWTP Secondary Upgrade; Oahu, Hawaii.** The City and County of Honolulu (CCH) own and operate the Honouliuli WWTP, which has an average primary treatment capacity of 38 mgd (144 MLD) and a secondary treatment capacity of 13 mgd (49 MLD) using the trickling filter solids contact process. Solids are anaerobically digested and dewatered. Due to a consent decree and growing population, CCH retained RM Towill and Jacobs to engineer upgrades to the WWTP, including full secondary treatment. The liquid train will consist of an AB treatment system, with an A-stage high rate biological contactor with dissolved air flotation and B-stage bioreactors and clarifiers. The solids treatment train will include thermal hydrolysis, anaerobic digestion, dewatering and thermal drying. Solids will be imported from other WWTPs and treated in the solids train. The project will be constructed in phases, with the Phase 1A that

includes thermal drying, using belt dryers began construction in 2018. Mr. Burrowes led the solids pre-design and is providing senior technical advice during the design of the thermal dryers, thermal hydrolysis and the combined heat and power plant. He is the senior technology consultant for the solids processing component on the expansion.

- **Senior Technology Consultant (Solids), Tuas Water Reclamation Plant, Singapore.** The Public Utilities Board (PUB) is constructing the Tuas Water Reclamation Plant (TWRP), a key component of the Deep Tunnel Sewerage System (DTSS) Phase 2 project, It will be one of the most revolutionary facilities of its kind in the world. Domestic used water will be treated in a 172-mgd (650-ML/d) module and then further purified to NEWater, while industrial used water will be treated in a separate 40-mgd (152-ML/d) module and sent back to industries for reuse. The TWRP is to be co-located with an Integrated Waste Management Facility (IWMF) which will be constructed and managed by the National Environment Agency (NEA). The PUB retained Jacobs to engineer the TWRP, which will include a solids processing train comprising thickening, thermal hydrolysis pre-treatment, anaerobic digestion and dewatering. Greasy waste will also be processed. The dewatered solids will be conveyed to the IWMF for incineration. Biogas produced by the digesters will be stored and conveyed to the IWMF for electricity generation, which in turn, will provide steam to operate the thermal hydrolysis system. Mr. Burrowes is the senior technology consultant for solids processing.
- **Technical Lead, Hamilton Biosolids P3 Business Case; City of Hamilton, Ontario.** Jacobs working with Deloitte, assisted the City of Hamilton staff to develop a business case to obtain P3 funding for the Biosolids P3 project, which will implement a long-term biosolids strategy at the Woodward Avenue WTP using a DBFOM delivery, with a 30-year operating period. Mr. Burrowes led the technical aspects of the business case.
- **Technical Lead, Hamilton Biosolids P3 Transaction Advisor; City of Hamilton, Ontario.** Jacobs working with Deloitte and Blakes assisted the City of Hamilton with selecting a P3 entity to provide a 30-year biosolids solution for the City using a DBFOM delivery. The Transaction Advisor (TA) team developed an RFQ, and RFP and the project Agreement, assisted the City with evaluating, selecting and negotiating a financial close. The project included a 7,000-kg/h evaporation rate rotary drum dryer plant that included dewatered cake storage, pumping drum dryer, product separation, conveying, storage and loadout, recycle/cake granulation process gas condensing, recirculation, and exhaust gas scrubbing and RTO, as well as odour control. The TA team assisted the City in reviewing the design-builder's design report, commissioning and startup plans, as well as observing commissioning and performance testing and providing the City with a report on the Design-Builder's compliance with the Project Agreement. Mr. Burrowes led the technical advisory aspects of the P3, including services during design, construction, commissioning and performance compliance verification for the City.
- **Senior Technical Consultant, Solids Facility Plan; New Water, Green Bay, WI.** The Green Bay Metropolitan Sewerage District (GBMSD) retained Jacobs to carry out a solids study to determine its long-term biosolids management strategy. GBMSD operates WWTPs in Green Bay and DePere with management of biosolids at the GBMSD WWTP, primarily by incineration. When the DePere biosolids are pumped to Green Bay, the aging multiple hearth furnaces (MHF) will run out of capacity and there is concern with pending air emission regulations. One of GBMSD's goals was to develop a strategy in keeping with the District's strategic plan. Utilizing Jacobs multi-step decision framework with the proprietary BMP Toolkit to assess TBL, sensitivity analysis of operating parameters using Monte Carlo simulations and a collaborative approach using workshops. Seventy-three solids unit processes were considered, some were eliminated, and the remaining 52-unit processes were used to develop 17 process configurations. Of these seventeen configurations, six alternative configurations were selected and evaluated in detail. Jacobs facilitated GBMSD's decision to implement a diversified strategy including anaerobic digestion of biosolids with biogas cogeneration, dewatering of the biosolids and drying of a portion of the biosolids and incineration of the remainder, with heat recovered from incineration providing heat for drying. This strategy met many of the District's strategic goals. Mr. Burrowes was the senior technical consultant and led the technical components, as well as facilitated workshops.
- **Senior Technical Consultant, Residuals Resource and Electrical Energy Project; New Water, Green Bay, Wisconsin.** The Green Bay Metropolitan Sewerage District (GBMSD) retained Jacobs to engineer a new solids processing facility, previously selected by the long term biosolids management strategy. The project, called the Residuals Resource and Electrical Energy (R2E2) project provides GBMSD with solids processing facilities to

the design year of 2045, with a processing capacity of 45 dry tons per day. The facility includes anaerobic digestion of plant biosolids and imported high strength waste to produce biogas to be utilized in a combined heat and power plant (CHP). The resultant biosolids are dewatered by centrifuges and partially dried and incinerated in a fluid bed reactor with heat recovery and state-of-the-art air pollution control equipment to meet 40 CFR Part 60 subpart LLLL. Ash is decanted in repurposed ash tanks for landfilling. The CHP includes biogas treatment to remove H₂S and siloxanes and two 2-MW internal combustion engine generators. Electricity production offsets utility purchases and recovered heat is used for digester and plant heating. Mr. Burrowes led the preparation of the purchase documents for the incineration system and provided senior review for the project during design, construction, startup, performance verification and operator training.

- **Senior Technology Consultant (Solids), Central Contra Costa Sanitary District's Comprehensive Master Plan; Martinez, California.** Central Contra Costs Sanitary District (District) hired Carollo and Jacobs to prepare a master plan for the District's collection system and wastewater treatment plant (WWTP). The master plan at the WWTP assessed several options for both the liquids trains and solids trains and evaluated four combined liquids/solids scenario to develop a preferred alternative. These were determined, with close collaboration with District staff at two retreats and several workshops, as well as presentation to the District's Board. Mr. Burrowes was the senior technology lead for the solids trains evaluations.
- **Senior Technical Consultant, Biosolids Digestion Facility Project, San Francisco, California.** The San Francisco Public Utilities Commission is replacing its solids processing facility at its Southeast Water Pollution Control Plant (SEP). Jacobs, as part of an engineering consortium, is providing engineering for the 80 dry ton per day facility. Following conceptual design, which evaluated alternatives and selected the process scheme, preliminary and detailed design were completed and construction is underway. The process scheme will include thermal hydrolysis pre-treatment of combined, thickened primary and waste activated solids, followed by anaerobic digestion and dewatering. A combined heat and power system utilizing a gas turbine will produce electricity and heat (steam and hot water) from conditioned biogas to offset power usage and provide process and plant heating. Mr. Burrowes provided QC review and senior technical overview for the project.
- **Senior Technical Consultant, Biosolids Management Plan Update, Region of Waterloo, Ontario.** The Region of Waterloo retained Jacobs to update its 2003 biosolids management plan. The Region, which owns 13 WWTPs and managed biosolids either by agricultural land application or by landfill, was faced with changing regulations, emerging technologies and a shrinking agricultural land base. In addition, the Region adopted its Environmental Sustainability Strategy in May 2009. The update was based on a multi-step decision analysis approach within a sustainability framework, enhanced through extensive stakeholder involvement. Using Jacobs proprietary BMP Toolkit, which includes the Technomic model and the BMP decision model, and a collaborative approach using workshops, Jacobs facilitated the Region's staff in determining the preferred strategy. A unique feature of the update was the Life Cycle Assessment of the short-listed strategies to determine long-term impacts on the natural environment in terms of abiotic depletion of resources, climate change, land use, eutrophication and acidification. Mr. Burrowes was the senior technical consultant and led the technical components, as well as facilitated workshops.
- **Senior Technology Consultant, Jurong WRP Phase 4 Expansion.** Singapore's National Water Agency, the Public Utilities Board (PUB), owns and operates the Jurong Water Reclamation Plant (JWRP). The JWRP treats domestic and industrial used water from the western catchment basin of Singapore. The plant was constructed in 3 phases (Phases 1, 2 and 3) and recent modifications have segregated the influent into domestic used water and industrial used water. The Phase 1 and Phase 2 facilities treat domestic used water and the Phase 3 facilities treat industrial used water. The Phase 1 and Phase 2 facilities have sufficient capacity to meet the domestic used water flows projected up to 2028. The industrial used water flows, on the other hand, currently exceed the capacity of the Phase 3 facilities. Consequently, some of the industrial influent is currently treated by Phase 2. Jacobs was selected as the consultant responsible for the study, design and supervision of the construction and commissioning of the Phase 4 expansion and upgrade of the works at the JWRP. This included expanding the liquid and solids treatment capacity by an additional 55 MLD (15 MGD). After comparing all options to expand the existing anaerobic digesters and adding pre-treatment, thermal hydrolysis was selected to pretreat the waste activated sludge (WAS) from the whole plant to increase the capacity of the existing anaerobic digesters. The new system includes pre-dewatering with centrifuges, Cambi

Thermal Hydrolysis Process (THP), hydrolyzed biosolids cooling and modifications to the existing anaerobic digesters. Construction and commissioning of the plant was completed in late 2017. The THP plant at the JWRP is the first in the tropics, where waste solids is typically in the range of 28 to 30°C (82 to 86°F). The anaerobic digesters were originally unheated and not insulated. The thermally hydrolyzed WAS is cooled using a once-through final effluent heat exchanger system and injected into the existing anaerobic digester recirculation lines provides dilution to avoid thermally shocking the biomass. Mr. Burrowes was the senior technology consultant for the Cambi pre-treatment system.

- The City of Calgary owns the Bonnybrook Wastewater Treatment Plant. Bonnybrook is a 500-MLD advanced secondary treatment facility that uses state-of-the-art biological nutrient removal processes to treat municipal wastewater. The plant has undergone several major expansions. Jacobs is part of a multi-discipline consulting team engineering the Plant D Expansion which will service a population equivalent of 325,000. The expansion includes addition of primary and secondary clarifiers, effluent filtration, UV disinfection, primary and secondary sludge thickening, a sludge pre-treatment facility, anaerobic digester mixing upgrades and upgrade of the biogas collection and treatment systems. The sludge pre-treatment system includes centrifuge dewatering of thickened waste activated sludge (WAS), thermal hydrolysis (THP) of the WAS and blending of the THP WAS with primary sludge. The pre-treatment system will process an average of 55 t/d WAS and is expandable to meet the ultimate requirement of 70 metric tonnes (77 dry tons) of solids a day by adding a 4th reactor. In addition to treating both thickened and un-thickened WAS, the THP system will process concentrated grease waste, collected from island-wide grease traps. All the WAS streams are combined and then centrifuge dewatered prior to the THP, with the grease waste being fed directly to the THP system as well. Mr. Burrowes was the senior technology consultant for the THP pre-treatment system.
- Gippsland Water, Victoria, Australia, entered into an Alliance with Jacobs and other partners to construct the Gippsland Water Factory (GWF). The first phase of the GWF processes up to 9 mgd (35 MLD) of domestic wastewater from the service area, together with industrial wastewater from a paper mill and other industrial dischargers. The GWF produces industrial grade water that is recycled to the paper mill. As a member of the Alliance's Technical directorate, Peter provided process development, technical oversight and QA/QC for the anaerobic reactors, biogas utilization and cogeneration and dewatering systems during the TOC, detailed design, construction and commissioning phases of the water factory, as well as supported the pilot plant design and operations. The anaerobic reactor is a unique design to provide high rate treatment for paper mill waste and stabilization of sludges from the domestic treatment plant. The dewatering facility processes residuals from the wastewater plant, as well as the recycling plant. Peter also provided technical oversight for the plant-wide odour control systems and technical review on the headworks design and carried out the plant-wide hazardous location study.
- The Greater New Haven Water Pollution Control Authority (WPCA) operate the 40-MGD (150 MLD) East Shore WPAF. The facility produces about 22.5 dry tons per day of residual solids. The residuals solids together with imported solids are dewatered and mixed with fats, oils and grease from regional commercial institutions and fed to a multiple hearth incinerator. The multiple hearth incinerator is permitted to process up to 40 dry tons per day and is equipped with an innovative flue gas recycle, air pollution control and a regenerative thermal oxidizer. Jacobs was retained to develop a biosolids management plan for the WPCA. Mr. Burrowes was Senior Technology Consultant and made presentations before the Board of the WPCA and at public meetings.
- The City of Calgary is implementing the 185-mgd (700-MLD) Pine Creek Wastewater Treatment Plant to eventually replace the Fish Creek WWTP. The current phase will provide 26.5 mgd (100 MLD) of treatment and is being provided in ten contracts. The first phase consists of preliminary treatment; primary treatment; secondary treatment including biological nutrient removal and secondary clarification; disinfection and filtration and anaerobic digestion. Mr. Burrowes was the Senior Technical Consultant for the treatment contracts and participated in the milestone reviews, as well as provided technical oversight to the multi-firm design team. Mr. Burrowes continued to provide technical support during construction.
- The City of Calgary selected Jacobs to develop an Organic Waste and Biosolids Master Plan that would provide the City with opportunities to co-manage organic waste and biosolids generated within The City. The study team selected many alternatives, which were evaluated in multiple workshops, using multi-criteria utility

analysis. The City ultimately decided to implement an organics campus which included co-composting of biosolids and organic waste. Mr. Burrowes was Senior Technology Consultant.

- **Senior Technology Consultant; Biosolids Drying Feasibility Study; Vancouver, BC.** Metro Vancouver retained Jacobs to investigate the feasibility of siting a biosolids facility at one of the two cement manufacturing plants in the Greater Vancouver area to dry biosolids generated at the Metro Vancouver WWTPs and utilizing waste heat from cement manufacturing to provide heat for drying. The dried product would be used in place of coal as a fuel for the cement kilns. The study included evaluating several dryer technologies and selecting belt drying, due to its ability to utilize waste heat from the cement plant's clinker cooler. Mr. Burrowes was the senior technology consultant.
- **City of Stamford Biosolids Drying Facility, Stamford, Connecticut.** The City of Stamford selected Jacobs to provide a biosolids drying plant by design-build delivery in Phase A of its Biosolids-to-Energy program. The dryer processes up to 25 tons per day of solids to produce a Class A pelleted product using rotary drum drying. Mr. Burrowes led the dryer selection and overall process design during proposal preparation and was Quality Manager and Senior Technology Consultant during design and commissioning for the drying process, including submittal review of drying equipment, shop drawings, O&M manuals coordinating technical issues on the drying process and assessing performance. For the next phase, which included a demonstration study to convert the pelleted product to energy and design of a gasification/syngas cleaning system to generate electricity using IC engines with heat recovery, he led the technical assessment of gasification and energy production.
- **Senior Technical Consultant, Wastewater Sector Market Assessment for Private Biosolids Processing Company, USA.** Jacobs carried out a biosolids market assessment for a private biosolids processing company to determine potential wastewater treatment plant sectors that would be potential users of this biosolids processing technology. Surveyed multiple agencies and reviewed several data bases including EPA's wastewater needs survey flow report and added information related to biosolids processing technology used for larger plants in the 20-MGD (75-MLD) and larger range. Evaluated various drivers including regulatory, renewable energy standards, costs of competing technologies and developed a series of strategic business recommendations.
- **Senior Technical Consultant, Technology Review and Assessment for Private Clean Technology Investment Company, UAE.** Jacobs carried out a technical review and assessment of the suitability of a thermal biosolids processing technology for a planned city of the future. The study included visiting an operating facility in California, as well as reviewing the technical designs and previous technical, contractual and financial assessments by others. Mr. Burrowes led the study.
- **Senior Technology Consultant, Study into the Feasibility of Constructing a Biosolids-to-Energy Facility, Northern Virginia.** Jacobs carried out a study as a sub-consultant to McGuire Woods to assess the feasibility of developing a regional biosolids-to-energy facility in Northern Virginia. The participating wastewater utilities included the Alexandria Sanitation Authority, Arlington County, DC Water, Fairfax County, Loudon Water, Prince William County and the Upper Occoquan Service Authority. Commercially viable biosolids-to-energy technologies were identified and evaluated to determine general sizing and cost information for various capacity facilities. This information was used to also determine the technical and practical feasibility of locating each technology on various potential sites taking into consideration surrounding land uses, required local land use approvals, federal and state permitting requirements, and transportation. Mr. Burrowes was senior technology consultant.
- **Senior Technical Lead, Central Contra Costa District's Mercury Study; Martinez, California.** The Central Contra Costa District (District) were concerned that impending effluent regulations would be impacted by mercury in the sludge incineration process. The District retained Jacobs to study the impacts of mercury from incineration of sludge on plant effluent and air emissions and recommend solution. Jacobs developed a mercury mass balance model and evaluated several mercury control technologies for treating scrubber effluent, as well as controlling incinerator emissions. Mr. Burrowes led the study.
- **Biosolids Management Study and Drum Dryer Rehabilitation Project, Clayton County, Georgia.** The Clayton County Water Authority (CCWA) own and operate the 24-mgd (90-MLD) W.B. Casey Water Reclamation Facility (WRF), together with two other smaller WRFs. W.B. Casey will be expanded to 30 mgd (114 MLD) to meet CCWA's estimated

2030 wastewater flows of 44 mgd (166 MLD). Biosolids at W.B. Casey are thermally dried and marketed, using two rotary drum dryers. Biosolids from the other WRFs are dewatered on-site and composted offsite. Jacobs was retained by CCWA to prepare a biosolids management plan (BMP). The BMP evaluated the monetary and non-monetary feasibility of several alternatives, including replacing the existing 20 year-old dryers with new dryers, digestion options and upgrading the existing dryer system. CCWA decided to upgrade the existing dryer system. Following completion of the BMP, Jacobs was retained to carry out a pre-design study, detailed design and construction services to upgrade the existing dryer system. Mr. Burrowes provided senior technical support for evaluating the dewatering and drying system during the BMP and was STC for the dryer rehabilitation.

- In 1998, Watercare Services Ltd. awarded the US\$180M, design-build contract for Project Manukau, an upgrade of the Mangere Wastewater Treatment Plant (WWTP), to Manukau Wastewater Services Ltd., a consortium of Fletcher Construction, CH2M BECA Ltd., Civil and Civic Ltd., and New Zealand Water Services Ltd. The upgraded 400-ML/d plant has been operating since 2001 and provides the population base of 950,000 with a world-class WWTP. After extensive stakeholder involvement, the project will also restore the tidal foreshore around Auckland's Manukau Harbour for swimming, fishing, shellfish harvesting, and provide a habitat for migratory birds. Mr. Burrowes led the preparation of a Variation Price Proposal for a 90-ton-per-day drying/blending facility that included preparing a preliminary design for the facility, procurement documents and conducting a three-step procurement process consisting of expressions of interest from vendors, shortlisting of vendors, tenders from vendors, evaluation of tenders and negotiations with the preferred tenderer. The facility included dewatered biosolids storage, conveying, fluidized bed drying, blending, product storage, energy recovery of steam from the plant's cogeneration facility and a biofilter. In addition, Mr. Burrowes oversaw odour sampling of odour sources in the plant and participated in the development of odour compliance and performance testing protocols and the verification testing.
- The City of Ottawa-Carleton owns and operates the 700-MLD (175-mgd) Robert O. Pickard Environmental Centre in Gloucester, Ontario. The plant provides conventional wastewater treatment, utilizing preliminary treatment; primary treatment; high rate activated sludge; secondary clarification; disinfection; centrifuge thickening of waste activated sludge; anaerobic digestion, and centrifuge dewatering of digested sludge. The City is adding additional capacity through two 3.3-MG (12,500-m³) silo type anaerobic digesters and upgrading the East Boiler Plant. Mr. Burrowes was the Senior Technology Consultant for the planning, permitting, design and construction of the expansion.
- The Northeast Ohio Sewer District owns and operates three wastewater treatment plants that serve 1.1 million residents, businesses and industries in the Cleveland Metropolitan Area. The District currently disposes of its residual solids by incineration. The District is committed to dispose of the residuals generated from the treatment process in a manner that is cost-effective and complies with all applicable laws and regulations. The District has retained the services of Jacobs to carry out a District-wide Residuals Management Study to assist the District in selecting cost-effective options that will provide for the continuous disposal of the District's residuals for the long term. Mr. Burrowes was a senior consultant and project lead for the management alternatives evaluation and selection, as well as thermal and incineration components of the study.
- The City of Guelph owns and operates the 64-MLD (17.5-mgd) Guelph WWTP. The plant provides conventional wastewater treatment, anaerobic digestion, belt filter press dewatering of digested sludge, and in-vessel composting. Mr. Burrowes led a Biosolids Management Planning study to determine the preferred method of managing biosolids and provided recommendation to the City on a strategy for the next 20 years. The project employed Jacobs proprietary Biosolids Management Plan Tool, a decision science model and in a workshop format, facilitated evaluation of alternative strategies. Mr. Burrowes attended City Council and public meetings and made presentations. Strategies evaluated included expanding the existing process, thermal drying, advanced alkaline stabilization and thermal oxidation. Technology innovations included supporting a pilot demonstration of the LYTEK process, followed by full-scale implementation. He provided on-going support to the City during the implementation program.
- The Region of Niagara operates eight wastewater treatment plants and three water treatment plants. For over 30 years, the Region has managed its biosolids utilization through application on agricultural land. The application program has been largely handled through contracting with qualified biosolids contractors;

however, the application contract expired in 2000. The Region is committed to managing its biosolids in an environmentally responsible manner that is cost-effective and endorsed by its stakeholders. Therefore, Jacobs was retained to assist the Region in developing a long-term management plan that included a short-term component to address the biosolids contract. The project has been carried out in accordance with the MOE master planning process for environmental projects. A key component of the study was to use key stakeholder input in the decision process through stakeholder steering committees and public information sessions/town hall meetings. As project manager, Mr. Burrowes led the Jacobs project team throughout the study and participated in stakeholder meetings and presentations. Jacobs are currently assisting the Region in developing an alternative management program for 25% of the Region's annual biosolids production. Mr. Burrowes was the Senior Technology Consultant for this assignment.

- Project manager and lead engineer for the Biosolids Management Alternatives study for Toronto's Ashbridges Bay Wastewater Treatment Plant (ABWWTP). The City of Toronto's ABWWTP is an 818-MLD (200-mgd) activated sludge plant. The ABWWTP currently processes 100 tonnes (110 tons) per day (dry solids) from the ABWWTP and the Humber Treatment Plant. Over the next 20 years, the solids processing requirements in the ABWWTP service area are expected to more than double. The existing incineration system would need to be upgraded and expanded to satisfy solids processing requirements. The study reviewed alternatives to incineration and developed an implementation plan for managing biosolids for the next 20 years. The study investigated direct land application, composting, alkaline stabilization, and pelletizing. Public participation was a key component of this project. Mr. Burrowes made several presentations and conducted workshops with the public.
- The Metropolitan Council Environmental Services (MCES) in St. Paul, Minnesota owns and operates the 818-MLD (200-mgd) Metro WWTP. Jacobs was lead consultant for a solids processing facility plan that determined the preferred long-term solids management strategy for the Metro plant. The project included preparation of the air permit application. Mr. Burrowes carried out analyses and prepared the technical sections on incineration and heat drying for the plan and permit engineering. Jacobs was the lead consultant for the design and contract services for the facility, which is designed to dewater and incinerate up to 300 dry tons of solids per day. Mr. Burrowes led the pre-design of the fluidized bed combustor and air-pollution-control system components, as well as the preparation of the contract documents for the design-build of the major incineration system. His role included participating in the bid evaluation and the contract negotiations with the design-build contractor and technical review. He provided oversight during the construction phase, as well as evaluation of performance testing and performance verification. He has provided on-going assistance to MCES and conducted a thorough review of operating practices and solids processing performances and recommended improvements to operating practices.
- Environment Canada retained Jacobs to study energy opportunities and greenhouse gas reductions from the generation, treatment, use and disposal of biosolids. The study included an investigation of biosolids generation, treatment, use and disposal of biosolids in Europe and North America, a survey of the 50 largest wastewater treatment plants in Canada, development of a database of these plants and an estimation of energy recovery opportunities, and greenhouse gas reductions potential in Canada. Mr. Burrowes was project manager and lead technical engineer.
- **NYOFCO Pelletizing Facility, New York, New York.** Mr. Burrowes studied the technical and economic feasibility of the 300 tons (275 tonnes) per day New York Organic Fertilizer Company pelletizing facility in the Bronx, New York, as part of the Sumitomo Bank's investigation prior to providing project financing. The study included reviewing all background documentation, contracts, designs, visiting existing facilities and site inspections at the facility during construction. The study assisted the Sumitomo Bank in deciding to finance the project for JWP, project owners. The project included four rotary drum dryers.
- **Senior Technology Consultant; Palo Alto RWQCP Biosolids Facility Plant; City of Palo Alto; Palo Alto, California.** The City of Palo Alto retained Jacobs to prepare a Biosolids Facility Plan at the 39-mgd (148-MLD) Regional Water Quality Control Plant. The Jacobs team working collaboratively with City staff, identified several onsite and offsite processing/utilization alternatives and using financial, environmental and technical criteria, City staff evaluated and shortlisted alternatives and selected the preferred alternative, using multi-criteria utility analysis in a workshop setting facilitated by Jacobs. The City in parallel with the Facility plan

solicited proposals from proponents to process organic solids waste with biosolids. Jacobs assisted the City in evaluating proposals. The City elected to manage biosolids separately and Jacobs developed a phased implementation plan. Mr. Burrowes was senior technology consultant.

- The City of Palo Alto retained Jacobs to develop and implement a plan for managing biosolids at the Palo Alto WWTP. The project included a study of alternative technologies to multiple hearth incineration, as practiced at the time, including an extensive emission testing program and alternatives evaluation program. The study recommended an innovative permitting strategy, as well as significant upgrades to the two existing multiple hearth incinerators to provide up to 20 years of continued operation. Jacobs negotiated a construction permit, designed, provided construction services, commissioned the plant upgrades and led a performance verification test program. Mr. Burrowes was a technical advisor on incinerator related components of the project, as well as the performance verification testing.
- The Metropolitan Council Environmental Services, Minneapolis/St. Paul, Minnesota, retained Jacobs to manage an alternative delivery program for managing biosolids at the Blue Lake WWTP. The program included developing multiple procurements for design/build and operate services for dewatering and heat drying. The procurement process included expressions of interest, a request for proposal and “best and final” offer with contract negotiations. Jacobs managed the program as owner’s agent through contractor design, construction and commissioning. Mr. Burrowes was a technical advisor to the project.

Other biosolids and residuals projects that Mr. Burrowes has participated in include:

- **Senior Technology Consultant; Rock-Tenn Waste to Energy Project; Saint Paul Port Authority.** Provided senior technical review for the predesign, request for proposal and proposal evaluation for anaerobic digestion technology to process organic wastes, including biogas energy production and digestate management.
- **Expert Technical Witness; SUBBOR Waste to Energy Project; City of Guelph, Ontario.** Provided expert technical witness services to the City of Guelph in litigation on the SUBBOR waste to energy facility that included municipal waste materials recovery, anaerobic digestion, biogas energy production and digestate composting.
- **Senior Technology Consultant; Progress in Anaerobic Digestion of Food Waste and Organic Waste; San Francisco Public Utilities Commission.** Provided senior technical oversight for an overview of anaerobic digestion technologies for food waste and organic wastes in Europe. Study included visits to European facilities to investigate operating technologies, including wet and dry AD technologies
- **Senior Technology Consultant, Source-Separated Organics (SSO) Co-Digestion Feasibility Study, Region of Waterloo, Ontario July 2013 to January 2014.** Provided technical oversight for the feasibility study of implementing SSO co-digestion at six Region WWTPs and two Waste Management Facilities (WMFs) by evaluating criteria in four dimensions: technical, economic, social, and environmental against a customized scoring matrix. Collaboratively developed scoring matrix and alternative rankings with the Region stakeholders in workshops. Completed sensitivity analyses and lifecycle cost assessments; presented results from the study’s final report in a workshop.
- **Senior Technical Consultant, Food Waste Disposer Study, Region of Waterloo, Ontario, March to May 2016.** Provided technical oversight for the review, analysis, evaluation, and reporting of a study examining the use of food waste disposers, their effects on the wastewater and solid waste systems, and potential updates to the current municipal legislation.
- The Region of York retained Jacobs to carry out a technical due diligence of the CCI Newmarket organic processing facility in 2003. The Region of York were considering purchasing the facility, which included an organic preparation and anaerobic digestion system for source separated organic materials, based on the BTA Process. Mr. Burrowes led the investigation, prepared a report on the findings and presented to Regional staff and council.
- The Town of Newmarket retained Jacobs to carry out a technical due diligence of the Halton Recycling Limited (HRL) Newmarket Organic Recycling Facility. HRL purchased the CCI Newmarket facility and are upgrading the

processing plant and adding an in-vessel composting facility. Mr. Burrowes led the investigation and prepared reports for the Town of Newmarket. He continues to provide technical support for on-going upgrades.

- The Region of Waterloo retained Jacobs to design a Materials Resource Recovery Facility (MRRF) and a refuse derived fuel (RDF) Energy From Waste (EFW) Plant to process up to 200 tonnes of municipal solid waste. Following pre-design, the estimated cost of the facilities far exceeded the original feasibility estimate prepared by another consulting firm. The Region elected not to proceed with the project due to cost. Mr. Burrowes was project engineer for the pre-design study. During pre-design, he visited several operating MRRF and RDF/EFW plants in the United States to investigate issues with the design and operations of the types of materials handling equipment used in these plants, including shredders, hammer mills, trommel screens, magnetic and eddy-current separators, air classifiers and belt, apron and pneumatic conveyors, as well as visited manufacturing facilities of some of these types of equipment.
- **Calgary Odour Control and Biosolids Management Study.** The study addressed odour emissions issues at the Sheppard storage lagoon and developed a long-term biosolids management plan for biosolids from The City's two wastewater treatment plants.
- **Sludge Dewatering Upgrade, Stage 2, Ashbridges Bay Wastewater Treatment Plant, Toronto, Ontario.** 100 tonnes (110 tons) per day dry solids dewatering facility housing eight high solids centrifuges and ten twin-cylinders, piston-type sludge cake pumps and sludge conveyance piping, including code compliance stress analysis.
- **Sludge Dewatering Upgrade Stage 1, Ashbridges Bay Wastewater Treatment Plant, Toronto, Ontario.** Installation of two 20-tonne- (22-ton) per-day dry solids high solids centrifuges and twin-cylinder, piston-type sludge cake pumps.
- **Sludge Cake Conveying, Ashbridges Bay Wastewater Treatment Plant, Toronto, Ontario.** Report on inspection tour of German facilities using twin-cylinder piston-type pumps for conveying sludge cake.
- Wastewater Treatment Plant Upgrade, UOSA, Virginia. Technical advisor for the heat dryer.
- **Polymer facility upgrade, Ashbridges Bay Wastewater Treatment Plant.** Additions to the polymer preparation and storage, including two dry polymer systems and solution storage tanks.
- **Abitibi Price, Iroquois Falls Division.** Project engineer for review of sludge management alternatives to use/dispose of combined primary/biological sludge from the mill's wastewater plant. Conceptual design for indirect drying of biological sludge.
- **City of Los Angeles.** Technical specialist for providing outside technical review of wet cake conveyance systems at the Hyperion Treatment Plant, including sludge cake pumps and piping systems.
- **Sludge Dryer, Buffalo Sewer Authority, New York.** Project manager for preparation of a report on sludge handling and disposal. Installation of an indirect steam heated sludge cake dryer at the 610-MLD (150-mgd) Bird Island STP. Report analyzing the test results of the indirect sludge dryer.
- **Pelleted Organic Fertilizer Demonstration Plant, Gray Engineering, Guelph, Ontario.** Process engineer for design of an in-vessel sewage sludge composting system complete with fertilizer demonstration plant to produce fertilizer from sewage sludge.
- Project manager for design of a direct steam dryer for pine cones, for Ontario Ministry of Natural Resources, Dryden, Ontario.

Air Quality Management and Odour Control

Mr. Burrowes has managed or participated in numerous projects involving the study, evaluation, planning, permitting, design, construction services, commissioning, and testing of systems air quality issues and odour control.

- The Orange County Sanitation District (OCSD) operates two wastewater treatment facilities in Orange County, California, as well as 200 miles of sewers and several pumping stations. The first plant, Plant No. 1, is located in Fountain Valley. The second plant, Plant No. 2, is located in Huntington Beach. They are about four miles from each other and both are adjacent to the Santa Ana River Channel. Both plants have substantial odour control

measures installed including both extensive covering and scrubbing systems. However, odour complaints associated with the treatment plants and collection system led OCSD to retain Jacobs to perform a comprehensive odour control study of the collection systems and the wastewater treatment plants and deliver an odour control master plan. Mr. Burrowes provided both senior consulting and led some of the study tasks.

- The City of Toronto retained a team led by Zorix Consultants and including Jacobs to carry out a comprehensive odour assessment of the Ashbridges Bay Treatment Plant and recommend solutions to mitigate odour emissions from the plant. A steering committee consisting of City staff and a Neighbour Liaison Committee oversaw the project and met regularly with the project team. The study consisted of extensive odour sampling and analysis, carried out during the four natural weather seasons. The results were modelled to determine current potential off-site impacts using air dispersion models. An assessment of technology and control options was carried out to determine their effectiveness in reducing potential offsite impacts. Further modelling was used to verify effectiveness and assist in selecting preferred options. Conceptual designs and cost budgets were prepared for the preferred options and a cost/benefit analysis carried out to select the preferred concept designs. Four conceptual designs were recommended for implementation. The four concept designs are expected to reduce any offsite odour impacts to within a community odour standard, established by the regulators, at the plant fence line. Mr. Burrowes led the assessment of technology and control options, the conceptual designs and implementation plan preparation.
- The City of Toronto retained a team led by Zorix Consultants and including Jacobs to carry out a comprehensive odour assessment of the Humber Treatment Plant and recommend solutions to mitigate odour emissions from the plant. A steering committee consisting of City staff and a Neighbour Liaison Committee oversaw the project and met regularly with the project team. The study consisted of extensive odour sampling and analysis, carried out during the four natural weather seasons. The results were modelled to determine current potential offsite impacts using air dispersion models. An assessment of technology and control options was carried out to determine their effectiveness in reducing potential offsite impacts. Further modelling was used to verify effectiveness and assist in selecting preferred options. Conceptual designs and cost budgets were prepared for the preferred options. Two conceptual designs were developed for each major processing unit. Mr. Burrowes led the assessment of technology and control options, the conceptual designs and implementation plan preparation.
- The City of Toronto installed a 100-dry-tonne-per-day biosolids loading facility at the Ashbridges Bay Treatment Plant. The odour control system includes a wet chemical scrubbing system and a 42,0300-cfm (20,000-L/s) biofilter. Jacobs designed the process and mechanical components of the biofilter for Biorem Technologies, the biofilter manufacturer. Mr. Burrowes was the project manager and lead designer.
- The Region of Ottawa-Carleton retained Jacobs to design a biofilter facility for the Glen Cairn trunk sewer system. The purpose of the project was to control corrosion and odour. The project included modelling the trunk system using Jacobs Interceptor Model[®]. Mr. Burrowes was lead technical engineer for the predesign and provided senior review for the detailed design.
- Jacobs and the Los Angeles County Sanitation Districts were selected as co-principal investigators by the Water Environment Research Foundation to carry out an assessment of municipal and industrial odour sources and technologies from collection system through final use. The two-year project was divided into two phases. The first phase was a review of the contemporary literature on odours associated with collection systems through the wastewater facility including odours associated with the biosolids residuals. The second phase involved researching in greater depth one of the top ranked data gaps made apparent by the first phase. The project selected for research was Impacts of In-Plant Operational Parameters on Biosolids Odour Quality. The project consisted of comprehensive liquid, solid and gas space sampling of biosolids processing through anaerobic digestion, dewatering and solids handling/storage at twelve wastewater plants, followed by analysis of the results. For the Phase I study, Mr. Burrowes researched odour source measurement and sampling approaches for wastewater treatment plant odours and odour control technologies, including thermal oxidation. For Phase II, Mr. Burrowes provided technical oversight and assisted with sampling at two plants.

- The Region of Halton retained Jacobs to investigate odour complaints at the Georgetown Wastewater treatment plant. The report documenting the investigation provided recommendations to mitigate odour complaints. Mr. Burrowes was the project manager and lead technical engineer for the study.
- The City of Barrie retained Jacobs to implement upgrades for new primary clarification, grit removal, and screenings and grit handling systems at the Barrie WPCC. A biofilter was selected and recommended by an odour study to be designed and installed as part of the upgrade. Mr. Burrowes was technical advisor for the study and senior technical reviewer for the biofilter design.
- The City of Barrie retained Jacobs to implement upgrades to digestion and biosolids storage and loading at the Barrie WPCC. Biotechnology treatment was selected and recommended by an odour study to be designed and installed as part of the upgrade. Mr. Burrowes was technical advisor for the study and senior technical reviewer for the biotechnology design.
- The Region of Halton retained Jacobs to design upgrades to the solids facility HVAC system, including odour control solutions and to design upgrades to the primary clarifier bridges at the Burlington Skyway WPCP. Conceptual and predesign studies recommend a staged upgrade for odour control, including biofilters. An odour sampling and monitoring program was carried out to measure impacts before and after the upgrades. Mr. Burrowes was the Senior Technical Consultant for the project.
- Project manager and lead engineer for preparing applications for Certificates of Approval (Air) for a number of industrial and municipal clients, as well as coordinating with the MOE during application review. Preparation of these applications included developing emission factors and emission rates of contaminants, emission inventories, dispersion modelling, and report preparation. Following is a partial list of clients:
 - The Ford Motor Company of Canada
 - AlliedSignal Aerospace Canada
 - DuraShield
 - American Standard
 - Orlando Corporation
 - Torcad
 - Waterloo Furniture Manufacturing
 - The Regional Municipality of Ottawa-Carleton
 - The Region of Peel
 - The City of Toronto Works Department (formerly Metropolitan Toronto Works Department)
 - The City of Guelph
- For a confidential client in Scarborough, Ontario, Mr. Burrowes managed a comprehensive program to assist the company in dealing with an initial odour complaint. The program consisted of preparing a compliance plan, soliciting MOE approval for the plan and implementing it in stages. Components of the plan included testing and preparing an emission inventory report to define and quantify the problem, stack modifications, installation of a wet scrubber to remove hydrogen fluoride, and public consultation.
- For a confidential client in Peterborough, Ontario, Mr. Burrowes provided technical assistance to the receiver during the sale of the facility. The facility manufactures plastic parts for automobiles and applies various coatings. Due to a history of odour complaints, the facility had prepared a multi-stage program to mitigate odours from the facility. At the time of the sale, only part of the program had been implemented. Provided advice to the receiver on the suitability of the program and met with the MOE to get its continued support for the program after the sale.
- The Region of Waterloo retained Jacobs to assist the City of Kitchener, Ontario, and other parties in solving an odour problem in the east end of Kitchener. Mr. Burrowes developed a multi-stepped program and led a team in implementing it. The initial step was to define the odour problem, its source, and the causes. A testing program consisting of continuous flow monitoring and continuous hydrogen sulphide monitoring was used to identify sources and causes of odours. This program was supplemented by source testing at various locations for organic compounds. Once the problem had been defined, the remaining steps were implemented. These included instituting a regular maintenance program for force mains, adding air injection to force mains,

installation of temporary odour control (activated carbon adsorption) at the most odorous location, and a redesign of a portion of the sewer system. During the project, Mr. Burrowes met regularly with an advisory committee comprising representatives of the Region, councillors and staff of the City of Kitchener, the MOE, concerned residents, and representatives of an industrial facility alleged to be an odour generator. Mr. Burrowes also participated in a public open house.

- The Town of Georgina, Ontario, had an odour problem in their sewage collection system that had led to repeated odour complaints from residents and threatened legal action by the MOE. Jacobs were retained by the Town to assist in identifying the source and cause of odour, the extent of odour related problems within the sewer system, and recommendation and implementation of control measures. Actions taken included the following:
 - Inspection of the sewer system
 - Detailed sampling and analysis of wastewater from one connection considered to be the prime source of odour, and inspection of onsite wastewater management and pumping facilities
 - Sample collection and analysis from numerous locations within the sewer system including spot measurements of DO, H₂S, and methane. Continuous measurement and recording of H₂S at specific locations within the sewer system
 - Supervision of the cleaning of pumping stations and forcemains
 - Design and preparation of applications for C of As for odour scrubbing and sodium hypochlorite addition facilities.

