June 30, 2020

To all Parties,


The Wek’èezhìi Land and Water Board (WLWB) is requesting Parties provide their preferred Panel members for the Water Quality Monitoring Independent Review Panel (the Panel) from the attached list of candidates (Attachment 1) for the Board’s consideration. The Panel is a requirement from the Mackenzie Valley Environmental Impact Review Board’s Report of Environmental Assessment (REA) associated with Diavik Diamond Mines (2012) Inc.’s (DDMI) application to amend Water Licence W2015L2-0001 to allow for the deposit of Processed Kimberlite (PK) into the Mine Workings.

Background

DDMI applied to amend its Water Licence W2015L2-0001 on June 1, 2018 to allow for PK to be deposited in the Mine Workings.¹ On February 19, 2019, the Mackenzie Valley Environmental Impact Review Board (the Review Board) referred the project to environmental assessment. The Review Board submitted the REA on January 6, 2020 to the Minister of Lands; the REA included several measures to prevent or reduce the likelihood of significant adverse impact on the cultural use of Lac de Gras. REA measure 4 states “Diavik will establish an independent review panel for water quality modelling”.² As part of REA measure 4, the Review Board requires DDMI to develop the Panel terms of reference (ToR) for approval by the WLWB. REA measure 4 also states that the WLWB “will engage Diavik and intervenors to identify and select panel members with appropriate expertise in hydrodynamic water quality modeling and extra-fine processed kimberlite or clay hydrodynamics”.³

DDMI submitted the ToR on March 26, 2020, along with six suggestions for Panel member candidates with expertise in hydrodynamic water quality modeling and extra-fine processed kimberlite or clay hydrodynamics.⁴ On June 8, 2020, the Board released its decision to approve the ToR and provided

---

¹ See WLWB (www.wlwb.ca) Online Registry for Diavik - WL Amendment Application - PK to Mine Workings - Jun 4_18
² See the Review Board’s website for EA1819-01 Diavik Report of Environmental Assessment FINAL.pdf
³ Ibid.
direction for the next version of the ToR. The Board decided that the Panel will consist of a minimum of three Panel members with appropriate expertise in hydrodynamic water quality modeling and extra-fine processed kimberlite or clay hydrodynamics.

On June 8, 2020, an Information Request was sent to Parties requesting they provide recommendations on additional Panel member candidates for the Board to consider. Responses were received from DDMI, the Environmental Monitoring Advisory Board (EMAB), and the Government of the Northwest Territories (GNWT) Department of Environment and Natural Resources (GNWT-ENR). DDMI stated it had no additional names to provide outside of the candidates it provided with the ToR. Both EMAB and the GNWT-ENR recommended three candidates for the Board to consider.

Information Request

In the Board’s decision on the ToR, the Board stated that “Parties should be given an opportunity to provide their preferred Panel member candidates from a finalized list of candidates for the Board to consider”. In total, twelve (12) candidates have been recommended. The finalized list of Panel member candidates is provided in Attachment 1, along with other requested information (i.e., area of expertise, conflicts of interest to declare, confirmation that the candidate has expressed an interest in sitting on the Plane). Copies of the candidate’s resumes are provided in Attachment 2.

The Board requests Parties provide the following information on or before Tuesday, July 14, 2020:

1. Please choose a minimum of three candidates from the list of candidates provided in Attachment 1 that you would prefer as Panel members. Please include candidates within each area of expertise;
2. Rank your chosen candidates in order of preference; and
3. Provide rationale for why you chose those candidates and their rankings.

If there are any candidates that you do not think should be considered for this Panel, please indicate their names, and provide a rationale for your opinion.

Once Parties have provided their preferred candidates, DDMI will have an opportunity to respond. DDMI’s response is due on or before 12:00 PM MST on Monday, July 20, 2020. The Board will then consider Parties’ lists, DDMI’s response, and other supporting information in its decision on the Panel members.
Sincerely,

Chris Hotson,
Acting Executive Director, WLWB

Copied to: Diavik Distribution List

Attachment 1: Panel Member Candidates
Attachment 2: Resumes of the candidates
## Attachment 1: Panel Member Candidates

<table>
<thead>
<tr>
<th>Candidate</th>
<th>Expertise</th>
<th>Company</th>
<th>Recommending Party</th>
<th>Expressed interest in sitting on the Panel?</th>
<th>Conflict of Interest to Declare?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daniel Potts, Hydrotechnical Engineer</td>
<td>Hydrodynamic water quality modeling</td>
<td>Tetra Tech</td>
<td>DDMI</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Dr. Brenda Bailey, Manager, Environmental Geoscience and Permitting/Inspector of Mines</td>
<td>Hydrodynamic water quality modeling</td>
<td>BC Ministry of Energy, Mines, Petroleum Resources</td>
<td>DDMI</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Scott Wells, Professor of Civil and Environmental Engineering</td>
<td>Hydrodynamic water quality modeling</td>
<td>Portland State University</td>
<td>DDMI</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Dr. J. Craig Swanson, Principal Associate</td>
<td>Hydrodynamic water quality modeling</td>
<td>Swanson Environmental Associates LLC</td>
<td>DDMI</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Dr. Randy Mikula, Owner of Kalium Research</td>
<td>Clay Hydrodynamics</td>
<td>Kalium Research</td>
<td>DDMI</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Dr. Heather Kaminsky, Lead Researcher</td>
<td>Clay Hydrodynamics</td>
<td>NAIT</td>
<td>DDMI</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Dr. Scott Tinis</td>
<td>Hydrodynamic water quality modeling</td>
<td>Lorax Environmental</td>
<td>EMAB</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Dr. Bill Price</td>
<td>Hydrodynamic water quality modeling</td>
<td>Natural Resources Canada</td>
<td>EMAB</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Candidate</td>
<td>Expertise</td>
<td>Company</td>
<td>Recommending Party</td>
<td>Expressed interest in sitting on the Panel?</td>
<td>Conflict of Interest to Declare?</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------------------------------------</td>
<td>--------------------------------------------------------------</td>
<td>--------------------</td>
<td>-------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Dr. Christoph Wels</td>
<td>Hydrodynamic water quality modeling</td>
<td>Robertson Geoconsultants Inc.</td>
<td>EMAB</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Dr. Gregory Lawrence</td>
<td>Hydrodynamic water quality modeling</td>
<td>The University of British Columbia - Department of Civil Engineering</td>
<td>GNWT-ENR</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Dr. Roger Pieters</td>
<td>Hydrodynamic water quality modeling</td>
<td>The University of British Columbia - Department of Earth, Ocean and Atmospheric Sciences</td>
<td>GNWT-ENR</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Dr. Shahid Azam</td>
<td>Extra-fine processed kimberlite or clay hydrodynamics</td>
<td>University of Regina - Faculty of Engineering and Applied Science</td>
<td>GNWT-ENR</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Attachment 2: Candidate’s Resumes
EXPERIENCE SUMMARY

Mr. Potts is a Hydrotechnical Engineer in Vancouver, BC. He holds a Master’s Degree in hydrotechnical engineering, and has experience in coastal and oceanographic engineering projects and 3-D modelling. He has explained technical concepts to non-technical audiences ranging from regulators to lawyers to the general public and has developed numerical tools and models for many applications.

RELEVANT EXPERIENCE

Relevant project experience for Mr. Potts includes the following:

- Reviewed drill cuttings dispersion modelling and oil spill modelling for offshore drilling applications in New Zealand
- Reviewed regular monitoring data from Quesnel Lake, BC, for Mt Polley Mining Corporation in support of their discharge permit
- Reviewed court documents and public data for a civil case involving flooding in Black Creek, BC
- Assessed risks related to sanitary sewer overflows for a metropolitan coastal city using stochastic hydrodynamic modelling (confidential client)
- Simulated the fate of fugitive sediments from dredging and other construction activities for the proposed marine terminal expansion on Roberts Bank in Vancouver, BC
- Developed and operated an oil spill trajectory model accounting for wind and current advection and shoreline trapping
- Reconstructed sequence of underwater events in Quesnel Lake, following the Mt Polley Mine Tailings Storage Facility failure, using survey data and 3-D modelling
- Simulated delta formation in Lake Okanagan for Mission Creek in the freshet of 2012
- Assessed wave attenuation and wind, wave and current forces for various marina designs; implemented hydrodynamic, wave propagation, and wave-structure interaction models
- Designed hydraulic systems for deep-sea mine tailings placement, and evaluated pipe stresses during pipe sinking procedures
- Assessed the adequacy of mooring systems to withstand extreme wind and wave events
- Developed and updated protocols for a multi-firm project to model and assess Chicago’s trunk sewer network; quality-controlled model construction and updates made by others
- Evaluated capital improvements planned for City of Chicago sewers by simulating before-and-after levels of service

EDUCATION

M.A.Sc. in Hydrotechnical Engineering, University of British Columbia
B.A.Sc. in Civil Engineering, University of British Columbia

AREA OF EXPERTISE

Oceanography and hydraulic engineering
Wind-wave studies and marina design
Collection systems modeling and water quality protection

AFFILIATIONS

Member, Association of Professional Engineers and Geoscientists of British Columbia (APEGBC)

OFFICE

Vancouver, B.C.

YEARS OF EXPERIENCE

11 Years
PROFESSIONAL EXPERIENCE


Manager, Environmental Geoscience and Permitting/Inspector of Mines

- Manage and mentor a team of highly specialized technical staff and professional contractors related to water quality, geoscience and hydrogeology to meet legislative requirements and support an environmentally responsible mining industry.
- Provide expert advice to the Chief Inspector of Mines, Deputy Chief Inspector of Mines and senior executive on sensitive operational initiatives/issues and major mine approval matters.
- Negotiate technical resolution on difficult issues with multiple stakeholders, including other government agencies, indigenous groups, and mining proponents, and other government agencies to ensure consistency and coverage of environmental issues.
- Provide technical guidance to mining industry clients and consultants and liaison with Indigenous groups on technical aspects of mining projects.
- Conduct extensive technical review and analyses of mining proposals, applications and technical submissions to ensure mines are designed, constructed, operated and closed using methods and techniques that protect land and watercourses, and prevent, minimize and manage environmental liabilities associated with ML/ARD.
- Perform routine and reactionary inspections of environmental aspects of mines sites to assess compliance with regulations, permit conditions and environmental protection requirements, including the Mines Act and Health Safety and Reclamation Code for Mines in BC.
- Assess the long-term environmental liabilities of major mines sites and establish the amount of financial security required to cover environmental protection and reclamation requirements.
- Final reviewer of multidisciplinary regulatory permits for statutory decisions makers.
- Provincial represented on National Mine Environment Neutral Drainage; Ministry representative on the BC Technical and Research Committee on Reclamation.
- Develop and update internal policies and procedures for technical staff, and external policy and guidance documents for the mining industry.


Senior Environmental Geoscientist/Inspector of Mines

- Conducted extensive technical review and analyses of mining proposals, applications and technical submissions to ensure mines are designed, constructed, operated and closed using methods and techniques that protect land and watercourses, and prevent, minimize and manage environmental liabilities associated with ML/ARD.
- Performed routine and reactionary inspections of environmental aspects of mines sites to assess compliance with regulations, permit conditions and environmental protection requirements.
- Assessed the long-term environmental liabilities of mines sites and establish the amount of financial security required to cover environmental protection and reclamation requirements.
- Prepared regulatory permit conditions designed to evaluate the environmental effects of mining.
- Negotiated technical resolution on difficult issues with multiple stakeholders, including other government agencies, indigenous groups, and mining proponents, and other government agencies to ensure consistency and coverage of environmental issues.
- Provided technical guidance to statutory decisions makers and senior executive, and liaison with Indigenous groups on technical aspects of mining projects.
- Provincial represented on National Mine Environment Neutral Drainage; Ministry representative on the BC Technical and Research Committee on Reclamation.

ERM Rescan, Vancouver, British Columbia 2012-2014

Consultant – Geochemist

- Managed and conducted the examination of the geochemical behavior and reactivity of ore and mine wastes (waste rock and tailings materials) of existing and proposed mines, and their potential impacts on the environment.
- Responsible for ML/ARD prediction and assessment for projects in the environmental assessment and permitting phases within Canada, and Internationally. Responsibilities include ML/ARD program design, geological sampling, data management, memorandum and report writing, communication with project managers and clients, and budget development and management.
- Performed water quality prediction modeling for proposed and active mining operations, including water balance validation, geochemical source term development, scale-up predictions, treatment options, dewatering of open pit and underground facilities, cyanide and blast residual degradation rates, discharge criteria, and dilution ratios to the receiving environment.
• Provided third-party scientific reviews of the surface water quality and ML/ARD assessments, and water quality prediction models included in applications for environmental assessment certificates and mines act permits for industry and First Nations clients.
• Reviewed technical work completed by colleagues and provided technical guidance and advice to junior geologists and engineers. This includes data calculation and analysis, memorandums, and reports, such as responses to information requests and technical working group comments generated during the environmental assessment and permitting phases of mine project applications.

University of Waterloo, Department of Earth and Environmental Sciences, Waterloo, Ontario 2007-2012

Research Assistant
• Launched an innovative geochemical and microbiological field sampling program of waste rock piles at an industrial site.
• Established the laboratory facilities to perform microbial analysis related to PhD research (study design, budget development, procurement of supplies, method development, and mentoring of laboratory assistants).
• Contributed in a collaborative multi-disciplinary research team to design and execute specific research activities including hydrology, thermal and gas transport.
• Analyzed geochemical and microbiological data to prepare a thesis dissertation, scientific publications and reports to sponsors and stakeholders.
• Communicated scientific results to fellow students, principal investigators, project sponsors and stakeholders through daily communication and collaboration, written progress reports, scientific journal publications, and oral presentations in project team meetings and at industry conferences.
• Performed geochemical equilibrium modeling using MINTEQ and PHREEQC.
• Supervised undergraduate and graduate research assistants at the Diavik Diamond Mine during field work to ensure the research team followed NWT Mine Act and Rio Tinto safety standards.
• Co-supervised undergraduate UW research assistants in laboratory facilities to achieve quality results.


Junior Environmental Scientist
• Assisted project managers with water and soil quality monitoring programs to fulfill landfill Certificate of Approval monitoring and reporting requirements to the Ministry of Environment (Ontario).
• Conducted field studies related to groundwater and surface water monitoring of operating and closed landfills, groundwater supply and protection studies, hydrogeological site assessments, and indoor air quality assessments.
• Performed data analysis and interpretation, prepared reports and proposals, and conducted literature reviews.
• Developed a site-specific statistical tool to evaluate the water quality at an operational landfill site. This tool was designed to estimate changes in the background water quality as a result of local sources (landfill) or downstream sources. This method was accepted as a tool for evaluating if site-specific water quality guidelines were met on a seasonal basis.


Environmental Technician
• Designed and launched an experimental hydrocarbon contaminant remediation project.
• Performed extensive field work including water quality sampling of collection ponds, Lac de Gras lake water, seepage wells and streams, water treatment facilities and ground water wells in -40°C working conditions.
• Collected data for wildlife monitoring programs in locations accessed by helicopter, snow machine, boat and foot.
• Conducted laboratory analysis of water samples for ammonia, total suspended solids, turbidity, pH, and dissolved oxygen.
• Maintained water quality and wildlife data using environmental data manager program Envista and Microsoft access.
• Provided geographic information processing using ArcGIS 8.0 to create various maps such as dust gauge locations, water sampling stations, and Raptor nest locations.
• Organized 2003 Fish Palatability Study involving five aboriginal groups from five communities to determine fish quality.
• Co-dissected fish for samples of the liver, kidney, flesh and otiliths (ear bones) to establish fish health.

EDUCATION

Doctor of Philosophy (Ph.D) in Earth Sciences,
• Specialization in aqueous geochemistry, University of Waterloo, Waterloo, Ontario
• Thesis: The geochemical and microbiological characterization of low sulfur content waste rock at the Diavik Diamond Mine

Master of Science (MSc) in Earth Sciences,
• Specialization in chemical and environmental toxicology, Carleton University, Ottawa, Ontario
• Thesis: The potential role of bacteria as a bioremediation technique at the Sydney Coke Ovens site
Bachelor of Science (BSc) in Environmental Sciences (Highest Honours),

- Minor in Geographic Information Systems, Carleton University, Ottawa, Ontario, Canada
- Thesis: The removal of hydrocarbons from contaminated crushed granite rock at the Diavik Diamond mine site.

