Gretchen M. Bruce, DABT

Director of Toxicology

Professional Profile

Fields of Expertise

Toxicological Assessment; Human Health Risk Assessment; Exposure Assessment; Dose-Response and Pharmacokinetic Modeling; Extractables/Leachables; Emerging Contaminants (esp. Pharmaceuticals and Personal Care Products and Endocrine Disrupting Compounds) in Water/Food; Disinfection Byproducts; Regulatory Compliance; Dose Reconstruction; Litigation Support

Education/Certifications

Diplomate of the American Board of Toxicology (2009); Recertified 2014, 2019, 2024

B.S., Environmental Toxicology, University of California at Davis (1990)

Current and Previous Positions

Director of Toxicology, Intertox, Inc., Seattle, WA (2012–present)

Senior Scientist, Intertox, Inc., Seattle, WA (1999–2012)

Senior Health Scientist, McLaren/Hart/ChemRisk, Alameda, CA (1990–1999)

Research Assistant, University of California, Division of Occupational and Environmental Health, Davis, CA (1989–1990)

Research Assistant, University of California, Division of Environmental Toxicology, Davis, CA (1989–1990)

Select Project Experience

Thirty-five years of professional experience as a toxicologist/ human health risk assessor, assessing exposure to and health risks of chemicals in medical products, water, food, soil, air, consumer products, and other media. Areas of expertise include:

- **Toxicological assessment of extractables and leachables (E/Ls) and other drug product impurities,** according to International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH), United States Pharmacopeia (USP), and/or ISO 10993-17 guidelines. Established Analytical Evaluation Thresholds (AETs), Permitted Daily Exposure (PDE) levels, or Tolerable Intakes/Tolerable Exposures (TIs/TEs) and Margins of Safety (MOSs) for 200+ organic and

inorganic E/Ls. Conducted (quantitative) structure activity relationship ((Q)SAR) analyses to predict mutagenicity and implemented read-across methodologies in a manner with guidelines for chemicals lacking sufficient toxicology data. Assessed safety of excipients based on toxicity and use data. Prepared reports for FDA submissions.

- **Toxicological assessment of disinfection byproducts (DBPs) in drinking water,** including using *in vivo* animal data and *in vitro* data to characterize potential for mutagenicity/ carcinogenicity and reproductive/ developmental hazards and rank chemicals by potential hazard. Combined data with exposure information to identify DBPs most likely to contribute significantly to risk, and assess potential health risk reduction of changes in water regulations to include additional DBPs.

- **Toxicological assessment of emerging contaminants**, including pharmaceutical and personal care product ingredients (PPCPs) and endocrine disrupting compounds (EDCs), polyfluorinated substances (PFAS), 1,4-dioxane, and other chemicals, in reuse water or public water systems or vegetables grown in plots treated with reuse or river water. Assessed multi-pathway exposures, derived acceptable exposure levels based on toxicological data or established pharmaceutical dosing, estimated noncancer hazards and cancer risks, and implemented probabilistic methodologies to characterize uncertainty and variability in estimates. In other assessments, characterized potential cancer risks of PFAS in firefighting foams and turn out gear.

- **Toxicological assessment of chemical substances in aircraft cabin air or from accidental jet fuel releases**, including from jet engine oils, hydraulic fluids, fuels, combustion processes, and other sources. Assessed potential mechanisms of action and dose-response, identified toxicity thresholds, and characterized risks.

- **Development and implementation of physiologically based pharmacokinetic (PBPK) models** to predict internal doses of perchlorate and potential changes in thyroid hormone levels, and to predict concentrations of ethanol, lead, and other substances in blood over time. Assessed individual factors that can contribute to variability in blood concentrations.

- **Hazard assessment of workplace exposure to chemical agents and products**, including cellulose insulation, PCBs, wood treating chemicals, solvents, particulate matter, and other substances. Characterized appropriate hazard categorizations based on experimental results, including eye and skin irritation/ sensitization and other acute effects.

- **Development of programs to support worker protection measures, including developing protocols for biological monitoring of workers** at a Department of Energy (DOE) facility based on pharmacokinetic data and potential health effects, and establishing appropriate personal protective equipment (PPE) for workers based on predicted stack releases and fence line concentrations.