Since the implementation of these works, no further odour complaints have been received by the Town or MOE. Mr. Burrowes was senior technical consultant for the project.

- The Hampton Roads Sanitary District owns and operates several wastewater treatment plants in the Norfolk, Virginia, area. The Army Base and the Chesapeake-Elizabeth WWTPs had experienced a history of odour complaints. Mr. Burrowes led the pre-design and provided technical supervision of the design of odour control at both plants. During pre-design, Mr. Burrowes carried out onsite hydrogen sulphide testing to determine the locations and levels of controls required. The controls, as designed, included covering of several tanks and equipment, ducting, and two-stage wet scrubbers. Several concrete channels and tanks at the Army Base plant were lined to protect them from corrosion. A construction schedule was developed to allow the channels and tanks to be taken out of service for lining by providing temporary pumps and piping for bypassing unit processes.
- Project supervisor and technical specialist for odour assessment study for the Ashbridges Bay Treatment Plant, Toronto. Other ABTP projects include:
 - Incinerator emission improvements; installation of venturi scrubbers and afterburners on 6 to 12 hearth, 6.75-m-diameter multiple-hearth incinerators. Installation of a wet electrostatic precipitator on a multiple-hearth incinerator
 - Miscellaneous odour control contracts: odour collection and treatment for primary, secondary, and dewatering facilities
 - Secondary treatment additions, Tanks 10 and 11: 180-MLD secondary treatment addition, including aeration and final tanks, aeration blowers, and chemical scrubbing for odour control
 - Improvements to primary tanks ventilation Stages I, II, III: including odour control by dry chemical scrubbing
 - Plant water system – pumping station: cleaning of ventilation air by dry chemical scrubbing for 340-MLD plant water pumping station
 - Incinerator emission improvements: study to determine the best available control technology for the incineration of sewage sludge
 - Decant air modifications: improvements to the 51,000-m³/hr decant air emission system including conversion of an existing wet scrubber to a demister
- Report on odour emissions control strategy at the sludge thickening and dewatering facilities, for Robert O. Pickard Environmental Centre, Ottawa, Ontario.

- Project manager for study to reduce odours from the sludge processing yard and landfill, for Domtar Specialty Fine Papers, Cornwall.
- Technical leader for planning and design services for the 20-foot-diameter, 6-mile-long CSO tunnel odour control and ventilation system, for City of Fall River, Massachusetts. The project included activated carbon adsorption systems at intake and vent shafts, designed to allow adequate movement of air during tunnel filling and discharge. Fire suppression systems were provided because the unmanned facilities would operate intermittently.
- Technical specialist for the review of noise, air and dust impacts for the Essex-Windsor regional landfill site, for Town of Colchester North, Ontario.
- Technical specialist for compliance with Certificate of Approval, including noise, air and dust impacts, at the Quarry Road landfill site, Town of Lincoln, Ontario.
- Technical specialist for noise, air, and dust impacts at the Humberstone landfill site, for Town of Welland, Ontario.
- Ford Motor Company: supervisor and technical specialist for conducting:
 - Stack emission testing twice a year on an energy-from-waste facility at the Oakville Assembly Plant
 - Air survey at the Oakville Assembly Plant
 - Air emission survey at the Niagara Glass Plant
 - Air emission survey at the St. Thomas Assembly Plant
 - Emission inventory at the Ford Essex Plant
 - Emission inventory at the Ford Ensite Plant
 - Emission inventory at the Ford Glass Plant.

Biogas Use and Energy Management

Mr. Burrowes has managed or participated in numerous projects involving the study, evaluation, pilot testing, planning, permitting, design, construction services, commissioning, and testing of biogas utilization and energy management at wastewater treatment plants.

- **Senior Technology Consultant, Cogeneration Project, Region of Waterloo, Kitchener, Ontario, 2016 to Present.** The Region of Waterloo retained Jacobs to design cogeneration facilities for the Galt Wastewater Treatment Plant, the Kitchener Wastewater Treatment Plant and the Waterloo Wastewater Treatment Plant. Each facility will include biogas treatment and a biogas fueled engine/generator. Heat will be recovered for digester and building heating. Mr. Burrowes is the Senior Technology Consultant.
- [Senior Process Specialist \(Biosolids/Biogas\), Development of Strategy for Energy Security and Initiatives at the Region's G.E. Booth and Clarkson WWTPs, Peel Region, Ontario; 2017 to 2019.](#) [The Region of Peel retained Jacobs to develop a long-term energy strategy that aligns with the Region's sustainability vision and short and long-term capital plans, including conceptual design of energy recovery and conservation opportunities at the Region's wastewater treatment plants, a standby power plan, and sewer heat recovery-based district energy opportunities for the Inspiration Lakeview Development Project. Peter provided senior review and input into the development of preliminary design concepts for six promising opportunities including thermal hydrolysis pretreatment and digestion of partial sludge and biogas CHP at the G.E. Booth WWTP, and primary sludge thickening and biogas CHP expansion at the Clarkson WWTP.](#)
- [Senior Technology Consultant, Cogeneration Facility at the San Jose-Santa Clara Regional Wastewater Facility; City of San Jose, California, 2016 to 2020.](#) [The City of San Jose retained Jacobs to design and build a cogeneration facility at the 630 MLd San Jose – Santa Clara Regional Wastewater Facility. The facility includes 4 – 3.5 MW internal combustion engine-generators, a biogas treatment system, constructed in a new facility. Each engine is dual fueled by biogas and natural gas, with blending capabilities to operate on any blend of the two fuels. The engines are equipped with state-of-the art emission control systems permitted in California, including NOx and volatile organic controls. Heat recovered from the jacket water and exhaust are used to provide heat year-round for digester and plant heating. The facility began successful operation in 2020. Mr.](#)

[Burrowes provided senior technical advice and review during the preliminary and detailed design phases of the project.](#)

- **Senior Technology Consultant, Miami-Dade Water and Sewer Department, Cogeneration Upgrade at the South District WWTP, Florida, 2011 to 2013.** The Miami-Dade Water and Sewer Department own and operate the 225-MGD (850-MLD) South District Wastewater Treatment Plant. Jacobs was retained to engineer and provide owner agent services for an upgrade to the existing cogeneration facility. Three existing 900-kW cogeneration engines were replaced by up to four 2-MW cogeneration engines that can be fired on a combination of digester and landfill gas, with natural gas as a backup. The existing gas conditioning system was upgraded to remove hydrogen sulfide, moisture and siloxanes. Mr. Burrowes was the Senior Technology Consultant.
- **Technical Reviewer, Water Environment Research Foundation, Siloxane Removal Study, 2013.** The Water Environment Research Foundation in partnership with CETaqua, a Division of Suez Environmental carried out a study: "Evaluation of the Efficiency of Biogas Treatment for the Removal of Siloxanes". The study included identifying siloxane speciation from various sources, sampling and analytical techniques and a pilot study to evaluate the performance of multiple adsorption media side-by-side. Mr. Burrowes was a member of the Technical Review Committee and provided subject matter expert review and advise during the study and final technical review of the report.
- **Senior Technology Consultant, Biogas Pretreatment Project, City of Hamilton, Ontario, 2012 to 2014.** The City of Hamilton retained Jacobs to deliver the biogas pretreatment project using an Engineer-Procure-Construct delivery approach. The project included mixing upgrades to the existing anaerobic digesters, a new gravity belt thickening facility for primary sludge, a biogas purification facility and a biofilter for odour control. The biogas purification facility which used pressurized water scrubbing has a nominal capacity to purify 247 scfm (420 Nm³/h) of biogas to 95% pure methane for injection to the local utility pipeline. Technologies evaluated included pressurized water scrubbing (Greenlane), chemical liquid absorption and stripping (Purac) and pressure swing adsorption (Xebec). Mr. Burrowes was Senior Technical Consultant for the biogas purification facility.
- **Senior Technology Consultant, Cogeneration Study, San Francisco Public Utilities Commission (SFPUC), San Francisco, California July 2011 to December 2011.** This project included analysis of various beneficial uses of biogas at the Oceanside Pollution Control Plant, including a wide array of combined heat and power options and renewable natural gas options. The study included energy conversion technologies as well as scrub and sell options. The study included using fats, oils, and grease to augment biogas production.
- **Lead Process Designer, Guelph WWTP Digester Expansion and Cogeneration Upgrades, City of Guelph, Ontario, 2007 to 2009.** The City of Guelph owns and operates the 55-MLD (15-mgd) Guelph WWTP. The plant provides conventional wastewater treatment, anaerobic digestion, belt filter press dewatering of digested sludge, and in-vessel composting. Biogas from the digestion process was used as fuel in hot-water boilers. Mr. Burrowes led a study to evaluate cogeneration for the plant and provided technical support during design and commissioning of the energy facility, which includes three 350-kW naturally aspirated Waukesha gas engine/generators and two biogas/natural gas boilers. Mr. Burrowes was also project manager for the design, construction, and commissioning of a waste gas flare to handle biogas during power failures. Mr. Burrowes was senior technology consultant for a new gas conditioning system to remove siloxanes and upgrades to the cogeneration cooling system.
- **Senior Technical Consultant, Barrie WWTP Cogeneration Facility, City of Barrie, Ontario.** The City of Barrie's 57-MLD (15-mgd) WWTP provides conventional wastewater treatment, two-stage digestion, and liquid digested biosolids disposal. Biogas from the digestion process was used as fuel in sludge heaters or flared. Mr. Burrowes led the feasibility study, pre-design, and design for the cogeneration facility incorporated into the digester expansion. The facility contains two 250-kW Waukesha turbocharged gas engine/generators. Due to recent issues with high siloxane concentrations in the biogas, Jacobs replaced two boilers and designed and provided SDC services for a gas conditioning system consisting of gas boosters, a refrigerated dryer and dual carbon-based towers to remove siloxanes.

- **Process Design Lead, Robert O. Pickard Environmental Centre (ROPEC) Biogas Cogeneration Facility, City of Ottawa, Ontario.** The Regional Municipality of Ottawa-Carleton, Ontario, owns and operates the 700-MLD (175-mgd) ROPEC in Gloucester. The plant provides conventional wastewater treatment, anaerobic digestion, and centrifuge dewatering of digested sludge. Biogas from the digestion process was used as fuel in hot water boilers. Due to operational and maintenance problems, the Region decided to review the use of biogas. Mr. Burrowes was project manager for the biogas utilization program. The program was carried out in logical stages: in the first stage, the project team analyzed present and future biogas characteristics and production trends and evaluated a number of utilization technologies, including cogeneration (gas engines and gas turbines), gas processing to pipeline quality with sale and distribution, and expanded use as fuel for boilers. The Region accepted the recommendation to implement cogeneration using gas engines, as well as installing a waste gas flare. Mr. Burrowes led the design team, preparing the pre-design, selecting the equipment, and designing the contract to install the cogeneration equipment and its ancillaries. He provided technical support to the Region during construction and led the commissioning team, as well as training of the operations staff. The project (pre-design to operations) was accomplished in 18 months and incorporates three 800-kW Caterpillar gas engine/generators.
- The City of Toronto, Ontario, owns and operates the 818-MLD (200-mgd) Ashbridges Bay Wastewater Treatment Plant. The plant provides conventional wastewater treatment, anaerobic digestion, centrifuge dewatering of digested sludge, and incineration/land application. Biogas from the digestion process was used as fuel in the incinerators, which have waste heat recovery boilers and steam boilers. Mr. Burrowes led a study on the feasibility of cogeneration under normal operations and emergency power generation. The study was later expanded to report on all of the utilities at the plant, including updating cogeneration economics. Mr. Burrowes revisited and updated the study to reflect the City's long-range plans to phase out incineration and a conversion of the heating system to hot water. Mr. Burrowes also led a study to evaluate conditioning of biogas. The study evaluated many processes and recommended the Binax process to condition the biogas to pipeline quality. Mr. Burrowes provided senior review for the staged design of the gas conditioning system. The first phase included a gas compression station. The Binax system was never installed. Mr. Burrowes provided technical oversight for the design and construction of an enclosed waste gas flare station containing three flares.
- The City of Calgary, Alberta, retained Jacobs to carryout a landfill gas feasibility study at three landfills owned by The City. The study included modelling and estimating gas production through installation of wells and demonstrating the feasibility of microturbines for landfill gas utilization at the Shepard Landfill Site. The demonstration program was managed by Jacobs and included designing, procuring and installing a gas conditioning system, a waste gas flare, gas collection wells and plumbing gas to the gas conditioning system, the self-contained Capstone microturbine trailer and the waste gas flare, as well as operating and maintaining the system during the demonstration. The project was partially funded by a grant from Natural Resources Canada. Mr. Burrowes was technical advisor for biogas conditioning and power production.
- The City of Toronto, Ontario, owns and operates the Humber Treatment Plant (HTP). The HTP is the second largest wastewater treatment plant in the city of Toronto and has a nominal treatment capacity of 125 mgd (473 MLD). The City retained a consultant to design a cogeneration system to combust digester gas and natural gas to produce electricity and heat. The system was constructed and utilized two Caterpillar G3612 gas engine/generators, supplied by Toromont. The system was designed to operate on a blend of digester/natural gas. During commissioning, an explosion occurred within the exhaust piping of one of the engines. Following investigation of the incident by an independent consultant, Jacobs was retained to design a purge/vent system for the engine exhausts. The purge/vent was intended for purging the exhaust system, prior to start up. Jacobs completed the design and provided services during construction, including shop drawing review, site inspection, management of site meetings and change management issues with the installation contractor. The purge/vent system was successfully commissioned. Mr. Burrowes was the senior technical consultant and developed the purge/venting conceptual design.
- Mr. Burrowes has been project manager or technical lead for other related projects at the ABTP, including:
 - The design and installation of three waste gas incinerators with a total capacity to incinerate 3,175,000 cubic feet (90,000 m³) per day of biogas
 - The rehabilitation of Digester 1-4 to comply with the gas code (CGA B105)

- Feasibility study on biogas cleaning and pre-design for a new gas control building incorporating Binax technology to purify the biogas to pipeline quality
 - Full-scale demonstration of an Apollo gas cleaning system to remove H₂S from biogas
 - Design, construction services and commissioning of three 33-metre-diameter (110 ft) anaerobic digesters
 - Modifications and additions to the burner fuel system for six multiple-hearth incinerators to use the biogas as fuel.
- The City of Guelph owns and operates the 55-MLD (15-mgd) Guelph WWTP. The plant provides conventional wastewater treatment, anaerobic digestion, belt filter press dewatering of digested sludge, and in-vessel composting. Biogas from the digestion process was used as fuel in hot-water boilers. Mr. Burrowes led a study to evaluate cogeneration for the plant and provided technical support during design and commissioning of the energy facility, which includes three 350-kW naturally aspirated Waukesha gas engine/generators and two biogas/natural gas boilers. Mr. Burrowes was also project manager for the design, construction, and commissioning of a waste gas flare to handle biogas during power failures. Mr. Burrowes was senior technology consultant for a new gas conditioning system to remove siloxanes and upgrades to the cogeneration cooling system.
 - The City of Barrie, Ontario, 57-MLD (15-mgd) WWTP provides conventional wastewater treatment, two-stage digestion, and liquid digested biosolids disposal. Biogas from the digestion process was used as fuel in sludge heaters or flared. Mr. Burrowes led the feasibility study, pre-design, and design for the cogeneration facility incorporated into the digester expansion. The facility contains two 250-kW Waukesha turbocharged gas engine/generators. Due to recent issues with high siloxane concentrations in the biogas, Jacobs replaced two boilers and designed and provided SDC services for a gas conditioning system consisting of gas boosters, a refrigerated dryer and dual carbon-based towers to remove siloxanes. Mr. Burrowes was the Senior Technical Consultant.
 - **Process Design Lead, Anaerobic Pre-treatment System, City of Cedar Rapids, Iowa.** Mr. Burrowes led the technical and economical evaluation of technologies to remove H₂S from the biogas. The system was required to treat 1,200,000 cubic feet (34,000 m³) per day with an H₂S concentration of 3 percent. A biological scrubbing system supplied by PAQUES was selected. Mr. Burrowes also led the planning and design of additions to the incinerator burner system to incorporate biogas as a fuel.
 - **Senior Technical Consultant, Thunder Bay WWTP Cogeneration Project, City of Thunder Bay, Ontario.** Jacobs engineered the cogeneration system which consisted of a 600-kW cogeneration engine, heat recovery equipment and upgrades to the plant heating system to integrate use of the recovered heat.
 - The Miami-Dade, Florida, Water and Sewer Department own and operate the 225-MGD South District Wastewater Treatment Plant. Jacobs was retained to engineer an upgrade to the existing cogeneration facility. Three existing 900-kW cogeneration engines are being replaced by up to five 2-MW cogeneration engines that can be fired on a combination of digester and landfill gas, with natural gas as a backup. The existing gas conditioning system will be upgraded to remove hydrogen sulfide, moisture and siloxanes. Mr. Burrowes was the Senior Technology Consultant.

Other related projects include:

- Regional Municipality of Waterloo (1994-1995): Technical supervisor for the digester gas use study and engineering services for a waste gas incinerator at the 36 MLD Cambridge WPCP.
- Cogeneration Feasibility Study, Brockville, Ontario: Senior Technical Consultant for the 100-kW cogeneration feasibility study of digester gas used for firing gas engine/generators to produce electricity and recover heat.
- Cogeneration Feasibility Study, Saskatoon, Saskatchewan: Senior Technical Consultant for the 1.5-MW cogeneration feasibility study of digester gas used for firing gas engine/generators to produce electricity and recover heat.
- Cogeneration Feasibility Study, Chatham, Ontario: Project supervisor and technical specialist for the 330-kW co-generation feasibility study of digester gas use for firing gas engine/generators to produce electricity and recover heat.

- Digester Gas Utilization Study, Winnipeg, Manitoba: Project supervisor and technical specialist.
- Cogeneration Rehabilitation and Biogas Utilization Study, Mid-Halton WWTP: Project manager for investigation of the rehabilitation of a cogeneration and heating facility containing two 150-kW gas engine/generators and hot water boilers.

Solid Waste Management

Mr. Burrowes has managed or participated in numerous projects involving the study, evaluation and planning at solid waste management facilities.

- The Region of York, Ontario, retained Jacobs to carry out a technical due diligence of the CCI Newmarket organic processing facility in 2003. The Region of York were considering purchasing the facility, which included an organic preparation and anaerobic digestion system for source separated organic materials, based on the BTS Process. Mr. Burrowes led the investigation, prepared a report on the findings and presented to Regional staff and council.
- The Town of Newmarket retained Jacobs to carry out a technical due diligence of the Halton Recycling Limited (HRL) Newmarket Organic Recycling Facility. HRL purchased the CCI Newmarket facility and are upgrading the processing plant and adding an in-vessel composting facility. Mr. Burrowes is leading the investigation and will prepare a report for the Town of Newmarket.
- Project manager for study of the potential energy recoverable from the combustion of municipal solid waste in Ontario, for Independent Power Producers' Society of Ontario, Toronto.
- Project manager for feasibility study of a large-scale energy-from-waste facility, Lambton Chamber of Commerce, Sarnia, Ontario.
- Technical advisor for feasibility study for a 600-t/d energy from waste facility in Kingston, Jamaica, for Canadian International Development Agency.
- **Materials Resource Recovery Facility, Waterloo, Ontario.** The Region of Waterloo retained Jacobs to design a Materials Resource Recovery Facility (MRRF) and a refuse derived fuel (RDF) Energy From Waste (EFW) Plant to process up to 200 tonnes per day of municipal solid waste. Following pre-design, the estimated cost of the facilities exceeded the original feasibility estimate prepared by another consulting firm. The Region elected not to proceed with the project due to cost. Mr. Burrowes was project engineer for the pre-design study. During pre-design, he visited several operating MRRF and RDF/EFW plants in the United States to investigate issues with the design and operations of the types of materials handling equipment used in these plants, including shredders, hammer mills, trommel screens, magnetic and eddy-current separators, air classifiers and belt, apron and pneumatic conveyors. He also visited the manufacturing facilities of some of these types of equipment.

Additional Training

Foundations of Leadership, University of Michigan Business School, 2002

Municipal Waste Combustion Course, Air & Waste Management Association, 1991

Fundamentals of Dispersion Modelling, Air & Waste Management Association, 1990

Control of Air Toxics by Incineration and Other Proven Techniques, University of Wisconsin, 1990

Design of Incineration Systems, New Jersey Institute of Technology, 1981

Application of Adsorption to Wastewater Treatment, Vanderbilt University, 1981

Other Information

Employment History

2015 to present: Water Business Group Senior Fellow Residuals Technologist

2010 to 2014: Water Business Group Global Service Leader for Wastewater Infrastructure

2007 to 2010: Water Business Group Global Technology Practice Director for Wastewater Infrastructure

2003 – 2007: Water Business Group Global Technology Leader for Residuals and Biosolids Management

1999 – 2003: Water Business Group Global Technology Leader for Air Quality and Safety Management

1999 – 2005, 2007: Water Business Group Canadian Region Regional Technology Manager

1996 – 1999: Environmental Business Group Industrial Services Group Leader in the Canadian Region responsible for industrial water, wastewater, air quality and solid waste management

1990 – 1996: Senior Technical Engineer Special Projects responsible for air quality and energy management and solids management

1980 – 1990: Senior Project Manager leading process improvement upgrades to the Metropolitan Toronto Main Treatment Plant

1976 – 1980: Project Manager and Process Design Engineer

1973 – 1976: Various positions at the Guyana Bauxite Plant including Mechanical and Senior Mechanical Engineer

Publications

The R2E2 Experience – Commissioning and Initial Energy Performance at the Green Bay Facility, Presented at the Residuals and Biosolids Conference 2019, Water Environment Federation, Fort Lauderdale, FL – May 2019.

The Ultimate Combination of Sustainable Biosolids Treatment Technologies, Presented at the Residuals and Biosolids Conference 2018, Water Environment Federation, Phoenix, AZ – May 2018.

Evaluation of Thermal Hydrolysis and Incineration of Sludge for Energy Recovery at an Advanced Water Reclamation Facility, Presented at the Residuals and Biosolids Conference 2018, Water Environment Federation, Phoenix, AZ – May 2018.

A U.S. Perspective on Alternative Uses of Thermal Processes, Presented at the 22nd European Biosolids & Organics Resources Conference, Leeds, UK – November 2017.

Challenges and Opportunities for Approaching Net Zero Energy and Improving Resiliency of a Unique Solids Handling Facility in California, Presented at the Residuals and Biosolids Conference 2017, Water Environment Federation, Seattle, WA – April 2017.

Thermal Hydrolysis Offerings in North America and Full Scale System Performance, Presented at the 21st European Biosolids & Organics Resources Conference, Edinburgh, UK – November 2016.

Thermal Hydrolysis Offerings and Performance, Presented at SLUDGETECH, London, UK, - June 2016.

Anaerobic Digestion of Primary Solids and Thermally Hydrolyzed Waste Activated Solids, Presented at the Residuals and Biosolids Conference 2016, Water Environment Federation, Milwaukee, WI – April 2016.

New Water's Resource Recovery and Electrical Energy Project - The Value of Biosolids, Presented at the Residuals and Biosolids Conference 2016, Water Environment Federation, Milwaukee, WI – April 2016.

Treatment of Waste Activated Sludge with Thermal Hydrolysis and Mesophilic Anaerobic Digestion, Presented at the Residuals and Biosolids Conference 2016, Water Environment Federation, Milwaukee, WI – April 2016.

Optimizing Anaerobic Digestion Performance with Silo-Shaped Reactor Configurations, Presented at the Residuals and Biosolids Conference 2016, Water Environment Federation, Milwaukee, WI – April 2016.

Treatment of WAS with Thermal Hydrolysis and Anaerobic Digestion. Presented at the 20th European Biosolids Conference, Manchester, UK – November 2015.

NEW Water's Approach to Optimizing Energy and Waste Heat Recovery presented at the 88th Annual Technical Exhibition and Conference, Water Environment Federation, Chicago, IL – September 2015.

Case Studies – Implementation of Emission Control Improvements for SSI MACT Compliance presented at the 88th Annual Technical Exhibition and Conference, Water Environment Federation, Chicago, IL – September 2015.

New Water's Approach to Optimizing Energy and Waste Heat Recovery, Presented at the Residuals and Biosolids Conference 2015, Water Environment Federation, Washington, DC – June 2015.

Optimizing Energy and Waste Heat Recovery without a Land Bank – NEW Water's Approach. Presented at the 19th European Biosolids Conference, Manchester, UK – November 2014.

The Duffin Creek Biosolids to Energy Experience: One Year On, presented at the 87th Annual Technical Exhibition and Conference, Water Environment Federation, New Orleans, LA – August 2014.

A Tale of Several North American Utilities to Meet the New SSI MACT Regulations, presented at the 87th Annual Technical Exhibition and Conference, Water Environment Federation, New Orleans, LA – August 2014.

Why Thermal Hydrolysis and Anaerobic Digestion is Rising to the Top: A Compendium of Recent North American Biosolids Facility Plans, presented at the 87th Annual Technical Exhibition and Conference, Water Environment Federation, New Orleans, LA – August 2014.

Gas-Phase, Wet Odor Control Scrubbers Overview, *Across the Plant Odor Control Workshop*, presented at the 87th Annual Technical Exhibition and Conference, Water Environment Federation, New Orleans, LA – August 2014.

Applying European Experience to Screen and Select a Sustainable Dewatering System for Green Bay, Presented at the Residuals and Biosolids Conference 2014, Water Environment Federation, Austin, TX – May 2014.

Strategies for Biosolids Energy and Resource Recovery for the Green Bay Metropolitan Sewerage District, presented at the 86th Annual Technical Exhibition and Conference, Water Environment Federation, New Orleans, LA – October 2013.

The Duffin Creek Biosolids to Energy Experience – Lessons in Energy Recovery, Presented at the Residuals and Biosolids Conference 2013, Water Environment Federation, Nashville, TN – May 2013.

Pilot Study of Siloxanes Removal from Digester Biogas through Various Adsorbents, Presented at the Residuals and Biosolids Conference 2013, Water Environment Federation, Nashville, TN – May 2013.

Creation of a sustainable water resource through reclamation of municipal and industrial wastewater in the Gippsland Water Factory, *Journal of Water Reuse and Desalination*, IWA Publishing - March 2013.

Driving Water and Wastewater Utilities to More Sustainable Energy Management – WEF Energy Roadmap, Version 1.0, Water Environment Federation, Alexandria, VA – October 2012.

New Tools for Planning a Sustainable Biosolids Management Program, Presented at the 39th Annual Technical Symposium and Exhibition of the Water Environment Association of Ontario, Ottawa, Ontario – April 2012.

Comparing Energy Recovery Opportunities: Anaerobic Digestion to Gasification and Combustion, Presented at the 26th Annual Residuals and Biosolids Conference 2012, Water Environment Federation, Raleigh, NC – April 2012.

The True Environmental Cost of Treatment, Published in *WE&T*, magazine of the Water Environment Federation, Volume 24, Number 3, March 2012.

Comparing Energy Recovery Opportunities: Anaerobic Digestion to Gasification and Combustion – Workshop A: the Business of Turning Biosolids into Energy and Fertilizer, Presented at the 26th Residuals and Biosolids Conference 2012, Water Environment Federation, Raleigh, NC – March 2012.

Biosolids Master Planning in Today's Environment: A Case Study, Presented at Residuals & Biosolids Utilization: Expanding Perspectives Today's Realities, a WEAO Specialty Seminar, Water Environment Association of Ontario, Burlington, Ontario, November 2011.

U.S. EPA Overview and Implications for Ontario, Presented at Residuals & Biosolids Utilization: Expanding Perspectives Today's Realities, a WEAO Specialty Seminar, Water Environment Association of Ontario, Burlington, Ontario, November 2011.

Cogeneration: A Growing Trend for Biogas Utilization by Ontario Municipalities, Published in Influent Official Publication of the Water Environment Association of Ontario, Fall 2011, Vol. 6.

A Sustainable Near-Potable Quality Water Reclamation Plant for Municipal and Industrial Wastewater Begins Delivering Water, presented at the 84th Annual Technical Exhibition and Conference, Water Environment Federation, Los Angeles, CA – October 2011.

Important Steps to Help Meet the New Sewage Sludge Incinerator Rule, Presented at the Biosolids Workshop, New Jersey Water Environment Association 2011 Technology Transfer Seminar, Eatontown, NJ, September 2011.

Moving Bioenergy Technologies from Disposal to Green Energy, Presented at the 25th Annual Residuals and Biosolids Conference 2011, Water Environment Federation, Sacramento, CA – May 2011.

Biosolids to Energy – New Regional Facilities will Build on Old Ideas, Presented at the 25th Annual Residuals and Biosolids Conference 2011, Water Environment Federation, Sacramento, CA – May 2011.

The Region of Waterloo's Biosolids Management Plan – Magnifying the Sustainability Lens, Presented at the 25th Annual Residuals and Biosolids Conference 2011, Water Environment Federation, Sacramento, CA – May 2011.

Selection of a Solids Management Plan to meet a Sewerage District's Vision of Becoming a Leader in Sustainability, Presented at the 25th Annual Residuals and Biosolids Conference 2011, Water Environment Federation, Sacramento, CA – May 2011.

Sustainable Energy Management: Concentrated Solar Fuelled Thermal Processes, Presented at the 25th Annual Residuals and Biosolids Conference 2011, Water Environment Federation, Sacramento, CA – May 2011.

Thermodynamics of Gasification, Presented at Workshop C at the 25th Annual Residuals and Biosolids Conference 2011, Water Environment Federation, Sacramento, CA – May 2011.

Technology Impacts for Multiple Hearth and Fluidized Bed Incineration Units, Presented at the National Biosolids/Water Environment Federation webcast Implementing the New Sewage Sludge Incineration MACT Standard – Issues and Challenges Ahead, April 2011.

Trends in Global Biosolids Management, Presented at the 38th Annual Technical Symposium and Exhibition of the Water Environment Association of Ontario, Toronto, Ontario – April 2011.

Brown Gold - Ontario's New Feed-In-Tariff (FIT) Improves Viability of Biogas Cogeneration, Presented at the 38th Annual Technical Symposium and Exhibition of the Water Environment Association of Ontario, Toronto, Ontario – April 2011.

Energy Recovery from Thermal Treatment: To Digest or not to Digest – Is this Sustainable?, presented at the 83rd Annual Technical Exhibition and Conference, Water Environment Federation, New Orleans, LA – October 2010.

Selection of a Solids Management Plan to Meet a Sewerage District's Vision of Becoming a Leader in Sustainability presented at the 83rd Annual Technical Exhibition and Conference, Water Environment Federation, New Orleans, LA – October 2010.

YP Professional Development during Tough Economic Times: presented at the 83rd Annual Technical Exhibition and Conference, Water Environment Federation, New Orleans, LA – October 2010.

Feeding FOG to Thermal Oxidation Units – Its all in the Presentation!, Presented at the Residuals and Biosolids Conference 2010, Water Environment Federation, Savannah, GA – May 2010.

Sustainable Energy Management: Achieving Energy Independence at Wastewater Utilities, presented at the 82nd Annual Technical Exhibition and Conference, Water Environment Federation, Orlando, FL – October 2009.

Focused-Pulsed Treatment of Waste Activated Sludge – A Year in Review, presented at the 5th Canadian Residuals and Biosolids Management Conference, Water Environment Association of Ontario, Niagara Falls, ON – September 2009.

Peter A.T. Burrowes

SENIOR FELLOW RESIDUALS ENGINEER

PRINCIPAL AIR QUALITY AND SAFETY MANAGEMENT ENGINEER



The Stamford WPCA Biosolids to Energy Project, presented at the 5th Canadian Residuals and Biosolids Management Conference, Water Environment Association of Ontario, Niagara Falls, ON – September 2009.

The Stamford WPCA Biosolids Demonstration Energy Project, presented at the Residuals and Biosolids Conference 2009, Water Environment Federation, Portland, OR – May 2009.

Sustainable Energy Management: Achieving Energy Independence, Presented at the Residuals and Biosolids Conference 2009, Water Environment Federation, Portland, OR – May 2009.

Energy Recovery from Thermal Treatment – Is This Sustainable, Presented at the 38th Annual Technical Symposium and Exhibition of the Water Environment Association of Ontario, Toronto, Ontario – April 2009.

Technology Assessment for the City of Winnipeg’s Biosolids Master Plan using CH2M’s Technomic Model, Presented at the 38th Annual Technical Symposium and Exhibition of the Water Environment Association of Ontario, Toronto, Ontario – April 2009.

Energy Efficiency- Finding the Right Formula for Your Facility, Presented at the Energy Workshop - Conventional and Creative Ways to Save Energy, New Jersey Water Environment Association 2009 Spring Technology Transfer Seminar, Eatontown, NJ, March 2009.

Biosolids to Energy, presented at 81st Annual of the New York Water Environment Association, New York City, February 2009.

Is Cogeneration Viable for Wastewater Treatment Facilities? Presented at the 37th Annual Technical Symposium and Exhibition of the Water Environment Association of Ontario, Blue Mountain Resort, Ontario – May 2008.

The Stamford WPCA Biosolids Energy Demonstration Project, Presented at the Residuals and Biosolids Conference 2008 – Traditions, Trends and Technologies, Water Environment Federation, Philadelphia, PA – April 2008.

Focused-Pulsed Treatment of Waste Activated Sludge: Application to Waste Biosolids Reduction and Increased Methane Production, Presented at the Residuals and Biosolids Conference 2008 – Traditions, Trends and Technologies, Water Environment Federation, Philadelphia, PA – April 2008.

Biosolids Master Planning from a Greenhouse Gas Perspective – How Different Options Affect the Carbon Footprint - Presented at the Residuals and Biosolids Conference 2008 – Traditions, Trends and Technologies, Water Environment Federation, Philadelphia, PA – April 2008.

The Twin Cities Sludge-to-Energy (StE) Plant Reduces Greenhouse Gas Emissions, Presented at the 80th Annual Technical Exhibition and Conference, Water Environment Federation, San Diego, CA – October 2007.

Secondary Sludge Thickening to Optimise Anaerobic Digester Capacity and Performance in Auckland, NZ, Presented at the 80th Annual Technical Exhibition and Conference, Water Environment Federation, San Diego, CA – October 2007.

Focused-Pulsed Treatment of Waste Activated Sludge: Application to Waste Biosolids Reduction and Increased Methane Production, Presented at the 80th Annual Technical Exhibition and Conference, Water Environment Federation, San Diego, CA – October 2007.

Current Status of Thermal Biosolids Processing and Emerging Technologies, Presented at Managing Biosolids Beyond 2010, Water Environment Association of Ontario, Burlington, Ontario - October 2007.

Overview of High Temperature Thermal Biosolids Processing, Presented at the 9th Annual Biosolids Technology and Management Training Workshop, Environmental Protection Agency, Bolger Center, MD, October 2007.

Thermal Oxidation for Electricity Production, Presented in Workshop A: Energy Balancing in Bioenergy Utilization Systems, Residuals and Biosolids Conference 2007 – Innovation and Sustainability, Water Environment Federation, Dallas TX, April 2007.

Thermal Drying of Sludge – Is this the Solution to Biosolids Management? Presented at the Central States Water Environment Association Education Seminar, Madison Wisconsin, April 2007.

Centrifuge Selection and Specification for the Clark County Water Reclamation District, Presented at the Residuals and Biosolids Conference 2006 – Bridging to the Future, Water Environment Federation, Greater Cincinnati, March 2006.

The Key to a Successful Thermal Dryer System—Safety. Presented at Texas Water 2006, Austin, TX, March 2006.

Development in Emissions Technology for Incinerators, Presented at the 78th Annual Technical Exhibition and Conference, Water Environment Federation, Washington, DC – November 2005.

Odor and air emissions control using biotechnology for both collection and wastewater treatment systems, Selected papers from the USC-CSC-TRG Biofiltration Conference, October 2004, Chemical Engineering Journal, Volume 113, Issues 2-3, 20 October 2005.

Advances in Biogas Treatment – Keeping up with Demographic Changes, Presented at the 34th Annual Technical Symposium of the Water Environment Association of Ontario, Deerhurst Inn, April 2005.

Wastewater Treatment Plant Facility Capital Planning, Presented at the 34th Annual Technical Symposium of the Water Environment Association of Ontario, Deerhurst Inn, April 2005.

Ultrasound for Improved Solids Management – How, Who, When and Why, Presented at the Joint Residuals and Biosolids Management Conference 2005, Water Environment Federation, Nashville, TN – April 17 – 20, April 17 – 20, 2005.

Increased Biogas Production and Use, Presented at the Bioenergy: High Performance Anaerobic Digestion Workshop at the Joint Residuals and Biosolids Management Conference 2005, Water Environment Federation, Nashville, TN – April 17 – 20, April 17 – 20, 2005.

Air emission Permitting for the Twin Cities' New Fluid Bed Incineration Process, Presented at the 77th Annual Technical Exhibition and Conference, Water Environment Federation, New Orleans, LA – October 2 to 6, 2004.

Energy Considerations with Thermal Processing of Biosolids, Presented at the Bioenergy Workshop – Permitting, Safety, Plant operations, Unit Process Optimization, Energy Recovery and Product Development, Water Environment Federation, Cincinnati, OH – August 11 and 12, 2004.

Ottawa Investigates the Health Effects of Land-Applied Biosolids through Literature Review, Biosolids Technical Bulletin, Water Environment Federation, Volume 9, Number 3, May/June 2004.

Biotechnology Based Odor Control: Design Criteria and Performance Data, Presented at the WEF/A&WMA Odors and Air Emissions, Water Environment Federation, Bellevue, WA, April 2004.

Impacts of the In-Plant Operational Parameters On Biosolids Quality – Final Results of WERF Odour Project Phase 2 Field and Laboratory Study, Presented at the 33rd Annual Technical Symposium of the Water Environment Association of Ontario, London, April 2004.

Biotechnology-Based Odour Control: Design Criteria and Performance Data, Presented at the 2nd IWA International Conference on Odour and VOCs: Measurement, Regulations and Control Techniques, International Water Association, Singapore, September 2003.

Pilot Centrifuge Biosolids Dewatering at the City of Calgary, Presented at the 2nd Canadian Organic Residuals Recycling Conference, Penticton, BC - April 23 to 26, 2003.

Best Management Practices (BMPs) for Hamilton's Land Application Program, Presented at the 2nd Canadian Organic Residuals Recycling Conference, Penticton, BC - April 23 to 26, 2003.

Best Management Practices and Assessment of Hamilton's Land Application Program, Presented at the 32nd Annual Technical Symposium of the Water Environment Association of Ontario, Toronto, April 2003.

Ontario's Pilot Environmental Management System for Biosolids, Presented at the 32nd Annual Technical Symposium of the Water Environment Association of Ontario, Toronto, April 2003.

Peter A.T. Burrowes

SENIOR FELLOW RESIDUALS ENGINEER

PRINCIPAL AIR QUALITY AND SAFETY MANAGEMENT ENGINEER



Alternative Biosolids Management Technologies for Niagara Region, Presented at the 32nd Annual Technical Symposium of the Water Environment Association of Ontario, Toronto, April 2003.

Biosolids Composting – State of the North American Industry, Presented at the Compost Council of Canada Technical Session, Canadian Waste & Recycling Exposition, Ontario Waste Management Association, Toronto, Ontario, December 2002.

Impact of High Shear Solids Processing on Production of Volatile Sulfur Compounds from Anaerobically Digested Biosolids, Presented at 75th Annual Technical Exhibition and Conference, Water Environment Federation, Chicago, IL, September 2002.

Environmental Management System for Biosolids in Ontario, Presented at the Integrated Solutions to Manure Management, Canadian Environmental Industry Association, London, Ontario, September 2002.

Do You Have An Odor Problem? We Have a Plan That Will Work For You, Presented at Odors and Toxic Air Emissions 2002 Conference, Water Environment Federation, Albuquerque, NM April 2002.

Source Control and Regulation of Dioxins and Furans in Municipal Biosolids, Presented at the 31st Annual WEAO Technical Symposium and OPCEA Exhibition, Water Environment Association of Ontario, Hamilton, Ontario April 2002.

Bench-Scale Dewaterability Testing, Presented at the 31st Annual WEAO Technical Symposium and OPCEA Exhibition, Water Environment Association of Ontario, Hamilton, Ontario April 2002.

Ontario's Biosolids EMS Demonstration Program: Ensuring Regulatory Compliance and Building Public Confidence in the Management of Biosolids, Presented at the 31st Annual WEAO Technical Symposium and OPCEA Exhibition, Water Environment Association of Ontario, Hamilton, Ontario April 2002.

A State-of-the-Art Fluidized Bed Incineration Process to Meet the Solids Processing Needs of the Twin Cities, Presented at the 16th Annual Residuals and Biosolids Management Conference, Water Environment Federation, March 2002.