SELECT PROFESSIONAL TRAINING

- Various BC Mine Inspector Training 2014- present (e.g. administrative law, confined space awareness, defensive driving and winter driving, H2S awareness, transportation of dangerous goods, compliance and enforcement skills, note taking, incident command system, WHIMIS)
- BC Mine Supervisor Certificate 2020
- Wilderness First Aid (4 day training course) 2018
- Mine Rescue Training Surface and Underground (5 day, BC Gov’t Internal Training) 2016
- Annual Metal Leaching / Acid Rock Drainage Field School; (5 day Bulkley Valley Research Centre) August 2015
- Environmental Geochemistry, Mineralogy, and Microbiology of Arsenic, Scheduled June 15-16, 2014
- Rare-Metals: Geology, Mineralogy and Geochemistry, March 5, 2011
- Geoenvironmental Modeling of Ore Deposits (192 hours), February 13-20, 2010
  Modules: Introduction to Geoenvironmental Modeling, Geoenvironmental Models of Ore Deposits, Environmental Mineralogy, and Hydrogeochemistry in Mining and Exploration
- Laboratory Research Visit Bangor University, Bangor, Wales, UK, February 2008 and December 2009
  Facilitated the development of appropriate sample collection techniques for Diavik waste rock and effluent samples
  Learned molecular biology techniques including DNA extractions, electrophoresis, T-RFLP, and PCR
- Standard First Aid with CPR-C and AED
- Occupational Safety and Health Administration (OSHA), 2007-2013
- HAZWOPER - OSHA 29 CFR 1910.120 - 40 hr. course plus annual 8 hr. recertification
- Northwest Territories and Nunavut Mine Supervisor II, 2008-2012
- Environmental Monitoring Techniques Course, 2004
  Practiced precision and accuracy in mock environmental monitoring programs related to Canada’s Diamond industry monitoring regulations, including water quality and wildlife monitoring. Discussed sampling techniques, accepted field book practices, data sheet creation, data management, and quality control/quality assurance.

PROFESSIONAL VOLUNTEER SERVICES

- BC Technical and Research Committee on Reclamation, Treasurer 2018 - present
- MEND committee member for Province of British Columbia 2017 - present

MEMBERSHIPS & ASSOCIATIONS

- Professional Geoscientist, Engineers and Geoscientists BC, 2014 - present
- Member, CIM – 2018

PUBLICATIONS

Articles published in refereed journals


Articles submitted to refereed journals


Articles in preparation for refereed journals


Other contributions


Short Course Volumes


Public Technical Reports

SCOTT A. WELLS
Department of Civil and Environmental Engineering
Portland State University
P. O. Box 751
Portland, Oregon 97207-0751
(503) 725-4282 or (503) 725-4276 FAX (503) 725-5950
e-mail: wellss@pdx.edu web page: http://www.cee.pdx.edu/~scott

Biographical sketch
Ph.D. from Cornell University in Civil and Environmental Engineering, Master's degree in Civil Engineering at Massachusetts Institute of Technology, BS in Civil Engineering at Tennessee Technological University. Since 1987 he has been at Portland State University and is currently Professor of Civil and Environmental Engineering and is an Institute for Sustainable Solutions Fellow. His research areas are in modeling of environmental fluid mechanics: surface water quality and hydrodynamics and solid-liquid separation processes. He has written over 100 technical publications and is a co-developer of the latest version of the CE-QUAL-W2 water quality and hydrodynamic model. He has been called in for expert peer review by the USEPA, the State of California, the State Department, and many other organizations and has been used by EPA to conduct webinars in water quality modeling.

He has been involved in about 150 water body studies. In Oregon, he has been involved in hydrodynamic/water quality modeling on the Tualatin River, Hagg Lake, Barney Reservoir, the Columbia Slough system (Lower Columbia Slough, Upper Columbia Slough, Smith and Bybee Lakes, Peninsula Canal), Klamath River, Russel Creek (near Eugene), Coast Fork of the Willamette River, Bull Run Reservoir #2, Bull Run Reservoir #1, Bull Run Reservoir #3, Bull Run Lake, Upper and Lower Bull Run River, Dexter Reservoir, Willamette River (Oregon City Falls to Columbia River, including Multnomah Channel, Willamette River basin), Johnson Creek, Ashland Creek, Cooper Creek Reservoir, Skipanon River, Schooner Creek, Siletz Bay, South Santiam River, Middle Fork Willamette River, Bear Creek, Stone Creek below Timothy Lake, Laurance Lake, Waldo Lake, South Slough off Coos Bay, Yaquina Bay and Yaquina River, the Clackamas River Basin (Clackamas River, Timothy Lake, Lake Harriet, Frog Lake, North Fork Reservoir, Faraday Lake, Estacada Lake) and areas of Tillamook Bay and the Columbia River (Bonnieville Dam to St. Helens). His experience also includes water quality and hydrodynamic studies in Hawaii (Wahiawa Reservoir), Virginia (N. Anna Reservoir), Tennessee (Center Hill Lake), Kentucky (Laurel River Reservoir), Idaho (Boise River, Lower Snake River from Brownlee Reservoir to C. J. Strike Reservoir, Brownlee Reservoir, C. J. Strike Reservoir, Spokane River, Oxbow Reservoir, Hells Canyon Reservoir, Coeur D’Alene Lake, Pend Oreille River and Lake), California (Klamath River, Philbrook Reservoir, DeSabla Reservoir, Butte Creek, Millerton Lake, Lake Spaulding, Bowman Lake, Rollins Reservoir, Fordyce Reservoir, Jackson Meadows Reservoir, Oroville Thermalito diversion pool, Oroville Reservoir, Thermalito Afterbay, Feather River, Folsom Reservoir, Lake Curry), Washington (Columbia River, Clear Lake, Spirit Lake, Spokane River, Long Lake, White and Puyallup Rivers, Snohomish River and Estuary, Green River, Lake Roosevelt, Chelan River, Pend Oreille River, Tolt Reservoir, Lake Chaplain, Budd Inlet/Capitol Lake/Deschutes River, Chester Morse Reservoir, Cedar River, Banks Lake, Kachess Reservoir, Keechelus Reservoir), Colorado (Cherry Creek Reservoir, Three Lakes: Shadow Mountain, Granby Lake, Grand Lake), Wisconsin (Kinnickinnic River, Lake George), North Carolina (Jocassee and Keowee Reservoirs, High Rock Lake), Oklahoma (Tenkiller Reservoir on the Illinois River, Eucha Reservoir, Sparnaw Reservoir), Texas (Lake Lavon, Lake Travis, Trinity River), Montana (Warm Springs Ponds, Butte, MN), New York (Conesus, Hemlock, Cayuga, and Honeoye Lakes), West Virginia/Pennsylvania/Ohio (Ohio-Alleghany-Monongahela Rivers), Florida (Tampa Bay Water Supply Reservoir, Reservoir C-44), Israel (Lake Kinneret or Sea of Galilee, Jordan River, Dead Sea, experimental ponds at Dead Sea Works), China (Three Gorges Reservoir, Xiangxi Bay), Spain, Peru (Chaglla Reservoir), Brazil (Tabajara Reservoir), Costa Rica (El Diquis Hydroelectric Project), Guyana (Amaila Reservoir), Canada (Lake Lagopede, Pit Lakes region lakes, Lac des Manages), Iraq (Tigris River), and in the Ukraine (Dnieper River-reservoir system and Kiev Sea), where he spent the 1993-1994 year as a Fulbright scholar. For the 2007-2008 year, he was selected again as a Fulbright Scholar and taught and did research at the Earth Institute at Hebrew University and at the Israeli Geologic Survey in Jerusalem. During that time, he worked on the environmental impacts of the proposed Peace Conduit between the Gulf of Aqaba and the Dead Sea and was an advisor for the PBS NOVA special on ‘Saving the Dead Sea’ in 2019.

EDUCATIONAL BACKGROUND:
Ph.D. Cornell University 1990
"Modeling and Analysis of Compressible Cake Filtration"

**S.M. Massachusetts Institute of Technology** 1982

"Calibration and Verification of the Cooling Lake Model for North Anna Power Station"

**M.S.C.E. Tennessee Technological University** 1980

"Three-Dimensional Field Evaluation and Analysis of Water Quality in Two Reservoirs"

**B.S.C.E. Tennessee Technological University** 1979

**PROFESSIONAL EXPERIENCE:**

Principal Investigator, Collaborative Center for Geo-hazards and Eco-Environment in Three Gorges Area, Hubei Province, Three Gorges University, Yichang, China, 2016-2019.

Chair, Department of Civil and Environmental Engineering, Portland State University (September 2002 to December 2014)

Professor (September 1995 to present)

Associate Professor (September 1990 to August 1995)

Assistant Professor (September 1987 to August 1990)

Department of Civil Engineering, Portland State University

Graduate Research Assistant (September 1984 to August 1987)

Cornell University

Visiting Assistant Professor (January 1983 to August 1984)

Department of Mechanical and Aerospace Engineering, Boston University

Research Engineer (April 1982 to December 1982) R. M. Parsons Laboratory for Hydrodynamics, Massachusetts Institute of Technology

Graduate Research Assistant (September 1980 to March 1982)

Massachusetts Institute of Technology

Graduate Research Assistant (March 1979 to August 1980)

Tennessee Technological University

**HONOR SOCIETIES, AWARDS, REGISTRATION, MEMBERSHIPS AND PROFESSIONAL SOCIETIES:**

**Committee and Advisory Board Memberships:**

- Project Advisory Committee (PAC) for American Water Works Association (AWWA) Research Foundation for "Hydrodynamic Distribution of Pathogens in Lakes and Reservoirs," 2000/2001
- ASCE Energy Engineering Division (EY) Environmental Effects Committee Task Committee on Effects of Energy Production on Reservoir Water Quality, 2001-2004
- Member, Bronson Creek Water Quality Technical Advisory Committee, Unified Sewerage Agency, 1995-1998
- Member, Tualatin Basin Water Quality Technical Advisory Committee, Department of Environmental Quality, 1995-1998
- Member, Winchester Tidelands Restoration Project Advisory Group, South Slough National Estuary Reserve, Charleston, Oregon, 1993-1997
- Member, Technical Advisory Committee, Columbia Slough Water Quality Implementation Plan, 1993-1999
- Member, METRO Wetlands Technical Advisory Committee for Smith and Bybee Lakes, 1991-1993
- Member, METRO St. John's Landfill Technical Advisory Committee, 1990-1993
- Member, Portland Water Bureau Technical Advisory Committee, 1989-1990
- Member, Water Treatment Residuals Committee, AWWA, 1988-1990
- Member, ASCE Student Affairs Committee, Oregon Section, 1991-1993
- Member Task Force for PORT of Portland’s NPDES Permit for Deicing Chemicals, 1997-1998
- Portland State University Committees (Academic Requirements Committee, CE and EAS Scholarship Committees, Honors Program advisor, ASCE advisor, Tau Beta Pi advisor, Departmental Promotion and Tenure Committee
Reviewer:
- Reviewer for National Science Foundation Research Proposals
- Reviewer for USGS Water Resource Research Institute Proposals
- Reviewer for Journal of Freshwater Ecology
- Reviewer for Fluid/Particle Separation Journal
- Reviewer for Powder Technology
- Reviewer for Separations Technology
- Reviewer for Separation Science and Technology
- Reviewer for Journal of Environmental Engineering, ASCE
- Reviewer for Journal of Geotechnical Engineering, ASCE
- Reviewer for Journal of Hydrologic Engineering, ASCE
- Reviewer for Journal of Hydraulic Engineering, ASCE
- Reviewer for Journal of Irrigation and Drainage, ASCE
- Reviewer for Environmental Science and Technology
- Reviewer for Water Resources Research
- Reviewer for International Journal of Heat and Mass Transfer
- Reviewer for Estuarine, Coastal and Shelf Science
- Reviewer for AFS Book: Introduction to Filtration
- Reviewer for Journal of HydroInformatics
- Reviewer for Water
- Reviewer for Water Research
- Reviewer for Science of the Total Environment
- Reviewer for American Society of Agricultural and Biological Engineers
- Reviewer for CRDF (U.S. Civilian Research and Development Foundation for the Independent States of the Former Soviet Union) Proposals for Armenian-US Bilateral Grants Program III and the BRHE Program
- Judge Intel Northwest Science Expo 2002

Expert Peer Review (other than those mentioned in University and private contracts)
- Fulbright Peer Review Committee for Middle East and Israel: 2012-2014, CIES, Washington, D.C.
- Fulbright Research and Development Program, 2019, Ukraine engineering research proposals

Professional Societies:
- Water Environment Federation
- Past affiliation: American Society of Civil Engineers; American Filtration and Separations Society (Member, Board of Directors 95-96, 97-99; Chair, Education Committee 96-2000)

Honor Societies:
Phi Kappa Phi, Tau Beta Pi, Kappa Mu Epsilon, Chi Epsilon, Sigma Xi

Fellow
Institute for Sustainable Solutions at Portland State University

Awards:
- Fulbright Scholar Award 1993-1994 Academic Year to Kiev, Ukraine
- Fulbright Scholar Award 2007-2008 Academic Year to Jerusalem, Israel
- PSU CECS Faculty Research Award, 2001
- Pathfinder Award of Excellence – HDR Engineering, Boise ID, 2002
• PSU Branford Price Millar Award, 2019, for demonstrated excellence in the areas of scholarship, instruction, university service, and public service, and whose performance in the area of scholarship and research is judged to be exceptional.

**Registration:**
Professional Engineer: P.E. (Oregon #15050) (Civil Engineer, Environmental Engineer)

**Conference Moderator:** American Filtration Society, Cake Filtration Session, St. Louis, Mo., 1998; American Filtration Society, Fundamentals of Cake Filtration Session, Boston, MA, 1999; American Filtration Society, Fundamentals of Cake Filtration, Myrtle Beach, SC, 2000; AGU Conference 2004 Session co-chair; Yearly CE-SQUAL-W2 Seminar

**Science Advisor for PBS Nova Special on Dead Sea:** Served as reviewer for narrator script and animations for PBS special “Saving the Dead Sea” [https://www.pbs.org/wgbh/nova/video/saving-the-dead-sea/] which premiered in the US on April 24, 2019.

**COURSES DEVELOPED:**

Boston University, Department of Mechanical and Aerospace Engineering:
- EK 390,391,392 Calculus and Differential Equations, Fluid Mechanics and Thermodynamics, Solid Mechanics
- EK 401,402,403,404 Fourier Series and Partial Differential Equations, Linear Algebra for Engineers, Vector Field Theory for Engineers, Approximation Methods for Engineers
- AM 513 Compressible Fluid Dynamics
- AM 519 Heat Transfer
- AM 701 Advanced Fluid Mechanics

Portland State University, Department of Civil and Environmental Engineering:
- CE 112 Computations in Civil and Environmental Engineering
- CE 315 The Civil and Environmental Engineering Profession
- CE 361 Fluid Mechanics
- CE 364 Water Resources Engineering
- CE 371 Environmental Engineering
- CE 410/510 Water Quality Modeling: Sediment Dynamics
- CE 474 Unit Operations of Environmental Engineering
- CE 510 Near-Field Mixing Modeling
- CE 569 Groundwater Hydraulics and Contaminant Transport
- CE 572 Environmental Fluid Mechanics I
- CE 573 Numerical Methods in Environmental and Water Resources Engineering
- CE 574 Advanced Physical/Chemical Environmental Engineering Processes
- CE 576 Environmental Fluid Mechanics II
- CE 578 Water Quality Modeling

Technion University, Department of Water Resources, Faculty of Civil Engineering, Haifa, Israel: “Water Quality and Hydrodynamic Modeling”, Spring 2001


**EPA Region 6 Water Quality Modeling Conference and Workshop**, November 2013, Dallas, TX, invited workshop session on CE-QUAL-W2 and 2 presentations.