- **Conducting California Proposition 65 risk assessments** to evaluate whether exposures to facility releases exceed no significant risk levels for inorganic substances and organic compounds. Provided recommendations for labeling or warnings.
- **Probabilistic modeling to predict potential pathogen levels in fresh produce**, including predicting pathogen growth and decay under various processing conditions and applying results to predict potential health risks. Statistically analyzed grower audit data and characterized trends in metric compliance for professional groups.
- **Toxicity assessment of nanoparticles** based on animal data, including assessing trends in toxicity of nanomaterials based on composition, size/ shape, and other parameters, and using data to predict product risks. Developed multicriteria decision analysis (MCDA) models to support decisions about the use of nanomaterials.
- **Conducting chemical fingerprint modeling**, including application of principal components analysis and graphical methods, to assess the likelihood that chemicals detected offsite are associated with specific release events.
- **Conducting toxicological assessments for perchlorate**, including assessing data on iodine uptake inhibition, thyroid hormone and thyroid effects, and neurodevelopment, to support review of toxicity criteria derived by U.S. EPA, the State of California, and others. Identified and consulted with experts in neurodevelopment to establish the state of the science.
- **Developing automated multi-pathway risk assessment models** to calculate exposures and potential human health risks from inhalation, ingestion (of soil, fish, vegetables, milk, and meat), and dermal contact to emissions from electrical generating facilities and cement plants.
- **Designing and conducting sampling to measure odor causing compounds** in air downwind of a cement kiln and in background areas. Evaluated the likelihood that detected concentrations could be associated with adverse health effects.
- **Conducting multi-pathway risk assessments of exposures to contaminants in the Ohio River**, including PCBs, chlorinated pesticides, and metals to support the State's identification of hot spots and characterization of significantly exposed populations.
- **Conducting toxicological assessments of lead and arsenic in soil near smelter facilities**. Characterized the scientific community's state of knowledge of lead and arsenic toxicity at the time of smelter operations.
- **Dose reconstruction of mercury released from the Department of Energy's Oak Ridge Reservation facilities** from 1950 to 1990. Developed chemical source terms based on review of historical monitoring records, assessed fate and bioavailability, developed automated probabilistic models to reconstruct multi-pathway exposures for each year of operation, and communicated findings at public meetings.

- **Investigation of risk factors contributing to increased incidence of lung disease among California workers**. Compiled a database of asbestosis and silicosis cases based on extensive review of worker compensation claims.

Publications and Presentations

Peterson E.S., Raseman W.J., Stanford B.D., **Bruce G.M.**, Klintworth H., Reckhow D. 2023. Evaluating regulatory scenarios to limit U.S. nationwide exposure to cytotoxic haloacetic acids. AWWA Water Science. 5(5):e1351. https://doi.org/10.1002/aws2.1351.

Pleus R.C., **Bruce G.M.,** Klintworth H., Sullivan D., Johnson W., Rajendran N., Keenan J. 2018. Repeated dose inhalation developmental study in rats exposed to cellulose insulation with boric acid additive**.** *Inhal. Toxicol. 30(13-14):542-552.*

Bruce G.M., Corey L.M., Pearce E.N., Braverman L.E., Pleus R.C. 2018. Determination of thresholds of radioactive iodine uptake response with clinical exposure to perchlorate: a pooled analysis. *J Occup Environ Med*. 60(4):e199-e206.

Bruce G.M. 2017. Toxicity Assessment in Safety/Biocompatibility Evaluations of Drug Packaging/Container Systems. Presentation to West Pharma, Exton, PA. July 18.

Bruce, G.M. 2015. Pharmaceuticals and Endocrine Disrupting Compounds in Water: A Primer for Public Outreach. Sponsored/Published by Water Research Foundation.

Bruce G.M., Pleus R.C. 2015. Washington State Water Quality Standards─ Where Do We Stand? K.L. Gates Brown Bag Seminars. August 10.

Colton R., Pleus R.C., **Bruce G.M.** 2014. The Importance of Toxicology in the E&L Process; Webinar, Seattle, WA. March 14.

Bruce G.M., Corey L.M., Mandel J.H., Pleus R.C. 2013. Urinary nitrate, thiocyanate, and perchlorate and serum thyroid endpoints based on NHANES 2001 to 2002. *J Occup Environ Med*. 55(1):52-8.

Bruce G.M. 2013. Apple Growing and Packing Microbial Risk Factors and Their Potential to Lead to Foodborne Disease Outbreaks; Apple Crop Protection Research Review, Wenatchee, WA. January 29.

Bruce G.M. 2012. MABEL: Use of Preclinical Data to Set Acceptable Standards for Exposure. Presented at the Society of Environmental Toxicology and Chemistry Annual Meeting, Long Beach, CA. November 13.