Where Do Your Sewers Smell and What Can You Do About It, Presented at the Odour and Corrosion Assessment and Controls for Collection Systems and WWTPs Workshop, 74th Annual Conference & Exposition on Water Quality and Wastewater Treatment, Water Environment Federation, Atlanta, GA. October 2001.

Corrosion Mechanisms and Prevention: Chemical, Material, and Structural Approaches, Presented at the Odour and Corrosion Assessment and Controls for Collection Systems and WWTPs Workshop, 74th Annual Conference & Exposition on Water Quality and Wastewater Treatment, Water Environment Federation, Atlanta, GA. October 2001.

How an Agency Should React When It's Incinerators Begin to Age: The Twin cities Story, Poster Presentation at the 74th Annual Conference & Exposition on Water Quality and Wastewater Treatment, Water Environment Federation, Atlanta, GA. October 2001.

WERF Odour Study – Viable Odour control Approaches Used by Other Industries or Agricultural but Have Applicability to POTWs, Presented at the 74th Annual Conference & Exposition on Water Quality and Wastewater Treatment, Water Environment Federation, Atlanta, GA. October 2001.

Biosolids Management in the Region of Niagara, the Next 20 Years, Presented at the 30th Annual WEAO Technical Symposium and OPCEA Exhibition Technology and vision...protecting our resources, Water Environment Association of Ontario, Toronto, Ontario April 2001.

Biofilters – Wastewater Collection and Treatment Odour Experiences of a Sustainable Technology in North America. Presented at the 1st IWA International Conference on Odour and VOCs: Measurement, Regulations and Control Techniques, International Water Association, University of New South Wales, Australia, March 2001.

Strategic Planning: "One-Stop Shopping" for Odor Evaluation, Controls, and Public Outreach At Both Sewage Collection Systems and Wastewater Treatment Plants. Presented at the 1st IWA International Conference on

Odour and VOCs: Measurement, Regulations and Control Techniques, International Water Association, University of New South Wales, Australia, March 2001.

The Vancouver Washington Westside 2000 Expansion Reduced Incineration Emissions by Selecting Fluidizing Bed Technology. Presented at the 73rd Annual Conference & Exposition on Water Quality and Wastewater Treatment, Water Environment Federation, Anaheim, CA. October 2000.

Predictive Models to Estimate Odours and Corrosion Potential in Collection Systems and Wastewater Plants. Presented at the Odour and Corrosion Prediction and Control in Collection Systems and WWTPs Workshop, 73rd Annual Conference & Exposition on Water Quality and Wastewater Treatment, Water Environment Federation, Anaheim, CA. October 2000.

Wastewater Treatment Systems Task Leader's Findings & Research Agenda. Presented at the Odour Investigation Study Workshop, Water Environment Research Foundation, Anaheim, CA. October 2000.

Greenhouse Gas Issues with Biosolids Recycling. Presented at the First Canadian Biosolids Conference, WEAO, Toronto, Ontario. September 2000.

The Guelph Biosolids Composting Experience - 5 Years of Operations. Presented at the First Canadian Biosolids Conference, WEAO, Toronto, Ontario. September 2000.

Collection Systems Model Demonstration for Odours and VOC. Presented at the Odour Control Pre-Conference Workshop, WEFTEC 99, New Orleans, Louisiana. October 1999.

Reducing Odours: Sewage Collection Systems Design/Effect on Odour Generation. Presented at the Odour Control Seminar of the Water Environment Association of Ontario, Toronto. September 1999.

The Great Lakes Initiative (GLI) – Is it Time to Be Concerned about the Effects on our Business? Presented at the 1998 EQO-FEP Environmental Conference, Ford Motor Company, Bellaire, Michigan. October 1998.

Water and Sewage Standardized Approvals. Presented at Approvals Reform Workshop sponsored by the Air & Waste Management Association – Ontario Section, Toronto, Ontario. March 1998.

Acid Gas Controls. Presented at the Air Emission Control Seminar, EPIC Educational Program Innovations Centre, Toronto, Ontario. March 1997.

VOC and Odour Control (Toxics). Presented at the Air Emission Control Seminar, EPIC Educational Program Innovations Centre, Toronto, Ontario. March 1997.

Composting of Wastewater Treatment Plant Sludges. Presented at the Fall Seminar of the Professional Waste Water Operations Division Ontario, Southeastern Region, Cornwall, Ontario. November 1996.

VOC and Odour Control (Toxics). Presented at the Air Emission Control Seminar, University of Toronto and EPIC Educational Program Innovations Centre, Toronto, Ontario. March 1996.

Obtaining Approvals. Presented at the Air Emission Control Seminar, University of Toronto and EPIC Educational Program Innovations Centre, Toronto, Ontario. March 1996.

Viability of Biosolids Composting in Ontario. Presented at the 25th Annual Technical Symposium of the Water Environment Association of Ontario, Toronto, Ontario. March 1996.

Processing Organics (Composting). Presented at the Solids Waste Management Seminar, University of Toronto and EPIC Educational Program Innovations Centre, Mississauga, Ontario. December 1995.

“Sewers Don't Have to Smell,” *Environmental Science & Engineering*. July 1995.

Metro Toronto's Biosolids Management Program. Presented at the Biosolids Management Specialty Conference, Water Environment Federation, Kansas City, Missouri. July 1995.

The Effects of the 503 Sludge Regulations on Sludge Incineration at the Buffalo Sewer Authority's Bird Island STP. Presented at the 88th Annual Meeting and Exhibition of the Air and Waste Management Association, San Antonio, Texas. June 1995.

Odour Assessment Study for Toronto's Main Sewage Treatment Plant. Presented at the 88th Annual Meeting and Exhibition of the Air and Waste Management Association, San Antonio, Texas. June 1995.

Emission Assessment at a Large Canadian Wastewater Treatment Facility - What Are the Impacts? Presented at the 88th Annual Meeting and Exhibition of the Air and Waste Management Association, San Antonio, Texas. June 1995.

Composting of Sewage Sludge Update. Presented at Composting - An Answer to Environmental Pollution, University of Toronto and EPIC Educational Program Innovations Center, North York, Ontario. January 1995.

Alternatives Available for Utilization of Biogas. Presented at Biosolids Treatment and Utilization: Innovative Technologies and Changing Regulations, Water Environment Association of Ontario, Mississauga, Ontario. November 1994.

In-Vessel Composting Comes to Ontario, The Guelph Experience. Presented at Biosolids Treatment and Utilization: Innovative Technologies and Changing Regulations, Water Environment Association of Ontario, Mississauga, Ontario. November 1994.

Removal of Hydrogen Sulphide from Waste Treatment Plant Biogas Using the Apollo Scrubber. Presented at the Clean Air Technology Conference, Toronto, Ontario. September 1994.

"Thermal Dryer Dewater Solids," *Water Environment & Technology*. September 1993.

Wastewater Primary Treatment Indoor Air Sampling and Indoor Odour Control. Presented at 86th Annual Meeting and Exhibition of the Air & Waste Management Association, Denver, Colorado. June 1993.

Sewage Sludge Composting in Practice. Presented at the European Seminar on Energy Efficient Options for Treatment of Sewage Sludge, Dublin. May 1993.

Full Scale Demonstration of Sludge Thermal Dewatering at Buffalo's Bird Island Sewage Treatment Plant. Presented at 65th Annual Conference, Water Environment Federation, New Orleans, Louisiana. September 1992.

"Incineration Technology Advances with Tightening Regulations," *Pollution Prevention*. August 1992.

Thermal Dewatering Demonstrated at Buffalo's Bird Island Sewage Treatment Plant. Presented at the 85th Annual Meeting & Exhibition of the Air & Waste Management Association, Kansas City, Missouri. June 1992.

Why Not Incineration? Presented at the 21st Annual Conference of the Pollution Control Association of Ontario, Toronto, Ontario. April 1992.

Energy from Waste: What Future? Presented at the Third Annual Ontario Independent Power Conference and Trade Show, Toronto, Ontario. September 1991.

Updating Sludge Incineration Systems to Meet the Challenge. Presented at the 84th Annual Meeting and Exhibition of the Air & Waste Management Association, Vancouver, B.C. June 1991.

The Expansion of a Net Producer of Thermal Energy. Presented at the 84th Annual Meeting and Exhibition of the Air & Waste Management Association, Vancouver, B.C. June 1991.

Incineration of Waste: Solids, Sludge, Gases. Presented at the Incineration of Hazardous and Non-Hazardous Waste, Technical University of Nova Scotia, Toronto, Ontario. March 1990.

Fundamentals of Combustion. Presented at the Incineration of Hazardous and Non-Hazardous Waste, Technical University of Nova Scotia, Toronto, Ontario. March 1990.

Fluidized Bed O&M Experiences. Presented at the Incineration O&M Task Force pre-conference workshop, 61st annual conference, Water Pollution Control Federation, Dallas, Texas. October 1988.

Incineration Manual of Practice OM-11. Water Pollution Control Federation, Task Force on Incineration (principal author), Alexandria, Virginia. 1988.

Sludge Handling and Disposal at the Lakeview Water Pollution Control Plant in A Net Producer of Thermal Energy. Presented at the 60th annual conference of the Water Pollution Control Federation, Philadelphia, Pennsylvania. October 1987.

Closed-Loop Thermal Sludge Processing - Bioenergy at Work. *Proceedings of the National Conference on Municipal Treatment Plant Sludge Management*, HMRCI, Orlando, Florida. May 1985.

"Incineration Makes a Comeback in Canada," *World Water*, October 1985.

Energy Source Potential from Sewage Treatment, presented at a seminar of the Biogas Energy Recovery System at the Orangeville Water Pollution Control Plant, Orangeville, Ontario. July 1985.

Energy Recovery from Sewage Incineration, presented to the Air Pollution Control Association, Ontario Section Fall Meeting, Minett, Ontario. September 1981.

Supplemental

Special Experience

Plant Operation Instruction and Design Manual Preparation

- Prepared plant operation manuals and provided classroom lectures to operating and maintenance staff at:
 - Green Bay Facility – Operator Training for SSI Emission Guidelines and Standards Rule.
 - Noman C. Cole Jr. WPCP, Fairfax County – Operator Training and Certification for SSI Emission Guidelines and Standards Rule.
 - Green Bay Facility – Incineration and Energy Recovery
 - Duffin Creek WWTP – Incineration and Energy Recovery
 - ROPEC Digester Expansion
 - Metropolitan Toronto Ashbridges Bay Wastewater Treatment Plant - Waste Heat Recovery Boiler system
 - Lakeview WPCP, Mississauga - Sludge Treatment Processes
 - Lakeview WPCP, Mississauga - Odour Control
 - Guyana Bauxite Company - Bauxite Calcining Processes

Technical Manual Preparation

- Member of the Incineration Task Force of the Technical Practice Committee of the Water Environment Federation – Author of the Incineration (Manual of Practice No. OM-11, 2nd Edition)
- Member of the Incineration Task Force of the Technical Practice Committee of the Water Environment Federation – Author (1987-1988)
- Member of the Sludge Conditioning and Dewatering Task Force of the Technical Practice Committee of the Water Environment Federation – Reviewer (1987-1988)

Expert Witness

- Expert witness representing the City of Guelph in their legal action versus Super Blue Box at the Ontario Supreme Court, 2006
- Technical expertise to legal council representing the CWML Citizens' Committee at the Smithville Mobile PCB incinerator hearings, 1990

Awards

The following are projects Mr. Burrowes has been involved in for which engineering awards were received:

- American Council of Engineering Companies
 - Grand Award by the MN ACEC for MCES Solids Processing Facility (2005)
- Banksia Foundation Sustainability Awards (Australia)

- Gold Banksia Award for the Gippsland Water Factory (2011).
- Canadian Consulting Engineering Awards
 - Award of Excellence in Engineering for Toronto Ashbridges Bay Wastewater Treatment Plant Hightech Retrofit of Sludge Dewatering, Sludge Cake Pumping and Incineration Systems (1991)
- Canadian Construction Association Awards
 - Environmental Achievement Award for the design of the Sludge Handling Upgrade at Metro Toronto Ashbridges Bay Wastewater Treatment Plant (1991)
- Environmental Science and Engineering Magazine
 - National Environment Awards Program. Award of Merit for Environment-Oriented Sludge Management Program at the Lakeview WPCP, Mississauga, Ontario (1989)
- Canadian Consulting Engineering Awards
 - Award of Excellence in Engineering for Ministry of the Environment, Lakeview WPCP, Conditioning and Sludge Thermal Conditioning and Thermal Oxidation Facilities Expansion (1985)

Plant Visits

Mr. Burrowes has visited sewage treatment plants in Canada, the United States, Sweden, Germany, and Switzerland to investigate and observe the various methods of sludge treatment and disposal. He has also visited municipal solid waste incineration and resource recovery facilities to review energy recovery processes and resource recovery techniques. These installations and their respective capabilities are described below.

Wastewater Treatment Plants

- Duffin's Creek, Ontario: Chemical conditioning, pressure belt filtration and/or diaphragm recess plate filtration, and incineration (fluidized bed)
- Hamilton, Ontario: Chemical conditioning, pressure belt filtration, and incineration (multiple hearth)
- London, Ontario: Chemical and pump conditioning, pressure belt filtration of raw sludge, followed by incineration (fluidized bed)
- Highland Creek, Ontario: Chemical conditioning, WAS thickening by DAF, thermal conditioning, centrifugation, and incineration (multiple hearth)
- Guelph, Ontario: Chemical conditioning and pressure belt filtration
- Iona, Vancouver, British Columbia: Anaerobic digestion and sludge lagoons. Cogeneration with gas engines
- Kelowna, British Columbia: Anaerobic digestion
- Hyperion, Los Angeles, California: Digestion, chemical conditioning and centrifugation (conventional and high solids), multiple effect dehydration (Carver-Greenfield), indirect steam drying and incineration (fluidized bed). Cogeneration with digester gas, gas turbines
- Palo Alto, California: Chemical conditioning, pressure belt filtration, and incineration (multiple hearth)
- San Jose/Santa Clara, California: Digestion, sludge drying in drying beds, and cogeneration with gas engines
- East Bay Municipal Utility District, California: Chemical conditioning, WAS thickening with centrifuge, dewatering by centrifugation, windrow composting, and cogeneration with gas engines
- Hartford, Connecticut: Chemical conditioning, belt pressure filtration, and incineration (multiple hearth)
- Stickney Water Reclamation Project, Chicago, Illinois: Chemical conditioning, WAS thickening with centrifuge, dewatering by centrifuges, and train transport to drying beds
- Cedar Rapids, Iowa: Thermal conditioning, vacuum filtration, and incineration (multiple hearth)
- Dubuque, Iowa: Chemical conditioning and vacuum filtration, WAS thickening by centrifuge followed by thermal conditioning vacuum filtration and incineration (fluidized bed)

- NEFCO Boston, Massachusetts: Chemical conditioning, pressure belt filtration, sludge drying and pelletizing (Enviro-Gro Technology)
- Lansing, Michigan: Thermal conditioning, vacuum filtration, and incineration (multiple hearth)
- Minneapolis-St. Paul, Minnesota: Thermal conditioning, roll press, and recessed plate dewatering followed by incineration (multiple hearth)
- Duluth, Minnesota: Chemical conditioning, vacuum filtration, and co-incineration with refuse derived fuel (fluidized bed)
- Independence, Missouri: Thermal conditioning, vacuum filtration, and incineration (fluidized bed)
- Little Blue Valley, Missouri: Thermal conditioning, pressure belt filtration, and incineration (fluidized bed)
- Omaha, Nebraska: Chemical conditioning, vacuum filtration, and incineration (fluidized bed)
- Dupont, New Jersey: Chemical conditioning, pressure filtration, and landfilling
- Amherst, New York: Chemical conditioning, WAS thickening, pressure belt filtration, vacuum filtration and centrifugation, and incineration (multiple hearth) or landfill
- Niagara Falls, New York: Chemical conditioning, cloth vacuum filtration, and carbon regeneration (multiple hearth)
- Buffalo, New York: Chemical conditioning, WAS/Primary thickening by DAF, pressure belt filtration, thermal dewatering, and incineration (multiple hearth)
- Oswego, East Side, New York: Chemical conditioning, pressure belt filtration, and incineration (multiple hearth)
- North River, New York, New York: Sludge anaerobic digestion, barge transportation
- Wards Island, New York, New York: Sludge anaerobic digestion, chemical conditioning, and centrifugation (high solids)
- NYOFKO, New York: Wet cake storage, sludge drying, and pelletizing
- Little Miami, Ohio: Thermal conditioning, vacuum filtration, and incineration (multiple hearth)
- Cleveland Southerly, Ohio: Thermal conditioning, vacuum filtration, and incineration (multiple hearth)
- ALCOBAN, Pittsburgh, Pennsylvania: Chemical conditioning, pressure belt filtration, thermal dewatering, incineration (fluidized bed), and lime stabilization
- Philadelphia - North East, Pennsylvania: Chemical conditioning, WAS thickening by DAF, and temporary dewatering; sludge transported by barge to central composting facility
- Providence, Rhode Island: Chemical conditioning, pressure belt filtration, and incineration (multiple hearth)
- Woonsocket, Rhode Island: Chemical conditioning, pressure belt filtration, and incineration (multiple hearth) with wet ESP
- Army Base, Norfolk, Virginia: Chemical conditioning, centrifugation, and incineration (multiple hearth)
- Chesapeake/Elizabeth, Virginia Beach, Virginia: Chemical conditioning, centrifugation, and incineration (multiple hearth)
- VIP, Hampton, Virginia: WAS thickening by centrifuge, chemical conditioning, centrifugation, and incineration (multiple hearth)
- Boat Harbour, Newport News, Virginia: Chemical conditioning, centrifugation, and incineration (multiple hearth)
- Renton, Seattle, Washington: Chemical conditioning and pressure belt filtration. Digester gas cleaning with Binax technology
- Washington Suburban Sanitary Commission, Silver Spring, Maryland: Aerated static pile composting, multistage spray mist scrubbing
- Eferding, Austria: Dryer/cyclone furnace (Andritz Eco-Dry)

- Frohnleiten, Austria: Landfill receives dewatered sludge, dries on a belt drier and uses for daily cover; heat from landfill gas cogen, biofilter
- Paris, France: Valenton WWTP: Chemical conditioning, centrifugation, drum drying, gasification (multiple hearth), fertilizer production
- Susteren, Netherlands: Fluid bed dryer
- Leksand, Sweden: Chemical conditioning, centrifugation, and in-vessel composting
- Basel, Switzerland: Chemical conditioning and centrifugation followed by incineration (multiple hearth/fluidized bed)
- Wohlen, Switzerland: Chemical conditioning, BFP and belt dryer
- Bochum, West Germany: Chemical conditioning, centrifugation, and incineration (fluidized bed)
- Ulm, West Germany: Chemical conditioning, centrifugation, and incineration (fluidized bed)
- Bottrop, West Germany: Chemical conditioning, pressure filtration, and disposal at power plant; WAS thermal conditioning pressure filtration and incineration (fluidized bed)
- Krefeld, West Germany: Chemical conditioning, centrifugation, flash drying, and co-incineration with refuse (waterwall roll grate)
- Niersverband, West Germany: Chemical conditioning and centrifugation followed by landfilling
- Ingolstadt, West Germany: Chemical conditioning, centrifugation followed by pumping to refuse fired power plant for co-incineration
- Wuppertal, West Germany: WAS thickening by centrifugation, anaerobic digestion, chemical conditioning, centrifugation, and incineration (fluid bed)
- Oberwald, West Germany: Chemical conditioning, pressure belt filtration, and in-vessel composting
- Neckarsteinach, West Germany: Chemical conditioning, pressure belt filtration, and in-vessel composting
- Oberer Kraichbach, West Germany: Chemical conditioning, pressure belt filtration, and in-vessel composting
- Bickenbach, West Germany: Chemical conditioning, pressure belt filtration, and in-vessel composting
- Stuttgart, West Germany: Chemical and thermal conditioning, centrifugation, indirect steam drying, and incineration (fluidized bed)
- Karlsruhe, West Germany: Chemical conditioning, pressure filtration, indirect steam drying, and incineration (fluidized bed)
- Beckton (Greater London), Kent, U.K.: Chemical conditioning, filter press dewatering, thermal dewatering, fluid bed sludge to energy
- Belfast, Northern Ireland, U.K.: Chemical conditioning, BFP dewatering, thermal dewatering, fluid bed sludge to energy
- Calder Valley, Yorkshire, U.K.: Chemical conditioning, BFP dewatering, thermal dewatering, fluid bed sludge to energy
- Glasgow, Scotland, U.K.: Daldowie Fuel Plant: Chemical conditioning, centrifugation, drum drying, centrate treatment with MBR
- Leeds Knostrop, Yorkshire, U.K.: Chemical conditioning, BFP dewatering, thermal dewatering, fluid bed sludge to energy

Solid Waste Incineration and Resource Recovery

- MOE Downsview, Ontario: Refuse transfer, material separation, and in-vessel composting
- General Motors, Oshawa, Ontario: Shredding of packing waste followed by incineration (rotary kiln)
- Ford Motors, Oakville, Ontario: Incineration of packing waste (modular)
- SWARU, Hamilton, Ontario: Shredding, metals separation, and incineration (waterwall boiler)

- North Haven, Connecticut: Refuse incineration (reciprocating grate)
- Wilmington, Delaware: Shredding, materials separation, and recovery; in-vessel co-composting with sewage sludge, drying, and pelletizing
- Pinellas County, Florida: Refuse incineration (waterwall, reciprocating grate)
- Baltimore, Maryland (2 Plants): Refuse incineration, shredding, materials separation and recovery, light fraction fuelling boiler at power plant
- Reuter, Eden Prairie, Minnesota: Materials separation and recovery
- Ramsey Washington Co-Resource Recovery, Newport, Minnesota: Shredding, materials separation, and recovery
- Duluth, Minnesota: Materials separation, processing, and recovery followed by co-incineration with sewage sludge (fluidized bed)
- Rolling Environmental, New Jersey: Incineration of hazardous Aliquid and solid waste (rotary kiln)
- Glen Cove, New York: Co-incineration of refuse and sludge in a refractory wall incinerator
- Northern States Power, LaCrosse, Wisconsin: Shredding, materials separation, and recovery; light fraction fuelling fluidized bed boiler
- Dusseldorf, Germany: Refuse incineration (waterwall roll grate)
- Krefeld, Germany: Co-incineration of refuse and sewage sludge (waterwall roll grate)
- Wuppertal, Germany: Refuse incineration (waterwall roll grate)
- Ingolstadt, Germany: Co-incineration of refuse and sewage sludge (waterwall reciprocating grate)
- Emmenspitz, Switzerland: Refuse incineration (waterwall reciprocating grate)
- Bern, Switzerland: Refuse incineration (waterwall reciprocating grate)



Rashi Gupta, P.E.

Rashi Gupta, a vice president and project manager with Carollo Engineers, has specialized in delivering sustainable solutions for biosolids management and wastewater treatment throughout her career. Ms. Gupta is Carollo's National Biosolids Technology Integration Lead, which allows her to remain current on leading technologies and changes within the biosolids management field.

Education

MS Environmental and Water Resources Engineering, University of Texas, Austin, 2001

BS Civil and Environmental Engineering, University of California, Davis, 1999

Licenses

Civil Engineer, California

Professional Affiliations

California Water Environment Association (CWEA)

Santa Ana River Basin Section of CWEA (SARBS):

- Past-President, Board of Directors
- Professional Development Committee

Southern California Alliance of Publicly Owned Treatment Works

Water Environment Federation

- Member, Residuals and Biosolids Committee
- Incoming Chair, Solids Separation Sub-Committee
- Member, Bioenergy Sub-Committee
- Member, Municipal Resource Recovery Design Committee

Her responsibilities as project manager and process specialist on solids-related projects across the country have taken her from the initial planning phase through design to start-up after construction. She also leads applied research projects for solids processes to assess the best ways to integrate innovation into facilities. From this experience, Ms. Gupta has become a national expert in all things related to solids – from thickening and dewatering to digestion and subsequent practices to beneficially use biogas and biosolids. A summary of her experience includes:

Biosolids Processing and Management

→ Solids systems lead for Durham Advanced Wastewater Treatment Facility East Basin 2019 Master Plan. Ms. Gupta is leading the existing solids system capacity analysis and evaluation of solids treatment alternatives. The alternatives considered include innovative technologies like hydrothermal liquefaction, gasification, and pyrolysis as well as thermo-chemical hydrolysis and high solids digestion with recuperative thickening. The capacity analysis includes existing solids thickening, digestion, co-digestion, dewatering, fermentation, WASSTRIP/Ostara, and biogas utilization processes.

→ Project engineer for the City of Sioux Falls, South Dakota Wastewater Treatment Expansion Project. She is responsible for preliminary and final design of a comprehensive overhaul of the plant's existing solids handling system. The preliminary design includes the addition of WAS thickening with rotary drum thickeners and associated systems within an existing solids handling building, a new digested sludge storage tank, a new solids dewatering facility with screw presses, and covered cake storage. The design also includes provisions for direct truck-loading.

→ Alternatives analysis task lead for the 2020 Energy Management Master Plan at the Nine Springs Wastewater Treatment Plant operated by the Madison Metropolitan Sewerage District, Wisconsin. This project includes assessment of the plant's exist-

ing energy baseline within its solids processes, and evaluation of alternatives to reduce energy consumption, increase energy production, and increase resource recovery. Additional tasks include assessment of regulatory impacts on solids alternatives, identification of funding opportunities, and evaluation of business cases for various options. Ms. Gupta is leading the team responsible for conducting alternatives analyses.

→ Technical advisor for the Sludge Thickening and Dewatering Building projects at the 285 mgd Central District WWTP and 112.5 mgd South District WWTP operated by the Miami-Dade Water and Sewer Department, Florida. She is providing technical reviews and checks for the design of the thickening and dewatering facilities for both treatment plants. Each treatment plant will be provided new thickening and dewatering buildings with four 30-inch bowl dewatering centrifuges, dry polymer make-down, cake pumping systems and truck loading silos. The Central District WWTP will include thickening with eight gravity belt thickeners whereas the South District WWTP will include six 30-inch bowl thickening centrifuges. Each facility will also include new odor control, centrate management, electrical and controls systems.

→ Process specialist for the City of Burlington's Digester Equipment Building and Digester No. 2 preliminary design in California. The preliminary design includes a new 55-ft diameter digester, rehabilitation of an existing pump mixing systems for both digesters, and a new digester equipment building to house new sludge recirculation

Awards

Induction into Select Society of Sanitary Sludge Shovelers (5S) by the California Water Environment Association

Spotlight Volunteer Award from the Santa Ana River Basin Section of CWEA

Other

Accomplishments

National Science Foundation Fellow - University of Texas, Austin

Regents Scholar - University of California, Davis

Recipient of University of California, Davis M.S. Ghauri Medal for the College of Engineering

Quotes

See end of resume

Rashi Gupta, P.E.

and heating systems and a new electrical room. Ms. Gupta is leading the design effort.

→ Technical advisor for the Primary Sludge Thickening Improvements project at the 150 mgd Flamingo Water Resource Center operated by the Clark County Water Reclamation District, Nevada. She is providing technical reviews and checks for the design of the primary sludge pumping, screening, and gravity thickening facilities. The design includes installation of 20 thin primary sludge pumps, 7 sludge screens, four 80-ft diameter gravity thickeners, and 8 thickened primary sludge pumps.

→ Project manager for the Blower Building Condition Assessment at the JB Latham Treatment Plant for the South Orange County Wastewater Authority, California. This project included condition assessment of the building, mechanical, and electrical systems, and performance assessments of the plant's existing blowers, primary influent pumps, RAS pumps, WAS pumps, and primary sludge pumps. Ms. Gupta managed the project.

→ Project manager for the Hydraulic Study at the JB Latham Treatment Plant for the South Orange County Wastewater Authority, California. This project includes the development and calibration of a full plant hydraulic model, and hydraulic modeling to assess plant capacity under varying hydraulic scenarios. Ms. Gupta managed the project.

→ Co-Principal Investigator for the Characterization and Contamination Testing of Source Separated Organic (SSO) Feedstocks and Slurries for Co-Digestion at Resource Recovery Facilities project for the Water Research Foundation (WRF). The project includes multiple tasks to ultimately provide industry guidance on sampling and analytical methods to characterize food waste, standardized monitoring protocols, minimum feedstock quality standards, impacts of feedstock on digestion and biogas utilization processes, and recommended SSO feedstock pre- and post-treatment practices.

→ Project manager for the Chiquita WRP Digester Heat Loop Improvements project for the Santa Margarita Water District, California. She developed conceptual level modifications to the digestion heat loop to address heating deficiencies and mitigate corrosion related failure of the heat loop system.

→ Task lead for the Tahoe-Truckee Sanitation Agency's Master Sewer Plan. She is responsible for addressing operational and capacity issues within the solids processing system, which includes gravity thickeners, thermophilic digestion, dewatering of chemical sludge with a plate and frame press, dewatering of biological sludge with centrifuges, and ancillary chemical conditioning systems.

→ Project manager for the Union Sanitary District's WAS Thickener Replacement Project at the Alvarado Wastewater Treatment Plant in Union City, California. The project includes evaluation of thickening technologies, and preliminary and final design for a retrofitted thickening facility with new polymer, thickened sludge conveyance, HVAC, electrical and other ancillary systems. Ms. Gupta is managing the project.

→ Project engineer and task lead for the Treasure Island Wastewater Treatment Plant and Recycled Water Facility Project for the San Francisco Public Utilities Commission, California. Her responsibilities include the conceptual design of new solids blending, thickening, and truck loading facilities for this greenfield plant. The conceptual design documents will be used by a design/build team for delivery of the final constructed facility.

→ Project manager for the Solids Management Study for the City of Los Angeles' Terminal Island Water Reclamation Facility. The study includes an assessment of existing solids processing capacity and capacity available for co-digestion of food waste. The processes evaluated include thickening, thermophilic digestion, centrifuge dewatering, and dewatered cake loading systems. Biosolids management and digester gas utilization options were studied to determine feasibility of the various options for the plant.

Awards

Induction into Select Society of Sanitary Sludge Shovelers (5S) by the California Water Environment Association

Spotlight Volunteer Award from the Santa Ana River Basin Section of CWEA

Other

Accomplishments

National Science Foundation Fellow - University of Texas, Austin

Regents Scholar - University of California, Davis

Recipient of University of California, Davis M.S. Ghausi Medal for the College of Engineering

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→ Project manager for the Flare Study at the JB Latham Treatment Plant for the South Orange County Wastewater Authority, California. This project included an evaluation of expected SCAQMD permitting requirements and recent code requirements on new flares and digester gas storage systems that SOCWA may need to install at the JBLTP. Ms. Gupta managed the project.

→ Technical advisor for the Innovative Biosolids Technologies project for the South Orange County Wastewater Authority, California. The project included identification of promising innovations in biosolids management, development of an RFP for related solutions providers, and evaluation of proposals received relative to criteria important to SOCWA.

→ Technical advisor for the Biosolids Capital Conversion Projects 2 and 3, PAD, Thickening, and Dewatering Facilities project for JEA Buckman Wastewater Treatment Facility, Florida. She reviewed and advised on development of a centrifuge pilot plan, and checked the 30-percent design for the post-aerobic digestion, thickening, and dewatering facilities.

→ Technical lead for the Biosolids Facility project for Kansas City Blue River Wastewater Treatment Plant, Missouri. She led the design team's development of a 30-percent design for the centrifuge thickening and dewatering facilities as part of an overall incorporation of thermal hydrolysis at the plant. Additional areas under Rashi's purview included polymer, sludge conveyance, and coordination with other disciplines for necessary support facilities.

→ Project engineer for the Solids Thickening Project for the Encina Wastewater Authority in Carlsbad, California. Her responsibilities include the preliminary and final design of the RDT-based solids thickening facilities in an existing dewatering building. She is also leading the design of the polymer and thickened sludge conveyance, and coordinating with other disciplines for necessary support facilities.

→ Task lead for the Phase IIB Improvements project for the City of Fargo, North Dakota. Her responsibilities include the final

design of the centrifuge-based solids thickening facilities in a new building. She is also leading the design of the polymer, thickened sludge conveyance, and bridge crane systems, and coordinating with other disciplines for necessary support facilities.

→ Project manager for the Co-Digestion Capacity Analysis for the California State Water Resources Control Board. This project includes a statewide analysis of food waste quantities, anaerobic digestion capacity needs/availability, investment needs, impacts on greenhouse gas production, lessons learned through case studies, and measures that can be taken to successfully implement co-digestion of food waste across California.

→ Project engineer for the Biosolids Master Plan for the Fresno Clovis Wastewater Reclamation Facilities. This project includes a capacity assessment of solids treatment processes, evaluations of technologies to achieve a diverse portfolio of biosolids, investigation of local markets for different classes of biosolids, and determination of potential regulatory changes that could affect the plant. Ms. Gupta is responsible for solids system capacity assessment and evaluations of solids processing technologies.

→ Project engineer for the Plant 3 Upgrades Project for the City of Lubbock, Texas, Southeast Water Reclamation Plant. This project includes replacement of existing secondary clarifiers, new RAS and scum pump stations, and upgrades to the existing aeration piping. Ms. Gupta is responsible for design of the pump stations.

→ Process Specialist for the Solids Handling Improvement Project at the Bend Water Reclamation Facility for the City of Bend, Oregon. The project includes the rehabilitation of existing thickening and dewatering facilities to install new equipment for increased capacity and reliability. Preliminary design included an assessment of dewaterability through external sludge testing, investigation of potential optimization measures to improve process efficiency, and an evaluation of screw presses, centrifuges, and belt filter presses for installation in an existing solids handling building. Final design was

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Other

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based on the results of that evaluation and includes centrifuges and upgrades to the polymer, ventilation, cake load-out, automation, and electrical facilities.

→ Design manager for the Cogeneration and Solids Improvements at Willow Lake WPCF for the City of Salem, Oregon. The project includes the rehabilitation of existing thickening and dewatering facilities to install new equipment for increased capacity and reliability. The final project, which includes rotary drum thickeners, centrifuges, and emulsion polymer systems, was based on an earlier project phase that included evaluation of various technologies.

→ Technical lead for the Solids Handling Improvements Project for the Rock Creek AWTF for Clean Water Services, Oregon. The project included evaluation, selection, and procurement of dewatering centrifuges, design of modifications for installation of the new dewatering centrifuges in an existing belt filter press building, new polymer system, HVAC modifications, and odor control.

→ Project engineer and task lead for the RP-1 Liquid and Solids Capacity Recovery Project for the Inland Empire Utilities Agency in Chino, California. Her responsibilities include the preliminary and final design of the multi-phase digestion system and new solids thickening facilities.

→ Project manager for the Dewatering and Digester System Assessment Project at the JB Latham Treatment Plant for the South Orange County Wastewater Authority, California. This project includes capacity and condition assessment of the existing digester heating and dewatering processes. Ms. Gupta is managing the project.

→ Project manager for the Dewatering System Assessment Project at the Regional Treatment Plant for the South Orange County Wastewater Authority, California. This project includes capacity and condition assessment of the existing dewatering equipment and processes. Ms. Gupta is managing the project.

→ Project manager for the South Orange County Wastewater Authority (SOCWA),

California, JB Latham Facility Improvements Package "B". Planning, design, and engineering services during construction (ESDC) for various plant upgrades and basin rehabilitation. The planning of this project used process and hydraulic modeling to assess the plant's capacity under a variety of operating scenarios, assessed various effluent management options, evaluated the condition of existing infrastructure onsite, and made recommendations for facility improvements to address capacity and condition-related constraints. Those recommended improvements were then designed and implemented in the design and ESDC project phases. Improvements included rehabilitation of primary and secondary sedimentation basins, dissolved air flotation thickeners, thickened sludge pumping, digester mixing, digester heating, effluent pump station and valves, and associated electrical and controls systems.

→ Project manager for the Plant Solids System/Capacity Assessment (Phase 1) project at the Alvarado Wastewater Treatment Plant for the Union Sanitary District, California. This project includes a loadings-based capacity assessment of all solids treatment processes, optimization of existing processes to improve operations and increase capacity, and planning-level recommendations for additional solids processes required to reach the plant's permitted capacity of 33 mgd. The project also includes evaluations of technologies to achieve Class A biosolids, investigation of options to achieve energy neutrality, and determination of potential regulatory changes that could affect the plant. Some of the focus areas of the project include codigestion, high solids digestion with recuperative thickening, chemically-enhanced primary treatment, solids drying, low-temperature thermal hydrolysis, and high-temperature thermal hydrolysis. Ms. Gupta is responsible for project management, solids optimization and capacity assessment, analyses of digestion options, and overall technical oversight.

→ Project manager for the Plant Solids System/Capacity Assessment (Phase 2) project at the Alvarado Wastewater Treatment Plant for the Union Sanitary District, California.

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This project includes a loadings-based capacity assessment of all liquid treatment processes, optimization of existing processes to improve operations and increase capacity, and planning-level recommendations for additional liquid processes required to reach the plant's permitted capacity of 33 mgd. Ms. Gupta is responsible for project management and overall technical oversight.

→ Project manager for the CLARTS Impacts Study for the City of Los Angeles' Hyperion Treatment Plant. The study focuses on the impacts at the treatment plant of organic waste conveyed from the CLARTS facility to the plant by sewer. The study includes an assessment of existing solids processing capacity, including centrifuge thickening, thermophilic digestion system, sludge screening, centrifuge dewatering, and dewatered cake loading systems. The impacts of increased load from the organic waste on the existing solids systems and ancillary processes will also be determined and recommendations to mitigate those impacts will be made.

→ Project engineer for the Improvements to Anaerobic Digesters Nos. 1-3, Omnivore Cost Evaluation study, and final design at the City of South San Francisco's Water Quality Control Plant. The original project included the replacement of two existing digesters with new digesters and rehabilitation of a third existing digester to meet seismic requirements and improve system reliability. The preliminary design phase of this project included an evaluation of digester mixing, digester roof, and heating system options as well as finalization of the required rehabilitation necessary for the single digester being upgraded. The Omnivore study included a cost-based evaluation of the Anaergia Omnivore process compared with conventional digestion. The study included both capital and life-cycle costs, and the results were sufficiently attractive for the City to change the original design intent of the project to include a preliminary design of an Omnivore system. Ms. Gupta conducted the evaluation and developed the subsequent report for the City. The final

project includes the replacement of two existing digesters with one new high solids ("Omnivore") digester and rehabilitation of a third existing digester to meet seismic requirements and improve system reliability. A linear motion mixer will be provided for the retrofitted digester. Modifications to the digester heating and sludge transfer systems are also included as part of overall system improvements. She is responsible for the final design of the Omnivore and conventional digestion system at the plant.

→ Project engineer for the City of Lubbock, Texas Southeast Water Reclamation Plant Solids Handling Improvements Project. She was responsible for project management, interdisciplinary coordination, preliminary and final design of a comprehensive overhaul of the plant's existing solids handling system. Her work inside an existing solids handling building included staged replacement of three existing gravity belt thickeners, four belt filter presses, and associated dry polymer systems with three new rotary drum thickeners, three dewatering centrifuges, and emulsion polymer feed systems while retaining the plant's ability to thicken and dewater the solids produced during construction. Improvements to the solids handling system also included replacement of an existing truck-loading system located within the building with an external, drive-through truck-loading bay. In addition to her responsibilities for the design of the solids handling facilities, she also coordinated the replacement of the existing building ventilation system and the addition of a new odor control facility dedicated to the solids handling system. The modifications will provide a reliable solids handling capacity sufficient for 29-mgd average annual flow.

→ Project engineer for the San Jacinto Regional Water Reclamation Facility, Title 22 Tertiary and Plant 2 Facilities Expansion for the Eastern Municipal Water District, California. The project expanded plant capacity to 14-mgd average annual flow through the expansion of the digestion and solids handling facilities as well as the replacement of the existing headworks, addition of a new liquid treatment train, and expansion of the

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tertiary treatment facilities. Her primary design responsibilities included two new 80-ft diameter digesters with Rotamix mixing systems, chopper pump-based sludge recirculation and heating systems, heating and feed system modifications for three existing digesters, a new sludge storage tank, a boiler facility and primary heating system for the digesters, primary sludge and scum pump stations, a digested sludge transfer pump station, and a waste activated sludge thickening facility with rotary drum thickeners. As part of preliminary design, she also analyzed the modifications required for an existing sludge pasteurization system to meet Class A biosolids requirements.

→ Project team member for the Co-Digestion of Organic Waste: Addressing Operational Side Effects report for the Water Environment and Reuse Foundation (WERF) and the New York State Energy Research and Development Authority (NYSERDA). The Final Report, published in 2017, included a comprehensive review of operational impacts and considerations associated with co-digestion of organic waste. Ms. Gupta wrote about lessons learned and the practical challenges overcome by successful facilities. She also reviewed and edited the report.