**FUNDED UNIVERSITY RESEARCH PROJECTS:**

- "Environmental Engineering Laboratory Development and Demonstration Project," Portland State University, Faculty Development Grant, 1988, $3000.
- "Field Study and Analysis of Water Level Management in the Upper Columbia Slough," City of Portland, Oregon, 1993-1995, $80,000.
- “CE-QUAL-W2 Model Development,” Waterways Experiments Station, Vicksburg, MS, 1997, $12,000.
▪ “CEQUALW2 Model Development,” Corps of Engineers, Waterways Experiments Station, Vicksburg, MS, 1998, $17,000.
▪ “Habitat Restoration in the Columbia Slough”, City of Portland, Bureau of Environmental Services, 1998-2000, $68,792.
▪ Water Quality and Hydraulic Modeling of the Green River Estuary in Washington,” King County METRO Seattle, WA, 2002-2003, $52,000.
▪ “Lake Waldo Environmental Assessment”, US Forest Service, 2003-2005, $80,000 (Total PSU project funding: $400,000).
▪ CE-QUAL-W2 Model Development, Waterways Experiment Station, Corps of Engineers, Vicksburg, MS, 2003-2004, $38,500.
“Laurance Lake Hydrodynamic and Temperature Model,” Middle Fork Irrigation District, Oregon, 2005, $8,000.
“Clackamas River Model: Impact of Increased Drinking Water Usage on Water Quality,” Clackamas River Water Management Group, Sunrise, OR, 2005, $12,000.
“Modeling the Impact of Increased Water Use in the Clackamas River,” Clackamas River Water Management Group, Sunrise, OR, 2007-2008, $55,000.
“CE-QUAL-W2 and RESSIM Integration,” Corps of Engineers, Waterways Experiments Station, 2008, $82,000.
“CE-QUAL-W2 and RESSIM Integration Phase II,” Corps of Engineers, Waterways Experiments Station, 2009, $75,000.
“Cedar System Water Supply for the City of Seattle,” City of Seattle, 2009-2011, $168,000
“Snake River Temperature Study,” Columbia River Intertribal Fish Commission, 2009, $45,000
“Spokane River water quality and hydrodynamic modeling for TMDL development,” EPA Region IX, 2009, $80,000
“Clackamas River Model: Impact of Increased Drinking Water Usage on Water Quality – Model Updates,” Clackamas River Water Management Group, Sunrise, OR, 2009, $12,000.
“CE-QUAL-W2 and RESSIM Integration Phase III,” Corps of Engineers, Waterways Experiments Station, 2010-2011, $90,000.
“Snake River system model support”, Idaho Power, Boise, ID, 2012-2013, $19,800.
“Cherry Creek Reservoir Model Peer Review,” Cherry Creek Management Association, Aurora, CO, 2014-2015, $27,000
“CE-QUAL-W2 Integration into HEC WAT for Columbia River System Model,” Corps of Engineers, HEC, Davis, CA, 2015, $64,000
“Lake Roosevelt CE-QUAL-W2 Model Development,” US Bureau of Reclamation, Boise, ID, 2015, $49,950

“Yakima Reservoir Model Development with Fish Bioenergetics,” Washington Department of Ecology, 2015-2016, $147,000.


“Prineville Reservoir Model Development,” Deschutes Water Control Board, 2016, $39,000.


“Willamette River Model Update,” Water Environment Services, Clackamas County, Oregon, 2019-2020, $55,000.


CONSULTANT TO:

- Portland Water Bureau, Portland, Oregon (Waybo landfill effect on groundwater pollution for Portland wellfield, 1988)
- Metropolitan Portland District Commission, Portland, Oregon (Effect of St. John's landfill on water quality in Columbia River Slough, 1989)
- Rhone-Poulenc Chemical Company, Shelton, Connecticut (Conditioning aids for sludge dewatering processes, 1988-1989)
- State of Oregon, Division of State Lands, South Slough, Oregon (Design and construction of stream gaging sites, 1989)
- Linda K. Williams, Attorney, Portland, Oregon (Near field and far field analysis of Boise Cascade/City of St. Helens discharge into the Columbia River, 1989)
- OBEC Consulting Engineers, Eugene, Oregon (Design of modifications for the Leaburg Power Canal Fish Screens, 1989)
- EWEB (Eugene Water and Electric Board), Eugene, Oregon (Hydraulic impacts of baffles after placement behind the Leaburg Power Canal Fish Screens, 1990)
- Woodward-Clyde Consulting Engineers, Portland, Oregon (Evaluation of storm water master plan for the City of Portland, 1990)
- Fishman Environmental Services, Portland, Oregon (Johnson Creek Water Resources management program including water quality, flood, natural resource, and human environmental issues in the watershed, 1990)
- Cornforth Consultants, Inc., Portland, Oregon (Finite element modeling of the groundwater levels associated with pumping to fill a reservoir for a pumped storage project, 1991)
- Unified Sewerage Agency, Hillsboro, Oregon (Assessment of groundwater contamination from a temporary wastewater sludge storage facility; modeling the unsteady leachate plume, 1992)
- Cascade Environmental Services, Bellingham, Washington (Dissolved oxygen modeling of the discharge of Timothy Lake to Stone Creek near Mt. Hood, Oregon, 1993)
▪ CH2M Hill, Portland, Oregon (Water quality modeling of the Klamath River system in Southern Oregon, 1995-1996)
▪ Carollo Engineers, Portland, Oregon (Water quality modeling of the Wahiawa Reservoir in Oahu, Hawaii, 1995-1996)
▪ Carollo Engineers, Portland, Oregon (Water quality modeling of the near-field mixing of the Caldwell treatment plant discharge into the Boise River, Idaho, 1996)
▪ Carollo Engineers, Portland, Oregon (Water quality and hydraulic assessment of Bear Creek and Ashland Creek, in Ashland, Oregon, 1996, 1997)
▪ R. M. Towill Corporation, Honolulu, Hawaii (Water quality modeling of Wahiawa Reservoir, Oahu, Hawaii, 1997)
▪ SECOR International, Portland, Oregon (Water quality modeling of near-field mixing in the Willamette River, Oregon, 1997)
▪ Seifer, Yeats, and Mills, LLP, Portland, Oregon (Stormwater and hydraulic modeling of the February 1996 flood in Lake Oswego, Oregon, 1997)
▪ METRO, Portland, Oregon (Water quality monitoring plan for Smith and Bybee Lakes, Portland, 1997)
▪ Carollo Engineers, Portland, Oregon (Water quality assessment of Ashland Creek, in Ashland, Oregon, 1998)
▪ Crawford Engineering, Portland, Oregon (Assessment of City of Astoria, Oregon, near-field mixing problems, 1998)
▪ R. M. Martin, Inc., Lake Oswego, Oregon (Hydraulic modeling of 100-year flood events for sub-basin in Lake Oswego, Oregon, 1998)
▪ Abiqua Engineering, Salem, Oregon (Water quality modeling of Russel Creek and Coast Fork of Willamette River, Oregon, 1998/1999)
▪ Ogden-Beeman Engineers, Portland, Oregon (Evaluation of velocities and water levels around St. John's Landfill, 1998/1999)
▪ HDR Engineering, Inc., Boise, Idaho (Water quality and hydrodynamic modeling of Snake River, Brownlee Reservoir, Hells Canyon Reservoir, and Oxbow Reservoir, Idaho/Oregon, 1999-2001)
▪ U.S. Environmental Protection Agency, Seattle, Washington (technical review of temperature modeling of the Columbia River system, 1999)
▪ HDR Engineering, Inc., Boise, Idaho (Tampa, Florida Water supply reservoir modeling, 1999-2001)
▪ City of Sutherlin, OR (Water quality modeling of hypolimnetic aeration for Cooper creek Reservoir, OR, 2000)
▪ Lincoln City, OR (Far field water quality modeling of the Lincoln City discharge into Schooner Creek and Siletz Bay, OR, 2000)
▪ Duke Engineering, Bellingham, WA (Water quality modeling of the Clackamas River-Reservoir systems, OR, 2000-2001)
▪ SECOR, Inc., Portland, OR (Water quality analysis of the tidal river Skipanon River near Astoria, OR, 2000)
▪ Parsons Brinckerhoff, Quade & Douglas, Portland, Oregon (Evaluation of new discharge structure at the entrance between N. Slough and Smith/Bybee Lakes around St. John’s Landfill, 2001)
▪ Lincoln City, Oregon (Near field mixing modeling of the WWTP outfall into Schooner Creek), 2001.
▪ Tulalip Indian Tribes, Tulalip, Washington (Snohomish River system model review), 2001-2002.
▪ City of Portland, Water Bureau, Portland, Oregon (Boeing-Cascade groundwater pollution study), 2002.
▪ Idaho Department of Environmental Quality, Boise, ID (CE-QUAL-W2 training), 2003
▪ EPA Region IX, CA (Water quality and hydrodynamic modeling of the Klamath River system workshop), 2003.
▪ US Bureau of Reclamation, Sacramento, CA (CE-QUAL-W2 training), 2004
▪ City of Kansas City, Kansas City, MI through Kennedy-Jenks Consulting Engineers (Temperature modeling of biological activity in a trickling filter), 2004.
▪ City of Toledo, OR (Mixing zone study for WWTP outfall in the Yaquina River), 2005.
▪ EPA, Region IX (Review of Klamath TMDL model), 2005.
▪ HyQual Engineering, Boise, ID (Technical modeling assistance for modeling hydraulics and water quality in the Boise River), 2006.
▪ Quantitative Environmental Analysis, LLC, Austin, TX (Technical assistance with water quality modeling of Lake Travis, Texas), 2007.
▪ EPA, Region IX (Peer review of Budd Inlet, Capitol Lake, and Deschutes River modeling), 2008-2009.
▪ Alan Plummer Associates, Ft. Worth, TX (Water quality and hydrodynamic modeling of Lake Lavon, TX and Trinity River, TX), 2009.
▪ HDR, Inc. (Temperature and hydrodynamic modeling of 5 reservoirs in Nevada County, CA: Spaulding, Rollins, Jackson Meadows, Bowman, and Fordyce), 2009-2010.
▪ SAIC, Inc. (Temperature and water quality modeling of the Eucha and Spavinaw Reservoir system, OK), 2009-2010.
▪ MWH, Inc. (Temperature modeling of the Oroville Thermalito diversion pool below the Oroville dam, CA), 2010.
▪ Exponent, Inc. (Water quality modeling of Amalia Reservoir, Guyana), 2010.
▪ Brown and Caldwell (Hydrodynamic modeling of the Clackamas River and peer review of watershed modeling in Bull Run reservoir basin), 2010.
▪ Idaho Power Company, Boise, ID (Modeling support for the Snake river complex of Brownlee, Hells Canyon and Oxbow Reservoirs), 2010-2011
▪ ARCO/BP (Modeling the Warm Springs Ponds, Butte Montana), 2010-2012.
▪ Alan Plummer Associates, Ft. Worth, TX (Water quality and hydrodynamic modeling of Lake Lavon, TX and Trinity River, TX), 2011.
▪ Odebrecht Perú (Water quality and hydrodynamic modeling of the Chaglla hydropower project in Peru), 2011
▪ Environnement Illimité inc, Montreal, Canada (Water quality and hydrodynamic modeling support for Lake Lagopedé, Canada), 2011.
▪ City of Klamath Falls, OR (TMDL assessment of the Klamath River, OR using CE-QUAL-W2 model), 2011-2012
- Cumulative Environmental Management Association (CEMA), Fort McMurray, Alberta, Canada (Technical review of pit lakes model for sediment diagenesis), 2011
- McMillen, LLC and Idaho Power Company, Boise, ID (Review of Hells Canyon Reservoir water quality model), 2012
- Cardno-Entrix, Sacramento, CA (Hydrodynamic and temperature modeling of Folsom Reservoir, CA), 2012-2016
- Dead Sea Works, Beer Sheva, Israel (Modeling of the Dead Sea ponds), 2012-2014
- CDM Smith, Ft. Worth, TX (Hydrodynamic and surface water quality modeling of the Trinity River, TX), 2013-2014
- CEMA, Alberta, Canada (Greenhouse Gas modeling and sediment diagenesis for Pit Lakes region in Canada), 2013-2014
- CDM Smith, OH (Peer review of the Ohio-Alleghany-Monongahela River model), 2013
- JPG Consultoria, Brazil (Water Quality and Hydrodynamic Modeling of Tabajara Reservoir and tailrace in Brazil), 2014-2015
- ERM Inc., PA (Peer review of water quality and hydrodynamic modeling of a new reservoir in Panama), 2015
- Deltas/TVA, TN, (Model code development for the CE-QUAL-W2 TVA models for integration into FEWS) 2015.
- Waterkeeper Alliance Inc., NY (Expert review of Neuse and Tar/Pamlico water quality studies, NC), 2016.
- ICE (Instituto Costarricense de Electricidad), San Jose, Costa Rica (Modeling the El Diquis hydropower project), 2016-2017.
- Cooper Environmental, Butte, Montana (Development of Solar Bees in CE-QUAL-W2 model of Warm Springs Pond), 2017
- Stantec, Inc., Sacramento, CA (Development of Feather River, Afterbay, and Oroville Reservoir Model and Update to Thermalito Model, Oroville, CA), 2017-2019
- Deltas/TVA, TN, (Model code development for the CE-QUAL-W2 TVA models for integration into FEWS) 2018.
- John Harrison Consulting, CA (Review of Tillamook Wastewater Treatment Plant Temperature permit regulations), 2018.
- Rune Consultants, CA (Modeling of Lake Curry, CA), 2018-2019.
- Brown and Caldwell on behalf of Bellingham County, WA, (Water quality and hydrodynamic modeling of Lake Whatcom, WA), 2020-2021.

**PUBLICATIONS (Journals, Peer-reviewed Proceedings, Articles):**


CE-QUAL-W2 TECHNICAL REPORTS


TECHNICAL REPORTS:


TECHNICAL PRESENTATIONS:


Wells, S. A. (1998) "Modeling the Columbia Slough System," invited seminar Oregon Graduate Institute, October 2, Beaverton, Or.


---

**Graduate Student Supervision**

I have graduated 6 PhD students (Drs. Makina, Berger, Annear, McKillip, Muhanned Al-Murib, Hussein Al-Zubaidi) and currently have 1 PhD student in-progress. Besides PhD committees at PSU, I have also served on PhD committees at the University of Idaho (Sarah Burnett, Jack Harrison) and the University of Iowa. I have also served on many PhD and MS graduate committees at PSU.

I have graduated over 30 MS and MENG students. Some of these include Juza, Holly; Schwarz, Tracy; Karl, Joanna; Laliberte, David; Plaskett, Joe; Knutson, Mike; Huang, Qinsheng; Buzzone, John; Bashkitov, Dmitry; Gould, Sam; Kraft, Tim; McCullough, Andrew; Slominski, Spencer; Winter, Verena; Wells, Vanessa; Xu, Wenwei; Al-Murib, Muhanned; Al-Zubaidi, Hussein; Shojaei, Nasim; Rivas, Andres; Posovich, Michael; Dickerson, Peter; Whelan, Ela; Khan, Sherr-Jamal; Annear, Rob; Berger, Chris; McKillip, Michael; Hanna, Rachel; Lu, Minh; de Wit, Kieth; Van Glubb, Sarah; Overman, Corina; Jensen, Tel; and Stevens, Seth. Current (2020) Master’s students include Amory Ceravich and Bernadel Garstecki.

I also have been the advisor to one BS honor’s thesis through the PSU honor’s program with Michelle Henry who wrote a thesis on wind fetch corrections in numerical hydrodynamic models.
J. Craig Swanson – Principal Associate  
craig.swanson@swansonenvironmental.com  
401.741.4983  
78 Sycamore Lane  
Saunderstown, RI 02874

Capabilities
- Strategic technical advice to public and private clients on solutions to marine and freshwater related environmental problems
- Expertise in coastal and estuarine circulation; offshore alternative energy and LNG related projects; climate change effects on coastal infrastructure; thermal effluents and wastewater discharge; sediment dispersion from dredging, cable and pipeline burial; pathogen and other pollutant transport and water quality (nutrients, dissolved oxygen problems
- Development and/or application of hydrodynamic, water quality and sediment dispersion models in rivers, lakes, estuaries, and coastal regions
- Expert consulting in coastal physical oceanography, environmental impact assessments, and environmental data collection and analysis
- Litigation support including expert document review, developing strategic and tactical strategies, providing expert testimony.

Career Overview
Dr. Swanson is a Principal Associate of Swanson Environmental Associates, which he founded in 2015. He was a Senior Associate of RPS ASA between 2011 and 2015 and a cofounder and principal of Applied Science Associates from 1979 to 2011. He received a B.S. and M.S. in Mechanical Engineering from Purdue University and the University of Bridgeport, respectively, and an M.S. and Ph.D. in Ocean Engineering from the University of Rhode Island.

His initial professional focus was on the development and use of hydrodynamic, water quality, sediment and pollutant transport computer models to provide quantitative solutions for public and private sector clients in river, lake, estuarine, coastal and shelf environments. Dr. Swanson has directed the application of these models and associated field programs to solve a wide variety of problems in these aquatic surface water environments located in the United States and abroad. He has managed a large number of projects in his career that have incorporated a number of disciplines including physical oceanography; lake, riverine, coastal and marine processes; water quality; sediment dispersion and quality; and biological impact analyses from these physical and chemical processes.

