



Exponent®

Engineering & Scientific Consulting

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Professional Profile

Dr. Fleming is a Senior Associate in Exponent's Ecological and Biological Sciences Practice. She applies her training in water quality engineering to assess the ecological risks posed by pharmaceuticals, pesticides, personal care products, industrial chemicals, and emerging contaminants.

Dr. Fleming has extensive experience preparing environmental assessments for veterinary pharmaceutical products for use in a variety of farming practices and animal species as well as aquaculture in accordance with U.S. and EU regulations. She has developed an expertise in exposure assessment to support environmental assessments that range in complexity from categorical exclusions to watershed-level models.

In addition to conducting environmental assessments to support product approvals, Dr. Fleming has experience in evaluating ecological risks associated with the production of genetically modified organisms and contaminated sites, including Superfund sites. She has also applied her engineering background to evaluate water and wastewater treatment technologies and effluent toxicity issues.

Dr. Fleming's risk assessment experience extends to experimental design and data analysis as applied in her research characterizing the metal oxide nanoparticles used in the semi-conductor industry. Her work determining nanoparticle properties including charge, size, and aggregation rate was used to predict behaviors and interactions with biological cells in aquatic environments.

In addition to her work assessing the environmental impact of engineered nanoparticles, Dr. Fleming has also explored potential applications of these particles. Her research involved the evaluation of low-pressure water filtration membranes modified with antibacterial silver nanoparticles. The ability of this modification to decrease bacterial growth and increase energy efficiency was tested in bench-scale laboratory studies.

Academic Credentials & Professional Honors

Ph.D., Geography & Environmental Engineering, Johns Hopkins University, 2020

M.S.E., Environmental Process Engineering, Johns Hopkins University, 2018

B.S., Environmental Engineering, Cornell University, 2014

American Chemical Society Graduate Student Award (2016)

Integrative Graduate Education and Research Traineeship (IGERT) Water, Climate, and Health Fellow

Licenses and Certifications

Professional Engineer Environmental, New Hampshire, #18055

Prior Experience

Technical Associate, EcoSafety Sciences, 2014-2019

Professional Affiliations

Society of Environmental Toxicology and Chemistry (SETAC)

American Water Works Association (AWWA)

Publications

Book Chapters

Fleming ML, Saxe JK. Chapter 10: Regulatory Environmental Risk Assessment of Human Pharmaceuticals. Fundamentals of Pharmaceutical and Biologics Regulations: A Global Perspective, McBride L and Schmitt S, Regulatory Affairs Professional Society (RAPS), 2023, 99–110.

Conference Proceedings

Steele, AN, Kulacki, KJ, Fleming, ML, Goodfellow Jr, WL. Whole effluent toxicity assessments and experimental considerations for evaluating coagulation agents and polymers for wastewater treatment of coal combustion. World of Coal Ash 2022 Conference Proceedings.

Peer-Reviewed Publications

Fleming M, Bouwer E, Chen KL. Biofouling response of laboratory-scale polysulfone membranes modified with bioinspired polydopamine and silver nanoparticles. Environmental Engineering Science 2019; 36:335-343.

Tang L, Huynh KA, Fleming M, Larronde-Larretche M, Chen KL. Imparting antimicrobial and antiadhesive properties to polysulfone membranes through modification with silver nanoparticles and polyelectrolyte multilayers. Journal of Colloid and Interface Science 2015; 451:125–133.

Buchanan BP, Fleming M, Schneider RL, Richards BK, Archibald J, Qiu Z, Walter MT. Evaluating topographic wetness indices across central New York agricultural landscapes. Hydrology and Earth System Sciences 2014; 18:3279-3299.

Presentations

Fleming M, Staveley J. Incorporating Farm Management Practices to Support Simplified Environmental Assessment of Veterinary Drugs. Society of Environmental Toxicology and Chemistry North America 44th Annual Meeting, Louisville, KY, 2023.

Kulacki KJ, Fleming ML, Goodfellow Jr, WL. End-of-Life Repercussions for Cosmetics and PCPs: Are the Appropriate Decision Frameworks Being Used? Society of Environmental Toxicology and Chemistry North America 44th Annual Meeting, Louisville, KY, 2023.

Samel A, Staveley J, Fleming M, et al. Critical Review and Recommendations to Improve the Quality and Reproducibility of the U.S. EPA Chronic Mysid Shrimp Testing Guideline: Update on a CropLife America and CropLife Europe Project. Society of Environmental Toxicology and Chemistry North America 43rd

Annual Meeting, Pittsburgh, PA, 2022.

Fleming ML, Goodfellow Jr, WL, Kulacki KJ, Steele, AN. Experimental considerations for assessing coagulation agents and polymers for wastewater treatment of coal combustion products. Society of Environmental Toxicology and Chemistry North America 42nd Annual Meeting, Virtual, 2021.

Kulacki KJ, Steele AN, Fleming ML, Goodfellow Jr, WL. Assessment of Potential Effluent Toxicity from Ash Basin Dewatering Operations. Society of Environmental Toxicology and Chemistry North America 42nd Annual Meeting, Virtual, 2021.

Fleming M. Ecological and Human Health Risk Assessment Training Workshop: Veterinary Pharmaceuticals Module. Society of Environmental Toxicology and Chemistry 10th Biennial Conference, 2021.

Fleming M, Bouwer E. Interactions of chemical mechanical planarization nanoparticles and synthetic cell membranes. Association of Environmental Engineering and Science Professors Education and Research Conference, Tempe, AZ, 2019.