→ Project engineer for the Anaerobic Digester No. 4 and FOG Receiving Facility Project for the Dublin San Ramon Services District. This project included design of a new 70-ft diameter digester and FOG receiving facility at a severely constrained site. The digester design included roof-mounted draft tube mixing and a sludge heating recirculation system. The FOG receiving facility was designed with cone-bottom FOG tank, FOG recirculation with a chopper pump, tube-in-tube heat exchanger, rotary lobe positive displacement digester feed pump, and other O&M friendly features. The FOG system was designed to allow feed to any of the four digesters onsite to maximize operational flexibility and process stability.

→ Project manager for the CLARTS RFP Development Project for the City of Los Angeles. The City is developing an RFP for the organics processing system to be installed at the CLARTS facility. Carollo is providing

technical review of the RFP and managing the project's team members.

→ Project engineer for the Co-Digestion and Digester Gas Utilization Feasibility Study for the Inland Empire Utilities Agency. This study included estimation of external feedstock available in the Agency's service area and projections of associated digester gas production. Ms. Gupta conducted the evaluation and developed the subsequent report for the City.

→ Technical reviewer for the Delta Diablo Regional Sanitation District's Food Waste Receiving Facilities Assessment. This project supported the District's East County Bioenergy Project, which will include food waste collection and processing by a private waste management partner and co-digestion of food waste slurry and FOG at the District's wastewater treatment plant. The assessment included a study of best management practices, operational side effects, odor control, and O&M needs for food waste receiving facilities. Ms. Gupta advised the project team and reviewed the study.

→ Project engineer for the Facilities Master Plan for the Central Marin Sanitation Agency. Ms. Gupta is responsible for an assessment of current digester capacity, estimation of additional FOG and food waste that could be accommodated at the facility, projections of additional digester gas production, planning level modifications to add capacity at the existing FOG/Food Waste Receiving Facility, and recommendations for modifications to the current dewatering system.

→ Project manager for the Perris Valley Regional Water Reclamation Facility Dual-Fuel Boiler Installation Project for the Eastern Municipal Water District, California. Her responsibilities included management of a quick-paced project to install a new dual-fuel boiler and digester gas pressurization system during the construction of two other projects onsite. The new boiler and gas system were installed under a canopy to minimize project cost and maintain an accelerated schedule. The project required coordination with permitting agencies to ensure

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compliance with stringent emissions requirements. Due to project schedule, the project was delivered in a hybrid design-build approach that shared many of the features of the design-assist model.

→ Project manager for the San Jacinto Valley Regional Water Reclamation Facility Interim Solids Handling Project for the Eastern Municipal Water District, California. Her responsibilities included management of a critical, fast-tracked project; evaluation of the existing biosolids systems; and design and start-up of an interim sludge heating system to increase reliability of existing digesters. The project also included analysis of capacity-limiting cake conveyance equipment within the existing belt filter press and centrifuge-based dewatering system and implementation of changes to increase system reliability ahead of an overall plant expansion. Before system start-up, she assisted with development of an operations and maintenance manual and provision of operator training on the system.

→ Project engineer for the EMWD 2015 Regional Water Reclamation Facilities Master Plan Update for the Eastern Municipal Water District, California. Carollo was retained to update the comprehensive Capital Improvements Plan we developed fifteen years ago for each of the District's four reclamation facilities. The update includes a review of existing capacity, impacts of regulatory changes, and recommendations for future projects to address those regulatory changes as well as the increasing loads experienced at each facility. The plan covers both liquid and solids treatment processes and Ms. Gupta is responsible for the solids system work.

→ Project manager for the Southside Water Reclamation Facility FOG Receiving Station Study for the Albuquerque Bernalillo County Water Utility Authority, New Mexico. Ms. Gupta managed the project, which initially included a comprehensive survey of existing FOG receiving facilities to determine operational histories, types of equipment and materials used, and lessons learned. A second project task included development of documentation for the Utility to use to

assess the quality and quantity of FOG available in their vicinity. Finally, operational requirements associated with FOG receiving stations were evaluated and documented to help the Utility understand required staffing, tasks, and maintenance frequency for FOG systems.

→ Assistant project manager for the Michelson Water Recycling Plant Biosolids and Energy Recovery Facilities Master Plan and Preliminary Design for the Irvine Ranch Water District, California. Rashi was responsible for project management, interdisciplinary coordination, and preliminary design of the digestion system. During planning, she evaluated the feasibility of diverting volatile fatty acids as carbon substrate for the secondary treatment system. As part of the master plan, she assisted with the evaluation of various digestion technologies and several biogas management alternatives. The preliminary design of the 28-mgd "greenfield" project included an evaluation of several conventional and advanced sidestream treatment processes to minimize the impacts of the solids systems on the existing liquid treatment processes. The preliminary design for the facility included phased digestion, centrifuge thickening and dewatering, solids storage, centrate treatment, biogas treatment and utilization systems, and digester heating.

→ Project manager for the Emulsion Polymer System Modifications project at the Orange County Sanitation District's Plant No. 1 in California. This fast-tracked project included the addition of new emulsion polymer storage, mixing, containment, and connections to existing polymer feed units to improve the District's dewatered cake dryness and reduce hauling costs. Ms. Gupta led the design effort and managed the project.

→ Project manager of the Dewatering Optimization Project for the Eastern Municipal Water District (EMWD). In addition to managing the project, Ms. Gupta conducted audits of the centrifuge dewatering systems at each of the four facilities operated by EMWD to determine baseline dewatering performance, capacity, and operating costs. She also conducted centrifuge training and

Rashi Gupta, P.E.

Awards

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Other

Accomplishments

National Science Foundation Fellow - University of Texas, Austin

Regents Scholar - University of California, Davis

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developed optimization protocols to help the facilities standardize operations and data collection.

→ Project manager and facility support engineer for the Biogas Enhancement Project Modifications at the Sacramento Regional Wastewater Treatment Plant for Sacramento Regional County Sanitation District, California. Project includes a fats, oils, and grease (FOG) facility that provides FOG processing capacity of 50,000 gallons per day to increase the generation of digester gas. She assessed corrosion and abrasion resistance of various system components and material alternatives to enhance facility life and operability. Based on evaluation results and District preferences, she designed modifications to the FOG facility to reduce operational attention required for the facility.

→ Project engineer for the Palm Springs Wastewater Treatment Plant Upgrade operated by Veolia Water NA for the City of Palm Springs. This project includes much-needed upgrades to both the liquid and solids treatment systems necessary to maintain the plant's treatment capacity and reduce odors. Ms. Gupta is responsible for the work associated with the solids treatment systems including rehabilitation of two gravity thickeners and one anaerobic digester as well the evaluation of a new mechanical sludge dewatering facility. The preliminary design included an evaluation of sludge dewatering technologies including belt filter presses, screw presses, and centrifuges. Final design for the facilities is based on the decisions made during the preliminary design phase.

→ Design engineer and construction support for the Perris Valley Regional Water Reclamation Facility Plant 3 Facilities Expansion to 22 mgd for the Eastern Municipal Water District, California. This project included the addition of a new liquid treatment train and completely new anaerobic digestion systems to handle solids from both liquid trains. A new centrifuge, associated polymer, and electrical systems were installed in the existing dewatering facility to increase dewatering capacity and improve performance. Ms. Gupta was a lead engi-

neer for the solids processes and set the design criteria for those systems. Her design responsibilities also included new primary sludge and scum pump stations, a waste activated sludge thickening facility with rotary drum thickeners, two return activated sludge/waste activated sludge pump stations, a digested sludge transfer pump station, and tertiary filter backwash and concentrate return water pump stations. She also provided construction support services through submittal review and responses to contractor requests for information.

→ Project engineer for the Sludge Thickening and Digester Upgrades Project at the South Cross Bayou Water Reclamation Facility for the Pinellas County Utilities, Clearwater, Florida. The project included preliminary design services for conversion from conventional to acid-phased digestion and upgrades to the County's sludge thickening system. She was responsible for analysis of the existing digester heating system, investigation of the existing fats/oil/grease (FOG) collection and digester feed system, evaluation of sludge thickening alternatives, and development of preliminary design drawings and technical memoranda for required modifications.

→ Project engineer for the City of Las Vegas Water Pollution Control Facility, Nevada, Centrifuge Cooling System Project. She was responsible for assessing the cooling provisions for eight existing centrifuge lubrication systems and recommending improvements to increase their life. She inspected existing shell-and-tube heat exchangers and cooling water characteristics to determine suitability, and studied other options for exchanger type, materials of construction, water source, and cooling via air or chiller water. A memorandum summarizing findings and recommendations was submitted to the City.

→ Project engineer for the El Dorado Irrigation District's Evaluation of the Deer Creek WWTP Biosolids Operations Project in El Dorado Hills, California. Ms. Gupta conducted site visits and an audit of the overall solids system to determine if existing belt filter press performance could be improved. The evaluation covered gravity thickening,

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Other

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Rashi Gupta, P.E.

aerobic digestion, sludge transfer, dewatering, polymer, lime addition, and conveyance systems.

→ Project engineer during the construction phase of the Digester No. 1 Rehabilitation Project for the City of Palm Springs/Veolia Water NA. Her responsibilities included development and review of field changes during construction, assistance with the startup of the digester heating system, and advising operations staff on various questions about the digestion system during initial operations. She conducted field inspections to assess construction progress and developed design documents to address piping conflicts with unknown underground utilities. In addition, she suggested specific modifications to the digester heating loop that were incorporated during construction to better control the digester heating system.

→ Project engineer and construction support for the Soscol Water Recycling Facility for the Napa Sanitation District, California. She studied the performance and capacity of the existing aeration system and developed recommendations for aeration system upgrades to improve secondary treatment performance. During a separate project phase, she provided construction management services and reviewed submittals for innovative digester gas storage system modifications.

→ Project manager for Orange County Sanitation District's Process Engineering Training program. She is managing the provision of Carollo's training services for the District's trickling filter/solids contact, oxygen activated sludge, digestion, and dewatering systems. She is personally responsible for training District engineering personnel on digestion and dewatering processes.

→ Project manager for the Biosolids Regulations and Requirements training project for the Eastern Municipal Water District, California. Ms. Gupta developed and provided training on the 40 CFR Part 503 (Standards for the Use or Disposal of Sewage Sludge) regulations for each of the District's four reclamation facilities. The training focused

on the federal and state regulatory and operational requirements for consistent production of Class B sludge for land application.

→ Project engineer for the Comprehensive Wastewater Master Plan for the City of Riverside, California. Carollo was retained to develop a master plan for all wastewater facilities owned and operated by the City. The master plan included projections of the impacts of regulatory changes, and recommendations for future projects to address those regulatory changes as well as the increasing loads experienced at the City's treatment facility. The plan covered both liquid and solids treatment processes and Ms. Gupta was responsible for the solids system work.

→ Project engineer for the Facilities Master Plan 2017 for the Orange County Sanitation District, California. Carollo was retained to develop a facilities master plan for all wastewater facilities owned and operated by the District. The master plan included documentation of existing facilities, determination of operation issues that must be addressed, and recommendations for future projects to address those issues. The plan covered both liquid and solids treatment processes and Ms. Gupta was responsible for the solids system work.

→ Project engineer for the AquaCritox Demonstration Facility at the Orange County Sanitation District's Plant No. 2. Carollo was retained by SCFI Group LTD to develop conceptual level documents describing how a full scale demonstration facility for the SCFI supercritical water oxidation system would be integrated into the existing plant. Ms. Gupta assisted with facility layout, piping connections, and the conceptual level cost estimate for the facility.

→ Technical advisor and reviewer for the Five Year CIP Projects and Digester Cover Replacement Project for the Sewerage Agency of Southern Marin, California. Her responsibilities included collaboration with Agency personnel to highlight impacts of potential regulatory changes on the plant's solids processes, review of digester cover

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evaluation, and advising project team on digester heating system design parameters.

→ Technical advisor and reviewer for the digester modifications, mixing system evaluation, Omnivore analysis, centrifuge selection process and associated specifications for the Rock Creek Solids Handling Improvements Project for Clean Water Services (CWS), Oregon. For the dewatering system, her responsibilities included collaboration with CWS personnel to highlight differences between centrifuges, advising on centrifuge selection parameters, and finalization of centrifuge specifications for the project. Ms. Gupta's responsibilities for the digestion system included review of re-quired modifications for existing digesters to increase capacity, advising on potential causes for digester foaming, analyzing results of mixing system tests, development of improvements for sludge transfer, and review of an analysis of the Omnivore system to increase digester capacity at the facility.

→ Technical advisor for the Willow Lake WPCF - Solid Waste Storage Facility and 5-Year CIP Guideline Phase 2 projects for the City of Salem, Oregon. Assisted team with facility layouts, equipment selection, and evaluations of various sludge thickening and dewatering options for the facility. Collaborated with project team and plant staff at workshop to finalize planning level recommendations for solids system modifications.

→ Technical reviewer for the Rock Creek AWWTF Digester 1&2 Modifications Project for Clean Water Services (CWS), Oregon. Ms. Gupta's responsibilities included review of mixer specifications and modifications required to install Omnivore system mixers on an existing tank.

→ Technical reviewer for the dewatering centrifuge evaluation, selection, and final design for the City of Garland, Texas Biosolids Rehabilitation and Odor Abatement Project. Her initial responsibilities included review of the design team's evaluation of dewatering options based on results from centrifuge pilot tests. The dewatering centrifuges will be installed in an existing dewatering building that will be retrofitted for the selected units. Ms. Gupta analyzed the

proposed modifications and provided suggestions to improve process reliability and constructability during final design.

→ Technical advisor and reviewer for the Southside Water Reclamation Facility Rotating Drum Thickener Facility Design Project for the Albuquerque Bernalillo County Water Utility Authority, New Mexico. During preliminary design, her responsibilities included review of the design team's evaluation of rotary drum thickeners, advising plant staff on equipment selection, and review of the facility layout for new rotary drum thickeners and associated equipment. During the final design phase of the project, Ms. Gupta will provide final checks on system design.

→ Technical advisor and reviewer for the centrifuge selection process and associated specifications for the Dewatering and Strain Press Final Design Project for the City of Fort Collins, Colorado. Her responsibilities included collaboration with City personnel to highlight differences between centrifuges, advising on centrifuge selection parameters, and finalization of centrifuge specifications for the project.

→ Technical reviewer for the sludge thickening evaluation, selection, and final design for the GBT Project for the Rock River WRD, Illinois. Her responsibilities included review of the design team's evaluation of thickening options, advising plant staff on equipment selection, and review of the facility layout for new gravity belt thickeners and associated equipment.

→ Technical advisor for the Primary Digester No. 3 Rehabilitation project for the Union Sanitary District, California. Assisted team with evaluation of digester foaming mitigation measures and design details necessary for rehabilitation and repair of an existing digester.

→ Technical advisor for the Process Master Plan for the Encina Wastewater Authority, California. Assisted team with evaluation of the Omnivore process for increased digester capacity at the plant and reviewed master plan for technical accuracy.

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→ Technical advisor and quality control for the High Strength Waste Project for the City of Petaluma, California. This project included design of a new high strength waste (HSW) receiving station, modifications to an existing acid phase digester complex to provide storage of digestion feedstock, and a digester feed pump station. The HSW receiving facility included pumps and macerators designed to be O&M friendly. The existing tanks were modified to allow easy removal of grit and contaminants and connected to a robust odor control system. Existing digester mixing and sludge heating systems were re-purposed for HSW. Digester feed pumps with large turndown capability were provided to maximize operational flexibility and digester stability.

→ Technical advisor for the El Estero Wastewater FY 2017 Improvements Project for the City of Santa Barbara. Assisted team with facility layouts for primary sludge and sludge transfer pumping systems, equipment selection, and evaluations of various options to reduce pipe clogging in sludge lines at the facility. Collaborated with project team and plant staff at workshops to finalize solids system modifications.

→ Technical advisor for the WWTP Critical Improvements Project for the City of Richmond, California. Assisted team with evaluation of sludge thickening and dewatering options for the facility.

→ Technical advisor for the Oak Harbor, Washington Clean Water Facility Design. The project includes dewatering and dryer technology evaluation, preliminary, and final design for the City's new solids handling processes to replace current sludge lagoons. She has advised the design team and client on available technologies and key differences between manufacturers. Final design for the system will be based on the results of the evaluations.

→ Technical advisor for the Post Point Biosolids Planning and Plant Expansion project for the City of Bellingham, WA. She advised the team on evaluation of digestion processes including temperature-phased anaerobic digestion.

→ Technical reviewer for sludge storage, pumping, and dewatering system design as part of the Spring Street Sewage Treatment Plant Upgrades project for the City of Klamath Falls, Oregon. Ms. Gupta reviewed the design team's sizing criteria and design for a screw press-based dewatering system, sludge storage tanks, tank mixing, and system pumps.

→ Technical reviewer for the Dallas Water Utilities Solids Handling Improvements at the Central and Southside Wastewater Treatment Plants. The project included a projection of solids loading at the plant, evaluation of existing facilities, and recommendations for improvements to increase process stability, reduce unintended fermentation, and maximize digester gas production. She reviewed the analytical results, process recommendations, and overall evaluation.

→ Technical reviewer for the City of Oxnard's Public Works Integrated Master Plan. The project included an evaluation of biosolids management options and treatment processes to produce Class A biosolids to address uncertainty about future regulatory requirements. She reviewed the evaluation and provided input on process feasibility, historical performance, and future outlook.

→ Technical reviewer for the Southside Water Reclamation Facility Solids Dewatering Facility Project for the Albuquerque Bernalillo County Water Utility Authority, New Mexico. For one part of the project, she reviewed the design concepts for rehabilitating the existing dewatering facility and options for risk mitigation through provision of temporary dewatering and sludge storage during construction. This project phase includes replacement of existing dewatering centrifuges with new units and the addition of redundant cake conveyance systems. She is also the technical advisor for the addition of a 2-MG sludge holding tank that will be mixed with linear motion mixers and tied into the plant's existing sludge handling system.

→

Rashi Gupta, P.E.

Awards

Induction into Select Society of Sanitary Sludge Shovelers (5S) by the California Water Environment Association

Spotlight Volunteer Award from the Santa Ana River Basin Section of CWEA

Other

Accomplishments

National Science Foundation Fellow - University of Texas, Austin

Regents Scholar - University of California, Davis

Recipient of University of California, Davis M.S. Ghausi Medal for the College of Engineering

Quotes

See end of resume

→ Technical reviewer for design of the dewatering system of the City of Nampa, Idaho Solids Handling Project. Her responsibilities included value engineering of a preliminary design completed by others and advising the Carollo/Keller design team during final design of a new solids handling facility and truck loading bay. The dewatering system will include centrifuges, polymer systems, and shaftless screw conveyors that will operate 24 hours per day. The solids handling facility will also house thickeners, thickening polymer system, an electrical room, and a bridge crane for equipment maintenance.

→ Technical reviewer for the dewatering technology evaluation and final design of the Dewatering Equipment Replacement project for the City of Simi Valley, California. Ms. Gupta reviewed the design team's evaluation of screw presses, centrifuges, rotary fan presses, and belt filter presses and advised the project team and plant staff of the most appropriate technology for specific project conditions. Final design for the system includes replacement of the existing belt filter presses with new belt filter presses, polymer system, and conveyors.

→ Technical reviewer for the dewatering technology evaluation and final design of the City of Orlando, Florida Conserv II Biosolids Dewatering System Improvements Project. Her responsibilities included review of the design team's evaluation of screw presses, centrifuges, and belt filter presses for a facility that produces only secondary sludge. Final design for the system is based on the results of the dewatering evaluation and includes replacement of the existing belt filter presses with new belt filter presses.

→ Technical reviewer for the preliminary and final design of the Tohopekaliga Water Authority, Florida Biosolids Dewatering Centrifuge Project. Her responsibilities included review of the preliminary and final design of centrifuge dewatering systems at two facilities owned and operated by the Authority. One facility will be provided with a new dewatering building that will house new centrifuges, polymer systems, and conveyance to a new truck loading bay. The other facility

includes existing belt filter presses and polymer systems in a severely constrained canopy-covered structure. These existing belt filter presses are being replaced with centrifuges and dedicated polymer systems. Dewatered cake will be discharged to an existing conveyor and truck loading facility.

→ Technical reviewer for the preliminary and final design of the City of Orlando's Iron Bridge WRF Dewatering Improvements Project in Florida. Her responsibilities included review of the preliminary and final design of belt filter press dewatering systems at the facility. The existing facility, which included gravity belt thickeners and belt filter presses, was modified to replace the thickeners with new 3-belt presses that could provide both dewatering and thickening functions.

→ Technical reviewer for the dewatering facility design included in the Ammonia Treatment and Biosolids Dewatering Improvements Project for the City of Longmont, Colorado. Her responsibilities included review of the basis of design, preliminary design concepts, and system layout for the new dewatering facility. The project includes centrifuge dewatering, a dry polymer storage and make-down system, and a dewatered cake truck loading facility.

→ Technical reviewer for the Truckee Meadows Water Reclamation Facility ECM 6- Dewatering Project for the City of Reno, Nevada. Ms. Gupta provided the technical check for the dewatering facility design which included two new centrifuges, associated polymer make down systems, and dedicated piston-style cake pumps.

→ Solids facilities technical lead for the City of Sunnyvale, California Water Pollution Control Plant Master Plan and Primary Treatment Facility Design project. Her responsibilities include leading the project team's master planning efforts for the sludge thickening, digestion, dewatering, and cake loading facilities. The master plan for the solids processes includes facility layouts, preliminary equipment sizing, and preliminary control procedures.

→ Technical reviewer for the City of Lubbock, Texas, Digesters 8 and 9 Improve-

Awards

Induction into Select Society of Sanitary Sludge Shovelers (5S) by the California Water Environment Association

Spotlight Volunteer Award from the Santa Ana River Basin Section of CWEA

Other

Accomplishments

National Science Foundation Fellow - University of Texas, Austin

Regents Scholar - University of California, Davis

Recipient of University of California, Davis M.S. Ghauri Medal for the College of Engineering

Quotes

See end of resume

Rashi Gupta, P.E.

ments Project at the Southeast Water Reclamation Plant. She performed the final design check and review for the work, which included comprehensive rehabilitation of two 120-ft diameter digesters. Both digester domes and the systems providing digester heating, sludge recirculation, and mixing were all replaced during the project.

→ Technical reviewer for the Sanitary District No. 5 of Marin Main Plant Rehabilitation Project. The project included a comprehensive rehabilitation of the headworks, primary sedimentation basins, aeration systems, secondary clarifiers, chlorine contact basin, chemical systems, sludge thickening system and anaerobic digesters. She performed the final design check and review for the sludge thickening modifications, which consisted of the replacement of existing dissolved flotation thickener with rotary drum thickening, and installation of new WAS and TWAS pumping.

→ Technical advisor for the City of Petaluma, California, Solids Process Upgrades at the Ellis Creek Water Recycling Facility (Facility) project. The project increases solids handling capacity and operational constraints by improving the Facility's sludge screening, thickening, digestion, and dewatered cake conveyance and hauling systems. Ancillary processes like digester heating and digester mixing are also included in the project. Ms. Gupta is advising the design team on the digestion and conveyance systems, and will review the final design of the improvements.

→ Project manager for the JBLTP Blower Building 1 Crack Repair Design project for the South Orange County Wastewater Authority. Managed project which included inspection of structural cracks and deficiencies within existing building and fast-tracked repair details, drawings, and specifications necessary for emergency repairs.

→ Project manager for the JBLTP Consolidated Headworks Feasibility Study project for the South Orange County Wastewater Authority. Managed project which included preliminary sizing, layouts, and cost estimates for a new headworks facility at the plant to assess the feasibility of such a system at this very constrained site.

→ Technical advisor for the Digester Improvements project for the City of Orem, Utah. Evaluated digester heating problems and mitigation measures for hydrogen sulfide formation in digester gas. Advised City of low-cost methods to improve operational issues without substantial capital expenditure.

→ Technical advisor for the Southside Water Reclamation Facility Electrical System Master Plan for the Albuquerque Bernalillo County Water Utility Authority, New Mexico. She evaluated potential digester gas production for future conditions to allow the Water Authority to assess feasibility of cogeneration at the plant.

→ Project manager for the RAS Interim Control Improvements project at the Alvarado Wastewater Treatment Plant for the Union Sanitary District, California. The plant faces poor sludge settleability that has impacts on effluent quality and solids processes. This project includes development of documents necessary to improve the RAS system control on an interim basis before large capital projects are completed. Ms. Gupta is responsible for project management and overall technical oversight.

Construction Management

→ Project engineer during the construction phase of the Digester No. 1 Rehabilitation Project for the City of Palm Springs/Veolia Water NA, California. Her responsibilities included development and review of field changes during construction, assistance with the start-up of the digester heating system, and advising operations staff on various questions about the digestion system during initial operations. She conducted field inspections to assess construction progress and developed design documents to address piping conflicts with unknown underground utilities. In addition, she suggested specific modifications to the digester heating loop that were incorporated during construction to better control the digester heating system.

→ Construction support and civil engineer for the San Jacinto Valley Regional Water Reclamation Facility, Interim Solids Handling

Awards

Induction into Select Society of Sanitary Sludge Shovelers (5S) by the California Water Environment Association

Spotlight Volunteer Award from the Santa Ana River Basin Section of CWEA

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National Science Foundation Fellow - University of Texas, Austin

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Quotes

See end of resume

Rashi Gupta, P.E.

Project for the Eastern Municipal Water District, California. She was responsible for construction management services, system start-up, submittal review, and response to contractor requests for information.

→ Construction support for the Water Quality Control Plant Secondary System Upgrades project for the City of Riverside, California. She provided construction management services and reviewed shop drawings for materials and equipment used in the construction of this project, which included the replacement of the biological treatment aeration diffusers, blowers, controls, piping, and ancillary equipment.

Economic Analysis

→ Project engineer for the economic analysis of the Digester Heating System Upgrades project for water reclamation facilities in San Jacinto, Moreno Valley, and Temecula for the Eastern Municipal Water District, California. She conducted cost analyses and quantity takeoffs for each facility.

→ Project engineer for the economic analysis for the Temecula Valley Regional Water Reclamation Facility Expansion to 18 mgd for the Eastern Municipal Water District, California. She assisted with the preparation of a comprehensive cost analysis through quantity takeoffs and construction estimates for the facility.

Operations and Maintenance

→ Assisted with the development of an operations and maintenance manual for the Interim Solids Handling System at the San Jacinto Valley Regional Water Reclamation Facility for the Eastern Municipal Water District, California. Her duties included development of operational procedures for the manual and provision of operator training on the system.

→ Assisted with the development of an operations and maintenance manual for the Sanderson Avenue Lift Station for Eastern Municipal Water District, California. Her duties included editing, ensuring that the client's comments were addressed, and helping to finalize the manual.

Wastewater Treatment

→ Project engineer responsible for preparation of bid-phase documents for a new 9.9-mgd wastewater treatment facility in Darsait, Sultanate of Oman. The project includes influent pumping, headworks, fine screening, and membrane bioreactors (MBRs) followed by tertiary effluent pumping and solids handling facilities.

→ Design engineer responsible for preparation of bid phase documents for the new 8-mgd Regional Water Reclamation Facility for the Spokane County, Washington. The project included headworks and biological aerated filtration (BAF) followed by tertiary membranes and solids handling facilities to meet the most stringent effluent phosphorous limits in the country (0.05 ppm).

→ Design engineer for the Perris Valley Regional Water Reclamation Facility Tertiary Facilities Expansion for the Eastern Municipal Water District, California. The project included design and construction management services for the expansion of disinfection and filtration facilities to achieve 22 mgd tertiary treatment capacity and provide reclaimed water meeting Title 22 requirements. Her responsibilities included the completion of preliminary design technical memoranda for required modifications to the disinfection and tertiary filtration facilities.

→ Design engineer for the Wastewater Treatment Plant Upgrade for the City of Camarillo, California. The project included design of a facility expansion, which included the addition of advanced secondary treatment and filtration to meet increased water quality standards. Her responsibilities included analysis of the hydraulics of both plants at the facility and generation of a complete hydraulic profile during the preliminary design phase of the project.

→ Project engineer for the Perris Valley Regional Water Reclamation Facility Project Development Report for the Eastern Municipal Water District, California. The project included development of a comprehensive planning-level report to outline recommendations and the necessary upgrades and modifications for the facility to reach 22

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Quotes

See end of resume

Rashi Gupta, P.E.

mgd capacity. Her responsibilities included evaluation and development of recommendations for fine-bubble aeration systems and tertiary filtration alternatives through economic and non-economic analysis.

Water Quality

→ Project engineer for the Advanced Water Treatment for Estuarine Water Supplies for Improving Water Quality project for the Contra Costa Water District, California, and the Water Research Foundation. She assisted in the development of a comprehensive Quality Assurance Project Plan by coordinating and reviewing analytical methods and quality assurance protocol.

Previous Experience

→ Conducted research and wrote a master's thesis on the removal of BTEX compounds from water produced during oil and gas extraction through sorption to surfactant-modified zeolite.

→ Analyzed effectiveness of recycling programs developed by the Solid Waste Planning Department of the Los Angeles County Sanitation Districts.

→ Assisted doctoral student with research on ultraviolet inactivation of coliform found in wastewater. Simple microbiological techniques were used to ascertain the effectiveness of the disinfection process at the University of California Davis Wastewater Treatment Plant.

Publications/Presentations

→ Swanback, S., A. Evans, H. Gerges, R. Gupta, A. Tartaglione. "Design of Municipal Wastewater Treatment Plants: Chapter 21 - Solids Thickening" Water Environment Federation Manual of Practice No. 8, 2018.

→ Gupta, R., Charbonnet, E., Deslauriers, S., "Food Waste Co-Digestion in California – The Role of WRRFs and Investment Needs to Maximize Co-Digestion in Support of SB 1383", Proceedings of California Water Environment Association and California Association of Sanitation Agencies Joint Specialty Webinar, September 9, 2020.

→ Gupta, R., Deslauriers, S., Charbonnet, E., Ransom, C., Williams, R., "Comprehensive

Assessment of Co-Digestion Capacity, Costs, Impacts, and Operational History in California", Proceedings of WEFTEC 2020, 93rd Annual Conference of the Water Environment Federation, Virtual, October 5-9, 2020.

→ Gupta, R., Park, B., Robertson, J., Truax, T., Miccolis, C., Sprick, M., Miner, J., McCormick, J., "Dewatering Technology Selection for the '2nd Most Difficult-to-Dewater Sludge in the World'", Proceedings of WEFTEC 2020, 93rd Annual Conference of the Water Environment Federation, Virtual, October 5-9, 2020.

→ Gherini, B., Eve, K., Bosick, C., R. Gupta, "Getting to Zero with Co-Digestion: Defining the Road to Energy Neutrality", Proceedings of the WEF Residuals and Biosolids Conference, 2018, Phoenix, AZ, May 15-18, 2018.

→ Appleton, A., Rauch-Williams, T., Gupta, R., Greene, M., S. Grimbert, "Addressing Operating Side Effects of Co-Digestion of Organic Wastes", Proceedings of the WEF Residuals and Biosolids Conference, 2018, Phoenix, AZ, May 15-18, 2018.

→ Gupta, R., S. Walker, M. Brehm, B. Stevenson, K. Tagny, M. Verosik, "Reducing Dewatering Costs Through an Optimization Program", Proceedings of the WEFTEC 2017, 90th Annual Conference of the Water Environment Federation, Chicago, IL, October 4.

→ Gupta, R., D. Meacham, P. Parkins, T. Peacock, A. Montoya. "Lifting the FOG from FOG Receiving" Proceedings of the WEF Residuals and Biosolids Conference, 2017, Seattle, WA, April 11.

→ Gupta, R. "Organics Management and Energy Recovery: The Future of Solids Processing", Proceedings of the Water Environment Association of Utah Mid-Year Conference 2017, West Valley City, UT, November 14.

→ Gupta, R. "Reducing Dewatering Costs: Case Studies of Successful Optimization", Proceedings of the California Water Environment Association Annual Conference 2017, Palm Springs, CA, April 26-29.

Awards

Induction into Select Society of Sanitary Sludge Shovelers (5S) by the California Water Environment Association

Spotlight Volunteer Award from the Santa Ana River Basin Section of CWEA

Other

Accomplishments

National Science Foundation Fellow - University of Texas, Austin

Regents Scholar - University of California, Davis

Recipient of University of California, Davis M.S. Ghauri Medal for the College of Engineering

Quotes

See end of resume

Rashi Gupta, P.E.

→ Gupta, R. "Fats, Oils, and Grease Receiving Stations - Practical Considerations and Lessons Learned" Proceedings of the Water Environment Federation Navigating the World of FOG Conference, Tempe, AZ, April 6-8.

→ Gupta, R., S. Walker. "Optimization for Centrifuge Dewatering" Proceedings of the WEFTEC 2016, 89th Annual Conference of the Water Environment Federation, New Orleans, LA, September 24-28.

→ Gupta, R. "Innovations in Anaerobic Digestion" Proceedings of the California Water Environment Association Annual Conference 2016, Santa Clara, CA, April 26-29.

→ Pretorius, C. F., R. Gupta, E.L. Jorgensen, D. Howell, J. Ahmadpour, G. Buenagua, D. Mathes, J. Rosenfield, "Increasing Digester Gas Production Using Residual Syrup" Proceedings of the Water Environment Federation, Residuals and Biosolids Conference, Raleigh, NC, March 2012.

→ Gupta, R. "Effects of Competitive Sorption and Salinity on the Sorption of BTEX Compounds in Produced Water onto Surfactant-Modified Zeolite." Masters Thesis, University of Texas, Austin. 2001.

Client Feedback

→ "Rashi's expertise, responsiveness and thoroughness has helped us develop a digester design that allows us to implement state-of-the-art, energy-saving technologies while still protecting the robustness of our anaerobic digestion systems. This project is a large undertaking for our team, but Rashi has always been available to listen to our concerns and addressed them quickly and in a collaborative manner. We are pleased to have worked with Rashi on this project and would be happy to work with her again on future work."

-Brian Schumacker, Plant Superintendent, South San Francisco-San Bruno Water Quality Control Plant, South San Francisco, CA

→ "Rashi has been working with EMWD for over 10 years. In that time she has designed our digesters and thickening facilities, trained our operators on solids processes and regulations, and continues to help us

with optimization of our dewatering processes. She listens to our concerns and follows through. When we have a solids-related question or need, we don't hesitate to call Rashi."

-Jeff Wall, P.E., Director of Water Reclamation, Eastern Municipal Water District, CA

→ "We were very pleased with Rashi's excellent performance and quality designs on our solids handling facility which included new Centrifuges, Rotary Drum Thickeners and Polymer systems. She is very thorough, follows up with every detail, finds answers to our questions and gets back to us in a timely manner".

-Kyle McCoy, Operations Coordinator, Southeast Water Reclamation Plant, City of Lubbock, TX

Hao Luo

4212 Meadow Field Ct. Fairfax, VA, 22033

Phone: 1-225-278-4618

E-mail: haol@vt.edu

Education

01/2019 – present: (expected in 02/2023): **Ph.D.** in Civil and Environmental Engineering, Virginia Polytechnic Institute and State University, USA

08/2017 – 12/2018: **M.S.** in Civil and Environmental Engineering, Lamar University, USA

08/2015 – 05/2017: **M.S.** in Science and Technology, Southeastern Louisiana University, USA

09/2010 – 6/2014: **B.S.** in Environmental Science, Kunming University of Science and Technology, China

Research Experience

Graduate Research Assistant: 12/2019- Present

Virginia Polytechnic Institute and State University, advisor: Zhi-wu Wang

- **Identification of the Source and Cause of the Biosolids Odor Emission in Western Branch Water Resource Recovery Facility:** This research is aimed to identify the causes of the biosolids odor issue experienced at Western Branch Water Resource Recovery Facility (WRRF), one of the five major WRRF of Washington Suburban Sanitary Commission (WSSC) and investigate potential strategies for biosolids odor reduction
- **Turning phosphorus pollution from digested dairy manure into a marketable product by using fungi:** The main objective of this study is to evaluate the efficiency of phosphorus recovery from digested dairy manure by using the selected white-rot fungi. The capacity of selected fungi in releasing and mobilizing phosphorus for crop utilization was also determined by evaluating the phosphorus solubilization capacity of the selected fungi.
- **Effect of aluminum addition and primary sludge blending on the anaerobic digestion of waste activated sludge:** The purpose of this study is to investigate the possibility of improving the digestibility of waste activated sludge (WAS) in one of the local wastewater treatment plant.

Graduate teaching Assistant

Virginia Polytechnic Institute and State University

CEE 3104 Introduction to Environmental Engineering (Summer 2019)

CEE 4147 Solid and Hazardous Waste Management (Fall 2020)

Graduate Research Assistant: 08/2017- 12/2018

Lamar University, advisor: Ren-zun Zhao

- **Spacial and Temporal variation of tap water quality in the city of Beaumont after hurricane Harvey:** A research aims to understand the temporal and spatial

variation of tap water quality during the water outage period on Lamar campus and the Beaumont area, to discover any potential source water contamination and to avoid any potential concerns.

Graduate Research Assistant: 08/2015- 05/2017

Southeastern Louisiana University, advisor: Junkun Ma and Cris Koutsougeras.

- **Study of a Vertical Axis Wind Turbine with Deflection Panels:** A study of the potential power output of a vertical axis wind turbine with deflection panels, computational fluid dynamics (CFD) models based on the COMSOL Multiphysics simulation software package have been built to estimate the energy output that can be achieved with an actual physical implementation of this turbine.
- **Vertical Axis Wind Turbines with Active Blade and Camber Control:** Using a numerical simulation and analysis method based on COMSOL®; The goal is to obtain an optimized blade and camber control profile so that a mechanism or mechanical system can be developed with the best efficiency.

Undergraduate Thesis: 03/2014- 06/2014

Kunming University of Science and Technology, China, Advisor: Bo Pan.

- **Protection of soil organic matter by inorganic minerals as investigated by biomarkers:** Using the biomarkers, comparing the change amount of the soil organic matter by the removal of inorganic mineral in order to determine whether the content of soil organic matters (SOM) were reduced or not detected due to inorganic mineral on protection of SOM.

Publications

Journal papers

1. **Luo H.**, Dian Z., Taylor M., Nguyen C., Quansah S., Wang Z.W. (2020) Aeration of the sludge holding tank as a simple means for biosolids odor control – A case study, *Water Environment Research* (Submitted)
2. **Luo H.**, Taylor M., Nguyen C., Wang Z.W. (2020) The effects and mechanisms of iron and aluminum-based coagulants on sludge anaerobic digestibility, dewaterability and odor emission, *Journal of Water Process Engineering* (Manuscript prepared)

Conference oral presentations

1. **Luo H.**, Taylor M., Nguyen C., Quansah S., Wang Z.W. (2020) Identification of the Source, Cause, and Solution of the Biosolids Odor Emission in Western Branch Water Resource Recovery Facility, *WEF Residuals and Biosolids 2020*, Minneapolis, MN, March 31 – April 3 (Accepted but not presented due to COVID-19)
2. **Luo H.**, Taylor M., Nguyen C., Quansah S., Wang Z.W. (2020) Identification of the Source, Cause, and Solution of the Biosolids Odor Emission in Western Branch Water Resource Recovery Facility, *ASABE 2020*, Chicago, IL, July 12-15

Hao Luo

(Accepted but not presented due to COVID-19)

3. **Luo H.**, Tenjo F., Wang Z.W. (2020) Turning phosphorus pollution from digested dairy manure into a marketable product by using fungi, ASABE 2020, Chicago, IL, July 12-15 (Accepted but not presented due to COVID-19)
4. **Luo H.**, Taylor M., Nguyen C., Quansah S., Wang Z.W. (2020) Aeration of Sludge Holding Tanks Can Reduce Odor Emission from Dewatered Biosolids, WEFTEC 2020, New Orleans, LA, October 12-15 (Accepted but not presented due to COVID-19)

Posters

1. **Luo H.**, Taylor M., Nguyen C., Quansah S., Wang Z.W. (2020) Aeration of sludge holding tanks as an economical means for biosolids odor control, WaterJam 2020, Virtual, September 9-12

Technical reports

1. **Luo H.** and Wang Z.W. (2020) Turning phosphorus pollution from digested dairy manure into a marketable product by using fungi, submitted to Virginia Department of Agriculture and Consumer Services, March
2. **Luo H.**, Zhang D., and Wang Z.W. (2020) Identification of the Source, Cause, and Solution of the Biosolids Odor Emission in Western Branch Water Resource Recovery Facility, submitted to Washington Suburban Sanitary Commission, March 4

Skills:

- Proficient in Programming Software: COMSOL; Solid works; Mathematical.
- Gas chromatography (GC).
- Biosolids dewatering in the lab scale.
- Proficient in HACH instruments.
- Microorganism cultivation.