Dr. Swanson’s professional activities have included:
- Industrial Advisory Board to the Ocean Engineering Department at the University of Rhode Island
- Environmental Business Council, former Rhode Island Chapter Chair and former member of the Board of Directors
- American Society of Civil Engineers, Life Member
- Marine Technology Society
- Water Environment Federation
- International Association for Hydraulic Research
- Coastal and Estuarine Research Federation

Dr. Swanson has recently served as an advisor to senior level undergraduates for OCE 495/496 Ocean Engineering Systems Design Project:
- Fall 2014 / Spring 2015: Impact of Climate Change on Rhode Island Marinas: Sea Level Rise and Storm Surge
- Fall 2015 / Spring 2016: Assessment of Damage from Storm Surge and Sea Level Rise along Matunuck Beach Road and Surrounding Communities
- Fall 2016 / Spring 2017: Assessment of Damage to the Misquamicut Beach Community from Storms and Evaluation of Mitigation Strategies
- Fall 2017 / Spring 2018: Application of Coastal Environmental Risk Index (CERI) to Providence and Fox Point Hurricane Barrier
Example Project Experience

**Hydrodynamics**

- Managed a study to assess the effects of various dredging scenarios of the lower reach of the Narrow River, Narragansett, RI, to increase the tidal prism and thus reduce flushing times to improve water quality.
- Directed a study to assess the effects on circulation, water quality and sedimentation of a proposed channel deepening project at Quonset Point, Rhode Island. The study included an extensive field program and application of models for a range of areas surrounding the site.
- Developed a general three-dimensional boundary-fitted coordinate finite difference hydrodynamic model. The model used a semi implicit solution technique to solve the hydrodynamic equations. Forcing included tides, wind, river flow and density differences.
- Directed a hydrodynamic and suspended sediment modeling study of the effects of the removal of bridge piers and abutments for the Sakonnet River Bridge in Rhode Island.
- Performed wave climate and wave refraction analyses for various sites in Rhode Island, Massachusetts, and New York.
- Directed a study to develop a hydrodynamic and pollutant transport model for Salem Sound in Massachusetts for use by state regulators. The model was applied to a wastewater treatment plant outfall to assess its effects on the sound.
- Directed a modeling study to estimate the circulatory and sediment effects of various bridge replacement configurations in Missisquoi Bay on Lake Champlain.
- Assessed the impacts of a restrictive bridge opening on the circulation and flushing in the Narrow River, Narragansett, RI. Analysis included and measurement program to determine the tidal characteristics of the estuary and application of analytical models to estimate changes with a new bridge.

**Offshore Alternative Energy**

- Responsible for preparing the water quality section of the Construction and Operations Plan for the lease holder of a portion of an offshore wind energy area off the northeast coast of the U.S. Included was an assessment of the potential water quality impacts of discharges and spills related to the wind farm and export cables with specific oversight of cable burial-related sediment dispersion modeling.
- Responsible for preparing the physical oceanography and water quality sections of the Environmental Assessment for the Massachusetts Wind Energy Area for the Bureau of Ocean Energy Management in support of commercial offshore wind energy lease activities.
- Led a study to develop a data base and synthesis of reference literature for selected scientific areas for use by the Minerals Management Service in support of developing Environmental Impact Statements for proposed alternative energy facilities on the mid and north Atlantic outer continental shelf. The project included performing a series of literature searches in the disciplines of chemical and geological oceanography, physical oceanography and air-sea interaction as well as research and development technology for alternative energy. A synthesis report was generated from the information gathered.
- Directing a study of the environmental effects of proposed Cape Wind farm of 130 turbines in Nantucket Sound. Studies included assessing the transport and fate of: a potential spill of insulating oil used in the turbines; estimating the recovery time of seabed scars from construction activities; predicting water column suspended sediment levels and bottom deposition patterns from jet plow burial of the connecting cables; assessing the cumulative effects of the turbine pile array on the waves, currents and sediment transport; and evaluating potential cable exposure from migrating sand waves.
- Directed a study to acquire environmental data via a multi component field program and perform an environmental characterization of a site of a proposed wave energy system off the south coast of Rhode Island. An assessment was performed on the environmental impacts of the deployment and operation of the floating structure.

**Liquefied Natural Gas (LNG)**

- Directing modeling studies of the effects of the thermal discharges from proposed LNG regasification facilities located on Cartagena Bay in Colombia and Sokhna Port in Egypt.
Directed a study for a proposed LNG terminal on the St. Croix River in Maine. The project involved preparing estimates of potential flooding at the site due to storm surge for various return periods, seiches, and tsunamis from regional and large scale events.

Directed a modeling study of the discharge and effluent dilution from LNG Shuttle and Regas Vessels (SRV) for a site offshore Tampa Bay, FL. The SRV discharge was modeled with a near field computer model to assess the extent of the thermal plume under different operational and environmental conditions.

Managed a study of the environmental effects of a deep water port on a constructed island off the coasts of New York and New Jersey designed to receive, store and regasify LNG. The analyses included assessing the environmental effects of suspended sediment and subsequent deposition from jet plowing the connecting pipeline into the ocean floor and the effects of the discharge of process water and wastewater from the terminal.

Directed a study to evaluate the potential biological effects of dredging a channel and turning basin for a proposed LNG facility in the Taunton River in Massachusetts. The study included a month-long field program and applications of a biological model to calculate doses and effects to categories of marine species and their life stages.

**Thermal Effluent Discharges**

- Managing the application of a baroclinic hydrothermal model to assess the effects of future buildout of Jubail Industrial City on the Arabian Gulf in Saudi Arabia.
- Directed CORMIX modeling to investigate the beneficial reuse of power plant heated effluent to control harmful algal blooms.
- Performed a technical review of a thermal plume mapping and modeling study for the once through cooling water discharge from a coal-fired facility located on the Mississippi River in Missouri.
- Directed a mixing study based on field data collected in the thermal plume downstream of a nuclear powered electric generating facility on the Connecticut River in Vermont.
- Managed a modeling study to evaluate the downstream thermal effects in a dammed pool on the Connecticut River located in Massachusetts below a nuclear-powered facility.
- Oversaw mapping of the thermal plume from a fossil-fueled plant on the Providence River in Rhode Island.
- Directed the hydrothermal modeling for a fossil-fueled power plant on the Merrimack River in New Hampshire. Three-dimensional modeling included simulation of the thermal structure of the discharge canal and the dammed pool in the River.
- Oversaw the thermal modeling of the discharge canal from a fossil-fueled power plant in Mt. Hope Bay, MA during phased conversion of the four units from once-through cooling to cooling towers. Also evaluated the effects of increased salinity discharge from cooling towers.
- Directed an extensive, multi-year field program planning and hydrothermal modeling study for a nuclear facility on the Hudson River in New York in support of discharge permit renewal. Additional tasks included review of documents and providing expert witness testimony.
- Oversaw the study of thermal effects for a proposed upgrade to a power plant on Lake Maracaibo in Venezuela. The primary focus was to optimize the location of intake and discharge structures to minimize recirculation of heated effluent and to efficiently disperse the thermal plume to minimize environmental impacts.
- Directed a study to assess the thermal effects on a pool in the Connecticut River in Vermont from a cooling water discharge. The study included a field program to measure existing temperatures and included a three-dimensional application of a hydrothermal model in support of a §316(a) demonstration.
- Oversaw the study of the thermal effects of increasing flow from a power plant in Jubail Harbor, Saudi Arabia. The study included a thermal mapping survey to develop a model calibration data set and a modeling study to evaluate the extent of possible temperature increases in the harbor and surrounding waters.
- Critically reviewed the three-dimensional hydrothermal modeling performed in support of a permit for a New England electrical generating facility. The review was part of a due diligence study for a possible buyer.
- Directed a study analyzing the thermal effects of a large electrical generating plant on the circulation and thermal structure in Mt. Hope Bay, MA. The study included an extensive field program and a three-dimensional model application. Later studies included simulation of the discharge canal thermal structure.
- Directed the analysis of thermal impacts from a proposed expansion at an electrical generating facility located on the Cape Cod Canal, Sandwich, MA. The study included application and calibration of a three-dimensional model to the canal and adjacent waters to estimate the increase in plume size with greater heat discharge.

**Wastewater Discharges**
Performed an analysis of the potential effects of increasing the discharge from an oyster processing plant in Willapa Bay, WA.

Led the effort to analyze receiving water quality benefits of Phase III of the planned combined sewer overflow system upgrade for the Seekonk and Providence Rivers and Upper Narragansett Bay for the Narragansett Bay Commission.

Managed a study to evaluate the water quality impacts of an upgrade of a wastewater treatment facility upgrade from secondary to tertiary treatment that included a hydrodynamic and pollutant transport model of Tarut Bay, Saudi Arabia.

Directed a critical review of a Massachusetts Estuary Program nutrient loading and receiving water impact analysis for the Nauset Harbor Embayment System on Cape Cod.

Directed a study to evaluate the optimal location for a wastewater treatment facility discharge from a proposed mixed use development at Weaver Cove in the East Passage of Narragansett Bay, RI that included a field program collecting physical and chemical and a flushing analysis to determine the effects of a proposed wave fence protecting the development marina.

Managed a series of studies of the effects of the Portsmouth, Kittery and South Berwick individual municipal wastewater treatment facility discharges on the Great Bay/Piscataqua River system in New Hampshire to determine their relative roles in adding nutrients that impact water quality.

Reviewed potential environmental impacts from proposed Botnia paper/pulp mill on River Uruguay, an estuarine river, between Uruguay and Argentina in support of a lawsuit between the countries.

Directed a review of RIDEM’s assessment of the nutrient reductions necessary to achieve water quality protection and enhancement in Green Hill Pond in South Kingstown and charlestown, RI which found that smaller reductions in nutrient loading could still achieve water quality goals. An analysis was also performed to increase flushing rates in Green Hill Pond with the creation of a breachway.

Managed a peer review of New Hampshire state documents establishing numeric nutrient criteria for wastewater discharge from the Town of Portsmouth, NH treatment facility to Piscataqua River and Great Bay.

Directed a critical review of a Massachusetts Estuary Program nutrient loading analysis for the Town of Fairhaven, MA relative to its discharge into New Bedford Inner Harbor.

Managed a study to evaluate wastewater discharge alternatives for the Town of Portsmouth, RI. The study focused on evaluating the potential water quality impacts at two alternative sites, one in the East Passage of Narragansett Bay and the other in the Sakonnet River.

Managed a study to estimate the likely elevated levels of pathogens from the proposed new offshore outfall for the Sanitary Districts of Los Angeles County. A particle based Lagrangian model was used in the calculation with hydrodynamics supplied by an extensive current meter field program conducted by LACSD.

Directed a study to develop a hydrodynamic and pollutant transport model for Salem Sound in Massachusetts for use by state regulators. The model was applied to a wastewater treatment plant outfall to assess its effects on the sound.

Directed a study to evaluate temporary ocean discharge from a barge of squid processing wastes into Rhode Island Sound while a facility upgrade was constructed.

Directed a study analyzing characteristics of receiving water quality impacts of various combined sewer overflow design alternatives for Fall River, Massachusetts system. A hydrodynamic and pollutant transport model system was applied to Mt. Hope Bay and the lower Taunton River supported by a field program.

Directed a series of studies to evaluate the water quality benefits of a series of combined sewer overflow design alternatives for the Providence River and upper Narragansett Bay. The study included modeling of hypothetical load reductions for various alternatives and two one-year simulations of receiving water quality based on the preferred alternatives.

Sediment Dispersion from Cable/Pipeline Embedment and Dredging

Consulted on dredging-induced sediment dispersion from the proposed installation of downstream oil pipelines by side cast and back filling and dredging vessel access channels at Berri Islands, Saudi Arabia.

Directed a hydrodynamic and sediment dispersion modeling effort to assess the effects of a proposed buried electrical cable crossing of Little Bay, a component of the Great Bay Estuarine System in New Hampshire.

Directed a multifaceted modeling and analysis study to evaluate the environmental impacts of construction and operation of a maritime yard (construction and maintenance) on the Arabian Gulf coast of Saudi Arabia. Components of the study included hydrodynamics, flushing and dilution, channel and harbor dredging and disposal, and the resulting biological effects.
Oversaw a sediment dispersion modeling study evaluating the construction impacts of a lateral pipeline tie-in to an offshore gas pipeline in Massachusetts.

Directed an analysis of the potential sedimentation effects of a proposed bottom located screened intake for once through cooling water for a nuclear powered facility on the Hudson River.

Managed a modeling study to evaluate the transport and fate of suspended sediment from dredging operations related to installation of a natural gas pipeline across the Hudson River in New York. Sensitivity analyses were conducted to ascertain the effects of different hydrodynamic effects and sediment loading estimates.

Directed a study to evaluate the potential biological effects of dredging a channel and turning basin for a proposed LNG facility in the Taunton River in Massachusetts. The study included a field program and applications of a hydrodynamic model to predict the currents, a dredged sediment transport model to estimate water column sediment concentrations and deposition patterns, and a biological model to calculate doses and effects to categories of marine species and their life stages.

Managed a study in the Thames River, CT to evaluate the environmental effects (elevated sediment and pollutant levels) from disposal of dredged material from a U.S. Navy submarine berth. Project used hydrodynamic, dredged sediment transport and pollutant transport models.

Directed a study to assess the dredged material plume created from dredging operations for a berth deepening project at a U.S. Navy pier in Sandy Hook Bay in New Jersey. The study included applications of a hydrodynamic model, a dredged sediment transport model and a pollutant transport model.

Directed a study to evaluate the environmental suitability of two potential disposal sites in Buzzards Bay, MA. Primary emphasis was on the long term stability and transport of disposed material under a variety of storm conditions.

Co-directed a study to estimate suspended sediment concentrations, deposition patterns and erosion potential along a proposed route from Connecticut to Long Island for a gas pipeline.

Co-directed a multi-phase study to estimate the deposition of suspended sediment from jet plow operations between Connecticut and Long Island for a proposed cable replacement project. The study also included a new cable installation to a different landfall on Long Island.

Directed a modeling study to assess the suspended sediment and contaminant concentrations from disposal of dredged material taken from the channel in New Bedford Harbor.

Co-directed a study to estimate the water column concentrations and deposition of suspended sediment from jet plow operations in the lower Hudson River for a proposed electrical cable crossing between New Jersey and Manhattan.

Directed a modeling study to estimate the circulatory and sediment effects of various bridge replacement configurations in Missisquoi Bay on Lake Champlain.

Directed a study of the deposition of suspended material from jet plow operations in New Haven Harbor for a proposed electrical cable to determine effects on adjacent leased oyster beds.

Directed a modeling study of the plume from proposed dredging operations in the Providence River and upper Narragansett Bay. The purpose of the study was to estimate suspended sediment concentration levels in relation to biologically based environmental windows.

Performed a modeling study of a proposed dredging project in Inner Boston Harbor. The analysis provided estimates of the resulting concentrations in Boston Harbor of suspended sediment.

Directed a modeling study to evaluate changes in hydrodynamics due to disposal operation at a series of proposed dredged material disposal sites in central Narragansett Bay, RI for the Corps of Engineers.

Directed a modeling study to assess the hydrodynamic environment at potential disposal sites in Narragansett Bay for the RI Coastal Resources Management Council.

Directed a study to develop a PC-based dredged material management system for New York City. The system combines Corps of Engineer fate models with data display capabilities.

Assessed the impacts of a proposed dredging project in the Thames River, Groton, CT. The influence on circulation in the river was investigated using a series of analytical models to estimate longitudinal changes and a numerical model was employed to estimate lateral changes.

**Pollutant Transport and Water Quality (Pathogens, Brine, Nutrients)**

Performed CORMIX modeling to evaluate potential outfall locations of a brine discharge from a reverse osmosis plant in Saudi Arabia.

Managing the application of hydrodynamic and water quality models to assess the impacts of future buildout of Juball Industrial City on the Arabian Gulf in Saudi Arabia.
Consulted on the water quality and biological impacts of the discharge from a road salt storage and distribution facility on Newark Bay, NJ

Managed a technical review of a critical nitrogen loading threshold analysis the Nauset Harbor Embayment System for the towns of Orleans and Eastham, MA

Directed a hindcast modeling study of a lampricide release and into the Missisquoi River and eventual transport and dilution in Missisquoi Bay at the northern end of Lake Champlain, VT. The study successfully predicted the trend and timing of the plume evolution based on data collected by the state.

Managed a field and modeling study to determine the potential changes in salinity from discharging treated water to Sag Harbor Cove on Long Island, NY from a proposed remediation project.

Directed a study to evaluate the water quality impacts from the trap shooting range in Middletown, RI that launches targets into Rhode Island Sound. A hydrodynamic and pollutant transport model system was used to predict circulation in the area and the resulting concentrations of iron and sulphate.

Managed a study to estimate the stormwater impacts on Scarborough Beach in Narragansett, RI under present conditions and for a series of collection and disposal scenarios to prevent beach closures from bacterial contamination.

Managed an integrated field program and hydro and pollutant transport modeling system application to identify the location and evaluate the distribution of bacteria sources responsible for closure of recreational shellfish beds in Southport Harbor, CT. Both forward and backward-in-time modeling was performed to establish likely pollutant sources.

Directed a field and modeling study to assess the effects on the salinity structure in the Palmer River of water withdrawal and brine discharge related to a desalination facility for Swansea, MA.