Fleming M, Bouwer E, Chen KL. Modifying water purification membranes with bioinspired polydopamine and silver nanoparticles for biofilm prevention. 4th Annual International Institute for Environmental Studies Science and Policy Workshop, Edinburgh, Scotland, 2018.

Fleming M, Bouwer E, Chen KL. Effects of modifying low pressure membranes with bioinspired polydopamine and silver nanoparticles on biofilm formation. 254th American Chemical Society National Meeting & Exposition, Washington, DC, 2017.

Fleming M, Chen KL. Polymeric membranes modified with bioinspired polydopamine and silver nanoparticles for water purification applications. 252nd American Chemical Society National Meeting & Exposition, Philadelphia, PA, 2016.

Project Experience

Prepared environmental assessments for human and veterinary pharmaceuticals in accordance with U.S. and EU regulations, with a focus on exposure assessment. Calculated predicted environmental concentrations (PECs) of active ingredients in soil, sediment, and surface water based on EMA and FDA guidance, modeled PECs using the U.S. Environmental Protection Agency (EPA) Pesticide in Water Calculator (PWC), and developed conceptual models for the environmental fate of active ingredients following wastewater discharge to surface waters.

Conducted literature review to identify and evaluate environmental risks associated with the production of genetically modified organisms. Contributed to several environmental assessments for these organisms for submission to the U.S. Food and Drug Administration (FDA) and the U.S. Department of Agriculture (USDA).

Led secondary review and engineering assessment of pilot-test drinking water treatment trains designed to achieve improved removal of per- and polyfluoroalkyl (PFAS) compounds. Treatment trains comprised various combinations of treatment technologies, including coagulation and flocculation, microfiltration, ultrafiltration, closed circuit reverse osmosis, reverse flow reverse osmosis, cross flow reverse osmosis, ion exchange, and granular activated carbon (GAC) treatment. Authored a report providing an overview of the pilot-test treatment trains including performance assessments.

Calculated the rolling annual averages of PFAS concentrations in treated drinking water based on quarterly monitoring, with and without GAC treatment in place, to determine the level of removal achieved by a full-scale drinking water treatment plant.

Compiled available data characterizing the PFAS levels in surface water and drinking water into a spreadsheet database and performed spatial and statistical analysis of the data. This analysis was performed in part to identify sites that may require remediation and drinking water intakes that would require additional treatment.

Managed evaluation of microbiological testing results for water samples collected from newly constructed drinking water pipeline. Reviewed the construction specifications, state water system standards, and distribution pipeline designs and performed statistical analysis of the microbiological testing results to inform conclusions regarding the quality of the water in the distribution system and the veracity of the interpretation of the results made by county employees.

Reviewed the results of NSF/ANSI Standard 61 tests to support failure analysis of EPDM hoses (water heater attachments). Evaluated differences in the water quality of the drinking water distribution systems where product failures had been observed, including assessing the source water, water treatment capacity, treatment technology, disinfectant process, storage system, water quality parameters and water quality violations.

Analyzed surface water data to determine whether unpermitted storm water discharges from a sugar processing plant were resulting in microbiological growth in stormwater drains and surface water. Performed a spatial analysis to identify potential sources of organic carbon entering the environment and to evaluate the “hot spot” areas where water quality characteristics, including biological oxygen demand, total organic carbon, *Escherichia coli*, and total fecal coliform, were exceeding state and county stormwater standards.

Assessed water and wastewater processes at coal-fired and gas-fired electric generation stations experiencing issues with intermittent toxicity of treated wastewater. Reviewed the water flow rates and chemical additions for key water and wastewater systems, National Pollution Discharge Elimination System (NPDES) permits, and the results of chronic toxicity testing performed with *Ceriodaphnia dubia* and *Pimephales promelas* to support the development of recommendations to help the client maintain long-term compliance with the facilities’ NPDES permits.

Reviewed federal and state definitions of hazardous waste toxicity as well as peer-reviewed literature on the bioavailability of metals in waste incinerator ash to inform an analysis of the suitability of regulating recycled cosmetics and personal care products as hazardous waste.

Performed document review and data analysis, including spatial data analysis, to support litigation projects related to Superfund (CERCLA) sites contaminated by chemicals of concern such as PCBs, PAHs, dioxins, and metals.

Conducted Screening-Level Ecological Risk Assessments (SLERAs) for contaminated sites by using available data to compare levels of chemicals detected in water and sediment (e.g., metals, PCBs, VOCs, SVOCs) to screening levels, identify chemicals of potential ecological concern, and calculate hazard quotients for relevant ecological receptors including benthic invertebrates, amphibians, fish, birds, and mammals.

Led data evaluation to assess the standards for control group performance required by the U.S. EPA test guideline for chronic toxicity testing with saltwater mysids (draft, 1996), which is routinely used by regulators to evaluate the environmental safety of crop protection products. Collected and anonymized data from more than 100 studies provided by participating agricultural companies, performed statistical analysis of control data, and co-authored report with recommendations for revisions to the draft test guideline.

Compiled and analyzed data related to honeybee exposure to neonicotinoids. Used results to develop comments on proposed pollinator protection regulations.

Evaluated peer-reviewed publications on the topic of bisphenol A (BPA) toxicity to ecological receptors for its reliability and applicability to future environmental assessments.

Study protocol development and monitoring for toxicity testing performed for a landscaping product.
Developed testing strategy based on review of product ingredient safety data sheets (SDS).

Conducted literature review on the historical development of several water bodies, including the evolution of natural resource services and the introduction of stressors including dam construction, climate change, overharvesting biological resources, and invasive species, to support causal analysis assessments.