Linguistics

- Mandarin (Native)
- English (Fluent)

Honors/awards

- Passed FE Civil Exam (11/2018)
- Sussman Foundation Internship Award (03/2020)

Pedro David Puente



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Ann Arbor, MI, USA

EDUCATION

University of Michigan

Ann Arbor, MI, USA

Ph.D. in Environmental Engineering (01/2020 – Current)

M.Sc. Environmental Engineering (08/2013 – 04/2015), GPA: 3.73

Certificate of Graduate Studies in Industrial Ecology (08/2014 – 04/2015)

San Francisco de Quito University

Quito, Ecuador

B.S. in Chemical Engineering, (08/2006 – 02/2013), GPA: 3.54, Cum Laude

RESEARCH AND PROFESSIONAL EXPERIENCE

Lecturer

Universidad de las Fuerzas Armadas – ESPE (10/2017 – 12/2019)

Santo Domingo, Ecuador

Taught General Chemistry and Organic Chemistry for Agronomics and Biotechnology Engineering majors.
Founded the Sustainable Development Club to support research and community projects related to the United Nations Sustainable Development Goals.

Consultant

Proveinnova S.A. (04/2017 – 08/2017)

Quito, Ecuador

Provided technical support for sustainable agriculture projects aiming to export products to the EU.
Assessed the potential of small and medium size producers to meet export criteria requirements.

Public policy analyst

Ministry of Knowledge and Human Resources (08/2015 – 12/2016)

Quito, Ecuador

Implemented international guidelines in the Ecuadorian vocational programs along with representatives of the United Nations, UNESCO and International Labour Organization.

Research assistant

University of Michigan (09/2013 – 04/2015)

Ann Arbor, MI, USA

Led the construction, start-up and maintenance of an anaerobic pilot plant employing ceramic discs, hollow fiber and flat sheet membranes for the treatment of real domestic wastewater.
Ran and reported laboratory wastewater analysis including gas and ion chromatography.

HONORS AND AWARDS

Scholarship. San Francisco de Quito University. Half coverage of tuition for Undergrad program. Ecuador, 2006-2013.
Excellence Universities Scholarship. SENESCYT. Full coverage of Master's program. Ecuador, 2013-2015.

LANGUAGES

Spanish – Native
English – Advanced / Technical
French – Intermediate

SKILLS

Data analysis / Laboratory analysis
Public speaking / Leadership / Decision-making
Work under pressure / Adaptability

Mr. Whitlock has more than 25 years of research, science, and engineering experience, including extensive biosolids experience, specializing in anaerobic digestion, biogas utilization, and energy management optimization. He is an active member of the Water Environment Federation (WEF) and Vice Chair of the WEF Residuals and Biosolids Committee.

EDUCATION

Masters of Business Administration, University of Utah, Salt Lake City, Utah, 2004

Bachelors of Science in Environmental Engineering, Utah State University, Logan, Utah, 1997

REGISTRATIONS

Professional Engineer #343868-2202, State of Utah, Board of Professional Engineers and Land Surveyors

MEMBERSHIPS

Member, Water Research Foundation

Member, Residuals and Biosolids Committee

Chair of the Bioenergy Technology Subcommittee
Chair, Water Environment Federation/Residuals and Biosolids Committee

Member, Past President and Secretary/Treasurer, Water Environment Association (Utah)

PROJECT EXPERIENCE

Biogas to Renewable Natural Gas Design-Build (Bioenergy Practice Leader), 2018-Present
Client: City of Edmonton, Calgary

Dru was the senior reviewer of the biogas system upgrades to renewable natural gas as well as anaerobic digestion process analysis. The project is a design build of a water scrubbing biogas upgrade system for the City of Edmonton. Stantec is in partnership with AECOM to deliver the project.

Coney Island WWTP Biogas-Fueled Engine Replacement Study*, New York, New York (Bioenergy Technology Lead), 2017-2018
Client: Department of Environmental Protection

Dru was the senior reviewer of the biogas system upgrades as well as anaerobic digestion process analysis. This project includes the replacement of two 1.6-megawatt spark-ignition combined heat and power engine generators, engine exhaust oxidation catalyst, exhaust heat exchanger, and silencer. Two diesel-only standby engine generators, digester gas compressors and conditioning, natural gas blending system, heat recovery system to capture heat from the spark-ignition engines for use in heating the digesters, replacement of the 5-kV switchgear, and upgrades to the Control Room.

* denotes projects completed with other firms

Dru Whitlock

Global Practice Leader, Wastewater

Biogas Utilization Study*, Chicago, Illinois (QC Reviewer), 2017-2018

Client: Metropolitan Water Reclamation District of Greater Chicago

Dru was the senior reviewer of the biogas system upgrades to renewable natural gas as well as anaerobic digestion process analysis at the Calumet Water Reclamation Facility. The project is focused on the economics and risks associated with leveraging Renewable Identification Numbers through the federal Renewable Fuel Standard as well as California Low Carbon Fuel Standard credits to fund the capital investment.

Biogas Conditioning Technology Evaluation*, Dallas, Texas (Bioenergy Technology Lead), 2018

Client: Trinity River Authority

Dru was the lead technologist to evaluate biogas conditioning technologies for natural gas pipeline injection, as well as a life cycle cost analysis for the selected conditioning technology and the economic benefits associated with the RIN market. The project is focused on the economics and risks associated with leveraging Renewable Identification Numbers through the federal Renewable Fuel Standard as well as California Low Carbon Fuel Standard credits to fund the capital investment.

Biogas Utilization Study, San Rafael, California (Senior Technology Consultant)

Client: Las Gallinas Valley Sanitation District

This project included analysis of various beneficial uses of biogas at the LGVSD. The study included alternatives evaluation of onsite energy conversion technologies focusing on microturbines and biomethane options, such as renewable CNG vehicle fuel or renewable pipeline NG.

Biogas Utilization Study and Design*, San Francisco, California (Senior Technology Consultant), 2012-2016

Client: San Francisco Public Utilities Commission Oceanside WPCP

This project included analysis of various beneficial uses of biogas at the Oceanside Plant. The study included alternatives evaluation of onsite energy conversion technologies as well as off-site biomethane options, such as CNG vehicle fuel or pipeline NG. The study included analysis of augmenting biogas production with FOG (fats, oils, and grease). After the study, SFPUC retained another consulting team to design the new cogeneration system. Dru provided consulting services during design and served as Quality Control document review. The project will be commissioned in 2018.

New Water Resource Recovery Electrical Energy R2E2 Design Project*, Green Bay, Wisconsin (Senior Technology Consultant), 2012-2016

The Green Bay New Water R2E2 project is an innovative solids handling system including anaerobic digestion, biogas fueled engine generators, and fluidized bed incineration with energy recovery. The project included complete solids handling design downstream of the primary and secondary clarifiers. Dru led the predesign of the anaerobic digestion system, the biogas handling system, and supported the predesign of the biogas-fueled engine generator system. He also led the bench-scale analysis of primary solids, waste activated solids, and high-strength waste co-substrate testing. During construction, Dru led the development of the anaerobic digestion system start-up protocol. This included importing digested solids in from an adjacent facility to seed the anaerobic digestion system.

* denotes projects completed with other firms

Dru Whitlock

Global Practice Leader, Wastewater

Southeast Plant Biosolids Digester Facility Project*, San Francisco, California (Anaerobic Process and Decision-Making Lead), 2013-2016
Client: San Francisco Public Utilities Commission

This \$1 billion solids processing upgrades project commenced in 2013 and is projected to be commissioned in 2022. Dru led the anaerobic digestion planning, conceptual engineering, and 35% design for this project. He also successfully led the decision-making methodology development and process for the planning phase. The planning phase examined four system-wide alternatives to meet Class A Biosolids including Temperature Phased Anaerobic Digestion, Thermal Hydrolysis and Mesophilic Anaerobic Digestion, Anaerobic Digestion and Offsite Composting, and Anaerobic Digestion and Thermal Drying. In six months, Dru led a large, complicated consulting team (consisting of Brown and Caldwell, CH2M, and Black and Veatch with 20+ sub-consultants) along with a sophisticated client to make a decision, resulting in SFPUC choosing thermal hydrolysis and anaerobic digestion. The new facility will include an entirely new solids process train on a "brown field" site.

WWTP Thermal Hydrolysis and Anaerobic Digestion System*, Honouliuli, Hawaii (QC Reviewer), 2016

Dru was the senior reviewer of the solids treatment upgrades at the Honouliuli WWTP, which included a new thermal hydrolysis system upstream of the anaerobic digesters.

Thermal Hydrolysis and FOG Receiving Facility VE Study*, Virginia (Value Engineering Consultant), 2014

Client: Hampton Roads Sanitation District

Dru was a member of the consulting team consisting of seven members who conducted a value engineering study for HRSD with a goal of reducing costs by \$6 million from a \$42 million preliminary engineering report estimate. As an expert in anaerobic digestion, energy recovery, and thermal hydrolysis processes, he assisted the value engineering team to identify over \$10 million in opportunities to economize. The project is scheduled to be commissioned by 2018. Many of the concepts that Dru advocated for were implemented at the York River Facility.

* denotes projects completed with other firms

Dru Whitlock

Global Practice Leader, Wastewater

Biosolids Facility Plan*, Palo Alto, California
(Senior Technology Consultant), 2013-2017
Client: Palo Alto Regional Water Quality Control
Dru led the methodology development, the evaluation, and the report development for this project. During this project, several wastewater residuals stabilization and dewatering and hauling technologies were evaluated, with considerations for capital cost, operation and maintenance cost, and non-financial factors such as renewable energy generation, greenhouse gas emissions/offsets, diversity of end-use options, odors, truck traffic, and local control of end use product. In addition, the Palo Alto City Landfill adjacent to the RWQCP provides options utilizing landfill biogas. The combination of scores resulted in a cumulative "Benefit" score for each biosolids option. Without consideration of the project cost, Thermal Hydrolysis received the highest benefit score. Ultimately, thermal hydrolysis and anaerobic digestion were chosen by Palo Alto. The project team conducted a pre-design for the staged process: 1) design and build the dewater/loadout facility, 2) decommission the multiple hearth furnaces, and 3) design and build the thermal hydrolysis and anaerobic digestion facility.

Conversion to Temperature Phased Anaerobic Digestion Study*, San Francisco, California
(Senior Technology Consultant), 2009-2011
Client: San Francisco Public Utilities Commission
Dru evaluated the feasibility of converting four 750,000 gallon egg-shaped digesters from conventional flow through mesophilic anaerobic digestion to thermophilic/mesophilic temperature phased sequencing batch reactor anaerobic digestion to achieve Class A Biosolids. After the study, he provided oversight, guidance, and QC during the Conceptual Engineering Report Development by SFPUC Wastewater Enterprise

Conversion to Temperature Phased Anaerobic Digestion Design*, San Francisco, California
(Senior Technology Consultant), 2011-2013
Client: San Francisco Public Utilities Commission
Dru led the technical aspects and provided QC for the process, mechanical, electrical, and instrumentation and controls (I&C) design of the conversion from conventional flow- through mesophilic anaerobic digestion to thermophilic/mesophilic temperature phased sequencing batch reactor anaerobic digestion to achieve Class A Biosolids. The system was commissioned in 2016

05-CTS-3 Evaluation of Processes to Reduce Activated Sludge Solids Generation and Disposal*
(Project Manager and Principal Investigator), 2007-2010
Client: Water Environment Research Foundation
Dru was the PM and co-principal investigator for this research project. He led the development of the methodology, data gathering, statistical analysis, and writing of the report. The report included the state of the technology to demonstrate current and future waste activated sludge (WAS) reduction processes for use by industrial and municipal facilities. The goal was to develop an evaluation methodology framework that allows for the assessment of any technology proposed for the reduction of sludge mass/volume considering solids reduction, applicability to local conditions, cost, and impact on other aspects of treatment. Much of this research formed the basis of hydrolysis adjudication and proliferation in North America starting in 2010.

* denotes projects completed with other firms

Dru Whitlock

Global Practice Leader, Wastewater

United Utilities Wirral Catchment Wastewater Treatment Asset Management Analysis*, United Kingdom (Project Engineer), 2006

Dru developed a plan for how the Utilities company can most effectively manage its asset base both now and in the future. The plan included optimization efforts and asset modernization and OPEX and CAPEX programs. He focused on implementation of short-term improvement tactics as well as long-term modernization and asset rationalization strategies.

Unitywater Services Strategy Future Technology Considerations*, Brisbane, Queensland, Australia (Senior Technology Consultant), 2012

Client: Unitywater

Unitywater currently operates 18 sewage treatment plants with an average loading of 53,000 equivalent population (EP) and a median loading of 49,000 EP. The region is experiencing continued population growth and it can be assumed that all treatment plants will require upgrade or improvement to increase capacity or performance within the coming decades. Dru was part of team that developed evaluation methodologies and guidance for Unitywater to consider how best to shape treatment plant planning in the context of what is 'best for business' over the next 30 years. One phase of the work is to consider technologies which may be relevant to the future provision of wastewater treatment as far out as 2050. From this vision, 'technology pathways' have been defined which will enable Unitywater to transition the existing asset base to some future alternative. Four technology themes as focus areas for the future include:

Theme 1 – Least Cost

Theme 2 – Energy Efficiency

Theme 3 – Nutrients and Discharge Quality

o) with Biogas-fueled CHP

91st Ave WWTP Biosolids Master Plan*, Phoenix, Arizona (Senior Technology Consultant), 2009-2011

Client: City of Phoenix

In conjunction with Greely and Hanson to develop a system wide wastewater master plan, Dru developed the biosolids management plan for the City of Phoenix including the development of improvements to solids conveyance and screening, digestion, analysis of the impacts on biosolids production of internal plant recycle streams, and assessment of potential future regulatory requirements including GHG emissions.

Deschutes Brewery Waste Anaerobic Membrane Bioreactor*, Bend, Oregon (QC Reviewer), 2017

Client: Deschutes Brewery

Dru was the senior reviewer of the Anaerobic MBR system for the Deschutes Brewery wastewater.

* denotes projects completed with other firms

Dru Whitlock

Global Practice Leader, Wastewater

PUBLICATIONS

Whitlock, D., Daigger, G., Crawford, G. Using a Decision Analysis Tool to Embed the Tenets of Sustainability into Water/Wastewater Utility Policy. Sustainable Water Resources: A Compendium of Issues and Trends Copyright © 2010 American Water Works Association, 2010, pp. 141-151.

Sandino, J, Whitlock, D. Evaluation of Processes to Reduce Activated Sludge Solids Generation and Disposal - Project 05-CTS-3. Water Environment Research Foundation, 2010.

MANUSCRIPTS AND PRESENTATIONS

Polo, Christine, Muller, Chris, Whitlock, Drury. "Workshop A: Anaerobic Digestion of Organics: Synergies between Public and Private Sector." 2019 Water Environment Federation/International Water Association Residuals and Biosolids Conference.

Whitlock, Drury, Cleaves, Bob, Schebesch, Rod, Voll, Michael. "RIN and California LCFS Credit Revenue from Electric Vehicle Fueling with Biogas Fueled Combined Heat and Power." 2019 Water Environment Federation/International Water Association Residuals and Biosolids Conference.

Whitlock, Drury. "Second Generation Fermentation Systems." 2019 Water Environment Association of Utah Conference.

Whitlock, Drury, Serfass, Patrick, Craig, Dustin, Holland, Jeremy, Overly, Will. "Renewable Identification Numbers: Risk Management in an Uncertain Future of the Renewable Fuel Standard." 2018 Water Environment Federation Residuals and Biosolids Conference.

Whitlock, Drury, Serfass, Patrick, Kester, Greg, Overly, Will. "How to Win with RINs. Creating Renewable Natural Gas from Anaerobic Digestion." 2018 Water Environment Federation Webinar.

Whitlock, Drury. "Biogas from Anaerobic Digestion and the Value in the RIN Market." 2018 Water Environment Association of Texas.

Whitlock, Drury. "Biogas Utilization and Renewable Identification Numbers: What are RINs? How are they used? What is their value? What are the risks and uncertainties?" 2017 Rocky Mountain Water Environment Association.

Whitlock, Drury. Thermal Hydrolysis Session Discussion Facilitator. 2017 Intensification of Resource Recovery (IR²) Forum.

Whitlock, Drury, Parry, David, Vandenburg, Scott, Strehler, Jennifer, Willis, John, Shimada, Toshio, Clark, Cameron, Bucher, Bob, DeBarbadillo, Chris, Hake, Willis, John, Moss, Lynne, Higgins, Matt. Workshop W22: "High-Performance Anaerobic Digestion: Can You Handle It?" 2016 Water Environment Federation's Annual Technical Exhibition.

Miot, A., Ballard, R., Guevarra, K., Chouinard, T., Bavishi, K., Whitlock, D. "Retrofit of Egg- Shaped Digesters for Thermophilic Batch Operation, Heat Recovery and Digester Foaming Abatement: Lessons Learned." 2016 Water Environment Federation's Annual Technical Exhibition and Conference Proceedings.

Whitlock, D., Klibert, C., Johnson, T., Williams, T., Burrowes, P. "Optimizing Anaerobic Digestion Performance with Silo-shaped Reactor Configurations." 2016 Water Environment Federation Residuals and Biosolids Specialty Conference Proceedings.

Williams, T., Burrowes, P., Fries, K., Newbery, C., Whitlock, D. "Treatment of Waste Activated Sludge with Thermal Hydrolysis and Mesophilic Anaerobic Digestion." 2016 Water Environment Federation Residuals and Biosolids Specialty Conference Proceedings.

Dru Whitlock

Global Practice Leader, Wastewater

Whitlock, D. led the roundtable discussion on "Achieving Energy Neutrality at WRRF's." 2016 California Association of Sanitation Agencies Winter Conference, Palm Springs, CA.

Whitlock, D., Green, D., Todd O. Williams, T., DCunha, L, Berg, M., Burrowes, P. 2014. "Why Thermal Hydrolysis with Anaerobic Digestion is Rising to the Top: A Compendium of Recent North American Biosolids Facility Plans." 2014 Water Environment Federation's Annual Technical Exhibition and Conference Proceedings.

Whitlock, D., DCunha, L., Green, D., Krupp, M, Allen, J, Bobel, P. 2014. "Palo Alto, CA's Integrated Source-Separated Organics Management Solution to Achieve Zero Waste Goals." 2014 Water Environment Federation Residuals and Biosolids Specialty Conference Proceedings.

Whitlock, D., Ho, H., Posey, D., Miot A., DCunha, L., Green, D., 2013. "Robust Evaluation Methodology for the Biogas Utilization Alternatives at the San Francisco Oceanside WPCP." 2013 Water Environment Federation's Annual Technical Exhibition and Conference Proceedings.

Whitlock, D., Green, D., Jones, B., Miot, A., Bauer, T., Barber, D., 2013. "San Francisco Sequencing Batch Reactor Temperature Phased Anaerobic Digestion: Efficient Adaptation to Class A Biosolids." 2013 Water Environment Federation Residuals and Biosolids Specialty Conference Proceedings.

Whitlock, D., Green, D., Jones, B., Miot, A., Bauer, T., Barber, D., 2012. "Drivers and Solutions to Develop a Low-Cost Class A Solution: San Francisco Sequencing Batch Reactor Temperature Phased Anaerobic Digestion." 2012 Water Environment Federation's Annual Technical Exhibition and Conference Proceedings.

Whitlock, D., Demke, G., Christensen, D., Schwing, J., Barber, D., Pollock, D., 2012. "Challenges Faced and Solutions Found During the Salt Lake City Water Reclamation Facility Anaerobic Digester Upgrade." 2012 Water Environment Federation Residuals and Biosolids Specialty Conference Proceedings.

Shea, T., Bauer, T., Berg, M., Burkhart, M., Gabel, D., Green, D., Whitlock, D., 2012. "Are We Over-Mixing Our Digesters?" 2012 Water Environment Federation Residuals and Biosolids Specialty Conference Proceedings.

Whitlock, D, 2012. "Energy Neutral Wastewater Treatment Plants." Presented at the 2012 Water Environment of Utah Annual Conference.

Whitlock, D. "Trends and Technology for Sustainable Biosolids Management." Presented at the 2011 Oregon Association of Clean Water Agencies.

Whitlock, D., Burrowes, P., Bauer, T., 2011. "Sustainable Energy Management: Concentrating Solar Fueled Thermal Processes." 2011 Water Environment Federation Residuals and Biosolids Specialty Conference Proceedings.

Whitlock, D., Coughenour, J., 2011. "Biosolids Class A Process Innovation: Solar and Biogas Fueled Thermal Drying at 91st Avenue WWTP." Presented at the 2011 AZ Water Conference.

Whitlock, D, 2011. "Biosolids Class A Process Innovation: Solar Fueled Thermal Processes." Presented at the 2011 Water Environment of Utah Annual Conference.

Sandino, J, Whitlock, D, 2010. "Evaluation of Processes to Reduce Activated Sludge Solids Generation and Disposal." Water Environment Research Foundation – Project 05-CTS-3.

Dru Whitlock

Global Practice Leader, Wastewater

Whitlock, D., Sandino, S., Johnson, B., Novak, J., R., Fillmore, L, 2010. "Sustainable Energy Management: Achieving Energy Independence at Wastewater Utilities." 2010 Water Environment Federation Residuals and Biosolids Specialty Conference Proceedings.

Whitlock, D, 2010. "Enhanced Digestion as Part of Workshop 115: Race to Energy Self Sufficiency, Energy Management at WWTPs." Presented at the 2010 Water Environment Federation Annual Technical Exhibition and Conference.

Whitlock, D, 2010. "Digester Gas Fuel Cells as Part of Workshop A: Digester Gas Combined Heat and Power." Presented at the 2010 Water Environment Federation Residuals and Biosolids Conference.

Whitlock, D., Daigger, G., Crawford, G., 2010. "Using a Decision Analysis Tool to Embed the Tenets of Sustainability into Water/Wastewater Utility Policy." Sustainable Water Resources: A Compendium of Issues and Trends Copyright © 2010 American Water Works Association, pp 141-151.

Whitlock, D., Sandino, S., Johnson, B., Novak, J., R., Fillmore, L, 2010. "Underlying Mechanistic Principles and Proposed Modeling Approach for Waste Activated Sludge Reduction Technologies." Presented at the 2010 New England Water Environment Association Annual Conference.

Whitlock, D., Sandino, S., Johnson, B., Novak, J., R., Fillmore, L, 2010. "Underlying Mechanistic Principles and Proposed Modeling Approach for Waste Activated Sludge Reduction Technologies." Presented at the 2010 POTW Nutrient Reduction and Efficiency Workshop, sponsored by Ohio River Valley Water Sanitation Commission, Indiana Department of Environmental Management, Illinois Environmental Protection Agency, Indiana Water Environment Association, Illinois Rural Water Association, Alliance of Indiana Rural Water, US Environmental Protection Agency Regions 4 & 5.

Whitlock, D., Sandino, S., Johnson, B., Novak, J., R., Fillmore, L, 2009. "Underlying Mechanistic Principles and Proposed Modeling Approach for Waste Activated Sludge Reduction Technologies." 2009 Water Environment Federation Residuals and Biosolids Specialty Conference Proceedings.

Whitlock, D., Sandino, S., Shea, T., Burrowes, P., 2009. "Sustainable Energy Management: Achieving Energy Independence at Wastewater Utilities." 2009 Water Environment Federation Residuals and Biosolids Specialty Conference Proceedings.

Whitlock, D., Burrowes, P., Shea, T., Erdal, Z., 2009. "Sustainable Energy Management: Augmenting Biogas Production and Biosolids to Energy." 2009 Water Environment Federation's Annual Technical Exhibition and Conference Proceedings.

Sandino, S., Whitlock, D., Johnson, B., Novak, J., R., Fillmore, L, 2009. "Underlying Mechanistic Principles and Proposed Modeling Approach for Waste Activated Sludge Reduction Technologies." 2009 Water Environment Federation's Annual Technical Exhibition and Conference Proceedings.

Dru Whitlock

Global Practice Leader, Wastewater

Whitlock, D., Sandino, J., Gall, D., Hatzigeorgiou, M., Shea, T., Katehis, D., 2008. "Sustainable Energy Management: Augmenting Anaerobic Digestion to Increase Biogas-fueled Combined Heat and Power Production." 2008 Water Environment Federation Sustainability Specialty Conference.

Whitlock, D., Sandino, S., Fillmore, L., 2008. "Current State of the Practice of Sludge Reduction Technologies." Presented at the 2008 Florida Water Resources Conference/Biosolids Energy Workshop, Tampa Bay, FL.

Whitlock, D., Williams, T., Shea, T., Heinemann, T., Higbee, S., Scott, R., Thayer, B., 2008. "Using Multi-attribute Utility Analysis to Facilitate Biosolids Master Planning." 2008 Water Environment Federation Residuals and Biosolids Specialty Conference.

Sandino, S., Whitlock, D., Roxburgh, R., Fillmore, L., 2008. "Current State of the Practice of Sludge Reduction Technologies." 2008 Water Environment Federation Residuals and Biosolids Specialty Conference.

Whitlock, D., Daigger, G., McCoy, N., 2007 "The Future of Sustainable Water Management: Using a Value Chain Analysis to Achieve a Zero Waste Society." 2007 Water Environment Federation's Annual Technical Exhibition and Conference.

Whitlock, D., 2007. "An Overview of Whole WWTP Solids Reduction Technologies." Presented at the Great Plains Waste Management Conference and the Water Environment Association of Utah Annual Conference.

Whitlock, D., 2006. "Anaerobic Processes and Augmenting Anaerobic Digesters to Increase WWTP Combined Heat and Power Production with Biofuel." Presented at the 2006 Water Environment Association of Utah Annual Conference.

Whitlock, D., 2006. "Using a Decision Analysis Tool to Embed the Tenets of Sustainability into Water/Wastewater Utility Policy." 2006 Water Environment Federation/American Water Works Association Joint Management Conference.

Sieger, R., Whitlock, D., 2005. "Designing a Wastewater Combined Heat and Power Project—Rules of Thumb and Questions to Ask." Intermountain CHP Workshop: Combined Heat and Power and Bioenergy for Landfills and Wastewater Treatment Plants.

Whitlock, D., Fox, W., Fisher, R., James, D., 2003. "The Performance Comparison of Conventional Versus Egg-shaped Anaerobic Digesters at Central Valley Water Reclamation Facility." 2003 Water Environment Federation/American Water Works Association Joint Residuals and Biosolids Specialty Conference.

Sam Villegas APR

Director of Strategic Communication Services



PROFILE

Sam is an award-winning communications and outreach strategist, with more 25 years of experience conducting strategic communication and public outreach for public works, in the areas of water, energy, solid waste and recycling. Sam began her career helping municipalities and corporations increase their recycling rates. From there she worked on a national campaign for EPA to promote energy efficiency investments to small businesses. After that, Sam turned her focus to water and wastewater, helping utilities and public works agencies build support for rate increases and infrastructure investments. Sam played the lead communications role at water and wastewater utility Loudoun Water and was part of the executive team at American Water, where she cultivated enterprise-wide understanding and support for proactive public outreach and she executed successful education campaigns that raised awareness of issues and programs, changed behaviors and attitudes, and built trust in the organization. As an independent consultant (SaVi PR), Sam continued to advise water and wastewater utilities, as well several municipal solid waste and recycling offices with strategic communication and public engagement.

KEY PROJECT EXPERIENCE

American Water (KY)

Sam led external affairs for nine state subsidiaries of the nation's largest investor-owned water and wastewater utility, American Water. Sam provided executive level proactive and strategic PR counsel to her division's leadership and successfully directed the development and execution of nine fully integrated communications strategies across nine states to explain complex water issues, and to elicit widespread understanding and support for rate increases, as well as positive environmental behaviors. Sam ensured all state strategies were aligned with corporate strategies and all were measurably successful using quantitative methods. Under Sam's guidance and direction, her team of six managers (1) averted a condemnation attempt in TN; (2) restored public trust following a crisis in VA; (3) obtained a favorable ruling on a rate increase in WV; and (4) garnered widespread public support for a major infrastructure project in KY.

American Water Works Association (CO)

Guide to Risk Communication

American Water Works Association (AWWA) looked to Raftelis to develop a comprehensive risk communication guide for utilities: *Trending in an Instant*. Sam served as copyeditor for this guidance document, which helps utilities enhance their ability to communicate effectively when they find themselves unexpectedly in the traditional and social media spotlight. The guide provides research into the psychology and behavior behind consumer response to media-driven community fears and, more importantly, deliver targeted tools and action steps to help utilities respond effectively before, during, and after a high-profile communications issue in their service area. The guide describes proven risk communication techniques, such as how to

Specialties

- Stakeholder engagement/public involvement programs
- Strategic communications planning & execution
- Crisis & risk communications planning, messaging & execution
- Community-based social marketing (behavioural change marketing)
- Outreach program assessment & measurement
- Development & oversight of paid (advertising), earned (stories placed), shared (social) & owned media
- Writing & copyediting
- Public speaking

Professional History

- Raftelis: Director of Strategic Communication Services (2021-present); Senior Consultant (2019-2020)
- SaVi PR, LLC: Owner
- American Water: Vice President
- Loudoun Water: Manager of Communications
- CEC: Public Affairs Specialist
- Lisboa: Senior Account Manager
- Mitchell Petersen: Account Executive

Education

- Accredited in Public Relations - The Public Relations Society of America
- Master of Science in Environmental Policy - Johns Hopkins University (1998)
- Bachelor of Science in Biology (Environmental Science) - Pennsylvania State University (1992)

Professional Memberships

- AWWA
- International Association of Public Participation
- NACWA
- Public Relations Society of America: Board Member
- Social Marketing Association of North America
- Water Environment Federation

return to productive conversation when people are communicating in a perceived high-risk environment and offers social media strategies to employ during crisis, such as how to prepare, how to react, and what to do after the crisis ends.

American Water Works Association (CO)

Communicating about Lead in Drinking Water

Upon the growing discussion of the health risks from very low levels of lead in drinking water, Sam was hired to assist AWWA in the development of a guidance document for water systems, on how and why they should proactively communicate with customers about lead exposure from drinking water, lead service line replacement, and other issues pertaining to the shared responsibility customers have with their utility, to jointly protect their family's health. For this guide, Sam compiled and developed key messages, sample outreach materials and she provided a framework for conducting outreach on all facets of the issue.

Arlington County Water Pollution Control Bureau (VA)

In recognition of the specific and direct impacts biosolids master planning can have on the community, Sam was retained to develop a comprehensive outreach plan over the course of the master planning process. Two key pieces of the effort were a stakeholder advisor committee, comprising a cross section of interested and impacted stakeholders in the County, which met quarterly over two years, and a strategic communication plan the County staff could execute through each stage of the project through design, build and operations. This program enabled early, frequent and two-way communication with key stakeholders and residents throughout the Planning, Design and Construction phases of the project, with the goal of exchanging ideas and knowledge, as well as garnering recommendations and asking support for the technology selected. The final biosolids master plan was presented to the County Board of Supervisors with support from most stakeholders.

Association of State Drinking Water Administrators (VA)

Sam began supporting the Association of State Drinking Water Administrators (ASDWA) with strategic communication and organizational development services in 2017. Sam transformed member engagement with revamped communications products such as its "Year in Review" annual report, and she has developed fact sheets, stakeholder emails, and revamped its board packet. Sam copyedited for voice, tone and grammar, all major documents and reports for ASDWA, such as its report to EPA on shortfalls of statewide funding for drinking water programs and its comments on the new Lead and Copper Rule Revisions. From a management standpoint, Sam plans and facilitates staff retreats and work sessions, coaches staff on project management, and she led the ASDWA staff and Board through the development of its first strategic plan. Sam continues to support ASDWA with strategic plan implementation and technical writing.

Charlotte Water (NC)

Raftelis was hired by Charlotte Water to help them promote a new bill design. The goal of the campaign was to ensure no one was surprised. As project manager, Sam led the Raftelis team to create a six-week, measurable promotional campaign with tagline (*a bill as clear as the water we provide*) and graphics, that included paid digital ads, social media, a video, billing inserts, bill and envelope messages, city newsletter articles, website, and staff newsletter article.

Connecticut Water (CT)

Sam conducted a comprehensive audit and evaluation of Connecticut Water's employee communications program with surveys, one-on-one interviews, and small-group meetings. She also benchmarked its employee communication performance against several companies of similar structure and size.

Cleveland (OH)

Sam developed a comprehensive engagement strategy to turn around public opinion of the City's plan for sustainably managing its waste. The strategy spelled out specific tactics to achieve the City's objectives that included a new message platform, a series of community meetings, partnership development, and a social media plan, which was intended to work in tandem with other efforts to reset the public discourse on the topic, educate stakeholders on the waste issues the City is seeking to solve, and meaningfully engage the community in a dialogue about solutions.

Corpus Christi (TX)

The Raftelis team assisted the City of Corpus Christi (population 326,000) with the development of a stormwater utility fee to fund the City's stormwater management, operations, maintenance, and MS4 compliance. Ms. Villegas provided support and strategic guidance to the City on public involvement and communications. Ms. Villegas, with support from a local PR firm, conducted stakeholder research and developed a communications plan, and designed and helped facilitate a series of stakeholder advisory group meetings so affected stakeholders could have a voice into the stormwater fee development. The pandemic put a pause on the work, just as a fee was nearly finalized and Raftelis' work with the City is on hold until 2021.

Daphne Utilities (AL)

Sam developed a crisis communication plan, crisis communication training and media spokesperson training for Daphne Utilities, a water, wastewater and gas utility in Alabama. For the crisis training, Sam walked the staff through a series of table-top exercises to test and apply the plan. For the media training, Sam provided both off and on-camera guidance, where participants learned how to hook, bridge, and flag. She then filmed them so they could apply what they learned in mock, on-camera interviews, and then she facilitated a team coaching session while watching the videos. Sam also developed and delivered a three-year strategic communications plan to guide DU's communication and outreach activities through 2022.

Fairfax County (VA) (Sub to CDM)

Sam is currently under contract to develop and execute a strategic communication and engagement plan to help the County inform and engage internal and external stakeholders on the Tysons West Pump Station and Conveyance System. The work includes development of messages and materials, engagement strategies, facilitation of meetings and general counsel to the team on the public outreach.

Fort Worth (TX)

Sam designed and executed comprehensive public involvement plan to engage businesses and citizens in the development of the City's comprehensive solid waste management plan. She designed and executed intercept interviews, online surveys, focus group and workshop moderator guides, and provided general counsel to leadership team on best practices for engagement and soliciting input. As a result, the City had a solid waste management plan that had the buy-in and input from its community stakeholders.

Howard County (MD)

Sam conducted a comprehensive analysis of the division of recycling's communications and outreach program. The assessment included conducting a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis with the internal team; a County wide digital survey, three focus groups and benchmarks with three similar communities. The Howard County Recycling Division's (Division) current communications plan and all its educational materials as well as outreach efforts were reviewed and assessed for effectiveness in meeting the Division's goals and all was captured in a detailed report, with specific recommendations for improvement.

Loudoun Water (VA)

Sam served for 10 years as the organization's first official spokesperson and lead strategic public relations counsel. She planned and executed comprehensive and integrated communications strategy across multiple platforms to explain complex water issues and elicit positive environmental behaviors; she established the utility's first social media platforms and educated staff on their value and use; she established the utility's first media policy and employed proactive media strategies to garner story placements in local papers, and DC's broadcast media; she initiated and oversaw the successful and comprehensive re-branding of the organization from Loudoun County Sanitation Authority to Loudoun Water; she initiated and oversaw two major upgrades to the utility's internet and intranet sites automating several services and improving engagement opportunities with the public; she initiated and oversaw the design and production of a 3,500 square-foot education center; she developed and oversaw the utility's official outreach efforts on all capital projects; and she served as spokesperson to customers, elected officials, the media, community partners, school groups and others on topics of infrastructure investment, conservation, safe disposal of waste, rates, and watershed protection. Sam was an

active participant and leader in the Washington DC-area on water and wastewater outreach efforts and campaigns. Sam designed and executed several summer education campaigns to reduce water use, such as a “Brown is the New Green,” photo contest that challenged customers to let their lawns go brown and a long-term outreach campaign called “Water You Thinking” which focused on Loudoun residents’ overwatering of their lawns. The photo contest garnered Washington DC broadcast TV coverage, local print coverage, and reduced the maximum daily demand by about 15 percent. Sam also developed and executed a communication plan for two major rate increases. Strategies relied on the development of relationships with key community stakeholders, such as HOA leadership, environmental groups, and elected officials to build trust and credibility for the utility’s work. Following the announcement of the utility’s largest increase in its history, the editorial board of the local paper wrote an Op-Ed urging all customers to trust the utility and support the rate increase, and at the public hearing, several customers spoke in favor of it, a first in the organization’s 50-year history.

Maryland American Water (MD)

To address long-term water supply issues, Maryland American Water was planning to build a lined, earthen embankment with a capacity of 90 million gallons of raw water on a 40-acre historic site, which would provide a 100-day water supply in case of drought or emergency. Sam developed and executed a comprehensive stakeholder engagement strategy to build public understanding and support for the project. The plan applied a mix of strategies that included media outreach, the establishment of a stakeholder advisory committee to advise the company throughout the planning and design of the project; and storytelling through a variety of means, including direct mail, social media and e-mail. Because of these efforts, Maryland American Water was able to construct the impoundment with the support of local Town and County elected officials, the development and business communities, the department of parks and recreation who partnered with the team to plan a trail system through the site, and the family whose ancestors owned the property. Historic structures were preserved throughout construction and Maryland American earned the community’s trust for developing the project with their concerns at heart.

Metropolitan Washington Council of Governments (DC)

More than 15 different water and wastewater agencies serve the residents and businesses of the metropolitan Washington, DC region. With constant movement of customers across jurisdictional boundaries for work and play, it’s hard for any single utility to reach them well; having a shared media market doesn’t always help. Sam has been working with the group to elevate their communications coordination efforts to ensure these agencies coordinate their messaging to consumers and are as consistent as possible, focusing on the topics of greatest need and least public awareness. For this project Sam oversaw deployment of the first regional digital survey on water and wastewater awareness and behaviors, as well as a series of In-Depth Interviews with utility leaders. Using this data, she developed a strategic communications plan, coordinated messaging on key focus areas, and a seasonal content calendar to ensure consistency among - and credibility for - the region’s water and wastewater sector. Sam’s work with COG continues, as she is counseling the Anacostia Watershed Messaging Partnership with a comprehensive 3-year strategic outreach and messaging plan in support of raising awareness of and changing behaviors to protect the Anacostia River and its watershed.

Montgomery County, MD

Sam provided support to the execution of a comprehensive outreach program to increase recycling of yard trimmings and to increase proper disposal of household hazardous waste throughout the county. The program employed direct mail, public service advertising, point-of-purchase displays, and earned media.

Mount Holly, NC

Raftelis assisted the City of Mt. Holly (pop. 14,000) with developing a five-year financial forecast and rate study for the water and sewer utilities. The study involved projecting revenue requirements over a 10-year period and the rates necessary to ensure the City is self-sufficient and rate structure alternatives. When the City Council approved the recommended rate increases and the rate structure changes Ms. Villegas provided the City with talking points, FAQs, an article for the City’s newsletter, an infographic that explained the rate components, and a list of recommended

community outreach activities City staff could also perform. Ms. Villegas worked with the Raftelis data experts to also develop a rate calculator for the City's website.

National Association of Clean Water Agencies (DC)

Raftelis was hired by the National Association of Clean Water Agencies (NACWA) to develop, as part of their 50th anniversary, an inspirational and aspirational story about how clean water has transformed communities over the last 50 years. Deliverables include a printed book and website, plus more than 20 case studies nationwide from NACWA members. Sam worked with the members to develop 22 case studies, she conducted research for the book and website, she is the book's primary author and Sam provided assistance in the management of the deliverables.

Prince William County (VA)

Sam conducted a comprehensive analysis of the division of solid wastes' communications and outreach program. The assessment included conducting a literature search; developing and conducting email surveys of the commercial sector and multi-family sector; and intercept interviews of residents. The Division's current communications plan and all its educational materials were reviewed and assessed for effectiveness in meeting the Division's goals and all was captured in a detailed report, with specific recommendations for improvement.

Spring Valley (DC)

Under contract to the Army Corps of Engineers, Sam conducted public engagement for the Corps' cleanup of a formerly used defense site by recruiting for, and facilitating, a Restoration Advisory Board, composed of a cross section of community members.

Suffolk (VA)

Under contract to Army Corps of Engineers, Sam conducted public engagement for the Corps' cleanup of a formerly used defense site by recruiting for, and facilitating, a Restoration Advisory Board, composed of a cross section of community members.

Virginia American Water (VA)

Sam provided public outreach and strategic communication to support a comprehensive program to replace the city's aging water distribution system. At a replacement rate of approximately three to four miles of pipeline per year, it will take Virginia American Water 100 years to replace the entire system. For the residents of this historic town, that's a lot of disruption for a long time. Sam built understanding and support for this long-term endeavor, among residents, elected officials, businesses, commuters, and other city agencies. Through a series of face-to-face meetings, key partnerships, grassroots marketing and a mix of digital strategies, Virginia American has obtained the cooperation from town agencies, its businesses and its citizens. In addition, Sam developed and executed the communication plan for a complicated rate increase that affected all four communities differently and added a new sewer rate structure to Dale City customer bills. Sam developed the strategy, wrote talking points, handled media calls, developed and responded to social media posts and provided guidance to all customer service representatives.