Co-directed a field study to assess water quality in the Madaket Harbor / Long Pond system on Nantucket Island. A hydrodynamic and flushing model was developed to determine flushing times for various components of the system.

Directed a circulation and flushing study of a series of proposed marina designs in Yarmouth, MA assessing the configuration of the marina connection to the Parker River.

Directed a field and modeling study of water withdrawal and brine discharge on the Taunton River in Dighton, MA for a proposed desalination facility.

Oversaw a modeling study in support of a nutrient TMDL for the Providence River in upper Narragansett Bay that included a baroclinic hydrodynamic model and an eutrophication model.

Directed a field and modeling study to estimate flushing times in the Parker and Swan Rivers and Lewes Bay on Cape Cod as part of a larger study to estimate critical nutrient loading to the water bodies.

Oversaw a modeling study in support of a nutrient and pathogen TMDL for Greenwich Bay in Rhode Island that included baroclinic hydrodynamic, pollutant transport and full eutrophication models.

Performed a modeling study using CORMIX to optimize the dilution of brine from a proposed desalination facility submerged multiport diffuser to the Mediterranean Sea in Gaza.

Directed a study to evaluate the flushing of the Acushnet River Estuary. The study included measurements of the salinity distribution and a dye study and resulted in a comparison of flushing estimates by alternative techniques.

Managed a study to develop conceptual design plans for a small brine discharge for a proposed desalination project in the Sakonnet River. The study used CORMIX to optimize the design of a multiport submerged diffuser.

Analyzed water quality effects of the proposed Rhode Island Central Energy Facility at Quonset Point, Rhode Island. Thermal and chemical impacts were analyzed for both the once through cooling design and the stack emissions.

Directed a field program and water quality modeling study of the Blackstone River, Rhode Island, to assess potential impacts of withdrawal of water for cooling of an electrical generating facility.

Analyzed water quality data for the Thames River, Connecticut and recommended a research and modeling strategy to reduce eutrophication in the estuary.

**Litigation Support**

Provided expert witness testimony in permit proceedings before the New Hampshire Site Evaluation Committee relative to a proposed installation of an electrical cable crossing beneath a portion of the Great Bay Estuary System.

Provided expert witness deposition in legal proceedings relative to the once-through cooling water discharge from a nuclear powered electrical generating facility located on the Hudson River in New York. Worked with technical consulting team to review technical documents and develop strategy against opposing parties.
Testified as an expert witness in a legal proceeding in the Vermont Environmental Court on the effects of thermal discharge from the Vermont Yankee power plant on the Connecticut River. Worked with attorneys and technical team on technical approach before and during hearings.

Served as an expert witness in a legal suit to concerning discharge of hydrocarbons to a tidally influenced Penobscot River in Maine.

Testified before the Connecticut Siting Council on model-predicted deposition effects of sediment transport and deposition from jet plow technology to bury an electrical cable in New Haven Harbor.

Directed an analysis of water quality effects of the proposed Rhode Island Central Energy Facility at Quonset Point, Rhode Island. Thermal and chemical impacts to Frys Pond and Narragansett Bay were analyzed from both the once through cooling design and the stack emissions under dry and wet conditions. Provided expert testimony at Rhode Island Department of Environmental Management hearings on the technical aspects of the project.

Assessed the water quality impacts of a large marina development at Weaver’s Cove in Narragansett Bay, Portsmouth, RI. An analysis of flushing in the marina and the conceptual design of a breakwater were performed. Provided testimony before the Rhode Island Coastal Resources Management Council.

Assessed the impacts of three wastewater treatment plans on the Pawtuxet River in Rhode Island. Provided expert testimony at public hearing.

**Data Management, Mapping and Analysis**

Oversaw planning of a multi-year field program to assess the physical characteristics of the tidal estuary portion of the Hudson River, NY. The program consisted of three fixed bottom ADCPs, six CTDs and 400 thermistors on multiple moorings as well as mobile ADCP and thermistor surveys. Two two-month deployments occurred in 2009 and 2010. Data analysis included quality control, time series analyses, and interpretation of data, including public sources of meteorological and oceanographic monitoring.

Managed a large field and modeling program for Mt. Hope Bay, MA. Oversaw the quality control, data management and interaction of data use with models.

**Publications:**

Dr. Swanson has authored or co-authored 16 journal articles or book chapters, 47 conference proceeding papers and over 300 technical reports.

**Articles in Journals and Books**


Conference Proceedings


Cornillon, P., M. Reed, M.L. Spaulding and J.C. Swanson, 1980. The application of SEASAT-1 radar altimetry to continental shelf circulation modeling. 14th International symposium on remote sensing of environment, San Jose, Costa Rica, April.

EDUCATION/HONOURS
1975  BSc. in Chemistry, (Magna Cum Laude) University of Saskatchewan
1981  Ph.D. in Chemistry, University of British Columbia
2003  Elected as a Fellow of the Canadian Institute of Chemistry
2013  Winner of the ASTECH Award for Oil Sands Tailings Research

EXPERIENCE

Dr. Mikula was the team leader of Natural Resources Canada’s research group in oil sands extraction and tailings science and technology and since 2011 is the owner of Kalium Research, a company devoted to developing new and improving existing oil sands processes. Randy Mikula has more than 30 years experience researching oil sands tailings behaviour, including water chemistry and clay interactions. Projects have included pilot and commercial scale demonstrations of the gypsum consolidated tailings (CT) process, as well as work on carbon dioxide as a CT process aid. This research involves investigation of the fundamental chemistry of the carbon dioxide-clay interaction, including CT formation mechanisms and the potential for carbon dioxide sequestration. The program of fundamental research directed at practical oil sands tailings handling solutions has been a powerful combination. This has resulted in varied opportunities to discuss his work, ranging from testifying as an expert witness in the Shell-Albian and TOTAL environmental impact review, to public lectures on the role of nanotechnology in oil sands development (Visioning Alberta’s Future: The role of Nanotechnology in the Oil Sands Industry). Dr. Mikula has coordinated the scientific program around development and pilot scale demonstration of centrifuged fluid fine tailings, a process that Syncrude commercialized in the early 2010’s.

His understanding of oil sands tailings behaviour, including water chemistry and clay/flocculant interactions is supported by expertise in oil sands process chemistry for the slurry tank, hydrotreatment, Clark, OSLO, and other novel extraction processes. This includes fundamental, pilot and commercial scale projects on tailings and extraction behaviour as a function of water chemistry.

Dr. Mikula’s expertise in microscopy and fine particle characterization is widely recognized and has resulted in significant technical contributions to a variety of research projects outside of his nominal expertise in oil sands and heavy oil. Examples include contributions to research into lead exposure in the inner city, co-supervision of a Ph.D. thesis in sol-gel synthesis of metal sulphides, and co-supervision of a Ph.D. thesis on stabilization of hazardous wastes in cement. He has served at various times on the executive of the local and national sections of the Microscopical Society of Canada and treasurer of the Alberta section.

PUBLICATIONS
Over  60 Refereed papers and Conference proceedings
     10 Book contributions
     8 Patents
Over  160 Divisional Reports
# Heather Kaminsky

Phone: (587)-707-7851  
E-mail: heather.kaminsky@yahoo.com

<table>
<thead>
<tr>
<th>Summary of Research Interests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heather has a passion for Clays and Tailings and hopes to play a key role in solving tailings as an issue for the oil sands industry. This passion has earned her the moniker “Queen of Clay”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education</th>
</tr>
</thead>
</table>
| **Doctor of Philosophy in Materials Engineering**  
University of Alberta  
Edmonton, Alberta  
[09/2003-10/2008]  
- Thesis Title: Characterization of an Athabasca oil sand ore and process streams. |

| Bachelor of Science in Materials Engineering (Co-op)  
University of Alberta  
Edmonton, Alberta  
[09/1998-05/2003]  
Graduated with first class honors. |

<table>
<thead>
<tr>
<th>Work Experience</th>
</tr>
</thead>
</table>
| **Lead Researcher – Mining team**  
NAIT  
Edmonton, Alberta  
[07/2016-present]  
- Program lead for the Mining team at the center for oil sands sustainability, directly responsible for managing 4 technical staff and initiating and managing ~$1 Million in projects annually.  
- Organized the 54th Clay Minerals Society Annual meeting and 5th Oil Sands Clay Conference along with the 10th Powder diffraction workshop. |

<table>
<thead>
<tr>
<th>Research Engineer</th>
</tr>
</thead>
</table>
| Suncor Energy Inc.  
Calgary, Alberta  
[07/2014-07/2016]  
- Developed and managed the work scope for tailings research programs worth approximately $1M with a focus on understanding and measuring the behavior of tailings as they transition from slurries to soils.  
- Vice chair and Suncor representative on the COSIA research Working Group, responsible for evaluating and stewarding over 22 academic and industrial research projects representing over $3 million of research on oil sands tailings.  
- Chair of the COSIA Soft Deposit Capping committee, responsible for assessing technology gaps in economically capping ultra soft tailings deposits.  
- Chaired the organizing team for the 4th COSIA-PTAC Clay conference and workshop |

<table>
<thead>
<tr>
<th>Tailings Planning Engineer</th>
</tr>
</thead>
</table>
| Total E&P Canada  
Calgary, Alberta  
[04/2013-06/2014]  
- Wrote the Operational philosophy documents for the external tailings facilities of the Joslyn North Mine  
- Chair of the COSIA Clay Focus group, responsible holding quarterly meetings bringing together academia, oil sands operators, regulators and service companies to discuss fundamental clay science and measurement methods. |
Research & Development Mine Specialist
Total E&P Canada  Calgary, Alberta  [05/2009-04/2013]
- Evaluated the mineralogy of the Joslyn lease and how changes in mineralogy impacted extraction and tailings.
- Organized the 2nd CONRAD Clay workshop and co-organized the 3rd CONRAD Clay workshop & conference, both of which made a profit, attracted 150 attendees and had 86% and 98% of attendees respectively indicating that the conference was worthwhile or very worthwhile.

Select Volunteer experience
Brander Gardens Parent’s Advisory Council (03/2018-present)
Edmonton International Folk Dancers – Vice President (05/2017- present)
ISEESA/FUSE - Advisory Board Member (05/2013-07/2016)
MentorUp Calgary! – Co founder/Chair – 05/2010-05/2012
ASM International – The Materials Information Society: Edmonton Chapter
Chair  [05/2007-05/2009]
Vice Chair  [05/2006-05/2007]
Program Chair  [05/2004-05/2006]
Secretary  [05/2003-05/2004]
University of Alberta Student Representative  [05/2003-05/2004]

Select Publications

Znidarčić, D., Van Zyl, D., Mittal, K., & Kaminsky, H.A.W (2016) “Consolidation Characteristics of Flocculated MFT – Experimental Column and SICT data” Proceedings of the Fifth International Oil Sands Tailings Conference (IOSTC), Lake Louise, Canada.


EDUCATION:

Ph.D. Physical Oceanography
University of British Columbia

B.Sc. (Honours) Physics
University of Victoria

EXPERIENCE

Dr. Tinis is an expert in water balance and water quality modeling in support of mining operations in British Columbia and the Yukon. Dr. Tinis also has extensive experience conducting environmental effects monitoring programs in the marine environment, and for the past twelve years has led the development of numerical ocean modeling systems for storm surge forecasting for coastal British Columbia. Prior to this, Dr. Tinis worked as a research associate with the Canadian Centre for Climate Modeling and Analysis at the University of Victoria. Dr. Tinis’ doctoral thesis focused on the study of mixing and diffusive processes in deep highly-stratified coastal fjords, and the impact of environmental forcing on the evolution and distribution of hypoxic deep water.

AREAS OF EXPERTISE

• GoldSim environmental systems modelling

• Numerical ocean modeling, including development of coupled ocean/atmosphere model systems for operational forecasting

• Scientific programming

• Graphical interface development for analyzing model output and correlation analysis

• Coastal field work and instrument deployment including moorings, towed fluorometers, CTD/rosette water samplers and surface current measuring HF Radar
REPRESENTATIVE PROJECTS

Eagle Gold – Water Quality Modelling
Victoria Gold
Yukon, Canada

- Developed a daily watershed-based water balance/mass balance water quality GoldSim model for operations and closure for the Eagle Gold project, Yukon.
- Participated as expert for water quality modeling as part of Eagle Gold Type A Water Use License Application

Coffee Gold – Water Quality Modelling
Kaminak/Newmont-GoldCorp
Yukon, Canada

- Developed a daily water balance/water quality GoldSim model for operations and closure of the proposed Coffee Creek gold mine, Yukon.
- Model was fully calibrated and validated and used to forecast water quality changes as a result of mine discharges

Base Mine Lake – Closure Operational Model
Syncrude
Alberta, Canada

- Developed an operational closure model for management of supernatant discharge from the Base Mine Lake tailings disposal site.

Mount Nansen – Water Quality Modelling
Yukon Government
Yukon, Canada

- Developed a daily mass balance water quality GoldSim model for current closure conditions and mitigation strategies for of the Mount Nansen mine, Yukon.

Operational Storm Surge Forecasting for the British Columbia Coast
BC Ministry of Environment/Fraser Basin Council
Victoria, BC, Canada

- Responsible for the numerical model development and operation, validation and web-based product delivery of storm surge forecasts for the southern BC coast.

Capital Regional District – Effluent Dispersion Study
Capital Regional District
Victoria, BC, Canada

- Modeled the marine dispersion of effluent from the proposed secondary treatment plant for Greater Victoria.
Brucejack Lake – Water Quality Modelling
Pretivm Resources
Stewart, BC, Canada

- Developed a monthly mass balance water quality GoldSim model for operations and
closure of the proposed Brucejack Lake gold mine, BC.
CHRISTOPH WELS, Ph.D., P.Geo. (Hydrogeology)
Principal & Corporate Consultant

EDUCATION
Ph.D., Hydrogeology, University of British Columbia, 1995
Fellowship, Environmental & Soil Chemistry, Syracuse University, 1991
M.Sc., Watershed Hydrology, Trent University, Ontario, 1989
B.Sc., Environmental Sciences, Trent University (Freiburg University), 1985

PROFESSIONAL REGISTRATION
Professional Geoscientist, APEGBC
Professional Geologist, APEGGA
Licensed Geologist/Hydrogeologist, Washington State

EXPERIENCE
SUMMARY
Christoph Wels has over 25 years of experience in: design & implementation of site investigations and monitoring of mine impacts on groundwater resources; the development of groundwater flow and solute transport models to study current impacts and to evaluate the effectiveness of remedial activities; the design of mine dewatering systems for open pit and underground workings; study of waste rock hydrology including physical characterization, field monitoring and numerical modeling of key processes (infiltration, internal air flow and seepage); and the design of engineered covers for waste rock and tailings using numerical modeling and field trials.

Christoph Wels has been a third-party reviewer of pre-feasibility investigations, permitting documents and technical studies of mining projects on behalf of government agencies, mining companies and other consulting firms for project in Canada (BC, YT, NWT, Labrador), USA, Australia, Germany and Chile. He is also a member of several independent tailings review boards for some of the largest tailings dams in the world.