Pleus R.C., **Bruce G.M.** 2012. Keeping Up with the Chemists — Toxicological Risk Assessment for Extractables/ Leachables When Faced with Data Gaps. Extractables/Leachables Forum 2012, Boston, MA. September 20.

Bruce G.M. 2012. Use of the Minimum Anticipated Biological Effect Level (MABEL) to Set Acceptable Standards for Exposure. Presented at the Society of Toxicology Annual Meeting, San Francisco, CA. March 12.

Pleus R.C., **Bruce G.M.** 2012. Approaches to Toxicological Risk Assessment for Emerging Contaminants: Current State of the Science. PCWEA 39th Annual P3S Training Conference and Exhibition Emerging Contaminants: Regulatory Landscape, Huntington Beach, CA. February 27-29.

Bruce G.M. 2011. Multi-Criteria Decision Analysis Tool to Support Selection of Nanomaterial Studies: Development Update. Presented at Nanoinformatics 2011, Arlington, VA. December 8.

Bruce G.M., Pleus R.C. 2011. Adaptation of the Minimum Anticipated Biological Effect Level (MABEL) Approach to Developing Acceptable Daily Intakes for Emerging Compounds of Interest. Water Research Foundation, Denver, CO.

Bruce G.M. 2011. Adaptation of the Minimum Anticipated Biological Effect Level (MABEL) Approach to Developing Screening Levels for Emerging Compounds in Drinking Water. Presented at the Toxicology and Risk Assessment Conference (TRAC), West Chester Ohio. April 27.

Bruce G.M. 2011. Volatile Organic Compounds: Considerations in Assessing Risk. Presented at the Society for Chemical Hazard Communication Spring Meeting, Seattle, WA. March 30.

Bruce G.M. 2010. Development of a Multi-Criteria Decision Analysis Tool to Support Selection of Nanomaterial Studies. Presented at Nanoinformatics 2010, Arlington, VA. November 3.

Nellor M.H., Soller J., **Bruce G.M.,** Pleus R.C., Peterson M.K. 2010. Development and Application of Tools to Assess and Understand the Relative Risks of Drugs and Other Chemicals in Indirect Potable Reuse Water. WateReuse Foundation, Alexandria, VA.

Snyder S.A., Stanford B.D., Pleus R.C., **Bruce G.M.,** Drewes, J.E. 2010. Identifying Hormonally Active Compounds, Pharmaceuticals, and Personal Care Product Ingredients of Most Health Concern from Their Potential Presence in Water Intended for Indirect Potable Reuse. WateReuse Foundation, Alexandria, VA.

Bruce G.M., Pleus R.C., Snyder S.A. 2010. Toxicological relevance of pharmaceuticals in drinking water. *Environ Sci Technol*. 44(14): 5619-5626.

Bruce G.M. 2010. Using Leafy Green Products Handler Marketing Agreement (LGMA) Audit Data to Identify Non-Compliance Areas and Training Strategies. Poster at Center for Produce Safety (CPS) Research Symposium, Davis, CA. June 23.

Bruce G.M. 2010. Health Risk-Based Screening Levels for Pharmaceuticals and EDCs in Drinking and Reuse Water. Presented at the Pacific Northwest Section-American Water Works Association 2010 Annual Conference, Tacoma, WA. May 14.

Bruce G.M. Towards Estimating the Risks of EDCs: Insights and Issues. 2009. Presented at the American Water Works Association Annual Conference and Exposition, San Diego, CA. June 14-18.

Snyder S.A., Trenholm R.A., Pleus R.C., **Bruce G.M.**, Snyder E.M., Bennett E., Hemming J.C.D. 2009. Toxicological Relevance of EDCs and Pharmaceuticals in Drinking Water; American Water Works Association Research Foundation & WateReuse Foundation. Denver.

Bruce G.M. 2008. Safe Exposure Levels of Selected PPCPs, EDCs and Other Chemicals of Interest in Recycled Water. WRF Project #WRF-06-018: Tools to Assess and Understand the Relative Risks of Indirect Potable Reuse Projects. Presented at the WateReuse Symposium, Dallas, TX, September 8.

Snyder, S.A., Vanderford B.J., Drewes J., Dickenson E., Snyder E.M., **Bruce G.M.**, Pleus R.C. 2008. State of Knowledge of Endocrine Disruptors and Pharmaceuticals in Drinking Water, *AWWA Research Foundation*, Denver, CO.