Water Environment Federation (VA)

WEF hired Raftelis to develop a communication toolkit to help wastewater agencies communicate confidently about biosolids. Sam led the design and copywriting team that researched biosolids media coverage and interviewed agencies with successful outreach programs; then wrote a comprehensive guide and training module that walks readers through the steps needed to develop and execute a successful biosolids communication effort. The toolkit includes guidance for making the business case for proactive outreach, it covers best practices for handling a "hit piece," for managing pushback from the community, using social media and much more, including downloadable imagery, infographics, social media posts and templates. The team also supported WEF with training on the use of the toolkit.

Water Research Foundation (CO)

For this study, Sam developed and validated a series of messages to inform those that maintain building water systems about Opportunistic Pathogens in Premise Plumbing (OPPPs), with a focus on *Legionella*, and to offer proven steps they

can take to protect themselves (and their tenants) from waterborne disease. More specifically, Sam was tasked with (1) identifying the target audiences, routes of communication, and messages based on a series of interviews, workgroups, and material review of existing guidelines; (2) hosting a workshop to elicit experts' review and feedback on messaging materials; (3) refine the messages and routes of communication developed in the workshop. The final document was published by the Water Research Foundation and furnished to member water utilities.

U.S. Department of Energy (DC)

Sam was hired to support DOE's Office of Energy Efficiency and Renewable Energy (EERE). In this role, Sam ghost wrote blog posts on energy efficiency in manufacturing, she copyedited progress alerts, stakeholder emails, news releases, blog posts and web updates; she wrote talking points and prepared staff for media interviews; she oversaw all emailed requests from the media for information and interviews; she rewrote the content for the Technology to Market website and created a new navigational structure and content; she supported the development of a key message platform for Technology to Market group; and she trained managers in public speaking and developing their elevator pitches.

U.S. Environmental Protection Agency (DC)

Sam led a team that designed and launched a national education campaign to promote the benefits of energy efficiency, with a focus on the nation's 23 million small businesses. Sam wrote case studies, helped build the program's award-winning website, created public service advertising using celebrities Greg Germann and Peter MacNichol, and brokered partnerships with large trade organizations to help build support for the program.

PUBLICATIONS

- "Public Outreach Part II: More Cost Savings Than Cost Center," Waste Advantage, 2015
- "Public Outreach Part I: More Science Than Art," Waste Advantage, 2015
- "Eleven Myths About Social Media Every Water Utility Manager Should Know," AWWA Journal, 2013
- "Take the PR Pledge, Ragan Communications," The PR Daily, 2013
- "What Howard Stern Can Teach Us About PR," The PR Daily, 2012
- "Re-examining A Utility's Brand Image," AWWA Journal, 2007
- "A Brand-New Day - Things That Shocked Me While Rebranding," PRSA Tactics, 2007
- "Hydrant Use: Balancing Access and Protection," AWWA Opflow, 2006
- "Changing Behavior with Social Marketing Techniques," PRSA On the Environment Horizon, 2000

PRESENTATIONS

- "Trending in an Instant – Principles of Risk Communication," ACE Virtual Summit, AWWA, online, September, 2020
- "It's Scary Out There – How to Use Social Science in Communication to Decrease Fear and Build Trust," CAPIO Webinar, March, 2020
- "Be a Trusted Source: How to Handle Communication Challenges During COVID-19," AWWA Webinar, March 2020
- "Trending in an Instant – Principles of Risk Communication," Utility Management Conference, WEF, Anaheim, February, 2020
- "Get Your (Communications) Assessment in Gear," Catalyst Conference, June, 2019
- "So, Your Market's Been Disrupted, Now What?" Keynote Speech, Virginia Recycling Association Conference, May, 2019
- "Communications Guidance for Legionella in Building Water Systems," San Francisco Public Utilities Commission Workshop, November, 2018
- "Communications on the Other Side of the Meter," AWWA ACE, Philadelphia, 2017
- "Media Myths and Magic," AWWA ACE, 2016
- "Public Outreach, It's More Science Than Art," WasteCon, 2015
- "Communicating About Lead Service Lines," AWWA ACE, 2014

- “Eleven Myths About Social Media,” North Texas Water Symposium, 2013
- “The Power of Proactive Communications,” VAAWWA/VAWEA JAM, 2013
- “Building a Sustainable Brand: How to Identify, Attract and Engage Stakeholders in Your Mission,” Smart and Sustainable Pre-Conference Workshop, 2013
- “The Importance of PR To A Water Utility,” WLI Conference, 2012
- “Advocacy Communications,” PLANET Annual Conference, 2011
- “Managing Demand for the Blue in a Green is Godly World,” NAGC Conference, 2009
- “Web 2.0 Technology,” VA AWWA/VWEA JAM, 2009
- “Communicating Your Value Through Branding,” VAAWWA/VWEA JAM, 2007

Kathleen Bertoldi

Senior Environmental Scientist, EIT



Education

BS, Environmental Engineering
The Pennsylvania State
University
2013

Years with MM
1

Years with other firms
9

Professional Affiliations

American Society of Civil
Engineers (ASCE)
Solid Waste Association of North
American (SWANA)

Training and Certifications

Engineer in Training (EIT), 2013
PA License No. ET018544

Ms. Bertoldi is a Senior Environmental Scientist responsible for providing support to municipal wastewater clients related to biosolids beneficial use market research analysis, solids management, and regulatory permitting. She has ten years of experience in environmental and/or water resource engineering with eight years as a licensed engineer in training (EIT). Ms. Bertoldi has experience working in regulatory, consulting, and industry settings. In the public sector she worked as a hydrologist for an interstate water resource management agency, and as staff engineer for a county municipal solid waste (MSW) landfill. She also has experience in consulting focused on stormwater management, water resource engineering, and stream restoration. She has provided engineering support for numerous projects involving stormwater best management practices (BMP) design, MS4, NPDES, and E&S permitting, and stormwater management facility inspections. She also has several years of experience in water quality sampling, field surveys, site inspections, BMP assessments, and remediation plans related to solid waste disposal facilities and stormwater conveyance systems. She has provided data analysis (groundwater and surface water), hydrologic and hydraulic (H&H) analysis, survey data reduction, and AutoCAD modeling for design work and conceptual plans.

Allegheny County Sanitary Authority (Alcosan) *Biosolids Trends Analysis (for Hatch) Pittsburgh, PA (Nov 2019 - Sept 2020)*: Assistant Project Manager. Performed in-depth study related to regional biosolids landfill disposal practices and transportation trends. Conducted regulatory review of landfill disposal and interstate transportation regulations in PA, OH, and WV. Conducted regional landfill surveys in PA, OH, and WV about waste acceptance policies, available capacity, tip fees, and operational challenges related to extreme subsurface heating and slope failure. Performed literature review and interviewed industry experts about causes of extreme landfill heating and slope failures. Conducted surveys with regulators and regional haulers to glean additional information related to regional disposal trends, biosolids stabilization requirements, transport of unstabilized wastewater solids and enforcement of state regulations. Participated as a co-presenter in a Workshop summarizing findings and drafted the Technical Memo reporting in-depth biosolids landfill trends findings.

Anne Arundel County *Biosolids Market Assessment (for Hazen and Sawyer), Anne Arundel County, Maryland (Mar 2020 – June 2020)*: Performed market assessment for Class A / EQ and Class B biosolids products in MD and the surrounding Mid-Atlantic region for initial planning of a regional biosolids processing facility in Anne Arundel County. Interviewed other MD utilities to assess current management practices and program management pricing in the region. Identified locally available beneficial use biosolids markets and conducted surveys with individual outlets to provide information on the beneficial use alternatives for products produced by each technology under consideration.

Maryland Environmental Services (MES) *Biosolids Market Assessment (for Hazen and Sawyer) Maryland (March 2020 – July 2020)*: Assisted PM with market analysis for biosolids in the Mid-Atlantic region (MD, VA, and PA) as part of MES's Biosolids Master Plan. Conducted a preliminary assessment of the market demand for various biosolids products to assist in evaluating viable technologies for MES biosolids. Conducted interviews with current full-service providers to understand customer demand and preferences and program management pricing. Conducted interviews with customers from considered markets, and established customers' preferred product qualities, defined outside the gate expenses and revenues relative to each market and product considered. Co-authored a Workshop presentation and Technical Memo reporting market assessment findings.

Delta Diablo Sanitation District *High Strength Waste Survey (for Hazen and Sawyer), Antioch, California (March 2020 – May 2020)*: Performed market analysis in the Contra Costa County, CA region for food and beverage processing high strength wastes (HSW) to support the economic model for development of Delta Diablo's hauled-in-waste program to generate energy via co-digestion in the utility's anaerobic digestors. Conducted regulatory review to identify regulatory barriers, drivers, and opportunities related to CA's mandatory organic's recycling law. Identified and surveyed generators of HSW to compile information related to quantities generated regionally, current disposal and/or beneficial use management practices, and program fees. Conducted surveys with regional transporters of HSW to identify current practices and disposition pricing at other regional digestors and HSW processing facilities.

City of Rock Hill Manchester Creek WWTP *Biosolids Market Assessment (for Hazen and Sawyer), Rock Hill, South Carolina (Jan 2020 – March 2020)*: Assisted PM in market assessment for Class A / EQ and Class B biosolids products in SC and NC for short-term and long-term biosolids management options. Compiled information about and interviewed other SC and NC utilities and third-party full-service service providers to assess current management practices in both states. Identified locally available beneficial use biosolids markets and conducted surveys with individual outlets to provide information on the beneficial use alternatives for products produced by each technology under consideration. Participated as a co-presenter in a Workshop summarizing biosolids market findings.

Albany-Saratoga *Biosolids Market Assessment (for Arcadis), Albany, New York (Aug 2019 – April 2020)*: Performed market assessment for Class A / EQ and Class B biosolids products in the Albany-Saratoga region of NY state for initial planning of a regional biosolids processing facility. Conducted regulatory review to identify regulatory barriers, drivers, and opportunities for each product under consideration. Interviewed other NY utilities and third-party full-service service providers to assess current management practices in the region and state. Identified locally available beneficial use biosolids markets and conducted surveys with individual outlets to provide information on the beneficial use alternatives for products produced by each technology under consideration. Participated as a co-presenter in a Workshop summarizing findings and co-authored a Technical Memo reporting the biosolids market assessment findings.

Buffalo Sewer Authority (BSA) *Feed Stock Market Evaluation (for AECOM), Buffalo, NY (Aug 2019 – April 2020)*: Assisted PM with market analysis in northwest NY state for food processing and other organic high strength residual wastes. Identified and surveyed generators of high strength waste (HSW) streams to support the economic model for expansion of BSA hauled-in-waste program to generate energy via co-digestion in the utility's anaerobic digestors. Project tasks included interviews of landfills and other regional digester facilities to determine disposal pricing and operational practices for food processing and organic residual waste and to quantify available capacity in existing digestors in the region. Completed regulatory assessment to identify regulatory barriers, drivers, and opportunities related to NY organics recycling. Conducted a Workshop presenting a summary of findings and co-authored a Technical Memo reporting the HSW market evaluation findings.

Publications and Presentations

Z. Zhang, J.W. Balay, K.M. Bertoldi, P.O. MaCoy. 2015. *Assessment of Water Capacity and Availability from Unregulated Stream Flows Based on Ecological Limits of Hydrologic Alteration (ELOHA) Environment Flow Standards*. *River Research and Applications* 32(7):1469-1480.

Todd O. Williams, PE, BCEE

Senior Principal Technologist

Years of Experience: 40 (as of 1/21)

Education

B.S., Civil Engineering Technology, Virginia Polytechnic Institute and State University, 1980

Professional Registrations

Civil Engineer: Virginia No. 017784; Iowa No. 12940

Board Certified Environmental Engineer (BCEE), American Academy of Environmental Engineers

Distinguishing Qualifications

- More than 200 publications and presentations specific to residuals management; contributing author for several articles and books significant to residuals management, composting, and odor control.
- One of the principal authors of "Odor Control in Wastewater Treatment Plants, WEF Manual of Practice No. 22", and "Biosolids Composting: Special Publication of the WEF Technical Practice Committee Task Force".
- Project Advisory Board member and a chapter author of the 2012 WEF/WERF/USEPA "Solids Process Design and Management" Manual.
- Advisory committee member of the WEF/WERF Report "Enabling the Future: Advancing Resource Recovery from Biosolids" released in March 2013.
- One of the principal authors of Environment Canada's "Technical Document on Municipal Solid Waste Organics Processing" released in 2012.
- Specializes in biosolids, residuals, and organics management, including solids management planning, process development evaluations and pilot studies, composting, and product utilization planning – this experience is directly relevant to evaluation and testing of new and emerging pilot-scale technologies for the treatment of biosolids and organic wastes
- Extensive experience includes designing compost facility process, equipment, and odor control systems for a wide array of wastes, including biosolids, sludges, food wastes, organic wastes, and industrial wastes
- In 2006, co-chaired WEF's first Technical Practice Update (TPU) entitled "Reactivation and Regrowth of Fecal Coliforms in Anaerobically Digested Biosolids," and in 2008, led effort to update this TPU based on more recent data and experience
- Chaired the WEF "Microconstituents in Biosolids" TPU in 2007.
- Past Chair of the WEF Residuals and Biosolids Committee from 2010-2013.
- Received two patents for an odor reduction technology (US 7,537,699 B2 entitled Methods for Reducing Biosolids Odors) in May 2009 and the second entitled "Method for Reducing Biosolids Odors" issued February 21, 2012; this proven technology effectively reduces odors of stored dewatered biosolids cake by 75 percent, as compared to odors produced from normal storage of dewatered cake.

Relevant Experience

Mr. Williams has a 40-year career in environmental engineering with experience and specific emphasis in the biosolids and residuals management field. Mr. Williams is a recognized biosolids management planning expert having supported the development of dozens of biosolids and residuals management master plans in his career. He has designed and provided evaluation and operational services for all aspects of compost facility process, equipment, and odor control systems on well over 100 projects. Mr. Williams has delivered over 200 technical presentations specific to residuals management and is a contributing author for several articles and books significant to residuals resource recovery, residuals and municipal solid waste management, composting, and odor

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control. He is one of the principal authors of, "Odor Control in Wastewater Treatment Plants, WEF Manual of Practice No. 22," in 1995 and "Biosolids Composting: Special Publication of the WEF Technical Practice Committee Task Force," in 1995. He is a chapter author of the WEF Manual of Practice No. 8 "Design of Wastewater Treatment Plants" released in 2008. Todd was a Project Advisory Board member and also a chapter author of the 2012 WEF/WERF/USEPA "Solids Process Design and Management" Manual. He also served on the advisory committee of the WEF/WERF "Enabling the Future: Advancing Resource Recovery from Biosolids released in March 2013. He was one of the principal authors of Environment Canadas "Technical Document on Municipal Solid Waste Organics Processing" released in 2012. He currently serves on the Scientific Advisory Board for the *Compost Science and Utilization* Journal.

In 2006 Mr. Williams co-chaired WEF's first Technical Practice Update (TPU) entitled "Reactivation and Regrowth of Fecal Coliforms in Anaerobically Digested Biosolids". He led the effort to update this TPU in 2008 based on more recent data and experience. Mr. Williams also chaired the WEF "Microconstituents in Biosolids" TPU which was released in July 2007. He was the Chair of the WEF Residuals and Biosolids Committee (RBC) from 2010-2013 having served as Vice-Chair from 2006-2010. Prior to that, Mr. Williams was Chair of the RBC Outreach and Education Subcommittee and he served as a member of the WEF Technical Practice Committee from 2007-2009. He is a member of the WEFTEC program committee serving on the biosolids symposia since 2006.

Mr. Williams holds two US patents for biosolids treatment processes. The first, patent No. 7,537,699 B2 entitled "Method for Reducing Biosolids Cake Odors" issued May 26, 2009 and the second entitled "Method for Reducing Biosolids Odors" issued February 21, 2012. Both patented processes provide advances in the issue of minimizing biosolids product odors.

Representative Projects and Dates of Involvement

Senior Technology Consultant, Biosolids Management Planning Study, City of Fayetteville, Arkansas (2019-2020). Served as project manager and senior technologist on project team to lead the evaluation and review of multiple technology options for biosolids management program for the two water resource recovery facilities and the biosolids management site that processes an average of 11 dry tons per day of 19% solids. Options reviewed included anaerobic digestion, thermal hydrolysis with anaerobic digestion, solar and thermal drying and pyrolysis in various combinations to provide needed expansion capacity, improve sustainability and reduce energy consumption of existing solids handling processes of solar and thermal drying.

Senior Technology Consultant, Biosolids Composting Demonstration Study, Guam EPA (2019-2020). Served as composting technical expert to design and conduct a biosolids compost demonstration study as part of Jacobs sustainability project with the Guam EPA to divert waste materials from landfilling to recycling and reuse. Oversaw coordination between multiple agencies and performed sampling and testing of wastewater solids and compost product to demonstrate compliance with US EPA 503 standards for Class A exceptional quality biosolids. Oversaw sampling and testing of PFAS compounds before and after composting.

Senior Technology Consultant, Biosolids Management Planning, Clayton County Wastewater Authority, Georgia (2018-2020). Served on project team to lead the evaluation and review of multiple technology options for biosolids management program at this 32 MGD wastewater facility. Options reviewed included anaerobic digestion, thermal hydrolysis and thermal drying in various combinations to update the Authority's 40 year-old thermal drying facility. The outcome of the study was a selected digestion of primary solids only followed by thermal drying expansion and the resultant preliminary engineering report.

Senior Technology Consultant, Biosolids Treatment Center Design Build Bid Preparation, UK client, (2017-2018). Served as the senior technology consultant for a design build pursuit of an 84 dry ton per day capacity centralized sludge treatment center including sludge receiving, thermal hydrolysis, anaerobic digestion, dewatering, cake loadout, biogas handling and combined heat and power system. Preliminary design developed used to develop cost estimates and submit bid for this design-build and operate facility.

Senior Technology Consultant, Biosolids Drying Product Market Analysis, Metro Vancouver, BC (2017-2018).

Served as the senior technology consultant to evaluate the feasibility of dried biosolids product markets in the greater Vancouver region. Analysis included established and emerging markets and SWOT analysis of various options for the planned biosolids drying facility.

Senior Technology Consultant, Biosolids Composting Permitting Assistance, Lee County, Florida (2017-2018).

Served as the senior technology consultant to update preliminary design report and assist in preparation and submittal of permit renewal for this 90,000 wet ton per year capacity biosolids composting facility.

Senior Technology Consultant, Compost Feasibility Study, Region of Halton, Ontario (2016-2019).

Served as the senior technology consultant to evaluate the feasibility of composting biosolids produced by the Region's 7 WWTP's. Evaluation included review of technology options, compost market analysis, multi-criteria evaluation of options, cost estimates and recommendation of best option. Included evaluation of biosolids only and biosolids and source segregated organics.

Senior Technology Consultant, Cost Estimation Analysis and Product Marketing Assessment for the Miami Dade Water and Sewer Department, Miami, Florida (2016-2017).

Served as senior technical advisor to evaluate costs for processing solids from all three Miami Dade wastewater treatment facilities with a production of 130 dry tons per day of biosolids. The evaluation compared costs of implementing thermal drying, thermal hydrolysis and anaerobic digestion, and composting. Assisted in the analysis of these three biosolids management options including a biosolids product market analysis for the three resultant products to be produced.

Senior Technology Consultant, Updated Comprehensive Biosolids Management Plan for the North Texas Municipal Water District, Wylie, Texas (2016-2017).

Assisted in the analysis of biosolids management options for this large regional water district in the Metropolitan Dallas area to incorporate solids handling from a potential additional wwtp and impacts on the 2014 plan which considered biosolids management options for 17 wwtp's over a wide area.

Senior Technology Consultant, Biosolids Management Long Term Planning, Alexandria Renew Enterprises, Virginia (2016).

Served on project team to assist in the evaluation and review of multiple technology options for wastewater treatment and biosolids management options to update long term Biosolids management strategy for future enhancements at this 54 MGD tertiary treatment wastewater facility.

Project Manager, Cape May County MUA, Cape May, New Jersey (2015).

Led the initial odor assessment and sampling and testing effort for the CMCMUA composting facility to determine relative odor contribution of all fugitive emission odor sources at this large biosolids composting operation as the first phase in a multi-phase effort to reduce offsite odor impacts.

Senior Technology Consultant, Prince William County Service Authority, Virginia (2014-2015).

Led project team in the review of alternatives and development of a back-up solids management program to treat and reuse biosolids when the existing fluid bed incinerator is offline for maintenance and repairs. Options considered included alkaline stabilization to Class B or Class A, landfilling, or hauling to third party incinerator. On-site alkaline stabilization was chosen with offsite land application of Class B or Class A materials.

Senior Technology Consultant, Collier County Utilities, Naples, Florida (2014-2019).

Served as the senior technology consultant to this utility to evaluate biosolids management alternatives with the goal to develop a resource recovery facility capable of managing dewatered wastewater solids, fats oils and grease, and other high strength wastes as a service to the community. The current practice of hauling 130 miles to landfill wastewater solids is not sustainable and the project goal is to develop a public-private partnership to build and operate a resource recovery facility within the borders of the County. Led the team in identifying and evaluating capital, O&M and life cycle costs as well as cost-benefit analysis of several potential biosolids management options including drying, anaerobic digestion and composting of wastewater solids with variations to capture energy

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through a combined heat and power system. The recommended solutions were developed into an RFP for private system suppliers to design, build, own and operate this facility.

Senior Project Consultant; Biosolids Digester Facilities Plan; San Francisco Public Utilities Commission; San Francisco, California (2014). Investigated and provided direction on the biosolids end use criteria and options for all processing solutions, identifying costs, markets, and possible product opportunities for current and future Class A product. Also led development of the composting alternative (one of the four possible Class A Biosolids Processing solutions for the City of SF), providing design guidance, costing, and operational input.

Senior Project Consultant, Hornsby Bend Biosolids Management Plant Digester Improvements and Sustainability Project, City of Austin, TX (2012). Led the analysis and design of biosolids composting facility expansion for the City as part of the effort to expand their ability to compost more biosolids. Expanded facilities included aerated static pile with odor control through biofiltration followed by windrow curing. The project was fully designed in fast track but later cut due to funding limitations.

Senior Project Consultant, Biosolids Management Plan, City and Borough of Juneau, AK (2014-2015). Served as senior project consultant for development of a biosolids management plan for the City and Borough (CBJ) of Juneau, Alaska. Assisted in identifying and evaluating capital, O&M, and life cycle costs as well as cost-benefit analysis of several potential biosolids management options including incineration, drying, anaerobic digestion, and composting of wastewater solids generated at CBJ's two main wastewater facilities. Developed recommended solution including drying and use of dried product to provide heating to the dryer and minimize the amount of residual requiring landfilling compared to the status quo alternative of barging to Oregon then rail hauling to a landfill for disposal.

Senior Project Consultant, UOSA Digester Complex and Residuals Handling Project – Preliminary Design, Upper Occoquan Sewage Authority, Centerville, VA (2014). Evaluated the economic and non-economic factors of implementing thermal hydrolysis or recuperative thickening to enhance the current mesophilic anaerobic digestion process by increasing gas production and reducing the solids load; analyzed the financial impacts to operational costs of the final centrifugal dewatering and thermal drying processes due to the decreased solids load. The evaluation also includes a life cycle analysis of different waste-activated sludge thickening technologies – centrifuges, gravity belt thickeners, and rotary drum thickeners – to replace the existing dissolved air flotation thickeners

Project Consultant, Design of a Biosolids Composting Facility for the City of Kodiak, AK (2013-2016). Lead engineer of the process design for a 40 wet ton per week capacity aerated static pile composting facility. Provided guidance during rigorous public debate of technology options and interim pilot project prior to design. Design involvement included compost technology selection, equipment selection, and aeration system design and biofiltration odor control system design and start-up training services.

Project Consultant, Development of a Comprehensive Biosolids Management Plan for the North Texas Municipal Water District, Wylie, Texas (2012-2014). Assisted in the analysis of biosolids management options for this large regional water district in the Metropolitan Dallas area. The plan needed to incorporate options for 17 wwtp's over a wide area. Alternatives considered included landfilling, land application, composting, anaerobic digestion, thermal hydrolysis, thermal drying and biogas recovery and combined heat and power recovery. Supported the multi-utility analysis and life cycle cost analysis evaluation of all options.

Project Consultant, Design of a Biosolids Composting Facility for the City of Winnipeg, Manitoba, Canada (2013). Assisted in the process design for a 220 wet ton per week capacity aerated static pile composting facility. Design involvement included compost process sizing and biofiltration odor control system design and review of overall facility design.

Senior Technical Consultant and Principal Author; Technical Guidance Document on Municipal Solid Waste Organics Processing for Environment Canada (2012). CH2M HILL was chosen through a competitive selection

process to develop a national guidance document on composting and anaerobic digestion technologies and facility design for Environment Canada. The document is intended to aid municipal solid waste and public works staff across Canada make sound decisions regarding organic waste collection and processing programs, including technology selection and procurement processes.

Project Consultant, Review of Biosolids Management Qualifications for Tohopekaliga Water Authority, Kissimmee, Florida (2011). Reviewed 13 statements of Qualifications for providing Biosolids Management Services for the Tohopekaliga Water Authority and evaluated the technical viability of biosolids management technologies presented in the SOQ's.

Project Manager, Davenport, Iowa Composting Facility Odor Control Upgrades (2011-2014). Managed a review of odor control upgrades for this 16 year-old composting operation which treats 210,000 cfm of odorous process air through an 8 cell wood chip based biofilter. Evaluated various biofilter aeration distribution flooring systems to retrofit existing to allow for rapid media change-out and use of either organic or inorganic media. Completed life-cycle cost analysis and provided recommendations for design options to provide a more robust odor control system for the next 20 years of operation. Served as lead process design engineer for selected alternative.

Senior Advisor, Biosolids Digester Upgrade Evaluation for Gwinnett County, GA (2011). CH2M HILL performed a comprehensive evaluation of different solids management technologies in conjunction with digester upgrade options for the F. Wayne Hill WWTP. Options evaluated included solids pre-conditioning, advanced digestion options, and post dewatering options for product management including mechanical drying, solar drying, composting, and incineration with energy recovery and landfilling. Mr. Williams assisted in the composting, incineration and drying option evaluation and provided input on the overall evaluation methodology.

Project Manager, Wastewater Sector Market Assessment for Private Biosolids Processing Company, USA (2011). Managed a biosolids market assessment for a private biosolids processing company to determine potential wastewater treatment plant sectors that would be potential users of this biosolids processing technology. Surveyed multiple agencies and reviewed several data bases including EPA's wastewater needs survey flow report and added information related to biosolids processing technology used for larger plants in the 20 MGD and larger range. Evaluated various drivers including regulatory, renewable energy standards, costs of competing technologies and developed a series of strategic business recommendations.

Project Manager, Study into the Feasibility of Constructing a Biosolids-to-Energy Facility, Northern VA (2010-2012). Managed a study as a sub-consultant to McGuire Woods to assess the feasibility of developing a regional biosolids-to-energy facility in Northern Virginia. The participating wastewater utilities included the Alexandria Sanitation Authority, Arlington County, DC Water, Fairfax County, Loudon Water, Prince William County and the Upper Occoquan Service Authority. Commercially viable biosolids-to-energy technologies were identified and evaluated to determine general sizing and cost information for various capacity facilities. This information was used to also determine the technical and practical feasibility of locating each technology on various potential sites taking into consideration surrounding land uses, required local land use approvals, federal and state permitting requirements, and transportation.

Senior Advisor, Facilities Plan for Regional Waste Management and Solids Processing, Green Bay Metropolitan Sewerage District, WI (2010). CH2M HILL developed a long-term solids facilities plan for GBMSD that included a comprehensive evaluation of different solids management technologies, including conventional composting, digestion, drying, and incineration with energy recovery. Mr. Williams assisted in the composting option evaluation and provided input on the overall evaluation methodology.

Project Manager, Composting Facility Evaluation and Preliminary Design, South Valley Sewer District, Utah (2011). Project Consultant to perform feasibility study for covered aerated static pile composting facility to manage biosolids from new wastewater treatment plant. Facility components included covered biosolids receiving, mixing, composting, screening and product storage. Odor control through biofiltration system design

Todd O. Williams, PE, BCEE

was included. Study included bulking agent assessment. Preliminary site layouts were developed for two potential sites and detailed cost estimates were prepared as part of this study for this 120 wet-ton-per day capacity facility.

Project Manager, Atlantic Plant Biosolids Management Assessment, Hampton Roads Sanitation District, Virginia Beach, Virginia, 06/2006 – 06/2010. Directed review and assessment of digestion, dewatering and post-dewatering treatment alternatives analysis for fecal coliform concentration reduction in biosolids cake generated at this 30 MGD WWTP. Developed work and testing plan to review all aspects of digestion, dewatering and storage practices to determine how existing operations could be adjusted to minimize fecal coliform regrowth to acceptable levels without changing from centrifuge to belt filter press dewatering in planned facility upgrades. Developed and directed testing plans for multiple alternatives and formalized an operating plan to ensure 100% compliance with District set target concentrations.

Senior Project Consultant, Biosolids Management Planning, Metro San Juan and Island of Puerto Rico, 05/2008 – 12/2008. Served as project consultant for the development of a biosolids management plan for the three major wastewater treatment plants in the metropolitan San Juan area and for an island wide plan to manage sludge and biosolids generated at 62 waste water treatment facilities and 130 water treatment facilities island-wide. Plan focused on optimization of existing residuals management facilities and the minimization of O&M costs. Management techniques used include incineration, composting, land application, and landfilling.

Project Manager, Composting Facility Design, County of Spotsylvania, Virginia, 01/2006 – 05/2010. Project Manager for the design, permitting and construction of a covered aerated static pile composting facility designed to process 80 tons per day (29,000 tons per year) of dewatered wastewater residuals cake. Directed all odor control testing, modeling and design as well as permitting and process design for the entire operation. Odor control biofiltration system includes four variable speed fans, humidification controls, and four biofilter zones with in-ground aeration ducting for easy media change-out. The facility was awarded the Solid Waste Association of North America's Composting Systems Gold Excellence Award in 2012.

Project Consultant, Biosolids Management Long Term Planning, Alexandria Renew Enterprises (AlexRenew) (formerly Alexandria Sanitation Authority), Virginia, 06/2007 – 01/2009. Served on project team to assist in the evaluation and review of multiple technology options for wastewater treatment and biosolids management options to develop long term strategy for future enhancements at this 54 MGD tertiary treatment wastewater facility.

Project Manager, Compost Facility Odor Control Demonstration and Assessment for Private Composter, Knoxville, Tennessee (2007). Served as project manager and technologist to assess odor impacts of an existing merchant biosolids composting operation on neighbors. Developed study protocols and supervised odor data collection and modeling performed to assist in the design of upgraded composting facilities to eliminate impact on sensitized neighbors.

Project Manager, Compost Facility Odor Control Demonstration and Assessment for Private Composter, Virginia (2008). Served as project manager and technologist to assess odor impacts of an expanding merchant biosolids composting operation on neighbors. Developed study protocols and supervised construction and operation of the demonstration facilities so that odor data could be collected and modeling performed to assist in the design of upgraded aerated static pile facilities to eliminate impact on sensitized neighbors and allow for facility expansion.

Project Consultant, Odor Control Assessment for Private Land Developer (2007). Served as principal technologist on a project team to assess existing odor impacts of a mushroom composting operation on an upscale private development project in Tennessee. Assisted in development of mitigation options for reducing odor impacts of the composting operation on adjacent land development activities.

Project Manager, James River Treatment Plant Improvements, Hampton Roads Sanitation District, Virginia Beach, Virginia (2007). Served as project manager for the preliminary design of plant improvements for this 20

MGD activated sludge treatment plant. Improvements include IFAS system retrofit of 9 aeration basins, hydraulic improvements, aeration system improvements, odor control improvements, and screening facility improvements that must be designed, installed and fully operational to meet mandatory Nutrient Waste Load Allocation requirements by January 1, 2011.

Project Manager, James River Treatment Plant Integrated Fixed Film Activated Sludge (IFAS) Demonstration Study, Hampton Roads Sanitation District, Virginia Beach, Virginia (2006). Served as the project manager for the evaluation, design and construction of an IFAS system retrofit of one of 9 aeration basin trains at the James River Treatment Plant in Newport News Virginia. The project was done on a fast track basis including evaluation and procurement of vendor systems, design and installation of this 2.25 MGD capacity project in 6 months.

Project Manager, Nutrient Waste Load Allocation Project, Hampton Roads Sanitation District, Virginia Beach, Virginia (2006). Led efforts of a senior level project team in the development of a Nutrient Waste Load Allocation (WLA) Strategy for the 7 James River Basin Wastewater Treatment Plants to systematically evaluate dozens of WWTP improvement options to meet a Virginia mandated waste load allocation goal that must be met by 2011. A multi-criteria evaluation tool was used to evaluate options and rank them based on costs, ease of implementation, performance, and a number of other criteria. The outcome of the project was a plan including upgrades at various plants to achieve the WLA limit of 6 million pounds of nitrogen annually.

Project Manager, Composting Facility Evaluation in Edmonton, Alberta Canada (2005). Project Engineer and Manager to perform facility audit and provide recommendations for composting facility improvements at the biosolids composting portion of the operation. Provided recommendations to increase weekly throughput in wintertime conditions by 80% through aeration improvements and aerated static pile technology adjustments at this 460 ton per week biosolids composting operation.

Project Consultant, Biosolids Land Application Private Well Assessment, Washington DC Water & Sewer Authority (2006). Performed assessment of current VDH regulations regarding the adequacy of buffer requirements for private wells in the vicinity of biosolids land application sites. Reviewed existing regulations, solicited input from VDH staff and Virginia Tech professors and directed geologist in the analysis using hydraulic models. Met with client and concerned citizenry to present findings and help gain confidence in the DCWASA biosolids land application program.

Project Director, Biosolids Market Study, Western Lake Superior Sanitary District, Duluth, Minnesota (2006-2007). Directed this multi-firm project assignment to assess markets for Class A and Class B biosolids products in the greater Duluth, Minnesota area. Assessment included markets for Class A and Class B dewatered cake, biosolids product blends and compost. The result of this effort was an updated biosolids master plan to position WLSSD to respond to changing biosolids use ordinances and regulations.

Project Consultant, Compost Odor Control Pilot Study and Long-Term Biosolids Management Recommendations, Grand Island, Nebraska (2006). Provided technical expertise to assess composting options and direct field-scale aerated static pilot study to demonstrate improved odor control performance as compared to existing windrow composting operation. Developed biofiltration system design and performance testing to demonstrate high degree of odor capture and treatment possible.

Project Consultant, Aerated Static Pile Composting Facility, South Kern Industrial Center, California (2006-2007). Reviewed process and facility design and ability of this huge (500 tons per day of biosolids) outdoor aerated static pile facility to achieve performance requirements once built. Review included process capacity, odor and emissions reduction and product requirements. Developed start-up plan and provided start-up testing assistance for this facility. Responsible for testing plan development and coordination and oversight of all emissions testing to demonstrate compliance with VOC, ammonia and odor emissions requirements of the engineering purchase contract for this design-build composting facility.

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Project Manager, Composting Facility Evaluation, Georgetown County, South Carolina (2007). Project Engineer and Manager to evaluate and provide recommendations for composting facility improvements at this outdoor aerated static pile sludge composting facility. Provided recommendations for improvement of facility performance that resulted in the elimination of high pathogen levels in the compost product.

Project Consultant, Operational Assistance for Privately Owned and Operated Aerated Static Pile Composting Facility in North Carolina (2007). Provided technical assistance for the correct operation and development of correct materials balances for existing facility with multiple feedstocks. Provided training and assistance in modifying methods used to demonstrate regulatory compliance and gain permit approval for distribution of product.

Experience Prior to CH2M HILL

I Biosolids Management and Composting Facility Experience

Project Engineer, Composting Facility Design, City of Bedford, Virginia. Project Engineer for the layout, design and permitting of the City's 1800 tons-per-year biosolids aerated static pile composting facility.

Project Consultant, Composting Facility Audit and Long Term Recommendations, City of Davenport, Iowa. Project Consultant for the review of this ten year old totally enclosed aerated static pile biosolids composting facility that processes 34,000 tons per year of biosolids and over 100,000 cubic yards per year of brush and green wastes. Provided recommendations for upgrading process controls, aeration system, building corrosion control and odor control system improvements for the next twenty years.

Project Consultant, Biosolids Management Study, City of Longmont, Colorado. Project Consultant for the evaluation of digestion and biosolids management options to achieve Class A status including thermal drying and composting. Participated on project team and led agitated bed and aerated static pile composting feasibility analysis.

Project Engineer, Digestion and Drying Facility Pre-Design, HRSD, Chesapeake, Virginia. Part of a multi-firm team for the evaluation and design of anaerobic digestion and drying facilities. Performed product marketing study and developed scum management alternatives preliminary design.

Project Engineer, Drying and Composting Evaluation, Dublin San Ramon Services District, California. Project Engineer for the economic and technical evaluation of biosolids drying and composting facilities sized to process over 17,000 tons per year of dewatered biosolids.

Project Engineer, Composting Facility Evaluation, South Orange County Wastewater Authority, California. Responsible for a composting facility feasibility study, including site layout and cost estimation, for an enclosed agitated bed facility.

Project Manager, Composting Facility Design and Operations, Spotsylvania County, Virginia. Responsible for the expansion design, permitting, and start-up training of staff for this covered 9600-ton per year aerated static pile biosolids composting facility. Responsible for developing site master plan and basis of design report for expanding the existing facility to a capacity of over 28,000 tons per year of biosolids.

Project Consultant, Dewatering and Composting Facility Design, Boulder, Colorado. Project Consultant for a multi-firm team commissioned to plan and design new dewatering and composting facilities to manage the City's entire biosolids production. Responsibilities included leading the team on preliminary design and layout of composting facilities and odor modeling of various facility layout configurations. The totally enclosed composting facility will have a capacity of 15,000 tons per year.

Project Manager, Composting and Alkaline Stabilization Merchant Facility Design, Private Operator, Virginia. Project Manager for a multi-firm team for the preliminary design and economic evaluation of a 1600-ton per day

biosolids processing composting and lime stabilization facility. Evaluation included odor control design and modeling to meet extremely stringent site proffer conditions.

Review Engineer, Warehouse Conversion to Composting Facility, Inland Empire Utilities Agency, Rancho Cucamonga, California. Assisted in the design of this 150,000-ton per year capacity totally enclosed aerated static pile composting facility involving the retrofit of a 410,000 square foot warehouse. Responsible for the detailed design of 12 cell biofiltration system using Bac-Tee aeration floor for this 800,000 CFM capacity biofilter system.

Project Engineer, Regional Plant No.1 Enclosed Aerated Static Pile Composting Facility, Inland Empire Utilities Agency, Ontario, California. Design of a totally enclosed 10,000-ton per year biosolids composting facility.

Project Engineer, Composting Facility Design and Start-up, City of Davenport, Iowa. Design and start-up of a 140 (28 dry) ton per day (35,000 tons per year) enclosed static pile biosolids composting facility. The facility handles yard wastes, as well as dewatered biosolids cake. Responsible for developing materials balance, sizing composting and curing pads, and associated aeration systems, as well as associated process controls. Responsible for design of biofilter of odor control and development of Operations and Maintenance Manual and start-up training.

Project Manager, Dewatering and Composting Facilities Design, Harrisonburg-Rockingham Regional Sewer Authority, Harrisonburg, Virginia. Project Manager of multi-firm team for the design and installation of biosolids dewatering and composting facilities. Directed all dewatering and composting pilot studies, compost market study, conceptual design, final design, permitting, and start-up activities associated with this 22 (5.5 dry) ton per day (5500 tons per year) biosolids processing facility. Belt filter press dewatering as well as covered aerated static pile composting facility and associated appurtenances make up this innovative facility.

Composting Facility Design Review, James City County, Virginia. Provided assistance for the review of a special use permit application by Hampton Roads Sanitation District for the development of a new composting operation. Reviewed all air dispersion modeling work and provided input in the development of odor monitoring and operational guidelines and permit conditions.

Project Manager, In-Vessel Composting Facility Audit, Hamilton County, Ohio. Managed the audit of 17-dry ton per day Simon in-vessel composting system. Reviewed overall operational practices, procedures, operating data, and budgetary considerations to determine means by which savings could be derived. Identified numerous opportunities for improved operations and savings at this major biosolids composting operation.

Project Manager, Compost Facility Dust Control, City of Longmont, Colorado. Managed the assessment and design of dust control measures at this eight-dry ton per day biosolids composting facility. Supervised all monitoring activities for total dust, respirable dust, endotoxin, and *Aspergillus fumigatus* to determine background levels and potential health impacts. Developed recommendations for operational changes and also engineering modifications at the facility by enclosing certain portions of the process, such as mixing and screening and then capturing dust through mechanical means.