Christoph Wels has written over 30 technical papers on seepage and groundwater movement, contaminant transport, cover design and mine closure planning and was the lead author for the BC MoE Groundwater Modeling Guidelines for the Resource Industry which are available at: http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/groundwater_modelling_guidelines_final-2012.pdf

PROFESSIONAL HISTORY
2011-present: Principal & Corporate Consultant, Robertson GeoConsultants Inc. (Canada)
2001-2010: Principal, Robertson GeoConsultants Inc. (Canada)
1995-2001: Senior Hydrogeologist, Robertson GeoConsultants Inc. (Canada)
1989: Hydrogeologist, Chalk River Laboratories, AECL, Ontario
1985-1986: Hydrochemist, Freiburg Municipality, Germany
PROJECT EXPERIENCE (SELECTED STUDIES)

GROUNDWATER IMPACT & SEEPAGE CONTROL STUDIES

Las Tortolas Mill Site, Chile (2010-present) for Anglo American Chile
- Detailed site characterization program (drilling and installation of monitoring wells) to delineate the seepage plume downstream of the Main Dam of the Las Tortolas TSF and the El Bosque irrigation areas
- Develop and calibrate groundwater flow and solute transport models for three dams and the entire facility to assess future groundwater impacts and seepage interception options
- Design of seepage interception systems for the Muro Principal, Muro Oeste, Muro Este and the El Bosque areas

El Soldado Mine Site, Chile (2010-present) for Anglo American Chile
- Detailed site characterization program (drilling and installation of monitoring wells) to delineate the seepage plume from the El Torito TSF in the Estero de Cobre valley
- Develop and calibrate groundwater flow and solute transport models to assess future groundwater impacts and seepage interception options
- Design of seepage interception system for the El Torito TSF

Faro Mine, Yukon Territory (2017 - present) for SRK/CIRNAC
- Hydrogeology Team Lead for Faro closure team (SRK)
- Design, implementation and interpretation of hydrogeological field programs to characterize Rose Creek Valley Aquifer
- Supervision of 3D groundwater modeling in support of Down Valley SIS design
- Design of Down Valley SIS (from conceptual design to 90% design)

- Technical Advisor for AAM on all hydrogeological aspects of Faro Mine Remediation Project
- Annual groundwater quality and SIS performance reviews
- Design & implementation of NFRC winter drilling program, including installation of seepage interception wells downgradient of Intermediate Dump (near rock drain)

- Assess acid rock drainage from waste rock piles and design seepage interception system
- Develop water & load balance model for Rose Creek Tailings Storage Facility
- Design groundwater interception system for impacted alluvial aquifer (using pumping tests and 3D MODFLOW model)

Granites Gold Mine, Australia (2006 - 2012) for Newmont Australia
- Complete detailed site characterization to evaluate impacts on local groundwater due to historic seepage from tailings storage facilities (paddock TSFs and backfilled open pits)
- Develop 3D groundwater flow and solute transport model to assess future migration of seepage plume at the Granites;
- Design & implement seepage recovery systems for GTD01/03 and Bunkers Hill TSFs
MINE PERMITTING & BASELINE STUDIES

**Prairie Creek Mine, NWT (2008-2019) for Canadian Zinc (CZN)**
- Design & implement groundwater monitoring program at Prairie Creek Mine
- Prepare hydrogeological baseline study for DAR application
- Develop groundwater flow model for Prairie Creek Mine site
- Assist CZN in DAR submission, EA approval and Water License Application

**Granites Gold Mine, Australia (2008 - 2011) for Newmont Australia**
- Complete groundwater baseline study required for permitting of the Dead Bullock Soak (DBS) Deep U/G project;
- Develop a 3D groundwater flow model of the DBS Deeps U/G project to assess groundwater inflow and potential impacts on open pits backfilled with tailings
- Predict groundwater impacts for alternative options of tailings storage facilities (Quorn North and GTD South) at the Granites using groundwater flow and transport model
- Provide recommendations for final selection of TSF expansion at the Granites for permitting

TAILING WATER BALANCE STUDIES

**Steepbank and Millenium Mine, Ft McMurray, Alberta (2010 - 2014) for Suncor Energy Ltd.**
- Perform water balance studies to understand the drying and consolidation of polymerized mature fine tailings (TMFT) using laboratory and field tests
- Assist Suncor in planning and operation of its Tailings Reductions Operations (TRO)
- Assist Suncor in monitoring and management of monitoring data
- Optimize tailings management to reduce water losses and make-up requirements

**El Abra Mine, Chile (2012) for ARCADIS (Freeport MacMoran)**
- Review and interpret tailings characterization program (laboratory)
- Predict tailings consolidation and seepage from tailings impoundment over life-of-mine (250 ktpd over 24 years)
- Review predictions of water make-up requirements for alternative tailings management options (thickened tailings vs sand-slimes splitting)

**Escondida Mine, Chile (2007 - 2009) for BHP Billiton**
- Review historic and proposed future tailings management for Laguna Seca TSF
- Design & implement a tailings characterization program (in-situ and laboratory)
- Develop and calibrate a water balance model for Laguna Seca TSF to assess water losses and make-up requirements
- Optimize tailings management to reduce water losses and make-up requirements

**Chuquicamata Mine, Chile (2001 - 2003) for Codelco**
- Review historic and proposed future tailings management for Tranque de Talabre
- Design & implement a tailings characterization program (in-situ and laboratory)
- Develop and calibrate a water balance model for Tranque de Talabre to assess water losses and make-up requirements
- Optimize tailings management to reduce water losses and make-up requirements

MINE CLOSURE PLANNING

**Myra Falls Mine, Vancouver Island (2013 - present) for Nyrstar**
- Design & implementation of a detailed hydrogeological site characterization program
• Design seepage interception system for Lynx TDF
• Develop site-wide water & load balance model
• Supervision of 3D groundwater modeling (flow & transport) to predict contaminant loading to Myra Cree and design interception systems
• Evaluate alternative closure scenarios from a hydrological, hydrogeological and geochemical viewpoint

_Rum Jungle Abandoned) Mine Site, Australia (2010 - present) for NT Dept. of Mines & Energy (Australia)_
• Design & implementation of a detailed hydrogeological site characterization (incl. drilling, well installations, and hydraulic testing)
• Groundwater flow and groundwater quality monitoring to assess impact of ARD on East Finnis River and local bedrock aquifer(s)
• Development of 3D groundwater flow & solute transport model to assess current seepage conditions and contaminant loading to the East Finnis River and the local aquifer(s)
• Assessment of alternative closure strategies using the 3D groundwater flow & solute transport model

_Los Bronces & El Soldado Mines, Chile (2013 – 2014) for Anglo American Sur_
• Develop conceptual mine closure strategies for Los Bronces Mine and associated Las Tortolas tailings storage facility
• Develop conceptual mine closure strategies for El Soldado Mine
• Assess hydrological, hydrogeological and geochemical data gaps for mine closure planning for Los Bronces, Las Tortolas and El Soldado

_Mt Morgan (Abandoned) Mine Site, Australia (2003 - 2010) for Qld. Dept Natural Resources (Australia)_
• Design & implementation of a detailed hydrogeological site characterisation (incl. drilling, well installations, and hydraulic testing)
• Groundwater flow and groundwater quality monitoring to assess impact of ARD on Dee River and local aquifer
• Development of a 3D groundwater flow model to assess current seepage conditions and contaminant loading to the Dee River and the local aquifer(s)
• Assessment of alternative closure strategies using the 3D groundwater flow model

_Giant Mine, NWT (2001 - 2006) for SRK Canada and DIAND_
• Participation in “Hydrogeological Expert Meetings” to review and critique hydrogeological studies carried out at the Giant Underground Gold Mine prior to 2001;
• Participation in hydrogeological studies in support of the Arsenic Trioxide Management Study;
• Development of a 3D groundwater flow model (as senior supervisor) to assess current groundwater conditions at the Giant Underground Mine and to evaluate closure options (reflooding, partial reflooding etc.);

_Woodcutters Mine, Northern Territories, Australia (2000 - 2009) for Newmont Australia._
• Hydrogeological field investigation (drilling) and design of a groundwater monitoring program
• Development of a 3D groundwater flow and transport model (using MODFLOW & MT3D) to assess reflooding of underground workings/open pit and post-closure groundwater quality
• Development of a 2D seepage model (using HYDRUS) to determine fate of seepage from waste rock pile
• Assistance in the development of closure criteria & post-closure monitoring
THIRD-PARTY REVIEW

Independent Tailings Review Board, Chile (2016-present) for Codelco
- Member of Review Panel for Codelco’s historic and currently active copper tailings dams at four Divisions of Codelco (including El Teniente, Andina, Norte, and Salvador)
- Responsible for technical review of hydrogeological studies related to seepage and seepage mitigation at Codelco’s TSFs, including Talabre, Caren, Ovejeria and Pampa Austral)
- Responsible for technical review of groundwater models developed for each TSF to assess seepage mitigation and contaminant transport in local aquifer(s)
- Provided workshop to Codelco’s site and corporate staff on seepage and seepage mitigation

Independent Tailings Review Board, Spence Mine, Chile (2018-present) for BHP
- Member of Review Panel to provide independent review of design and construction of new copper tailings facility for BHP’s Spence Mine (“SGO Project”)
- Responsible for technical review of hydrogeological site characterization and modeling to predict seepage and seepage mitigation at SGO tailings storage facility

Independent Tailings Review Panel, Mexico (2019-present) for Penoles & Fresnillo
- Member of Review Panel for historic and currently active silver and gold tailings dams owned by Penoles/Fresnillo
- Responsible for technical review of hydrogeological studies related to seepage and seepage mitigation at selected TSFs with hydrogeological concerns

Red Chris Mine, Canada (2012-present) for Imperial Metals Mining (now Newcrest Mining)
- Independent third-party review of hydrogeological studies completed for permitting of the Red Chris mining project
- Member of Independent Engineering Review Panel (IERP) for Red Chris TSF responsible for review of all hydrogeological studies (drilling, modeling, installations) and hydrogeological performance of tailings storage facility

Ovejeria Tailings Facility, Chile (2012-2014) for Codelco
- Technical review of hydrogeological studies aimed at characterizing seepage from the Ovejeria TSF into downstream groundwater system
- Technical review of field trials and groundwater modeling aimed at identifying and designing seepage control strategies (pump-back, clean water injection)
- Review of international groundwater quality standards for sulphate

Goro Nickel Mine, New Caledonia (2012-2014) for Vale New Caledonia
- Hydrogeology expert member of Technical Review Board advising VNC on Design, construction & operation of Kwe West Residue Storage Facility
- Design of Post-Kwe residue storage facility
- Seepage and contaminant transport in local (karst) hydrogeology

McArthur River Mine, Northern Territory (2015) for NT Dept. of Mines & Energy (Australia)
- Review of current groundwater impacts & groundwater management practices
- Review of hydrogeological aspects of Mine Closure Plan

- Technical advisor to the Yukon Government on hydrogeological issues related to care & maintenance and closure of abandoned mines in the Yukon Territory
- Review of technical studies on seepage mitigation and performance reviews of existing seepage interception systems at the Anvil Range Mining Complex (“Faro Mine”)

Morrison Project, Canada (2011-2012) for BC Environmental Assessment Office

- Independent third-party review of hydrogeological studies completed in support for BC EA of the Morrison mining project, including:
  - Hydrogeological baselines studies
  - Groundwater modeling to predict dewatering of open pit
  - Groundwater modeling to predict seepage and contaminant loading from proposed tailings storage facility, waste rock and backfilled pit (post-closure)

Collahuasi Mine, Chile (2010-2014) for X-Strata, Anglo American, and Mitsui

- Technical review of three groundwater models developed by Collahuasi’s consultants to predict future groundwater extraction from Coposa basin, Michincha basin and Rosario Pit
- Assess feasibility and risks of groundwater supply for mine expansion to 160 ktpd

SELECTED PUBLICATIONS


Shaw, S., Wels, C., Robertson, A., Fortin, S., and B. Walker, 2003, “Background characterization study of naturally occurring acid rock drainage in the Sangre de Cristo Mountains, Taos County, New Mexico”, In proceedings of the Sixth International Conference on Acid Rock Drainage, Cairns, Queensland, Australia, 14-17 July, 2003, pp. 605-616.


WILLIAM (BILL) A. PRICE, Ph.D., P.Ag.

Research Scientist, CanmetMINING, Natural Resources Canada

Bag 5000, Smithers, British Columbia, V0J 2N0
nrcprice@telus.net
Home Phone: 250-877-6787; Work Phone 250-847-9335; Fax 250-847-9345

ACADEMIC/PROFESSIONAL QUALIFICATIONS

2010        Noranda Land Reclamation Award, Canadian Land Reclamation Association
1990        Professional Agrologist (P.Ag.)
1989        Ph.D., Soil Science, University of British Columbia. Thesis topic: The Reclamation of Waste Rock Dumps at the Kitsault Mine Site
1981        M.Sc. course work completed, Faculty of Forestry, University of British Columbia
1980        B.Sc., Soil Science, McGill University

SUMMARY OF SKILLS AND ABILITIES

• Over 25 years of experience in environmental management and reclamation of mine sites, including regulation, research, teaching and public consultation.

• Leading practitioner in prediction and mitigation of acid rock drainage (ARD).


• Member of steering committee for Canadian ARD research (MEND) since 1992. Managed research projects and programs including creating, terms of reference and contracts.


• Practical and academic understanding of environmental and reclamation challenges facing mines in Canada and throughout the rest of the world, including regulatory issues, aquatic chemistry, land capability, soils and revegetation.

• Verbal communication and writing skills including ability to provide concise written and verbal assessment of technical issues to laymen. Public speaking experience at technical conferences and large public meetings, often political and technical pressure from proponents.

• Good listener, respectful of others, energetic and constructive. Enjoy working and successful working with all sectors of the mining industry.

EMPLOYMENT RECORD

2003-Present: Research Scientist, CanmetMINING, Natural Resources Canada
2000-Present: Organize and Instruct Courses on ML/ARD Theory and Practice
1979-1989: Teaching Assistant and Research Scientist, U.B.C. and McGill University
1979-1988: Conduct Reclamation Research at Kitsault and Canada Tungsten Mines
1984: Technical Advisor to B.C. Mining Association

DETAILS OF PREVIOUS WORK EXPERIENCE

2003-Present: Research Scientist, Mine Effluents Program, Mining Technology Branch, Natural Resources Canada
The main tasks are as follows.

• Technical advisor to the European Union regarding regulations for ARD prediction, Province of British Columbia regarding Britannia and Equity mine closures, the Yukon Territorial Government and INAC regarding Faro mine closure, the Independent Environmental Monitoring Agency regarding Ekati mine in Northwest Territories, Mt. Washington mine closure committee, Klohn Crippen Consultants regarding proposed Kemess North mine and the Canadian Environmental Agency regarding geochemistry aspects of the proposed expansion of the Sea to Sky Highway. Author of National Manual of Methods for the Prediction of Mine Drainage Chemistry written for several Provinces and Territories.

• Technology transfer, including editor of proceedings 2012 International Conference on Acid Rock Drainage. May 20-26. Ottawa, organizing technical program for annual BC MEND ML/ARD Workshop since 1995, editor of proceedings 2003-2010 BC Mine Reclamation Symposiums, and other MEND Workshops. Member of organizing committee for Northern Latitudes Mine Reclamation Conference. Organize and instruct courses on prediction and mitigation of Mine Drainage Chemistry, including annual five-day ARD field school and frequent presentation to First Nation, aboriginal and community groups.

• Papers and presentations at many international, national and community workshops and symposiums

• Reports, including ‘National Manual of ML/ARD Prediction Methods’, ‘List of Potential Information Requirements for Metal Leaching and ARD’, ‘Case Studies of ARD Assessment and Mitigation’ and ‘A Literature Review of Drainage Treatment in Pit Lakes’

I am a member of the steering committee for the national ARD research group MEND, member of the committees that organize reclamation research and conferences in British Columbia (B.C. Technical and Research Committee on Reclamation) and the Yukon (MERG) and a past-director of the Canadian Land Reclamation Association.

I served as provincial government's senior mining specialist for metal leaching and acid rock drainage (ML/ARD), land capability, geochemistry and soils. I was charged with enabling mines to cost-effectively meet regulatory requirements. The main tasks were as follows.

Mine Review: Responsible for Ministry’s review of ML/ARD issues. I assisted general mine inspectors in review of other reclamation issues. The tasks included:

• Reviewed new applications and closure plans submitted under Environmental Assessment Act and Mines Act. Recommended approval where warranted, assessed liability, set certificate and permit conditions, and inspected mines for permit compliance. Ordered corrective measures where plans or work did not meet regulatory requirements. Met response timeframes.

• Ensured industry personnel understand how provincial ML/ARD requirements applied to their site-specific issues.

• Provided guidance to other government staff, including other MEM person charged with conducting ML/ARD review.
• Participated on regional mine review committees and specific project committees. Produced reports and communicated verbally on progress of technical assessments to Ministry management, other agencies, proponents and public (e.g., Equity Silver Mine, Eskay Creek, Huckleberry, Kemess, Mt. Polly, QR Gold, Telkwa and Tulsequah).

**Developed Regulations, Policies and Guidelines:** Ensured provincial requirements were cost effective, up to date, scientifically defensible and clearly understood. This work included frequent communication with leading practitioners around the world, chair and coordination of provincial expert advisory committee and authorship of:

- 1998 Provincial Policy for ML/ARD at Mine Sites in British Columbia;
- 1998 Guidelines for ML/ARD at Mine Sites in British Columbia;
- ARD section of the 1997 Mineral Exploration Code;
- 1997 Draft Guidelines and Recommended Methods for Prediction of ML/ARD at Mine Sites in British Columbia; and

When these documents were produced, B.C. was the only jurisdiction in the world providing detailed guidance on ML/ARD. The ‘Guidelines for ML/ARD’ is supported by the environmental sub-committee of the B.C. Mining Association and the Environmental Mining Council of B.C., and is the prescribed guidance document in Ontario. The 1997 Guidelines and Recommended Methods for Prediction were adopted by Placer Dome and Rio Tinto.

With the assistance of BC Ministry of Water, Land and Air Protection and Teck-Cominco, I was also developing guidelines for assessing ecological and human health risks at mine sites.