Snyder E.M., **Bruce G.M**., Pleus R.C., Snyder S.A. 2007**.** Incidence and Toxicological Significance of Selected Endocrine Disrupting Chemicals (EDCs) in Drinking Water. Presented at the World Environmental and Water Resources Congress 2007, Tampa, FL. May 15-19.

Pleus R.C., **Bruce G.M.**, Snyder E.M., Snyder S.A., Corey L.M. 2006. Toxicological Relevance of EDCs and Pharmaceuticals. Invited speaker. Presented at the 2006 AWWA Annual Conference in San Antonio, TX. June 11-15.

Pleus R.C., **Bruce G.M.,** Snyder E.M., Snyder S.A., Corey L.M. 2006. Incidence and Toxicological Significance of Selected Pharmaceuticals in Drinking Water. Presented at the Groundwater Resources Association's Emerging Contaminants in Groundwater Symposium, Concord, CA. June 7-8.

Pleus R.C., **Bruce G.M.,** Snyder E.M. 2006. Addressing the Significance of Trace Level Findings. Presented at the Association of California Water Agencies Groundwater/ Water Quality Track: Pharmaceuticals in Groundwater: Public Health Issue or Public Relations Nightmare? Monterey, CA. May 10.

Bruce G.M., Pleus R.C., Snyder S.A., Snyder E.M. 2006. Toxicological Relevance of Pharmaceuticals and Endocrine Disrupting Chemicals in Water. Presented at the National Ground Water Association's 5th International Conference on Pharmaceuticals and Endocrine Disrupting Chemicals in Water, Costa Mesa, CA. March 14.

Snyder S.A., Pleus R.C., **Bruce G.M.**, Hemming J.D.C., Hulsey R.A., Snyder E.M. Approach for Assessing the Toxicological Relevance of Endocrine Disruptors and Pharmaceuticals in Drinking Water. 2005. Water Quality Technology Conference and Exhibition, Quebec, Canada. November 6-10.

Corey L.M., **Bruce G.M.,** Pleus R.C. 2005. Development of Nano-Based Risk Assessments: Challenges for the Present and Future. Mechanisms of Action of Inhaled Fibers, Particles and Nanoparticles in Lung and Cardiovascular Disease, Research Triangle Park, NC. October 25-28.

Chow J.C., Watson J.G., Savage N., Solomon C.J., Cheng Y., McMurry P.H., Corey L.M., **Bruce G.M.**, Pleus R.C., Biswas P., Wu C. 2005. Critical Review: Nanoparticles and the Environment. *Air & Waste Management Association.* 55: 1411-1417.

Corey L.M.**, Bruce G.M.**, Pleus R.C. 2005. Development of Nano-Based Risk Assessments: Challenges for the Present and Future. Mechanisms of Action of Inhaled Fibers, Particles and Nanoparticles in Lung and Cardiovascular Disease. Research Triangle Park, NC. October 25-28.

Bruce G.M., Peterson M.K., Pleus R.C. 2005. Comparative Risk Assessment of Multimedia Environmental Exposure to Perchlorate and Other Agents That Inhibit Iodide Uptake into The Thyroid. Poster at Society of Toxicology 44th Annual Meeting, New Orleans, LA. March 10.

Belzer R.B., **Bruce G.M.,** Peterson M.K., Pleus R.C. 2004. Using Comparative Exposure Analysis to Validate Low-Dose Human Health Risk Assessment: The Case of Perchlorate. In Linkov, I. and Ramadan, A., Eds. *Comparative Risk Assessment and Environmental Decision Making*. Kluwer. Pgs. 57-74.

Pleus R.C., **Bruce G.M.** 2004. Perchlorate Dose-Response Relationship and the Likelihood of Effects at Environmentally Relevant Levels. Presented at the American Chemical Society Annual Meeting, Philadelphia, PA. August 24.

Pleus R.C., **Bruce G.M.** 2004. Where Are We Now? An Update on the Perchlorate Action Level Debate. Seventh Annual Force Health Protection Conference. Albuquerque, NM. August 10.

Bruce G.M., Peterson M.K., Pleus R.C. 2004. Comparative Contribution of Perchlorate and Anti-Thyroid Agents in American Diets to Iodide Uptake Inhibition. Paper presented at the 32nd JANNAF Propellant Development & Characterization and 21st Safety & Environmental Protection Joint Meeting. Seattle, WA. July 29.