Consultant, Composting Facility Odor Evaluation, Nocatee, Florida. Consultant to private biosolids composting operator for a large windrow composting operation. This private facility is currently managing biosolids from numerous communities and had received odor complaints. Provided recommendations regarding improved operations and opportunities for minimizing odor generation.

Project Manager/Consultant, Composting Facility Odor Evaluation and Remedial Recommendations, Triple M Land Farms, Franklin, Kentucky. Involved in the expansion of large biosolids composting facility from ten tons per day to 400 tons per day. Expansion resulted in numerous odor complaints from neighboring residents. Assisted in providing operational recommendations that immediately impacted and reduced odor production at the facility. Long-term recommendations regarding the development and design of static pile composting followed by windrow composting with odor control through biofiltration were provided.

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Project Manager, Regional Composting Facility Evaluation, Lower Colorado River Authority, Austin, Texas.

Assessed land application and composting options, including materials/characterization, facility sizing, processing and composting alternatives, markets assessment, and ownership options. Preliminary site evaluations, site layouts, regulatory assessment, and cost analyses were performed.

Project Manager, Composting Facility Odor Control Recommendations, Snyderville Basin Sewer Improvement District, Park City, Utah. Project management and consulting for an initial facility audit to determine areas where odor control measures are necessary to reduce odors at this 20-ton per day aerated static pile biosolids composting facility. Redesigned existing biofilter system and provided a priority list for additional odor control measures.

Project Manager, Regional Biosolids Composting Evaluation, Triangle J Council of Government, Research Triangle Park, North Carolina. Study evaluated aerated static pile and agitated bed technologies for 10-, 20-, and 40-dry ton per day capacity operations. Assessed capital and operating costs as well as ownership issues for this multi-jurisdictional group that included Cary, Chapel Hill, and Durham, North Carolina, as well as several other communities.

Project Engineer, Composting Evaluation, City of New York. Project Engineer for design of a 35-dry ton per day biosolids composting facility. Developed materials balances; assisted in the development of materials handling, aeration and process control equipment design and specification preparation; and, personnel and Operation and Maintenance requirements.

Compost Process Consultant, Compost Facility Operational Consulting, City of Longmont, Colorado. Compost Process Consultant for the design and operation of covered static pile sludge composting facility on an on-going basis from 1988 to 1998. Participated in the development and review of facility design criteria and provided operator training at start-up.

Project Manager, Composting Facility Assessment, City of Salisbury, North Carolina. Assessed the viability of biosolids composting as a management alternative to supplement land application program. Assisted in permitting and the design and development of a pilot operation utilizing yard waste as the primary bulking agent for the biosolids. Also directed the economic evaluation associated with a three-dry ton per day full-scale static pile facility. Developed materials balances and conceptual design, including mixing, composting, screening, aeration equipment, and biofiltration for odor control.

Project Manager, Biosolids Management Study, Orange Water and Sewer Authority in Carrboro, North Carolina. The study evaluated current sludge management operations and alternatives for sludge management plan, which meets new State of North Carolina and Federal guidelines. The study included a regulatory review, evaluation of existing solids management system, and the development of alternative sludge management strategy. Alternatives included beneficial use operations, such as land application, composting, thermal drying and chemical stabilization.

Committee Member, Compost Facility Vendor Selection Assistance, City of Santa Rosa, California. Committee Member in the selection of agitated bed composting vendor-supplied equipment. Reviewed vendor proposals, conducted vendor interviews, and provided recommendations for the selection of an agitated bed system.

Compost Facility Management and Operation, Newport News, (HRSD) Virginia. Managed start-up and operation of a 12 dry ton per day static pile sludge composting facility from 1981 to 1986. Responsible for developing and overseeing operator training, sampling and testing protocols and schedules, Operation and Maintenance Manual and data recording program, preventative maintenance program, safety program, budgetary needs, and equipment selection/procurement.

Consultant, Composting Odor Control Recommendations, Rivanna Water & Sewer Authority, Charlottesville, Virginia. Consultant on a number of odor related issues including odor control for a pump station located in a

flood plain. Developed recommendations for odor control facility improvements at the Moore's Creek composting facility, including review of operational performance; recommendations for improvements and preliminary design for recommended equipment and site improvements for increased facility capacity and better process performance and odor control; recommendations for aeration system design. Assisted in developing a compost-marketing plan.

Compost Facility Audit, City of Morganton, North Carolina. Performed operational and economic analysis for City's sludge composting program. Recommended process and equipment improvements that saved the City 40 percent on its operating budget, once implemented.

Compost Process Consultant, Metropolitan Government of Nashville and Davidson Counties, Tennessee, 1987 - 1993. Consultant on the Metro's sludge composting program.

Project Manager, Composting Evaluation and EIR, Santa Rosa, California. Project Manager, as subconsultant to prime, on a sludge management Environmental Impact Report. Directed comprehensive marketing research to formulate projected quantities and price ranges for composted sludge. Evaluated a dewatered sludge program, including the prospect of application on agricultural soils, regulatory limits, landowner interest, and use of brokers. The project also involved evaluating the feasibility of sludge composting. Developed site assessment matrix, analyzed various alternative composting technologies and bulking agents, and performed economic analysis.

Composting Process Evaluation, Santa Rosa, California. Directed process evaluation to determine efficiency of co-composting yard wastes with sludge. Developed study to determine process design parameters for a full-scale facility as well as demonstrate performance of process on eucalyptus-laden yard wastes.

Composting Contingency Plan, City of Plattsburgh, New York. Participated in the development of a static-pile composting contingency plan so that a full-scale operation could be maintained while repairs and modifications were made to an in-vessel system. Work effort included development of conceptual and final designs for a temporary static pile facility designed to process 20-dry tons of sludge per day. Managed the development of equipment specifications, design drawings, permit application with the New York Department of Environmental Conservation, and an Operations and Maintenance Manual.

Compost Process Consultant, Compost Process Consulting, Reedy Creek Energy Services at Disney World, Florida. Conducted site visits and provided recommendations regarding process control, performance, operating procedures, operator training, etc. Also reviewed static pile facility upgrade design used to replace an in-vessel sludge composting facility.

Consultant, In-Vessel Composting Consulting, City of Springfield, Massachusetts. Consultant for the evaluation of the Taulman Sludge Composting Facility. Assisted in development of an acceptable performance-testing program for the private operator of the sludge composting facility. The review included materials balances, product stability, and odor and process-related issues. Designed an aerated static pile curing operation for stabilizing the composted sludge material.

Project Manager/Engineer, Compost Process Consulting, Lederle Laboratories, Pearl River, New York. Project Manager and Engineer for thorough operational review of an existing composting operation that manages yard wastes, sludges, and other industrial waste materials generated at this large pharmaceutical manufacturing facility. Developed a series of laboratory and full-scale tests to improve process performance and thereby decrease odors at the facility sufficiently to prevent continued offsite odor problems. Performed economic analysis for various levels of odor control by prioritizing implementation steps. Assessed the capacity of a newly constructed 25-dry ton per day in-vessel composting facility.

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Septage Dewatering and Composting Design, Thompson (Monticello), New York. Responsible for facility design, equipment purchase and installation, regulatory approval, operations, chemical analysis, and all other day-to-day activities at an innovative pilot septage dewatering and composting facility.

In-Vessel Composting Consulting, Cape May County, New Jersey. Performed feasibility analysis for sewage sludge composting facility that was under a consent decree due to odor complaints and several fires. Based on study results in which a curing area was developed, the facility was able to go back on line and double its capacity over the original design.

In-Vessel Composting Consulting, Baltimore, Maryland. Conducted technical evaluation on capital and operational changes required to improve performance on in-vessel sludge compost facility. Using a combination of site visits, materials balance formulations, and previous knowledge, was able to show client how to almost double the output with small capital investment.

Aerated Static Pile Composting Facility Design, Arecibo, Puerto Rico. Performed Compost facility layout design and review of the aeration system and biofilter design for static pile sludge composting facility. Authored Operations and Maintenance Manual and provided operator training during facility start-up.

Composting Facility Design Assistance and Start-up, Coeur d'Alene, Idaho. Assisted with sludge composting feasibility study, facility design, and start-up. Authored facility Operations and Maintenance Manual and provided operator training at start-up.

Training, Compost Facility Start-up, Claremont, New Hampshire. Conducted Operator training and authored the Operations and Maintenance Manual for static pile sludge composting facility.

Compost Facility Start-up, Mansfield, Massachusetts. Reviewed facility Operations and Maintenance Manual and provided start-up operator training for static pile sludge composting facility.

Compost Facility Start-up, Lebanon, New Hampshire. Assisted in conceptual design, economic analysis, and wrote technical specifications for mixing and screening equipment for a static pile sludge composting facility.

Technical Assistance, Compost Facility Odor Control Assistance, Westborough, Massachusetts. Provided technical assistance, as subconsultant to prime, to remedy odor problems at the composting facility. Established improvements in process control and biofilter operation to reduce facility odor production.

Compost Facility Odor Control Assistance, Southbridge, Massachusetts. Performed operational review of sludge composting facility to recommend methods for odor reduction/removal at this partially enclosed facility. With minimal capital investment and changes in the facility operation, improved facility odor conditions to community residents' satisfaction.

Compost Facility Design Review, Las Virgenes Municipal Water District, Ventura, California. Participated in the review of potential composting facilities. Assisted in the development and review of design criteria as a subconsultant to the prime.

Project Engineer, Industrial Wastes Compost Evaluation, DuPont de Nemours, Old Hickory, Tennessee. Project Engineer for evaluation of the potential of co-composting various waste sludges and waste ash at a polyester processing facility. Developed pilot testing protocol; established equipment needs, monitoring and testing program; and, directed product marketing survey. Assisted in the development of full-scale facility conceptual designs and economic analysis. Based on the favorable results of the pilot study and the economic review, it is anticipated that a full-scale facility be built.

II Solid Waste/Organics Composting and Management Project Experience

Project Manager, Food Waste Composting Consulting, Western Lake Superior Sanitary District, Duluth, Minnesota. Reviewed and evaluated expansion options and odor control management for this aerated static pile food waste composting operation.

Project Manager, Food Waste Composting Consulting, Private Facility, Ontario, Canada. Technical and economic evaluation of converting this large private windrow composting operation to a modified aerated static pile operation with odor control.

Project Engineer, Dairy Waste Digestion Study, California Energy Commission/Public Interest Energy Research Program. Project Engineer for this multi-firm team evaluating the feasibility of dairy manure-to-energy projects in the Chino Watershed Basin of Southern California. Responsible for developing protocols for the use of food processor waste materials as feedstocks in co-digestion projects at a 210-wet ton per day capacity plug flow manure digestion facility.

Dairy Manure Compost Consulting, Texas Water Resources Institute Manure Compost Facility Audits and Operator Training. As part of a manure compost marketing team, performed on-site audits of six large dairy manure compost operations in the Bosque River watershed and provided specific technical recommendations regarding the design and operation of these sites whose combined annual processing capacity is approximately 500,000 to 600,000-cubic yards of dairy manure. Developed and delivered a half-day compost training course in a workshop setting for the manure composters in this region.

Engineering Services, Solid Waste Recycling, Texas Natural Resource Conservation Commission (TNRCC) (formerly Texas Water Commission). Provided professional engineering services in connection with a Clean Cities 2000 program. This program was initiated to provide support to selected Texas cities and clusters of small communities and lessening the environmental and economic costs associated with municipal solid waste management. Reviewed the entire solid waste management program for two of the selected communities, and assisted in the review of grant applications to TNRCC by these communities. Provided input and recommendations for solid waste program components, such as source reduction, residential recycling, backyard composting, centralized composting, workplace recycling, used oil recycling, and waste tire clean up.

Lead Instructor, Yard Waste Composting Workshops, Texas. Lead Instructor for yard waste composting as part of TNRCC's recycling coordinator training workshops held throughout Texas in 1994 and 1995.

Instructor, State of Iowa Composting Workshops. Provided materials and gave presentations on various composting technologies, odor control technologies, and other aspects of composting waste materials, including biosolids, food wastes, yard wastes, and source separated solid waste.

Project Engineer, Compost Evaluation of RDF Rejects, Vedco Energy Corporation, North Carolina. Project Engineer for the evaluation of RDF unders composting. The study included developing pilot study protocols and conducting pilot study, economic analysis, and assessment of both static pile and windrow type-composting operations.

Compost Facility Audit, City of Greensboro, North Carolina. Performed yard waste composting facility audit. A private operator was managing this existing yard waste composting operation. Reviewed equipment and site needs as well as material quantities and type to determine means of improving the operation and assisting the City in the development of improved contract language for negotiating operations contract.

Manure Compost Permitting, North Carolina Zoological Park, Asheboro, North Carolina. Assisted in the layout, design, and permitting process to develop a solid waste composting permit to compost various animal manures, yard waste, and food waste generated at this large zoo.

Project Manager, Development Of An Assessment And Implementation Manual For Managing Wood Wastes Through A Multi-Community Approach, Tennessee. The assessment phase of the project involved contacting various communities throughout the Southeastern Regional Biomass Energy Program (SERBEP) area (13 states) and determining solid waste management practices and needs to manage wood wastes that are currently not recycled. Developed an implementation manual for use by communities in the planning and study phases of developing such programs. SERBEP and the Tennessee Valley Authority (TVA) produced two written manuals for

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general distribution. Reviewed all potential mobile equipment for use such as front-end loaders, grinding equipment, screening equipment, transporting equipment, etc.

Consultant, Compost Consulting, City of Harlingen, Texas. Consultant in the improvement of their yard waste management program. Assisted in the design of and specification preparation of yard waste grinding and sizing equipment. Evaluated proposals from equipment vendors. Also directed compost and wood products marketing assessment for the City.

Project Manager/Consultant, Compost Consulting, Central Tennessee Solid Waste Management District. Part of a team with Draper Aden Engineers to develop a solid waste management plan for this five-county jurisdiction. Evaluated yard waste composting options for inclusion in the study and in the recommended plan.

Project Manager, Wood Products Waste Utilization Study, Masonite, Nashville, North Carolina. Characterized by-products generated, evaluated chemical and physical suitability for reuse and compliance with state and federal regulations, as well as the feasibility of processing and utilizing several residual materials, such as ash, spent fiber, and sludges rather than disposing of them.

Compost Feasibility Study, Rivanna Solid Waste Authority, Charlottesville, Virginia. Managed and participated in a yard waste composting study. Evaluated the viability of various yard waste collection, transfer, and processing options. The study also included a regulatory analysis, market assessment, conceptual design, and cost analysis for collection and processing of yard waste at a centralized composting facility.

Project Manager, Yard Waste-Compost Program Development, Metropolitan Government of Nashville and Davidson County, Tennessee. Assisted in planning yard waste collection strategy, as well as the development of an operation and maintenance manual for the facility. Provided input and recommendations for equipment to be used at the composting site, as well as training of personnel.

Project Manager, Yard Waste Compost Feasibility Study, Putnam County, Florida. This study was performed in response to the 1992 ban of landfilling yard waste in Florida. The study included an overview of planning considerations, yard waste characterization, collection, pre-processing, composting and composting options, a marketing assessment, review of regulatory requirements, and development of a baseline design and implementation strategy.

Project Engineer, Compost Feasibility Study, San Mateo County, California. Project Engineer for a large yard waste composting feasibility study. Performed an analysis of various process design options, evaluated site conditions on an existing landfill, and developed site layouts and preliminary design for a yard waste processing facility. A detailed economic analysis was developed, as well as the identification of compost, mulch, and wood chip biomass fuel markets. The development of this facility will help the County meet its mandatory recycling goals and assist in the initial permit review process.

Project Manager/Engineer, Yard Waste Compost Feasibility Study, Orange County, North Carolina. Reviewed yard waste processing options available for managing yard waste and land clearing debris. The review included state regulatory issues, yard waste processing options, product utilization, and other similar issues. Developed a suggested alternative for the County to compost and mulch yard waste in order to comply with the January 1, 1993 ban on yard waste in landfills.

Project Manager, Yard Waste Compost Program Development, Town of Farmville, North Carolina. Performed a waste characterization study to assess the quantity and quality of readily compostable materials in the waste stream, such as yard waste, tobacco waste, and wastewater treatment sludge. Designed a pilot composting program to demonstrate process on various mixtures of waste and analyzed product quality. Assisted in the implementation of a full-scale yard waste composting program, including operating manual and training, permitting, product marketing, etc.

Project Manager/Engineer, Solid Waste Composting Feasibility Study, Private Company. Project Manager and Engineer to assess the economics for a 400-ton per day solid waste composting facility utilizing aerated windrow technology. Developed materials balances, process flow, equipment, and site sizing criteria so that a detailed economic analysis could be performed.

Compost Marketing Assessment, North Carolina Department of Energy, Raleigh, North Carolina. Performed a statewide compost marketing development analysis. The study estimated potential markets for composted products; identified waste products amenable for composting; and, impediments to the development of markets for composted products in the State of North Carolina.

Compost Feasibility Study, Rowan County, North Carolina. Completed a review of the applicability of municipal solid waste composting to conditions. Arranged and conducted facility reviews and site visits at four of the larger operating MSW composting systems in the United States. Based on the review of these operations, the County explored the integration of solid waste composting into its management program to divert materials from their double-lined landfill.

Waste Characterization Study, Santa Rosa, California. Directed a yard waste characterization study at a 1250-ton per day central landfill. Evaluation of yard waste quantity, quality, purity, and type was necessary to determine how well managing these wastes in a sludge/yard waste co-composting project would match the City's sludge generation. The use of yard wastes was estimated to save the sludge-composting project hundreds of thousands of dollars annually, as well as extend the useful life of the landfill.

Project Manager, Yard Waste Composting Program, Southeastern Public Service Authority, Chesapeake, Virginia. Project Manager for assistance in the development of a multi-jurisdictional yard waste-recycling program. Evaluated pre-processing equipment available for separating plastics from bagged leaves and grass clippings prior to composting. Evaluated various shredding technologies; performed economic analysis between various shredders; and, provided technical specifications for yard waste pre-processing equipment. The work also involved product marketing assessment, development of implementation plan, site selection and analysis, start-up assistance, and operator training.

Project Manager, Recycling Plan, Metropolitan Government of Nashville and Davidson County, Tennessee. Project Manager for work involving Tetra Tech, Hazen & Sawyer, and EMPE staff members to develop a Comprehensive Recycling Plan. The Recycling Plan reviewed current recycling practices; assistance in developing a curbside collection program; recommendations for developing yard waste collection and composting; and, commercial recycling activities. In addition, reviewed and assessed role of mixed waste processing, program cost estimates, and permitting requirements.

Engineering Review, Compost Facility Audit, Portland, Oregon. Performed engineering review of a 600-ton per day MSW compost facility as part of a financial feasibility analysis. Evaluated aeration system, permit compliance, materials balance assumptions, site sizing, financial feasibility, and market assumptions. Provided recommendations regarding design flows and means of improving design.

Project Engineer, Compost Facility Feasibility Study, Crow Wing County, Minnesota. Involved in the design of MSW compost facility. Responsibilities included development of materials balance, site sizing, site layout, design of aeration system, development of O&M Manual, and start-up services.

Compost Facility Feasibility Study, Monroe County (Rochester), New York. Managed a MSW composting feasibility analysis. Responsible for development of materials balance, technology assessment, economic analysis, and product market analysis for this 1,000 ton per day MSW facility.

Design/Supervision, Compost Facility Feasibility Study, Abitibi-Price Corporation, Roaring River, North Carolina. Designed and supervised field-scale pilot compost operation. Tasks included pilot facility site design, regulatory

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permit approvals, supervision of pilot activities, analytical analysis of compost, market assessment, preliminary design of full-scale facility, and economic analysis.

Compost Facility Feasibility Study, Brookhaven, New York. Completed technology assessment, materials balance analysis, site layout, equipment selection, and economic analysis for 250-, 500-, and 1,000-ton per day MSW compost and RDF/compost facilities.

Compost Facility Feasibility Study, Nantucket, Massachusetts. Developed economic assumptions for feasibility analysis of a MSW compost facility. Assisted in RFP development, visited potential vendors in Europe, evaluated proposals, developed protocols for acceptance testing, and assisted in regulatory approval process.

Compost Facility Feasibility Study, Munitions Disposal Facility, Louisiana. Performed field work for establishing proper mixtures of input materials to compost TNT waste at an old munitions disposal facility. Pilot study results showed satisfactory reduction in TNT wastes during the 50-day pilot study period.

III Odor & VOC Control and Biofilter Project Experience

Odor Training Workshop, Rivanna Water & Sewer Authority, Charlottesville, Virginia. Developed and conducted odor control training seminar to all WWTP operations staff to help minimize odor production at the Moores Creek Wastewater Treatment Facility.

Project Engineer, RP-1 Odor Control Facility, Inland Empire Utilities Agency, Chino, California. Reviewed and designed odor control facilities for the 44-mgd RP-1 wastewater treatment facility. Performed analysis of odor containment and collection options for headworks, primary treatment, sludge thickening, digestion and manure handling facilities, Evaluated biofilter and chemical scrubber treatment options.

Project Engineer, Odor Control Facility, Western Lake Superior Sanitary District, Duluth, Minnesota. Project Engineer for the design of a 3,000-cfm two-stage odor control biofiltration system at a major sewage pump station. Assisted in the development of the design criteria and reviewed design drawings and specifications for use at this innovative odor control biofiltration system.

Project Manager, Odor Control Evaluation, Cobb County, Georgia. Project Manager for Bedminster Bioconversion Corporation for the evaluation and redesign of the odor control biofiltration system at the Cobb County co-composting facility. Evaluated odor control collection and treatment design for upgrading the biofiltration system from 180,000-cfm to a 210,000-cfm system. Directed odor-modeling analysis for various design alternatives to evaluate the impact on neighbors within 300 feet of the facility boundary. Directed an economic analysis used to make design decisions in conjunction with performance criteria for the odor control system.

Project Manager, Biofiltration Sampling Protocol Development, Compost America, Florida. Compost America was in the process of developing an 800-ton per day capacity solid waste composting facility in the metropolitan Miami, Florida area. Developed odor monitoring protocols and performance testing at a similar compost facility in Sevierville, Tennessee to demonstrate the testing protocol to the area environmental regulatory agency.

Project Manager, Odor Control Facilities, Clark County Sanitary District, Nevada. As a subconsultant to the prime (Kennedy Jenks Consultants), served as project manager for the design of numerous biofilters at the District's wastewater treatment plant. Six odor control biofilter systems, with a total airflow capacity of 80,000-cfm, were designed for odor control to replace chemical scrubbing systems. Provided design input and reviewed all design documents for this odor control project.

Project Manager, Odor Control Facilities, Duluth, Minnesota. Project Manager for the design and construction of a 50,000-cfm capacity odor control system. The system was designed to treat headworks, grit removal, and DAF sludge thickening process exhaust gases. Managed multi-firm team in this fast-track design, bid, and build project, which was completed within only six months.

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Project Engineer, Odor Control Facilities, Everett, Washington. Worked with the prime consultant (HDR Engineers) to design odor control biofilter at the City's wastewater treatment plant. The biofilter system was designed to treat 15,000-cfm of odorous gases from the headworks portion of the wastewater plant, including screw pumps, distribution channels, bar screens, and aerated grit tanks.

Project Manager, Biofiltration Sampling Protocol Development, Dade County (Miami), Florida. Project Manager for Bedminster in the sampling, testing, and development of a biofilter testing protocol for a planned solid waste composting and biofilter system. Developed protocols, performed field sampling, and analyzed data from a similar 80,000cfm capacity biofilter system.

Project Manager, Compost Facilities Odor Control Improvements, Cape May, New Jersey. Project Manager for field-testing and design of a biofilter odor control system to treat odors from the compost curing process at this 20-dry ton per day in-vessel composting facility. This 3,500-cfm capacity system includes collection, ductwork, fans, two biofilter cells, and all controls and associated appurtenances.

Project Manager, Compost Emissions Evaluation, Hickory, North Carolina. Project Manager for odor and air toxics emissions sampling and analysis at the biosolids composting facility. Directed all sampling and analysis work, performed data analysis, and directed odor modeling efforts at the 20-dry ton per day in-vessel facility.

Project Manager, Compost Emissions Evaluation, Cape May, New Jersey. Project Manager for odor and emissions audit and sampling effort at the biosolids composting facility. Based on odor monitoring work, provided recommendations for the collection and treatment of curing process odors.

Project Engineer, Digestion Emissions Evaluation and Control Facilities, Waimanalo, Hawaii. Project Engineer for odor and VOC assessment of a private food waste digestion process. Performed site assessment, odor and VOC sampling, and designed emission containment and treatment system using a biofilter. Project was performed on a fast track basis, with temporary facilities on-line in three weeks after initial site assessment.

Project Manager, Sludge Thickening Odor Control, Central Contra Costa Sanitary District, Martinez, California. Project Manager for the design of an odor control biofiltration system. Managed the design and preparation of construction drawings and specification for this 3,500-cfm system to treat odors from a sludge thickening process. Developed performance-testing program to monitor system's effectiveness in removing VOC's and odors.

Project Manager, Pump Station Odor Control Facilities, Rivanna Water and Sewer Authority, Charlottesville, Virginia. Project Manager for the design and construction of a biofilter to treat odors from a sewage pump station. System treats 2,825-cfm and eliminated odor complaints from neighbors immediately after installation in late 1995.

Project Manager, Biofilter Pilot Study, Fortune 50 Client in the Wood Products Industry. This pilot study was designed to obtain critical design parameters for a full-scale biofilter used to reduce VOC and formaldehyde emissions from a wood press vent application. Assisted in the pilot unit design and review of operating data. Based on the outcome of the study, full-scale implementation was evaluated and biofiltration selected for use at several mills for VOC control in press vent applications.

Compost Odor Control Study, Private Sludge Composting Facility, Washington. Assisted in the development of an odor control strategy for a large (30- to 40-dry ton per day) private sludge composting facility. Reviewed operation, directed sampling and testing for odorous compounds, and directed odor panel activities to rate and characterize odors from various stages in process. Recommended operational and capital improvements to reduce odors.

Project Manager, Biofilter Pilot Study, Fortune 50 Client in the Wood Products Industry. Project Manager for Tetra Tech/E&A in the design and operation of a large-scale multi-unit field installed biofilter pilot system for a Fortune 50 client in the wood products industry. Six large biofilter cells and twelve small cells were constructed to test the efficiency of biofilters in removing VOC's, CO, NOx, and air toxics from a wood dryer, and developed data

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recording management system. Reviewed operational performance; provided process review and data analysis; and made recommendations for full-scale implementation. Based on study results, biofiltration was shown to be an acceptable air pollution control technology for use in this industry.

Compost Facility Odor Reductions, Brazos River, Temple-Belton, Texas. Assisted in odor remediation efforts at sludge composting facility. Performed detailed operational assessment, and then provided written recommendations for operational and capital improvements to mitigate odor problems at this windrow sludge composting facility. Facility implemented recommendations resulting in virtual elimination of odor complaints.

Compost Facility Expansion, Solid Waste Authority of Palm Beach County, Florida. Provided consulting services during the review of composting facility expansion plans from a 4-dry ton per day to a 36-dry ton per day sludge composting system. Reviewed the functional testing program for the biofilter odor control system and performed a site assessment and odor modeling work associated with the expansion of this agitated bed composting system.

WWTP Headworks Odor Control, City of Springfield, Massachusetts – Project Engineer responsible for the design of a biofilter for treating odorous gases from the wastewater treatment plant headworks.

Process Engineer, Odor Evaluation, Lederle Laboratories, Pearl River, New York. Process Engineer to evaluate the sources of odors and reduce odors at composting facility. Evaluated various operational and capital improvements for reducing and treating odors, including bench-scale process optimization and field-scale process optimization. Based on results of detailed field analysis, compared the economic impacts of implementing several acceptable scenarios from an odor control standpoint so a cost-effective operation could be developed.

Biofilter Design, San José, California. Consultant to prime (Montgomery-Watson) to provide critical design review of a biofilter system for treating sewer gases from a wet well. Provided input on design parameters, air handling, testing, and selection of media for use in the biofilter.

Critical Design Review, Biofilter Design, Las Virgenes, California. Performed critical design review of the biofilter used at sludge composting operation. Assisted in biofilter media selection and recommendations for moisture control strategy.

Biofilter Design Survey, Charlotte-Mecklenburg Municipal Utilities District. Consulting services to prime (CH2M Hill Engineers) for design of a biofilter odor control system for residuals handling facilities at composting and lime stabilization system. Surveyed nineteen biofiltration installations nationwide for design, operational, and removal characteristics. Provided recommendations for critical design parameters.

Expert Witness, Biofilter Expert Witness, Private Solid Waste Processing Firm, Tacoma, Washington. Expert Witness for the applicability of a biofilter system for odor control at a centralized yard waste-processing site.

Odor Evaluations, Rivanna Water & Sewer Authority, Charlottesville, Virginia. Consultant on a number of odor-related issues, including odor control for a pump station located in a flood plain. Performed odor evaluation study; pilot-tested odor control chemicals; and, designed odor control modifications. Project Manager for the design and construction of an odor control biofilter at the 5-mgd sewage pump station. Developed recommendations for: odor control facility improvements at the Moore's Creek composting facility, including review of operational performance; improvements and preliminary design for equipment and site improvements to increase facility capacity, better process performance and odor control; and, aeration system design. Assisted in developing a compost-marketing plan.

Design, Odor Control Study, Chemical Firm, Coventry, Rhode Island. Designed an odor control biofilter. Prior to final design, developed protocol for pilot-scale feasibility analysis; assisted in fabrication and installation of test unit; supervised two-stage pilot test; and, evaluated results.

Compost Facility Odor Control Improvements, Westborough, Massachusetts. Technical assistance to prime consultant (SEA Consultants) to remedy odor problems at Westborough's composting facility. Established improvements in process control and biofilter operation to reduce facility odor production.

Compost Odor Reduction Study, Southbridge, Massachusetts. Performed operational review of sludge composting facility to recommend methods for odor reduction/removal at this partially enclosed facility. With minimal capital investment and changes in the facility operation, improved facility odor conditions to community residents' satisfaction.

Professional Organizations/Affiliations

International Water Association Member
- Member Sludge Management Group Committee
Michigan Water Environment Association Member
Virginia Water Environment Association Member
Water Environment Federation
- Past Chair Residuals and Biosolids Committee
- Member WEFTEC Program Committee
Biocycle/JG Press -Science Advisory Board Member, *Compost Science & Utilization* Journal

Honors and Awards

Publications and Presentations

Williams, T.O. 2021. Biosolids Composting Impacts on PFAS. Presented at the US Composting Council's 29th Annual Meeting. Virtual Meeting. January 27, 2021.

Water Environment Federation 2020. Odor Emissions and Control for Collection Systems and Water Resource Recovery Facilities (Manual of Practice No. 25, Second Edition). WEF Special Publication, Arlington, Virginia. Chapter Author and Reviewer.

Williams, T.O. 2020. "The Future of Biosolids and Managing PFAS." Presented at the Central States Water Environment Association 93rd Annual Meeting. Virtual Meeting, August 17, 2020.

Williams, T.O. 2020. "Phosphorous Recovery from Wastewater: Current Practices and Future Opportunities." Presented at the Sustainable Water Resources Water Institute 2020 Symposium. Gainesville, Florida. February 26, 2020.

Williams, T.O. 2020. "Biosolids Composting Demonstration for Guam's Zero Waste Initiative." Presented at the 5th Assembly of Planners Symposium, Tamuning, Guam. February 20, 2020.

Williams, T.O. 2020. "Biosolids Composting – Another Step in Guam's Zero Waste Plan." Presented at the US Composting Council's 28th Annual Meeting. Charleston, South Carolina. January 20, 2020.

Williams, T.O. and S. Grieco. 2019. "The Future of Biosolids and Managing PFAS." Presented at the Rocky Mountain WEA Biosolids Committee Annual Seminar on the State of Biosolids. Brighton, Colorado. November 14, 2019.

Williams, T.O., Shen, E., Ross, D., Iamarino, D. and P. Morden. 2019. Biosolids Compost Feasibility Study: Halton Region's Long-Term Biosolids Management Strategy Development to Improve Diversity and Sustainability. Presented at WEFTEC. Chicago, Illinois. September 25, 2019.

Williams, T. O. 2019. "Biosolids Composting 101." Presented at WEFTEC Solids Stabilization Fundamentals Workshop. Chicago, Illinois. September 22, 2019.

Williams, T.O. 2019. "Odor Control Performance Comparison Between Composting Technologies." Presented at the PNCWA Annual Conference. Portland, Oregon. September 9, 2019.

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Williams, T.O. Hatzigeorgiou, M., P. Burrowes and D. Parry. 2019. "Thermal Hydrolysis Full Scale System Performance." Presented at Australian Water Biosolids National Conference 2019. Brisbane, Australia. February 21, 2019.

Williams, T.O. 2019. "Odor Control Performance Comparison Between Composting Technologies." Presented at the US Composting Council's 27th Annual Meeting. Phoenix, Arizona. January 30, 2019.

Williams, T. O., D. Gabel and D. Robillard. 2018. "FOG and Food Waste Receiving and Processing Considerations Before Digestion." Presented at European Biosolids and Organics Resources Conference. Leeds, United Kingdom. November 13, 2018.

Williams, T. O. and S. Jeyanayagam. 2018. "Enabling a Circular Economy by Recovering Commodity Products from Sludge." Presented at European Biosolids and Organics Resources Conference. Leeds, United Kingdom. November 13, 2018.

Williams, T.O., B. Alto, F. Damron, M. Kozak and L. Aldrich. 2018. "Development of Successful Biosolids Composting Program in Kodiak Alaska." *Water Environment & Technology*, Vol. 30 (9):78-83. September 2018.

Williams, T.O. 2018. "Water Resource Recovery Facility Nutrient Recovery and Sustainable Biosolids Management." Presented at the Treasure Coast Regional Biosolids Symposium. Stuart, Florida. June 8, 2018.

Williams, T.O. 2018. "Enhancing Biogas Production Through Addition of FOG, Food Wastes and High Strength Wastes." Presented at 60th Manhattan College Institute in Water Pollution Control Professional Short Courses 2018. New York, New York. May 30, 2018.

Williams, T.O. 2018. "Co-Digestion Receiving Facilities – FOG Off-Loading, Pretreatment, Odor Control and Gas Handling." Presented at 60th Manhattan College Institute in Water Pollution Control Professional Short Courses 2018. New York, New York. May 30, 2018.

Williams, T.O. 2018. "Biosolids Composting Technology Development and Continued Implementation in Large and Small Communities." Presented at the IWA Sludge Management in a Circular Economy Specialty Conference. Rome, Italy. May 24, 2018.

Williams, T.O. Hatzigeorgiou, M. and P. Burrowes. 2018. "Thermal Hydrolysis Full Scale System Performance." Presented at WEF Residuals and Biosolids 2018 Conference. Phoenix, Arizona. May 16, 2018.

Williams, T. O. 2017. "Development of a Successful Biosolids Composting Program in Kodiak, Alaska." Presented at the WEAO Specialty Seminar on Managing Biosolids From Small Facilities. Burlington, Ontario. November 29, 2017.

Williams, T.O. 2017. "Small Utility Biosolids Management Programs: Today's Opportunities and Challenges." Presented at the WEAO Specialty Seminar on Managing Biosolids From Small Facilities. Burlington, Ontario. November 29, 2017.

Williams, T.O., B. Alto, F. Damron, M. Kozak and L. Aldrich. 2017. "Development of Kodiak Alaska's Successful Composting Program." Presented at the WEFTEC 2017 Technical Exhibition and Conference. Chicago, Illinois. October 3, 2017.

Williams, T.O., D. Gabel and D. Robillard. 2017. "FOG Waste Receiving and Processing Facility Design Considerations." Presented at SludgeTech/IWA 2017. London, United Kingdom. July 11, 2016.

Williams, T.O. 2017. "Biosolids Dryer Technologies, Product Types and Market Value." Presented at the VWEA Education Seminar, Collaborative Biosolids: Fuel for Thought. Richmond, Virginia. May 11, 2017.

Williams, T.O., B. Alto, F. Damron, M. Kozak and L. Aldrich. 2017. "Development of Kodiak Alaska's Successful Composting Program." Presented at the WEF Residuals and Biosolids Conference 2017. Seattle, Washington. April 11, 2017.

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Williams, T. O. 2017. "Advances in Anaerobic Digestion Practices." Presented at New Jersey Water Environment Association 2017 Winter Technology Transfer Seminar. Eatontown, New Jersey. March 8th, 2017.

Williams, T.O. 2017. "Kodiak's Successful Biosolids Composting Program." Presented at Alaska Forum on the Environment. Anchorage, Alaska. February 9th, 2017.

Williams, T.O. 2017. "Digestion Biogas Use in Combined Heat and Power and/or Biogas Purification: How to Choose?" Presented at the New York Water Environment Associations 89th Annual Meeting. New York, New York. February 6th, 2017.

Williams, T.O. 2017. "Development of a Successful Composting Program in Kodiak, Alaska." Presented at the US Composting Council's 25th Annual Meeting. Los Angeles, California. January 25th, 2017.

Williams, T.O. and P. Burrowes. 2016. "Thermal Hydrolysis Offerings and Performance." Presented at European Biosolids and Organics Resources Conference. Edinburgh, United Kingdom. November 16, 2016.

Williams, T.O. 2016. "Thermal Hydrolysis Offerings and Performance." Presented at Water Jam 2016. Virginia Beach, Virginia. September 14, 2016.

Jeyanayagam, S., Khunjar, W., Pramanik, A., Williams, T.O. and Wankmuller, D. 2016. "Extractive Nutrient Recovery Represents Transition from Linear to Circular Economy." Presented at 2016 Tri-Association Conference, Ocean City, Maryland. September 1, 2016.

Williams, T.O., P. Burrowes, D. Whitlock and D. Parry. 2016. "Thermal Hydrolysis Offerings and Performance." Presented at SludgeTech2016. Guildford, United Kingdom. June 27, 2016.

Williams, T.O., J. Nywening, K. Fries and P. Burrowes. 2016. "Biogas Enhancements and Utilization at Hamilton's Woodward Avenue Plant." Presented at the Manhattan College Summer Institute. New York, New York. May 25, 2016.

Williams, T.O. and P. Burrowes. 2016. "Onsite Biogas Energy Use." Presented at the Manhattan College Summer Institute. New York, New York. May 25, 2016.

Williams, T.O., J. Surti and P. Burrowes. 2016. "Case Studies – Implementation of Emission Control Improvements for SSI MACT Compliance." Presented at the 101st Annual Conference and Exposition of the New Jersey Water and Environment Association. Atlantic City, New Jersey. May 17, 2016.

Williams, T.O. and P. Burrowes. 2016. "Nutrient Recovery from Incinerator Ash." Presented at the 101st Annual Conference and Exposition of the New Jersey Water and Environment Association. Atlantic City, New Jersey. May 16, 2016.

Williams, T.O. and B. Alto. 2016. "Development of Kodiak's Successful Composting Operation May Also Work in Your Community." Presented at the 56th Annual Statewide Conference of the Alaska Water and Wastewater Management Association. Anchorage, Alaska. April 20, 2016.

Williams, T.O. 2016. "Global Trends in Biosolids Management." Presented at the 45th Annual Water Environment Association of Ontario Technical Symposium and Exhibition. Niagara Falls, Ontario. April 11, 2016.

Williams, T.O., P. Burrowes, D. Whitlock, K. Fries, C. Newberry and R. Roberts. 2016. "Anaerobic Digestion of Primary Solids and Thermally Hydrolyzed Waste Activated Solids." Presented at the WEF Residuals and Biosolids Conference. Milwaukee, Wisconsin. April 6, 2016.

Whitlock, D., T. Williams, T. Johnson, C. Klibert and P. Burrowes. 2016. "Optimizing Anaerobic Digestion Performance with Silo-Shaped Reactor Configurations." Presented at the WEF Residuals and Biosolids Conference. Milwaukee, Wisconsin. April 4, 2016.

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Williams, T.O. 2016. "Thermal Hydrolysis with Anaerobic Digestion: State of the Practice." Clear Waters (A publication of New York Water Environment Association, Inc., Vol 46, (1):18-19. Spring 2016.

Williams, T.O., D. Lubben and B. Desing. 2016. "Davenport Compost Facility Odor Control Improvements." Presented at the WEF Odors and Air Pollutants Conference. Milwaukee, Wisconsin. March 23, 2016.

Williams, T.O., H. Bauer, T. Johnson, B. Johnson and D. Oerke. 2015. "Sidestream Treatment Comparison of Post Aerobic Digestion and Anammox." Presented at the 20th European Biosolids & Organic Resources Conference and Exhibition. Manchester, United Kingdom. November 11, 2015.