**Research:** Coordinated provincial and participated on national and international research programs aimed at developing cost-effective solutions to major reclamation problems. A large part of the focus was on ARD. Specific activities include:

- I was the B.C. representative on the steering committee of the new MEND (national ARD research) initiative, coordinated a provincial Molybdenum Research Group and was external technical advisor on projects conducted by INAP (international mining industry ARD research cooperative). From 1993-1989, I was active on almost all previous MEND committees. I also developed the research plan for the MEND waste rock prevention and control group and from 1992-1995, chaired the Prediction half of the BC ARD Task Force. In 2001, I coordinated a gap analysis on water covers for INAP and edited the proceedings.
- I was primary scientific authority, responsible for technical review and developing terms of reference and contract statements of work, for a large number of provincial and national projects, including work on blending, delay of ARD onset, waste rock modeling, underwater disposal of oxidized rock and ecological risk assessment. I also served on Ph.D. and M.Sc. thesis committees in the departments of soil science, oceanography, animal science and mining at the University of British Columbia.
- Organized industry/government/academic cooperatives that conducted individual projects. This included projects on dump hydrology and metals in mine site vegetation.
- Principal researcher in study of waste rock weathering and monitoring procedures.
- Represented the Province’s interests on national committees setting research priorities and allocating national spending.

**Technology Transfer:** Ensured mining industry and MEM stayed current with new developments. In addition to guidance documents and assistance during mine reviews, this included:
- Organize annual B.C. ML/ARD Workshop, including selection of topics, inviting presenters and editing workshop notes.
- Organized technical program for annual B.C. Mine reclamation Symposium, including selection of topics, inviting papers, setting guidelines for papers and presentations, and editing workshop proceedings.
- Part of organizing committee for biannual Northern Latitudes Mine reclamation Conference
- Presented papers and short courses at conferences (e.g., course on geology information and its use in ARD prediction).
- Developed plan for environmental management component of CIDA-Peru Minerals and Metals Public Assistance Project. Delivered resulting projects on financial security and closure planning.

**Supervision:** I supervised two half time contractors and up to $650,000 per year of joint industry/government contract research.

- Coordination of environmental impact assessments for various development projects. Duties included resource inventories, identification of impacts, recommendation of avoidance and ameliorative measures, report writing, liaison with regulatory and municipal officials, and listening and speaking at public meetings.
- Inventory of methane emissions and removal by wetlands, lakes, soils and ocean adjacent to British Columbia, conducted as part of a study of management measures for greenhouse gases.
- Soil survey and agricultural capability assessments for Ministry of Forests, farmers, and private developers.
- Wetland surveys on proposed development sites in Washington State.
- Environmental reviewer for the Resort Municipality of Whistler. Duties included authorship of a report on the importance of wetlands, and evaluation of predicted impacts to soil and water quality of proposed developments for housing, sports complex and a golf course.
- Served as soils, agriculture and water quality specialist on route selection and construction phases of the Inland Island and Pat Bay Highway Projects on Vancouver Island. Duties included resource mapping, capability assessment, and recommending mitigation measures (e.g., wetland treatment areas to filter contaminants and bioengineering techniques for erosion control).

**1979-1989: Research Scientist and Teaching Assistant, University of British Columbia and McGill University**
- Contract research, testing methods for predicting the onset and quality of ARD. Duties included the development of analytical procedures.
- Instruct laboratory sessions for undergraduate courses in soil genesis and land classification, introduction to soil science, soil chemistry and fertility, and biometeorology.

**1979-1988: Conduct Reclamation Work for Kitsault and Canada Tungsten Mines**
Duties included development of reclamation strategy, design program, build and monitor trials, liaison with company and regulatory agencies, conducting research and writing annual reclamation report.

**1984: Technical Advisor to B.C. Mining Association**
Duties included evaluation of work conducted by B.C. mines, wrote a report on the methods used and problems encountered, and wrote a script for presentation and produced audiovisual presentation on mine reclamation.
Monitored air and exhaust throughout the mine, and ensured air quality was adequate.

PROFESSIONAL SOCIETIES AND ACTIVITIES
MEND Steering Committee for Canadian ARD Research, 1992 to present
British Columbia Technical and Research Committee on Reclamation
  Director 1997 to present; Chair 2005/2006; 1999; Editor of conference proceedings 1999-2010; Head First Nations and Community Subcommittee 2011-present
Canadian Land Reclamation Association, 1980 to present
  Director, 1990 to 1992 and 2002 to 2006
  Secretary/Treasurer of B.C. Chapter, 1986 to 1996
British Columbia Institute of Agrologists (1989 to present)
British Columbia Soil Science Society, Editor of Newsletter, 1986 to 1991
Yukon Mining and Petroleum Environmental Research Group, 2003 to 2012

PUBLICATIONS
   http://bvcentre.ca/events/a_quick_introduction_to_ml_ard_at_mine_sites


52. Price, W.A. 2006. Challenges at Bell and Granisle Mines presentation at Workshop with Nedo’ats Hereditary Chiefs, Granisle, British Columbia April 10-11


89. Price, W.A. 2002. Information and Design Requirements for Drainage Treatment in British Columbia. in Price W.A. and K. Bellefontaine. (editors) Britannia – A Case Study of Collection and Treatment, Field Results of Biological and Other Non-Traditional Treatment Methods, and New Developments 9th Annual British Columbia MEM - MEND Metal Leaching and ARD Workshop, Vancouver, December 4-5. (http://www.trcr.bc.ca/httpwww-trcr-bc-ca-publications/)

90. Price, W.A. and K. Bellefontaine. (editors) 2002. Britannia – A Case Study of Collection and Treatment, Field Results of Biological and Other Non-Traditional Treatment Methods, and New Developments. 9th Annual British Columbia MEM - MEND Metal Leaching and ARD Workshop, Vancouver, December 4-5. (http://www.trcr.bc.ca/httpwww-trcr-bc-ca-publications/)


and Research Committee on Reclamation, Kamloops. p 11-25. (http://www.trcr.bc.ca/httpwww-trcr-bc-ca-publications/)


Courses
2001-2019 Metal Leaching and Acid Rock Drainage Field School, 5 Day Course, Northwest Community College and now Bulkley Valley Resource Center, Smithers, BC
2016-2020 Sulphidic Rock Drainage annual lectures to Reclamation and Remediation class at UNBC and Department of Natural Resource Sciences at Thompson Rivers University,
2010 Introduction to ML/ARD. Jan 22. MEND Course
2014 Introductory Guide to Metal Leaching and Acid Rock Drainage (ML/ARD) for Ontario Ministry of Northern Development and Mines, Sudbury, Ontario. Two days February 4th and 5th, 35 staff members who work on mine rehabilitation, inspection and compliance.
2014 Introductory Guide to Metal Leaching and Acid Rock Drainage (ML/ARD). Whitehorse, Yukon. Five days. Oct 7 to 9, Yukon College
2013 An Introduction to Metal Leaching and Acid Rock Drainage (ML/ARD) for CanmetMINING February 15, 2013 Ottawa, Ontario
2011 Prevention of Environmental Impacts from Sulphidic Geological Materials, a one day course for Tahltan Heritage Resources Environmental Assessment Team (THREAT). March 28th
2011 Short Course on Mitigation of Metal Leaching or Acidic Drainage at 6th Biennial Northern Latitudes Mine Reclamation Workshop, Fairbanks, Alaska May
2010 Prediction of Mining Drainage Chemistry, 4 Day Course, Whitehorse 2010 December 13th-16th
2010 Mine Reclamation 3 day Field Course for Selkirk Nation
2009 Metal Leaching and Acidic Drainage Two Day Course for Goldcorp Safety, Environment and CSR Workshop. Acapulco, Mexico. October 8 - 9th
2008 Mitigation of Metal Leaching or Acidic Drainage 3 day Field Course for Faro Mine Closure Office
2005 Theory and Practice of Metal Leaching and Acid Rock Drainage Prediction and Mitigation: A three day course for Ministry of Natural Resources and Ministry of Environment in Ontario (February 15-17th)
2003 Prediction of Metal Leaching and Acid Rock Drainage, A one day course for Sudbury 2003 – Mining and the Environment
2000  Case Studies in Prediction of Metal Leaching and Acid Rock Drainage. 3 Day Course for Northwest Community College, Continuing Education.

1995  Mining and the Environment: New Challenges for Field Geologists. Environmental Sciences Division, GAC. (Presentation)
CURRICULUM VITAE
The University of British Columbia - Department of Civil Engineering

Date: 31 March 2020

Initials: 

1. SURNAME: LAWRENCE  
   GIVEN NAMES: Gregory Allan

2. DEPARTMENT/SCHOOL: Civil Engineering

3. FACULTY: Applied Science

4. PRESENT RANK: Professor 
   SINCE: July 1998

5. POST-SECONDARY EDUCATION

<table>
<thead>
<tr>
<th>University or Institution</th>
<th>Degree</th>
<th>Subject Area</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>U. California, Berkeley</td>
<td>Ph.D.</td>
<td>Hydraulic Engineering</td>
<td>1981-85</td>
</tr>
<tr>
<td>U. California, Berkeley</td>
<td>M.S.</td>
<td>Hydraulic Engineering</td>
<td>1979-81</td>
</tr>
<tr>
<td>U. Western Australia</td>
<td>B.E. (1st Class Honours)</td>
<td>Civil Engineering</td>
<td>1973-76</td>
</tr>
</tbody>
</table>

6. EMPLOYMENT RECORD

(a) Prior to coming to UBC

<table>
<thead>
<tr>
<th>University, Company or Organization</th>
<th>Rank or Title</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dept. of Aerospace Engineering, U. Southern California</td>
<td>Post-Doctoral Fellow</td>
<td>1985-87</td>
</tr>
<tr>
<td>University of California, Berkeley</td>
<td>Research Assistant</td>
<td>1981-85</td>
</tr>
<tr>
<td>University of Western Australia</td>
<td>Research Assistant</td>
<td>1979</td>
</tr>
<tr>
<td>Public Works Department of Western Australia</td>
<td>Civil Engineer</td>
<td>1976-79</td>
</tr>
<tr>
<td>Public Works Department of Western Australia</td>
<td>Cadet Civil Engineer</td>
<td>1973-76</td>
</tr>
</tbody>
</table>

(b) At UBC

<table>
<thead>
<tr>
<th>Rank or Title</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor</td>
<td>1998 - present</td>
</tr>
<tr>
<td>Co-director of the Undergraduate Program in Environmental Engineering</td>
<td>2019 – present</td>
</tr>
<tr>
<td>Co-director of the Master of Engineering Leadership Program in Integrated Water Management</td>
<td>2017 - 2019</td>
</tr>
<tr>
<td>Canada Research Chair in Environmental Fluid Mechanics Tier I</td>
<td>2001 –2015</td>
</tr>
<tr>
<td>Co-director of UBC/UNBC Environmental Engineering Program</td>
<td>2004 –2005</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>1992 - 1998</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>1987 - 1992</td>
</tr>
</tbody>
</table>

(c) Date of granting UBC Appointment without Term (Tenure): July 1, 1992
7. LEAVES OF ABSENCE

<table>
<thead>
<tr>
<th>University, Company or Organization at which Leave was taken</th>
<th>Type of Leave</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of British Columbia/University of Western Australia</td>
<td>Sabbatical</td>
<td>Jul – Dec 2016</td>
</tr>
<tr>
<td>University of British Columbia</td>
<td>Sabbatical</td>
<td>Jan - Jun 2015</td>
</tr>
<tr>
<td>University of Western Australia</td>
<td>Sabbatical</td>
<td>Jul - Dec 2008</td>
</tr>
<tr>
<td>University of British Columbia</td>
<td>Sabbatical</td>
<td>Jan - Jun 2001</td>
</tr>
<tr>
<td>University of Western Australia</td>
<td>Sabbatical</td>
<td>Jan - Dec 1994</td>
</tr>
</tbody>
</table>

8. TEACHING

(a) *Brief description of areas of special interest and accomplishment*

Fluid Mechanics simultaneously demands a good understanding of fundamental physical principles and mathematics. Students learn from me that unless they are willing to use these skills, formulae and computer programs are of little use. Most of my class examples, are either related directly to problems of current engineering interest, or designed to provoke the curiosity of my students.

(b) *Undergraduate Core Courses Taught at UBC*

<table>
<thead>
<tr>
<th>Session</th>
<th>Course Number</th>
<th>Course Title</th>
<th>Class Size</th>
<th>Hours Taught</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lectures</td>
<td>Tutorials</td>
</tr>
<tr>
<td>91W</td>
<td>APSC 262</td>
<td>Technology and Society II</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>90W</td>
<td></td>
<td></td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>19W</td>
<td>CIVL 215</td>
<td>Fluid Mechanics I</td>
<td>163</td>
<td>36</td>
</tr>
<tr>
<td>18W</td>
<td></td>
<td></td>
<td>168</td>
<td>36</td>
</tr>
<tr>
<td>17W</td>
<td></td>
<td></td>
<td>173</td>
<td>36</td>
</tr>
<tr>
<td>15W</td>
<td></td>
<td></td>
<td>176</td>
<td>36</td>
</tr>
<tr>
<td>14W</td>
<td></td>
<td></td>
<td>167</td>
<td>36</td>
</tr>
<tr>
<td>13W</td>
<td></td>
<td></td>
<td>137</td>
<td>36</td>
</tr>
<tr>
<td>12W</td>
<td></td>
<td></td>
<td>129</td>
<td>36</td>
</tr>
<tr>
<td>11W</td>
<td></td>
<td></td>
<td>137</td>
<td>36</td>
</tr>
<tr>
<td>10W</td>
<td></td>
<td></td>
<td>142</td>
<td>36</td>
</tr>
<tr>
<td>09W</td>
<td></td>
<td></td>
<td>136</td>
<td>36</td>
</tr>
<tr>
<td>05W</td>
<td></td>
<td></td>
<td>116</td>
<td>36</td>
</tr>
<tr>
<td>99W</td>
<td></td>
<td></td>
<td>131</td>
<td>36</td>
</tr>
<tr>
<td>98W</td>
<td></td>
<td></td>
<td>127</td>
<td>36</td>
</tr>
<tr>
<td>97W</td>
<td></td>
<td></td>
<td>137</td>
<td>36</td>
</tr>
<tr>
<td>96W</td>
<td></td>
<td></td>
<td>129</td>
<td>36</td>
</tr>
<tr>
<td>95W</td>
<td></td>
<td></td>
<td>120</td>
<td>6</td>
</tr>
<tr>
<td>94W</td>
<td>CIVL 225</td>
<td>Computer Applications in Civil Eng.</td>
<td>102</td>
<td>6</td>
</tr>
<tr>
<td>04W</td>
<td>CIVL 315</td>
<td>Fluid Mechanics II</td>
<td>108</td>
<td>36</td>
</tr>
<tr>
<td>03W</td>
<td></td>
<td></td>
<td>103</td>
<td>36</td>
</tr>
<tr>
<td>93W</td>
<td></td>
<td></td>
<td>110</td>
<td>9</td>
</tr>
<tr>
<td>92W</td>
<td></td>
<td></td>
<td>73</td>
<td>9</td>
</tr>
<tr>
<td>91W</td>
<td></td>
<td>Closed Conduit Hydraulics</td>
<td>107</td>
<td>9</td>
</tr>
<tr>
<td>90W</td>
<td></td>
<td></td>
<td>66</td>
<td>9</td>
</tr>
<tr>
<td>89W</td>
<td></td>
<td></td>
<td>35</td>
<td>9</td>
</tr>
<tr>
<td>88W</td>
<td></td>
<td></td>
<td>71</td>
<td>9</td>
</tr>
<tr>
<td>90W</td>
<td>CIVL 316</td>
<td>Open Channel Hydraulics</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>89W</td>
<td></td>
<td></td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Session</td>
<td>Course Number</td>
<td>Course Title</td>
<td>Class Size</td>
<td>Hours Taught</td>
</tr>
<tr>
<td>---------</td>
<td>---------------</td>
<td>-----------------------------</td>
<td>------------</td>
<td>--------------</td>
</tr>
<tr>
<td>88W</td>
<td></td>
<td></td>
<td>78</td>
<td>16</td>
</tr>
</tbody>
</table>