Bruce G.M., Pleus R.C. 2004. Neurobehavioral Effects of Anti-Thyroid Agents in Rats: A Review of the Historical Literature and Comparison to the Results of the Perchlorate Studies. A report prepared for the Perchlorate Study Group. Submitted to the National Academy of Sciences Committee to Assess the Health Implications of Perchlorate Ingestion. July 27.

Bruce G.M., Pleus R.C. 2004. Concerns Regarding U.S. EPA's Assessment of Thyroid Follicular Cell Adenomas Identified in the Rat 2-Generation Reproduction Study of Perchlorate. A report prepared for the Perchlorate Study Group. Submitted to the National Academy of Sciences Committee to Assess the Health Implications of Perchlorate Ingestion. July 23.

Pleus R.C., **Bruce G.M.** 2004. Adverse Effect Levels for Neurodevelopmental Effects Associated with Maternal Perchlorate Exposure: What Do Existing Data Indicate? 21st International Neurotoxicology Conference. Honolulu, HI. February 12.

Belzer R.B., **Bruce G.M.**, Peterson M.K., Pleus R.C. 2003. Comparative Anti-Thyroid Effects of Dietary Nitrate and Environmental Perchlorate. Presented at the Society for Risk Analysis Annual Meeting, Baltimore, MD. December 10.

Bruce G.M., Pleus R.C., Peterson M.K. 2003. Relative Contribution of Natural Anti-Thyroid Agents in American Diets and Their Potential Thyroidal Effects in Pregnant Women. Poster at Society for Risk Analysis Annual Meeting, Baltimore, MD. December 8.

Bruce G.M., Pleus R.C., Peterson M.K. 2003. Dose-Response Investigation of Tricresyl Phosphates Potentially Present in Airplane Cabin Air from Jet Engine Oils. Poster at Society of Toxicology 42nd Annual Meeting, Salt Lake City, Utah. March 9-13.

Pleus R.C., **Bruce G.M.**, Peterson M.K. 2003. Assessing Neurodevelopmental Effects of Environmental Exposures to Anti-Thyroid Agents: How Relevant are High Dose Rat Studies? Poster at Society of Toxicology 42nd Annual Meeting, Salt Lake City, Utah. March 9-13.

Peterson M.K., **Bruce G.M**. and Pleus R.C. 2002. Implications for the Use of Thyroid Endpoints from Rat Reproductive/Developmental Toxicity Studies in Human Risk Assessment. Presented at the Society for Risk Analysis Annual Meeting Symposium on Perchlorate: Policy Implications, New Orleans, LA, December 8-11.

Bruce G.M., Peterson M.K., Pleus R.C. 2002. Sequence of Neurodevelopmental Effects of Anti-thyroid Agents in Rat Offspring: What Should We Expect to See? Poster at NIEHS Thyroid Hormone & Brain Development Conference, Research Triangle Park, North Carolina, September 23-25.

Belzer R.B., **Bruce G.M.**, Peterson M.K., Pleus R.C. 2002. Exposure to Anti-thyroid Chemicals in the Environment and Diet. Poster at NIEHS Thyroid Hormone & Brain Development Conference, Research Triangle Park, North Carolina, September 23-25.

Peterson M.K., **Bruce G.M.**, Pleus R.C. 2002. Identification and Risk Assessment of Odorous Chemicals Associated with Combustion Processes. Poster at Air & Waste Management Association's Hazardous Waste Combustors Specialty Conference & Exhibition, St. Louis, Missouri, April 17-19.

Bruce G.M., Pleus R.C. 2002. Summary of the Expert Review of the Argus, 2001 Evaluation of Perchlorate Effects on Brain Morphometry in Neonatal Rats. Submitted to Eastern Research Group, Inc. for the U.S. EPA /ORD Peer Review Workshop-Perchlorate Environmental Contamination: Toxicological Review and Risk Characterization. March 5-6, Sacramento, CA.

Bruce G.M., Johnson D., Pleus R.C. 2002. Assessment of the Validity of U.S. EPA's Interpretation of an Effect of Altered Neurobehavior in Offspring Treated with Perchlorate *in utero*: A Critical Review of the Argus (1998) and Bekkedal *et al*. (2000) Studies. Submitted to Eastern Research Group, Inc., for the U.S. EPA /ORD Peer Review Workshop-Perchlorate Annual Meeting, Washington D.C.