Williams, T.O., P. Burrowes, K. Fries, C. Newberry and D. Whitlock. 2015. "Treatment of WAS with Thermal Hydrolysis and Anaerobic Digestion." Presented at the 20th European Biosolids & Organic Resources Conference and Exhibition. Manchester, United Kingdom. November 10, 2015.

Williams, T.O. 2015. "Thermal Hydrolysis – Beyond the DC Story." Presented at the 2015 Mid Atlantic Biosolids Association Annual Symposium. Wilmington, Delaware. November 4, 2015.

Williams, T.O. and D. Crooks. 2015. "Composting Success Continues at Spotsylvania County." Presented at the WEFTEC 2015 Technical Exhibition and Conference. Chicago, Illinois. September 29, 2015.

Williams, T.O. and R. Bowen. 2015. "Changing Land Application Regulations: How they are Shaping Virginia and Maryland Biosolids Programs." Presented at Virginia WEA WaterJam 2015. Virginia Beach, Virginia. September 15, 2015.

Williams, T.O. 2015. "Biosolids Composting Technology: Where It Has Come from and Where It Is Going." Presented at the 44th Annual WEAO Technical Symposium and Exhibition. Toronto, Ontario. April 20, 2015.

Williams, T.O. 2015. "Pathogen Indicator (Fecal Coliform) Regrowth in Biosolids Cake Update." Presented at the Central States WEA 33rd Annual Spring Biosolids Symposium. Stevens Point, Wisconsin. March 17, 2015.

Williams, T.O., S. Jeyanayagam, R. Latimer, W. Khunjar and A. Pramanik. 2014. "Advancing Extractive Nutrient Recovery from Wastewater". Presented at the 19th European Biosolids & Organic Resources Conference and Exhibition. Manchester, United Kingdom. November 19, 2014

Williams, T.O., D. Whitlock, D. Green, L. DCunha, M. Berg and P. Burrowes. 2014. "Why Thermal Hydrolysis and Anaerobic Digestion is Rising to the Top in North America." Presented at the 19th European Biosolids & Organic Resources Conference and Exhibition. Manchester, United Kingdom. November 18, 2014.

Williams, T.O. 2014. "Thermal Hydrolysis Coming of Age in North America." Presented at Virginia WEA WaterJam 2014. Hampton, Virginia. September 10, 2014.

Williams, T.O. 2014. "Resource Recovery Opportunities at America's Water Resource Recovery Facilities." Presented at the U.S. Department of Energy Biomass 2014: Growing the Future Bioeconomy Conference. Washington, DC. July 30, 2014.

Williams, T.O. and S. Plett. 2014. "Davenport Compost Facility Odor Control Improvements." Presented at the WEF Odors and Air Pollutants Conference. Miami, Florida. June 1, 2014.

Williams, T. O. 2014. "Biosolids Composting Technology: Where It Has Come from and Where It Is Going." Presented at the WEF Residuals and Biosolids 2014 Conference. Austin, Texas. May 20, 2014.

Williams, T.O. 2014. "How to Develop a Successful Composting Project." Presented at Waste Expo's 2nd Annual Organics Recycling and Composting Conference. Atlanta, Georgia. April 29, 2014.

Williams, T.O. 2014. "Biosolids Composting Technology: Where It Has Come From, Where It Is Going." Presented at the US Composting Council's 22nd Annual Conference and Tradeshow. Oakland, California. January 27, 2014.

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- Williams, T.O. 2013. "Anaerobic Digestion and Co-Digestion Optimization." Presented at the Ohio WEA 2013 Biosolids Specialty Workshop. Columbus, Ohio. December 5, 2013.
- Williams, T.O. 2013. "Developing a Composting Facility with Effective Odor Control." Presented at Waste Expo's 1st Annual Organics Recycling and Composting Conference. New Orleans, Louisiana. May 20, 2013.
- Williams, T.O. and D. Crooks. 2013. "Composting Success at Spotsylvania County." Presented at the WEF Residuals and Biosolids 2013 Conference. Nashville, Tennessee. May 7, 2013.
- Williams, T. O. 2013. "How to Develop a Successful Composting Project." Presented at the AWWMA's 53rd Annual Statewide Conference and Expo. Anchorage, Alaska. April 30, 2013.
- Williams, T. O. 2013. "Biosolids Composting Technology: Where It Has Come From, Where It Is Going." Presented at the AWWMA's 53rd Annual Statewide Conference and Expo. Anchorage, Alaska. April 30, 2013.
- Williams, T.O. 2013. "The Future of Biosolids Management." Presented at the Central States WEA 2013 Education Seminar. Biosolids: Resource or Refuse. Madison, Wisconsin. April 2, 2013.
- Williams, T.O. and S. Plett. 2013. "Davenport Compost Facility Odor Control Improvements." Presented at the US Composting Council's 21st Annual Conference and Tradeshow. Orlando, Florida. January 30, 2013.
- Shea, T.G. and T. O. Williams. 2012. "Managing Codigestion of Multiple Substrates." *BioCycle*, Vol. 53(12):50-52. December 2012.
- Environment Canada Waste Reduction and Management Division (2012). Technical Document on Municipal Solid Waste Organics Processing. Principal Author.
- Khunjar, W.O., T. Williams, R. Latimer and S. Jeyanayagam. 2012. "Nutrient Recovery as a Sustainable Biosolids Management Strategy." Presented at the Ohio Water Environment Association's Annual Biosolids Workshop. Columbus, Ohio. December 6, 2012.
- Williams, T.O. and T. Shea. 2012. "Mixing Anaerobic Digesters with High Strength Waste Addition." Presented at the NorthEast Residuals and Biosolids Conference. Amherst, Massachusetts. October 23, 2012.
- Williams, T. O. 2012. "The Future of Biosolids Management – A WEF Perspective." Presented at the Florida Water Environment Association Biosolids Seminar. Gainesville, Florida. September 12, 2012.
- Williams, T.O. 2012. "Evaluation of Processes to Reduce Activated Sludge Solids Generation and Disposal." Presented at the Iowa Water Environment Association 94th Annual Meeting. West Des Moines, Iowa. June 7, 2012.
- Water Environment Federation (2012). *Solids Process Design and Management*. WEF Special Publication. McGraw Hill, New York, New York. Principal Author.
- Williams, T.O. 2012. "Anaerobic Digester Mixing: How to Avoid Operating Problems as Higher Solids and High Strength Wastes are introduced." Presented at the NJWEA 97th Annual Conference and Exhibition. Atlantic City, New Jersey. May 16, 2012.
- Williams, T.O. 2012. "Biosolids Composting Odor Control Systems that Work." Presented at the Water Environment Association of Utah Annual Conference. St. George, Utah. April 20, 2012.
- Williams, T.O. and D. Whitlock. 2012. "Energy Neutral Wastewater Treatment Plants." Presented at the Water Environment Association of Utah Annual Conference. St. George, Utah. April 17, 2012.
- Williams, T.O., Datta, T. and R. Alexander. 2012. "Biosolids Compost – What's it Worth?" Presented at the 26th WEF Residuals and Biosolids Conference. Raleigh, North Carolina. March 26, 2012.

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Datta, T., T.O. Williams and R. Alexander. 2012. "Biosolids Compost – What's it Worth?" Presented at the US Composting Council's 20th Annual Conference and Tradeshow. Austin, Texas. January 18, 2012.

Williams, T. O. 2011. "Co-Digestion of Fats, Oils and Greases with Municipal Wastewater Solids." Presented at the Biocycle Renewable Energy Conference. Madison, Wisconsin. November 1, 2011.

Williams, T. O. 2011. "Charting the Future of Biosolids Management – A WEF/NBP Perspective." Presented at the Florida Water Environment Association Biosolids Committee Seminar. Winter Haven, Florida. October 26, 2011.

Williams, T.O. and R. Bowen. 2011. "HRSD Experience with Fecal Coliform Regrowth and Odor Production at the Atlantic Plant." Presented at the 84th Annual Water Environment Federation Technical Exhibition and Conference. Los Angeles, California. October 16, 2011.

Williams, T.O., Surti, J. R., Shea and P. Burrowes. 2011. "Biosolids to Bioenergy – New Regional Facilities Will Build on Old Ideas." Presented at the Water Environment Association of Texas Biosolids, Odors and Corrosion Conference, San Marcos, Texas. August 4, 2011.

Surti, J.R., T.O. Williams, T. Shea and P. Burrowes. 2011. "Biosolids to Bioenergy – New Regional Facilities Will Build on Old Ideas." Presented at the WEF Residuals and Biosolids Conference, Sacramento, California. May 24, 2011.

Williams, T.O., M. Rahman, C. Easter, D. Crooks, B. Loveday and E. Petrovitch. 2011. "Spotsylvania County's Expanded Composting Facility Uses Advances in Aerated Static Pile Technology." Presented at the NJWEA 96th Annual Conference and Trade Show. Atlantic City, New Jersey. May 11, 2011.

Williams, T.O., T. Shea, D. Cooley, P. Burrowes and D. Gabel. 2010. "Feeding FOG to Thermal Oxidation Units – It's all in the Presentation." Presented at the Mid-Atlantic Biosolids Association's Annual Biosolids Science Symposium Meeting. Wilmington, Delaware. November 15, 2010.

Williams, T.O., T. Shea, D. Gabel and J. Kabouris. 2010. "Fats, Oils and Grease (FOG), a Resource, Not a Waste." Presented at the Chesapeake Water Environment Association Seminar on FOG Wastes. Washington, D.C. October 29, 2010.

Williams, T.O., M. Rahman, C. Easter, D. Crooks, B. Loveday and E. Petrovitch. 2010. "Spotsylvania County's Expanded Composting Facility Applies Aerated Static Pile Technology Advances." Presented at the 83rd Annual Water Environment Federation Technical Exhibition and Conference. New Orleans, Louisiana. October 4, 2010.

Ghylin, T., W. Angoli, B. Desing, P. Burrowes, J. Fisher and T.O. Williams. 2010. "Selection of a Biosolids Management Plan to Meet a Sewerage District's Vision of Becoming a Leader in Sustainability." Presented at the 83rd Annual Water Environment Federation Technical Exhibition and Conference. New Orleans, Louisiana. October 4, 2010.

Williams, T.O., C. Easter, D. Crooks, and E. Petrovitch. 2010. "Spotsylvania County's Expanded Composting Facility Uses Advances in Aerated Static Pile Technology." Presented at the Virginia Water Jam Annual Conference. Hampton, Virginia. September 21, 2010.

Williams, T.O., C. Easter. 2010. "Spotsylvania County's New Improved Composting Facility with State of the Art Odor Control." Presented at the WEF Residuals and Biosolids Conference. Savannah, Georgia. May 23, 2010.

Williams, T.O. 2010. "The Real Story of Microsludge on Digester Performance." Presented at the NJWEA 95th Annual Conference and Trade Show. Atlantic City, New Jersey. May 12, 2010.

Williams, T.O., G. Mayne, C. White and D. Whitlock. 2010. "Composting in the Plan for South Valley Sewer District." Presented at the WEAU 2010 Annual Conference. St. George, Utah. April 14, 2010.

Todd O. Williams, PE, BCEE

- Williams, T.O., C. Easter. 2010. "Spotsylvania County's New Improved Composting Facility with State of the Art Odor Control." Presented at the WEF Odors and Air Pollutants Conference. Charlotte, North Carolina. March 21, 2010.
- Williams, T.O., C. Easter. 2010. "Spotsylvania County's New Improved Biosolids Composting Facility." Presented at the US Composting Council's 18th Conference and Tradeshow. Orlando, Florida. January 25, 2010.
- Williams, T.O. and T. Shea. 2009. "FOG Waste Receiving and Storage Systems." Presented at the Virginia Water Jam Annual Conference. Richmond, Virginia. September 14, 2010.
- Williams, T.O. 2009. "Improving Anaerobic Digestion Performance Using Waste Activated Solids Pre-Treatment Technologies." Presented at the New Jersey Water Environment Association 94th Annual Conference. Atlantic City, New Jersey. May 13, 2009.
- Shea, T., R. Kent and T.O. Williams. 2009. "Optimization of Residual Haul and Disposal Costs Using TADCAM." Poster Presentation at the WEF Residuals and Biosolids Conference. Portland, Oregon. May 3-6, 2009.
- Easter, C., T. O. Williams, R. Bowen and M. Feltner. 2009. "Odor Emissions from Anaerobically Digested Biosolids During Onsite Storage and Land Application: Impacts of Lime Dosing and the Type of Dewatering Process Used (Belt Presses versus Centrifuges)." Presented at the WEF Residuals and Biosolids Conference. Portland, Oregon. May 4, 2009.
- Williams, T.O. 2009. "The Next Generation of Aerated Static Pile Biosolids Composting Facilities." Presented at the WEAU 2009 Annual Conference. St. George, Utah. April 2, 2009.
- Williams, T.O. 2009. "The Next Wave of Aerated Static Pile Composting Facilities – With Effective Odor and VOC Controls." Presented at the 17th Annual US Composting Council Conference. Houston, Texas. January 27, 2009.
- Williams, T.O., R. Bowen and E. Bonatz. 2008. "Anaerobically Digested Biosolids beyond Class B." Presented at the 81st Annual Water Environment Federation Technical Exhibition and Conference. Chicago, Illinois. October 21, 2008.
- Williams, T.O., R. Bowen and E. Bonatz. 2008. "Anaerobically Digested Biosolids beyond Class B." Presented at VWEA Water Jam Conference. Virginia Beach, Virginia. September 10, 2008.
- Water Environment Federation 2008. *Sudden Increase and Regrowth of Fecal Coliforms in Anaerobically Digested Biosolids*. WEF Technical Practice Update, Alexandria, Virginia. Task Force Co-Chair and Author.
- Williams, T.O., R. Forbes, D. Wagoner and T. Hahn. 2008. "Control of Biosolids Cake Odors Using the New Biosolids Odor Reduction Selector Process." Presented at the WEF/A&WMA Odors and Air Emissions 2008 Conference. Phoenix, Arizona. April 8, 2008.
- Williams, T.O., R. Forbes, D. Wagoner and T. Hahn. 2008. "Control of Biosolids Cake Odors Using the New Biosolids Odor Reduction Selector Process." Presented at the Water Environment Federation Residuals and Biosolids 2008 Conference. Philadelphia, Pennsylvania. April 1, 2008.
- Whitlock, D.D., T. Williams, T. Shea, T. Heinemann, S. Higbee, R. Scott and B. Thayer. 2008. "Using Multi-Attribute Utility Analysis to Facilitate Biosolids Planning." Presented at the Water Environment Federation Residuals and Biosolids 2008 Conference. Philadelphia, Pennsylvania. March 31, 2008.
- Williams, T. O., and J. Allen. 2008. "Practical Field Tools Used to Troubleshoot Odor Problems." Presented at the 16th Annual US Composting Council Conference. Oakland, California. February 10, 2008.
- Williams, T.O. 2007. "Occurrence of Microconstituents in Biosolids." Presented at the 80th Annual Water Environment Federation Technical Exhibition and Conference. San Diego, California. October 17, 2007.

Todd O. Williams, PE, BCEE

Feltner, M., R. Bowen, C. Easter and T.O. Williams. 2007. "Odor Emissions from Anaerobically Digested Biosolids During Onsite Storage and Land Application: Impacts of Lime Dosing and the Type of Dewatering Process Used (Belt Presses vs. Centrifuges)." Presented at the 80th Annual Water Environment Federation Technical Exhibition and Conference. San Diego, California. October 16, 2007.

Williams, T.O. and R. Bowen. 2007. "Impacts of Process Enhancements on Fecal Coliform Concentrations in Anaerobically Digested Biosolids." Presented at the 80th Annual Water Environment Federation Technical Exhibition and Conference. San Diego, California. October 16, 2007.

Williams, T.O., R. Forbes, D. Wagoner and T. Hahn. 2007. "Control of Biosolids Cake Odors Using the New Biosolids Odor Reduction Selector Process." Presented at the 80th Annual Water Environment Federation Technical Exhibition and Conference. San Diego, California. October 15, 2007.

Daigger, G.T., T.O. Williams, D. Katehis and G.D. Waltrip. 2007. "Determining Optimum Nutrient Management Strategies for Bubble Permits – A Case History Based on the Hampton Roads Sanitation District James River Discharge." Presented at the 80th Annual Water Environment Federation Technical Exhibition and Conference. San Diego, California. October 15, 2007.

Williams, T.O., Bowen, R.L. (2007) Biosolids Process Enhancements for Fecal Coliform Reduction. *Water Practice*, 1 (4), 1-9.

Williams, T.O. 2007. "Microconstituents in Biosolids." Presented at the WEF/WERF/NEWEA/PRMA Compounds of Emerging Concern Specialty Conference. Providence, Rhode Island. July 29, 2007.

Water Environment Federation (2007) *Microconstituents in Biosolids*. WEF Technical Practice Update, Alexandria, Virginia. Task Force Chair and Author.

Williams, T.O., R. Bowen 2007. "Biosolids Process Enhancements for Fecal Coliform Reduction." Presented at the WEF/AWWA/RMWEA 2007 Joint Residuals and Biosolids Conference. Denver, Colorado. April 18, 2007.

Williams, T.O., J. Borghesi, R. Alexander, M. Sharp, and L Walters 2007. "Biosolids Markets – Class A or Class B?" Presented at the WEF/AWWA/RMWEA 2007 Joint Residuals and Biosolids Conference. Denver, Colorado. April 15, 2007.

Williams, T.O., C. Easter. 2007. "Advancing the Design of Aerated Static Pile Odor Control Systems through Performance Testing and Modeling." Presented at the U.S. Composting Council 14th Annual Conference and Tradeshow. Orlando, Florida. January 22, 2007.

Water Environment Federation (2006) *Reactivation and Regrowth of Fecal Coliforms in Anaerobically Digested Biosolids*. WEF Technical Practice Update, Alexandria, Virginia. Task Force Co-Chair and Author.

Alix, C.A. and T. Williams. 2006. "Biofilters Make Good Neighbors." *Water Environment & Technology*, Vol. 18 (3):57-59. March 2006.

Williams, T. O. 2006. "Compost Marketing in Spotsylvania County, Virginia." Presented at the U.S. Composting Council 14th Annual Conference and Tradeshow. Albuquerque, New Mexico. January 24, 2006.

Williams, T.O. and C. Egigian-Nichols. 2005. "Management Options to Comply with Composting Emissions Standards." Presented at the Biocycle Southeast Conference. Charlotte, North Carolina. November 15, 2005.

Williams, T. O. 2005. "Compost Marketing in Spotsylvania County, Virginia." Presented at the Mid-Atlantic Compost Association Annual Conference and Tradeshow. Beltsville, Maryland. September 22, 2005.

Williams, T. O., C. Alix, E. Epstein and S. Plett. 2005. "A Decade of Operating Experience at the Davenport Iowa Aerated Static Pile Composting Facility." Presented at the WEF/AWWA/KY-TN WEA 2005 Joint Residuals and Biosolids Conference. Nashville, Tennessee. April 18, 2005.

Todd O. Williams, PE, BCEE

Williams, T.O., C.D. Barnes, and K. McWhirt. 2005. "Composting in Spotsylvania County, Virginia." Presented at the WEF/AWWA/KY-TN WEA 2005 Joint Residuals and Biosolids Conference. Nashville, Tennessee. April 17, 2005

Williams, T. O. and S. Servo. 2005. "Odor Modeling at a Biosolids Composting Facility." *BioCycle*, Vol. 46(3):34-36. March 2005.

Egigian-Nichols, C., and T.O. Williams. 2005. "Management Options to Comply with Composting Emissions Standards." Presented at the Biocycle West Coast Conference 2005. San Francisco, California. March 8, 2005.

Williams, T.O., E. Epstein and C. Alix. 2005. "Composting Biosolids from Medium to High Tech." Presented at the U.S. Composting Council 13th Annual Conference and Tradeshow. San Antonio, Texas. January 25, 2005.

Williams, T.O. and C. Alix. 2005. "Odor Modeling as a Tool for a Biosolids Processing Facility Design Configuration Analysis." Presented at the U.S. Composting Council 13th Annual Conference and Tradeshow. San Antonio, Texas. January 24, 2005.

Williams, T.O. 2004. "Biofilters for Controlling Biosolids Odors." Presented at the Rocky Mountain WEA Wastewater Biosolids Odors and Pathogens Issues Seminar. Denver, Colorado. November 18, 2004.

Williams, T.O. Composting in Spotsylvania County. 2004. Presented at the MACA Annual Meeting. Beltsville, Maryland. September 22, 2004.

Williams, T.O. Composting in Spotsylvania County. 2004. Presented at the Virginia Water Environment Association, 57th Annual Meeting. Portsmouth, Virginia. May 4, 2004.

Williams, T.O., and S. Servo. 2004. "Odor Modeling as a Tool for a Biosolids Processing Facility Design Configuration Analysis." Presented at the WEF/A&WMA Odors and Air Emissions 2004 Conference. Bellevue, Washington. April 19, 2004.

Williams, T.O. and E. Epstein. 2004. "Composting for Class "A"." Presented at the WEF/WEAU Residuals and Biosolids Management Conference and Exhibition 2004. Salt Lake City, Utah. February 23, 2004.

Williams, T.O., E. Epstein, D. Oerke, J. Velazquez, D. Sullivan and P. Heppler. 2004. "The Development and Design of Biosolids Dewatering and Composting Facilities for the City of Boulder, Colorado." Presented at the WEF/WEAU Residuals and Biosolids Management Conference and Exhibition 2004. Salt Lake City, Utah. February 22, 2004.

Williams, T.O. 2004. "Odor Modeling to Evaluate Compost Facility Layouts in Very Sensitive Areas." Presented at the U.S. Composting Council 12th Annual Conference and Tradeshow. Las Vegas, Nevada. January 26, 2004.

Williams, T.O. 2003. "Composting and Compost Markets in Virginia". Presented at the Southwest Virginia Solid Waste Management Association Annual Meeting. Roanoke, Virginia. September 11, 2003.

Williams, T.O., E. Epstein, C. Egigian-Nichols and J. Gundlach. 2003. "The Differences between Using Anaerobic Digestion for Dairy Manure and using it for Municipal Wastewater Solids." Presented at The Anaerobic Digester Summit. Raleigh, North Carolina. June 3, 2003.

Oerke, D., T.O. Williams, E. Epstein, J. Velazquez, D. Sullivan, and P. Heppler. 2003. Development and Design of Biosolids Dewatering and Composting Facilities for Boulder, Colorado. Presented at the Water Environment Federation Residuals and Biosolids Conference. Salt Lake City, Utah. 2003.

Williams, T.O., M. Maiden, N. Wescoat, D. Barnes, E. Epstein and C. Alix. 2003. "Composting for Class "A" in Virginia." 2003. Presented at the Virginia Water Environment Association's Annual Meeting. Roanoke, Virginia. April 30, 2003.

Williams, T.O., R.A. Boyette, L. Bergstedt, K.C. Hamel, S. Johnsen, and A. Parella. 1997. "Wastewater Treatment Plant Odor Control Using a Biofiltration System in Duluth, Minnesota." Presented at the Water Environment Federation 70th Annual Conference and Exposition. Chicago, Illinois. October 21, 1997.

Todd O. Williams, PE, BCEE

Williams, T.O., R.A. Boyette, J. Pomroy, and D. Berger. 1997. "Central Contra Costa Sanitary District Uses Biofiltration to Control Biosolids Thickening Odors" Presented at the Water Environment Federation 70th Annual Conference and Exposition. Chicago, Illinois. October 21, 1997.

Epstein, E., T.O. Williams, C. Youngberg, N.T. Wu. 1997. "Dust and Bioaerosol Assessment at Two Biosolids Composting Facilities." Presented at the Water Environment Federation 70th Annual Conference and Exposition. Chicago, Illinois. October 21, 1997.

Williams, T.O., R.A. Boyette, and W.W. Cathcart. 1997. "Composting Facility Odor Problems Solved with Biofiltration." Presented at the WEF/AWWA Joint Residuals/Biosolids Management Approaching 2000 Conference. Philadelphia, Pennsylvania. Proceedings pp.2/29-36. August 3, 1997.

Epstein, E., T.O. Williams, S. Plett, and C. Poe. 1997. "Operations at Two Aerated Static Pile Composting Facilities." Presented at the WEA/AWWA Joint Residuals/Biosolids Management Approaching 2000 Conference. Philadelphia, Pennsylvania. Proceedings pp.7/1-9. August 4, 1997.

Pomroy, J., D. Berger, T.O. Williams, and R.A. Boyette. 1997. "Central Contra Costa Sanitary District Uses Biofiltration to Control Biosolids Thickening Odors." Presented at the WEF/AWWA Joint Residuals/Biosolids Management Approaching 2000 Conference. Philadelphia, Pennsylvania. Proceedings pp.37-46. August 4, 1997.

Engel, P.L., T.O. Williams, and T. Muirhead. 1997. "Utilizing ISCST to Model Composting Facility Odors." Presented at the Air & Waste Management Association's 90th Annual Meeting & Exhibition. Toronto, Ontario, Canada. June 8 - 13, 1997.

Williams, T.O. and R.A. Boyette. 1997. "A New Generation of Biofilters for Controlling Odorous Emissions from a Wide Range of Municipal Sources." Presented at the Water Environment Federation Specialty Conference Series. Houston, Texas. Proceedings pp.3/47-54. April 20-23, 1997.

Williams, T. O. and P. Engel. 1997. "Mobile Processing Systems Fit Wood Residuals." *BioCycle*, Vol.38 (4):34-38. April 1997.

Williams, T.O. and R.A. Boyette. 1997. "Odor Control in Wastewater Applications Using Cost Effective Biofilters." Presented at the Nevada Water Pollution Control Association 1997 Annual Conference and Exhibition. Palace Station Hotel-Casino, Las Vegas, Nevada. March 5-7, 1997.

Plett, S. and T.O. Williams. 1996. "Operating a Biosolids Composting Facility," Presented at the Biocycle Midwest Conference '96, Des Moines, Iowa. November 21, 1996.

Boyette, R.A., and T.O. Williams, "Biofiltration for Odor Control at a Sewage Interceptor Pumping Station in Charlottesville, Virginia," Presented at the 1996 Annual Conference of North Carolina Water Works Association/Water Environment Association, Pinehurst, North Carolina. November 17-20, 1996.

Gilley, G., T. Williams, and T. Muirhead, "Air Emissions Testing and Odor Modeling at the Revitalized Regional Compost Facility in Hickory, North Carolina," Presented at Composting in the Carolinas Conference & Expo, Myrtle Beach, South Carolina. October 24, 1996.

Williams, T.O., R.A. Boyette, E. Epstein, S.Plett and C. Poe. 1996. "The Big and Small of Biosolids Composting," Presented at Composting in the Carolinas Conference & Expo, Myrtle Beach, South Carolina. October 24, 1996.

Williams, T.O., R.A. Boyette, and E. Epstein. 1996. "Biosolids Composting in Davenport, Iowa." Presented at the Water Environment Federation, 69th Annual Conference and Exposition, Dallas, Texas. Proceedings pp.285-291. October 5-9, 1996.

Williams, T.O. and R.A. Boyette, "Biofiltration for Odor Control at a Sewage Interceptor Pumping Station in Charlottesville, Virginia," Presented at the 69th Annual Conference of the Water Environment Federation, Dallas, Texas. October 8, 1996.

Todd O. Williams, PE, BCEE

Williams, T.O. 1996. "Mobile, Multi-Community Waste Wood Processing in the SERBEP Region," Presented at the Bioenergy '96 Conference, Nashville, Tennessee. September 18, 1996.

Williams, T.O. and R.A. Boyette, "Affordably Odor-Free," Operations Forum, Vol.13 (8):26-29. August 1996.

Williams, T.O., R.A. Boyette, and E. Epstein. 1996. "Biosolids Composting in Davenport, Iowa." Presented at the Water Environment Federation, 10th Annual Residuals and Biosolids Conference, Denver, Colorado. August 18, 1996.

Williams, T.O., R.A. Boyette, E. Epstein, S.Plett and C. Poe. 1996. "The Big and Small of Biosolids Composting," Presented at the Biocycle National Conference, Phoenix, Arizona. May 7, 1996.

Williams, T.O., R.A. Boyette, E. Epstein, S. Plett, and C. Poe. 1996. "The Big and Small of Biosolids Composting." BioCycle, Vol.37 (4):62-69. April 1996.

Williams, T.O., 1996. "Biosolids Composting in Harrisonburg," Presented at the Virginia Water Environment Association Annual Meeting, Williamsburg, Virginia. April 30, 1996.

Water Environment Federation and American Society of Civil Engineers (1995) Odor Control in Wastewater Treatment Plants. WEF Manual of Practice No 22, ASCE Manuals and Reports on Engineering Practice No. 82, Alexandria, Virginia. Principal Author.

Water Environment Federation (1995). Biosolids Composting. WEF Special Publication. Alexandria, Virginia. Principal Author.

Boyette, R.A., T.O. Williams, and D. Wynne, "Biofiltration Demonstration for Controlling Volatile Organic Emissions," Presented at the 1995 Conference on Biofiltration, University of Southern California, LA (sponsored by USC Environmental Engineering Program Department of Civil Engineering and The Reynolds Group). Proceedings pp.325-331. October 1995.

Williams, T.O. and R.A. Boyette, "Biofiltration for Odor Control at a Sewage Interceptor Pumping Station in Charlottesville, Virginia," Presented at the 1995 Conference on Biofiltration, University of Southern California, LA (sponsored by USC Environmental Engineering Program Department of Civil Engineering and The Reynolds Group). Proceedings pp.303-308. October 1995.

Williams, T.O. and P. Engel. 1995. "Control of Odorous and Volatile Organic Compound Emissions from Composting Facilities," Presented at The Composting Council's Sixth Annual Conference, Beltsville, Maryland. October 12, 1995.

Williams, T.O., E. Epstein, and S. Plett. 1995. "Biosolids Composting in Davenport, Iowa." Presented at the 4th Joint WEF & AWWA Residuals/Biosolids Conference, Kansas City, Missouri. Proceedings pp.3/17-23. July 23, 1995.

Williams, T.O. and R.A. Boyette. 1995. "Biofiltration for the Control of Odorous and Volatile Organic Compound Emissions in High Temperature Industrial Applications" (95-MP9A.02). Presented at the Air & Waste Management Association's 88th Annual Meeting & Exhibition, San Antonio, TX. June 18-23, 1995.

Williams, T.O. 1995. "Odors and VOC Emissions Control Methods," BioCycle, Vol.36 (5):49-56. May 1995.

Williams, T.O. 1995. "Biosolids Dewatering and Composting in Harrisonburg, Virginia". Presented at the Virginia Water Environment Association 49th Annual Conference. Richmond, Virginia. May 9, 1995.

Williams, T.O. 1995. "Control of Odorous and Volatile Organic Compound Emissions from Composting Facilities," Presented at the Composting in the Carolinas 1995 Conference and Expo in Charlotte, North Carolina. Proceedings pp.134-143. January 20, 1995.

Todd O. Williams, PE, BCEE

- Boyette, R.A., T.O. Williams, and J. Vest. 1995. "Pilot Study: Biosolids Composting in Salisbury, North Carolina." Presented at the Composting in the Carolinas 1995 Conference and Expo. Sheraton Airport Plaza Hotel, Charlotte, North Carolina. Proceedings pp.77-83. January 18-20, 1995.
- Williams, T.O. and E. Epstein. 1995. "Composting Public Health Aspects: Odors and Bioaerosols." Presented at the US/Canadian Federation Solid Waste Management Conference, Washington, DC. January 18, 1995.
- Williams, T.O. and J. Vest. 1994. "Biosolids Composting to Supplement Land Application in Salisbury, North Carolina." Presented at The North Carolina American Water Works Association and the North Carolina Water Pollution Control Association 74th Annual Conference, Asheville, North Carolina. November 14, 1994.
- Williams, T.O. 1994. "Simplified Approaches to Composting Grocery Organics." Presented at the Biocycle Southeast Conference '94. Clearview, Florida. October 31, 1994.
- Williams, T.O. and V. Marz. 1994. "Biosolids Composting". Presented at the Iowa Society of Solid Waste Operations Fall Conference, West Des Moines, Iowa. September 22, 1994.
- Williams, T.O., "Biofiltration for the Control of Odorous Emissions and Volatile Organic Compounds (VOC's) from Wastewater and Sludge Processing Facilities," Presented at the Water Environment Federation Specialty Conference Series: Odor and Volatile Organic Compound Emission Control for Municipal and Industrial Wastewater Treatment Facilities, Jacksonville, Florida. Proceedings pp.4/1-13. April 25, 1994.
- Williams, T.O. and F.C. Miller, "Composting Facility Odor Control Using Biofilters," Science and Engineering of Composting: Design, Environmental, Microbiological and Utilization Aspects, pp. 262-281. Editors: Harry A.J. Hoitink and Harold M. Keener, Renaissance Publications, 1993.
- Williams, T.O., "Biofiltration for the Control of Odorous Emissions from Composting Facilities," Presented at the 3rd Annual Meeting of the Composting Council of Canada, Montreal, Quebec. September 24, 1993.
- Williams, T.O. and F.C. Miller, "Biofilters and Facility Operations, Part II," BioCycle, Vol.33 (11):75-70. November 1992.
- Williams, T.O. and F.C. Miller, "Odor Control Using Biofilters, Part I," BioCycle, Vol.33 (10):72-77. October 1992.
- Williams, T.O. 1992. "Developing an Innovative Composting Program." Presented at the Solid Waste Management Planning Seminar. Jackson, Tennessee, October 27, 1992. Nashville, Tennessee, October 28, 1992. Knoxville, Tennessee, October 29, 1992.
- Williams, T.O. and F.C. Miller, "Composting Facility Odor Control Using Biofilters," Presented at the International Composting Research Symposium, Columbus, Ohio. May 28, 1992.
- Williams, T.O. 1992. "Yard Waste Composting Planning Considerations". County Lines Magazine, North Carolina Association of County Commissioners. January, 1992.
- Williams, T.O. 1991. "Yard Waste Composting Isn't Just a Pile of Leaves." County Lines Vol. XVII, No. 22. December 18, 1991.
- Williams, T.O. and B. Thavarajah. 1991. "Evaluating Project Proposals, How to Save Time and Dollars in Development Process." Presented at the BioCycle Southeast Conference, Raleigh, North Carolina. November 20, 1991.
- Williams, T.O. and O. North. 1991. "Performance Testing of an Innovative Sludge Composting Aeration System in Nashville, Tennessee." Presented at the 64th Annual Conference of the Water Pollution Control Federation, Toronto, Ontario. October 8, 1991.
- Epstein, E., J.E. Alpert, and T.O. Williams. 1991. "Composting Water Treatment Plant Residuals." Presented at the Water Pollution Control Federation Conference. Durham, North Carolina. August 1991.

Todd O. Williams, PE, BCEE

- Gould, M., T.O. Williams, and G. Croteau. 1991. "Dewatering and Composting of Septage, a Comparison of Three Facilities." Presented at the AWWA/WPCF Joint Residuals Management Conference. August 13, 1991.
- Williams, T.O., M. Gould, and T. Callihan. 1991. "Septage Dewatering, Treatment and Composting." *BioCycle*, Vol.32 (4): 66-75. April 1991.
- Williams, T.O. and E. Epstein. 1991. "Are There Markets for Compost?" *Waste Age*, pp.94-100. April 1991.
- Williams, T.O., M. Gould, and T. Callihan. 1990. "Dewatering, Treatment, and Composting of Septage - A Septage Management Solution for Rural Communities." Presented at the 63rd Annual Conference of the Water Pollution Control Federation, Washington, DC. October 10, 1990.
- Epstein, E., M. Gould and T. O. Williams. Sludge and Septage Composting: A Major Step in Integrated Waste Management. Presentation Unknown. September 1990.
- Williams, T.O. 1990. "An Integrated Approach to Developing Innovative Solid Waste Composting Programs." Presented at the North Carolina Agricultural Extension Service Waste Management Institute, Raleigh, North Carolina. April 30, 1990.
- Williams, T.O., M. Gould, and T. Callihan. 1990. "Dewatering and Composting of Septage: A Pilot Plant in Thompson (Monticello), New York." Presented at the Sixth Annual Conference on Solid Waste Management and Materials Policy, New York, New York. February 1, 1990.
- Williams, T.O., B. Hazlewood, E. Epstein, and W. Frye. 1989. "The City of Nashville's Sludge Composting Program - Implementing a 40 Dry Tons per Day Operation." Presented at the 62nd. Annual Conference of the Water Pollution Control Federation, San Francisco, California. October 18, 1989.
- Williams, T.O. 1989. "Solid Waste Composting Components." Presented at Western North Carolina Conference on Solid Waste Management Technologies, Haywood, North Carolina. May 23, 1989.
- Williams, T.O. 1989. "Integration of Solid Waste Stream Components into a Composting Program." Presented at the 1989 Pennsylvania Recycling Conference, Grantville, Pennsylvania. May 2, 1989.
- Alpert, J.E., D.O. White, and T.O. Williams. 1989. "The Realities of the Enclosed System Sludge Composting." E&A Environmental Consultants, Inc. Internal Document. May 1989.
- Williams, T.O. and E. Epstein. 1989. "Developing Markets for Solid Waste Compost." Presentation Unknown. March 1989.
- Epstein, E. and T.O. Williams. 1988. "Solid Waste Composting Gains New Credence." *Solid Waste & Power*, pp.24-30, June 1988.
- Williams, T.O. and E. Epstein. 1988. "Creating Markets for Solid Waste Compost." *Resource Recycling*, pp.20-21, pp.56-57. May/June 1988.
- Williams, T.O. 1988. "Experience at Five European Solid Waste Co-Composting Operations." April 1988.
- Epstein, E. and T.O. Williams. 1988. "Composting Components." Presented at the New York State 1988 Solid Waste Management and Material Policy Conference, New York, New York. February 28, 1988.
- Epstein, E., T.O. Williams, and K.W. Duffy. 1987. "Composting of Municipal Solid Waste." Presented at The New York State Department of Environmental Conservation's Third Annual Symposium on Materials & Energy Recovery From Municipal Solid Waste. Albany, New York. October 21, 1987.
- Williams, T.O. 1987. "Compost Marketing and its Effect on Operating Costs at a 50 Wet-Ton-Per-Day sludge Composting Facility." Presented at the National Conference on Municipal Treatment Plant Sludge Management, Hazardous Materials Control Research Institute. Boston, Massachusetts. May 27-29, 1987.

Todd O. Williams, PE, BCEE

Williams, T.O. 1986. "Taking a Composting Facility Designed to Process 10 Dry Tons per Day and Making it Work." Presented at the 16th National Conference on Municipal Treatment Plant Sludge Management, Orlando, Florida. May 30, 1986.

Williams, T.O. 1984. "Taking a Composting Facility Designed to Process 10 Dry Tons per Day and Making it Work." Presented at the 38th Annual Meeting of the Virginia Water Pollution Control Association. Williamsburg, Virginia. May 1, 1984.

Supplemental Information

Customer Contacts (*Users please verify before each use*)

Employment History

Jacobs Engineering, Inc., Bingham Farms (Detroit), Michigan: 2018-Present – Senior Principal Technologist and Global Technology Practice Leader for Residuals Resource Recovery Team. Responsible for providing technical support on biosolids and odor control related projects in local and regional offices throughout the Jacobs network. Responsibilities ranged from managing projects to new business development to serving as a senior technical consultant and subject matter expert on a wide array of biosolids management planning and design projects.

CH2M HILL, Inc., Richmond, Virginia: 2005-2017 – Principal Technologist and Global Technology Practice Leader for Residuals Resource Recovery Team. Responsible for providing technical support on biosolids and odor control related projects in local and regional offices throughout the CH2M Hill network. Responsibilities ranged from managing projects to new business development to serving as a senior technical consultant on a wide array of biosolids management planning and design projects.

Tetra Tech, Inc., Mechanicsville, Virginia: 2002-2005 – Senior Project Manager responsible for all organics management and odor control projects, as well as new business development, in the southeastern U.S.

Environmental and Engineering Services, Viasystems Technologies Corp., LLC, Richmond, Virginia: 1998-2002 – Various positions of responsibility for 600,000 SF/2200 employee printed circuit board manufacturing facility, including all environmental, health and safety programs, maintenance programs, and facilities engineering.

E&A Environmental Consultants Inc., Stoughton, Massachusetts: 1986-1998 – Senior Engineer and Office Manager of Southeast Regional Office in Cary, North Carolina.

Hampton Roads Sanitation District, Virginia Beach, Virginia: 1980-1986 – Plant Manager, James River Treatment Plant, 20 MGD activated sludge facility with gravity and DAF thickening, anaerobic digestion, BFP dewatering and ASP composting.

U.S. Environmental Protection Agency, Washington, DC: 1977-1979 – Student Assistant

CH2M HILL Hire Date: 7/18/05

Years' Experience Previous to CH2M HILL: 25

Resume Update: 11/11/2014 (by Trish Schwarz for resume initiative)

Resume Update: 11/30/2015 (by Meredith Lindsey upon request)

Last Employee Update: 6/15/2020