Paustenbach D.J., **Bruce G.M.**, Chrostowski P. 1997. Current views on the oral bioavailability of inorganic mercury in soil: Implications for health risk assessment. *Risk Anal.* 17(5): 533-544.

Brorby G.P., **Bruce G.M.**, Buddenbaum J.E., Ripple S.R., Widner T.E., Yarbrough M. 1994. Use of radionuclides and chemical screening methods to focus investigation of off-site health risks from past Oak Ridge operations. In: *Managing Radioactive and Mixed Waste, Proceeding of the Twenty-Seventh Midyear Meeting of the Health Physics Society*, Albany, NY. Feb 13-17.

Anderson R.A., Colton T.C., Doull J., Marks J.G., Smith R.G., **Bruce G.M.**, Paustenbach D.J., Finley B.L. 1993. Designing a biological monitoring program for exposure to chromium: Conclusions of an expert panel. *JTEH.* 40:579-607.

Research Grants

Principal Investigator, *Water Research Foundation (WaterRF) 5085—Impact of Haloacetic Acid (HAA) MCL Revision on Disinfection Byproduct (DBP) Exposure and Health Risk Reduction;* Years: 2021–2023. Co-Principal Investigator with Hazen and Sawyer and University of Massachusetts. Assessed potential human health impacts of HAAs and other DBPs based on *in vitro* and *in vivo* data characterizing the toxicity of DBPs. Combined data with nationwide water concentration data to characterize relative hazards associated with water from different sources or subject to different treatment technologies, to support recommendations regarding potential implications of revisions to the MCL.

Principal Investigator, *WaterRF 4387: "Development of a Water Utility Primer on EDCs/PPCPs for Public Outreach"*; Years: 2013-2015. Consolidated information on endocrine disrupting compounds (EDCs) and pharmaceutical and personal care product (PPCP) ingredients in a "primer" to support utility communication with non-technical audiences, including regarding sources, occurrence, health effects, regulations, and treatment options.

Co-Principal Investigator, *AwwaRF/ WaterRF 4214: "Development of Acceptable Daily Intakes (ADIs) for Pharmaceutical and Personal Care Product Ingredients, Hormonally Active Compounds, and Other Potentially Highly Toxic Compounds of Emerging Interest in Water Using the Minimum Anticipated Biological Effect Level (MABEL) Approach*". Years: 2009-2011. Developed and applied method to determine health-protective ADIs for compounds of emerging interest to the water industry, based on the MABEL (i.e., the lowest dose with any measurable effect on biological systems) as the point of departure.

Project Risk Assessor, *WRF-05-005: "Identifying Pharmaceuticals/ Personal Care Products of Most Health Concern and Persistence through Water Treatments Used for Potable Reuse*"; Principal Investigator: Shane Snyder (SNWA); Years: 2007-2010. Developed and directed an expert workshop to discuss alternative methods to efficiently derive human health risk-based screening levels for PPCP ingredients and EDCs in potable water. Established a consensus decision tree for developing screening ADIs using available toxicity information.

Project Risk Assessor, *WRF-06-018: "Development and Application of Tools to Assess and Understand the Relative Risks of Drugs and Other Chemicals in Indirect Potable Reuse Water*"; Principal Investigator: Margaret Nellor (Nellor Environmental Associates, Inc.), Jeffrey Soller (Soller Environmental); Years: 2007-2011. Identified screening level tolerable daily intakes based on human health risks for compounds that might be present in recycled water, including PPCP ingredients, components of household products, EDCs, and other emerging contaminants, and proposed risk metrics to support communication.

Project Risk Assessor, *AwwaRF/ WaterRF 3033: "Comprehensive Utility Guide for Endocrine Disruptors and Pharmaceuticals in Drinking Water"*; Principal Investigator: Shane Snyder (SNWA); Years: 2004-2008. Developed a utility guide

describing analysis, occurrence, treatment, and possible human health and environmental effects of trace EDCs and PPCP ingredients. Final report published by AwwaRF/WaterRF.

Project Risk Assessor, *AwwaRF/ WaterRF 3085/WRF-04-003: "Toxicological Relevance of Endocrine Disruptors and Pharmaceuticals in Drinking Water*"; Principal Investigator: Shane Snyder (SNWA); Years: 2004-2008; Narrowed candidate list of 3,000 PPCP ingredients based on usage, occurrence, analytical methods, toxicity, public interest, and drug representation. Developed human health risk-based acceptable daily intakes (ADIs) for 16 PPCPs and 13 EDCs to assess risk across U.S. utilities.