(c) Undergraduate Elective Courses Taught at UBC

<table>
<thead>
<tr>
<th>Session</th>
<th>Course Number</th>
<th>Course Title</th>
<th>Class Size</th>
<th>Hours Taught</th>
</tr>
</thead>
<tbody>
<tr>
<td>99W</td>
<td>CIVL 416</td>
<td>Environmental Hydraulics</td>
<td>55</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>56</td>
<td>36</td>
</tr>
<tr>
<td>98W</td>
<td></td>
<td></td>
<td>54</td>
<td>36</td>
</tr>
<tr>
<td>97W</td>
<td></td>
<td></td>
<td>54</td>
<td>36</td>
</tr>
<tr>
<td>96W</td>
<td></td>
<td></td>
<td>45</td>
<td>36</td>
</tr>
<tr>
<td>95W</td>
<td></td>
<td></td>
<td>38</td>
<td>36</td>
</tr>
<tr>
<td>94W</td>
<td></td>
<td></td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>92W</td>
<td></td>
<td>Hydraulic Engineering</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>08W</td>
<td>CIVL 417</td>
<td>Coastal Engineering</td>
<td>28</td>
<td>36</td>
</tr>
<tr>
<td>07W</td>
<td></td>
<td></td>
<td>27</td>
<td>36</td>
</tr>
<tr>
<td>06W</td>
<td></td>
<td></td>
<td>13</td>
<td>36</td>
</tr>
<tr>
<td>02W</td>
<td></td>
<td></td>
<td>15</td>
<td>36</td>
</tr>
<tr>
<td>01W</td>
<td></td>
<td></td>
<td>30</td>
<td>36</td>
</tr>
<tr>
<td>99W</td>
<td></td>
<td></td>
<td>20</td>
<td>36</td>
</tr>
<tr>
<td>98W</td>
<td></td>
<td></td>
<td>21</td>
<td>36</td>
</tr>
<tr>
<td>97W</td>
<td></td>
<td></td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>92W</td>
<td></td>
<td></td>
<td>37</td>
<td>36</td>
</tr>
<tr>
<td>91W</td>
<td></td>
<td></td>
<td>17</td>
<td>36</td>
</tr>
<tr>
<td>90W</td>
<td></td>
<td></td>
<td>15</td>
<td>36</td>
</tr>
<tr>
<td>89W</td>
<td></td>
<td></td>
<td>12</td>
<td>36</td>
</tr>
<tr>
<td>88W</td>
<td></td>
<td></td>
<td>20</td>
<td>36</td>
</tr>
<tr>
<td>87W</td>
<td></td>
<td></td>
<td>20</td>
<td>36</td>
</tr>
<tr>
<td>11W</td>
<td>CIVL 498</td>
<td>Fluid Mechanics in the Environment</td>
<td>2</td>
<td>36</td>
</tr>
</tbody>
</table>
(c) Graduate Courses Taught at UBC

<table>
<thead>
<tr>
<th>Session</th>
<th>Course Number</th>
<th>Course Title</th>
<th>Class Size</th>
<th>Hours Taught</th>
</tr>
</thead>
<tbody>
<tr>
<td>19S1</td>
<td>CIVL541/</td>
<td>Environmental Fluid Mechanics</td>
<td>3/2</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>IWME 501</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18S1</td>
<td></td>
<td></td>
<td>11/5</td>
<td>36</td>
</tr>
<tr>
<td>17S1</td>
<td></td>
<td></td>
<td>5/4</td>
<td>36</td>
</tr>
<tr>
<td>16S1</td>
<td></td>
<td></td>
<td>10/9</td>
<td>36</td>
</tr>
<tr>
<td>12W</td>
<td></td>
<td></td>
<td>11</td>
<td>36</td>
</tr>
<tr>
<td>11W</td>
<td></td>
<td></td>
<td>5</td>
<td>36</td>
</tr>
<tr>
<td>09W</td>
<td></td>
<td></td>
<td>8</td>
<td>36</td>
</tr>
<tr>
<td>05W</td>
<td></td>
<td></td>
<td>8</td>
<td>36</td>
</tr>
<tr>
<td>04W</td>
<td></td>
<td></td>
<td>4</td>
<td>36</td>
</tr>
<tr>
<td>03W</td>
<td></td>
<td></td>
<td>8</td>
<td>36</td>
</tr>
<tr>
<td>01W</td>
<td></td>
<td></td>
<td>7</td>
<td>36</td>
</tr>
<tr>
<td>99W</td>
<td></td>
<td></td>
<td>8</td>
<td>36</td>
</tr>
<tr>
<td>97W</td>
<td></td>
<td></td>
<td>8</td>
<td>36</td>
</tr>
<tr>
<td>96W</td>
<td></td>
<td></td>
<td>14</td>
<td>36</td>
</tr>
<tr>
<td>95W</td>
<td></td>
<td></td>
<td>14</td>
<td>36</td>
</tr>
<tr>
<td>94W</td>
<td></td>
<td></td>
<td>14</td>
<td>36</td>
</tr>
<tr>
<td>92W</td>
<td></td>
<td></td>
<td>14</td>
<td>36</td>
</tr>
<tr>
<td>91W</td>
<td></td>
<td></td>
<td>17</td>
<td>36</td>
</tr>
<tr>
<td>90W</td>
<td></td>
<td>Advanced Fluid Mechanics II</td>
<td>19</td>
<td>24</td>
</tr>
<tr>
<td>89W</td>
<td></td>
<td></td>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>88W</td>
<td></td>
<td></td>
<td>13</td>
<td>24</td>
</tr>
<tr>
<td>87W</td>
<td></td>
<td></td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>02W</td>
<td>CIVL 542</td>
<td>Physical Limnology</td>
<td>13</td>
<td>24</td>
</tr>
<tr>
<td>00W</td>
<td></td>
<td></td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>17W</td>
<td>CIVL 547</td>
<td>Estuary Hydraulics</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>13W</td>
<td></td>
<td></td>
<td>5</td>
<td>24</td>
</tr>
<tr>
<td>10W</td>
<td></td>
<td></td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>06W</td>
<td></td>
<td></td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>97W</td>
<td></td>
<td></td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>89W</td>
<td></td>
<td></td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>08S</td>
<td>CIVL 558</td>
<td>Water Resources Infrastructure</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>07W</td>
<td></td>
<td></td>
<td>7</td>
<td>24</td>
</tr>
<tr>
<td>00W</td>
<td></td>
<td></td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>99W</td>
<td></td>
<td></td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>93W</td>
<td>CIVL 566</td>
<td>Transport and Mixing of Pollutants in Aquatic Systems</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>92W</td>
<td></td>
<td></td>
<td>27</td>
<td>18</td>
</tr>
<tr>
<td>91W</td>
<td></td>
<td></td>
<td>37</td>
<td>18</td>
</tr>
<tr>
<td>90W</td>
<td></td>
<td>Water Pollution Control Engineering I</td>
<td>22</td>
<td>18</td>
</tr>
<tr>
<td>18W</td>
<td>CIVL 589L</td>
<td>Contemporary Topics in Physical Limnology</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>16W</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19W</td>
<td>CIVL598R</td>
<td>Turbulence and Mixing</td>
<td>4</td>
<td>36</td>
</tr>
</tbody>
</table>

1 CIVL 541 and IWME 501 were co-listed 2016 – 2019.
### Masters Students Supervised (* indicates major scholarship recipients)

<table>
<thead>
<tr>
<th>Student Name</th>
<th>Program Type</th>
<th>Year Start</th>
<th>Year Finish</th>
<th>Principal Supervisor</th>
<th>Co-Supervisor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Takis Labridis</td>
<td>MASc</td>
<td>July 87</td>
<td>July 1989</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Stephen Hnidei</td>
<td>MS (Math)</td>
<td>Sept 88</td>
<td>Aug 1990</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Emily Cheung</td>
<td>MASc</td>
<td>Sept 88</td>
<td>Oct 1990</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Michael Cole</td>
<td>MASc</td>
<td>Sept 90</td>
<td>Sept 1992</td>
<td>Michael Isaacson</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>Gary Allan</td>
<td>MASc</td>
<td>Sept 90</td>
<td>Oct 1993</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>*Christopher Rogers</td>
<td>MASc</td>
<td>Sept 90</td>
<td>Dec 1992</td>
<td>G. A. Lawrence</td>
<td>P. Hamblin (NWRI)</td>
</tr>
<tr>
<td>*Li Gu</td>
<td>MASc</td>
<td>Jan 91</td>
<td>Oct 1993</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>*Michael MacLatchy</td>
<td>MASc</td>
<td>Sept 91</td>
<td>Aug 1993</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Timothy Finnigan</td>
<td>MASc</td>
<td>Sept 92</td>
<td>Aug 1994</td>
<td>G. A. Lawrence</td>
<td>Susan Allan (Ocgy)</td>
</tr>
<tr>
<td>Ronald MacDonald</td>
<td>MASc</td>
<td>Sept 93</td>
<td>Dec 1995</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>*Wayne Evans</td>
<td>MASc</td>
<td>Sept 94</td>
<td>June 1996</td>
<td>G. A. Lawrence</td>
<td>Eric Hall</td>
</tr>
<tr>
<td>*Jason Vine</td>
<td>MASc</td>
<td>Sept 94</td>
<td>Aug 1996</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Bonnie Marks</td>
<td>MASc</td>
<td>Sept 94</td>
<td>Aug 1996</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>*Michael Wilton</td>
<td>MASc</td>
<td>Sept 96</td>
<td>Aug 1998</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>*Susan Greco</td>
<td>MASc</td>
<td>Sept 96</td>
<td>Sept 1998</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>*David Zabil</td>
<td>MASc</td>
<td>Sept 96</td>
<td>Oct 1998</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Edmund Tedford</td>
<td>MASc</td>
<td>Sept 97</td>
<td>Sept 99</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>*Wayne Jenkinson</td>
<td>MASc</td>
<td>Sept 97</td>
<td>Mar 00</td>
<td>G. A. Lawrence</td>
<td>Eric Hall</td>
</tr>
<tr>
<td>*Lillian Zaremba</td>
<td>MASc</td>
<td>Sept 98</td>
<td>Dec 00</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>*Yao Lan</td>
<td>MASc</td>
<td>Sept 99</td>
<td>July 01</td>
<td>M. C. Quick</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>Albert Leung</td>
<td>MASc</td>
<td>May 01</td>
<td>Oct 03</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>*Aurelie Goater</td>
<td>MASc</td>
<td>Sept 01</td>
<td>Aug 03</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Grant Lamont</td>
<td>MASc</td>
<td>Sept 02</td>
<td>Mar 05</td>
<td>Bernard Laval</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>Jeff Carpenter</td>
<td>MASc</td>
<td>Sept 03</td>
<td>Sept 05</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Chris Borstad</td>
<td>MS</td>
<td>Sept 03</td>
<td>Dec 05</td>
<td>D. McClung (Geog)</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>*Cynthia Bluteau</td>
<td>MASc</td>
<td>Sept 04</td>
<td>Nov 05</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Joel Atwater</td>
<td>MASc</td>
<td>Sept 05</td>
<td>Mar 08</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Davood Hasanlo</td>
<td>MASc</td>
<td>Sept 11</td>
<td>Aug 14</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Théo Cormon#</td>
<td>MSc</td>
<td>Feb 14</td>
<td>Jun 14</td>
<td>G. A. Lawrence</td>
<td>A. Schleiss (EPFL)</td>
</tr>
<tr>
<td>David Hurley</td>
<td>MASc</td>
<td>Sept 15</td>
<td>Aug 17</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Wenjing Dong</td>
<td>MASc</td>
<td>Sept 15</td>
<td>Aug 17</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td><strong>Teri Brito</strong></td>
<td>MASc</td>
<td>Jan 16</td>
<td>Current</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>(part time)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomy Doda#</td>
<td>MSc</td>
<td>Feb 17</td>
<td>Aug 17</td>
<td>G. A. Lawrence</td>
<td>A. Wuest (EPFL)</td>
</tr>
<tr>
<td>Sarah Chang</td>
<td>MASc</td>
<td>Sept 17</td>
<td>Current</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Richard Cunningham</td>
<td>MASc</td>
<td>Sept 18</td>
<td>Current</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
</tbody>
</table>

# Students enrolled at EPFL, Lausanne who have conducted their thesis research projects at UBC under my supervision.
(f) Ph.D. students supervised (* indicates major scholarship recipients)

<table>
<thead>
<tr>
<th>Student Name</th>
<th>Program Type</th>
<th>Year</th>
<th>Principal Supervisor</th>
<th>Co-Supervisor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Susan Haigh</td>
<td>PhD (Math)</td>
<td>Sept 90</td>
<td>Nov 1995</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>*Zhiwei Zhu</td>
<td>PhD</td>
<td>May 91</td>
<td>July 1996</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>*Leslie Gomm</td>
<td>PhD</td>
<td>Sept 91</td>
<td>April 1999</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>*Mirmosadegh Jamali</td>
<td>PhD</td>
<td>Sept 93</td>
<td>Dec 1998</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>*Michael MacLatchy</td>
<td>PhD</td>
<td>Sept 93</td>
<td>Mar 1999</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>*Li Gu</td>
<td>PhD</td>
<td>Nov 93</td>
<td>April 2001</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>*Annie Kim</td>
<td>PhD</td>
<td>July 97</td>
<td>Oct 2001</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>*Jim Fisher</td>
<td>PhD</td>
<td>Sept 97</td>
<td>April 2002</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>*Edmund Tedford</td>
<td>PhD</td>
<td>Sept 02</td>
<td>April 2009</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>*Jeff Carpenter</td>
<td>PhD</td>
<td>Sept 05</td>
<td>May 2009</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>*Mona Rahmani</td>
<td>PhD</td>
<td>Jan 05</td>
<td>Oct 2011</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>*Yehya Imam</td>
<td>PhD</td>
<td>Sept 05</td>
<td>Oct 2011</td>
<td>Bernard Laval</td>
</tr>
<tr>
<td>*Anirban Guha</td>
<td>PhD</td>
<td>Sept 09</td>
<td>June 2013</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>*Joel Atwater</td>
<td>PhD</td>
<td>Mar 08</td>
<td>Oct 2015</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>**Daniel Robb</td>
<td>PhD</td>
<td>May 16</td>
<td>Current</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>**Kelly Graves</td>
<td>PhD</td>
<td>Sept 16</td>
<td>Current</td>
<td>Bernard Laval</td>
</tr>
<tr>
<td>**Martin Schmid</td>
<td>PhD</td>
<td>Sep 16</td>
<td>Current</td>
<td>M. Parlange</td>
</tr>
<tr>
<td>Kai Zhao</td>
<td>PhD</td>
<td>Sept 17</td>
<td>Current</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>**Jiankang (Adam) Yang</td>
<td>PhD</td>
<td>Sept 17</td>
<td>Current</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>Kelsey Everard</td>
<td>PhD</td>
<td>Jan 18</td>
<td>Current</td>
<td>G. A. Lawrence</td>
</tr>
</tbody>
</table>

1 NSERC Post Graduate Scholarship-Doctoral (PGS D)
2 Alexander Graham Bell Canada Graduate Scholarship-Doctoral (CGS D)
3 Rio Tinto Alcan Higher Education Scholarship
4 UBC Four Year Fellowship
5 BC Hydro Scholarship
6 Swiss National Science Foundation Scholarship

(g) Supervision of Student Research (non-thesis) – since 1 April 2017 only:

<table>
<thead>
<tr>
<th>Student Name</th>
<th>Status</th>
<th>Source(s) of Support</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laura Irvine</td>
<td>MASc (Post thesis)</td>
<td>NSERC CRD, Syncrude</td>
<td>Apr – Jun 2017</td>
</tr>
<tr>
<td>Sarah Cheng</td>
<td>MEng (Directed Studies)</td>
<td>NSERC CRD, Syncrude</td>
<td>Apr – Aug 2017</td>
</tr>
<tr>
<td>Peggy Chen</td>
<td>BASc</td>
<td>NSERC Discovery Grant</td>
<td>Apr 2017 – Mar 2018</td>
</tr>
<tr>
<td>Adjoa Quinao</td>
<td>BSc (Co-op)</td>
<td>BC Hydro</td>
<td>Apr 2017 – Jul 2018</td>
</tr>
<tr>
<td>Alex Huang</td>
<td>BASc (Co-op)</td>
<td>NSERC CRD, Syncrude</td>
<td>May – Sep 2017</td>
</tr>
<tr>
<td>Paulina Buskas</td>
<td>BASc</td>
<td>BC Hydro</td>
<td>Sep 2017 – Mar 2018</td>
</tr>
<tr>
<td>Matthew Tong</td>
<td>BASc</td>
<td>NSERC Discovery</td>
<td>July 2018 - present</td>
</tr>
</tbody>
</table>
Postdoctoral Fellows Supervised:

Dr. Craig Stevens (from December 1991 until March 1996) studied the physical limnology of several B.C. lakes and mine disposal pits.

Dr. Noboru Yonemitsu (from February 1992 until March 1996) studied hydrodynamic stability and turbulence in stratified flows.

Dr. Violeta Martin (June-November 2003) modeled the dispersion of pollutants in the John Hart Lake.

Dr. Edmund Tedford (May 09 – Aug 10, and Nov 2012 – Jun 2014) studied hydrodynamic instabilities under my supervision, as well as studying the interaction of wave and currents and its potential application to Black-hole physics (co-supervised with Dr. W. Unruh, Physics).

Dr. Jason Olsthoorn (since September 2017) is working on under-ice convection within slightly-brackish lakes, where the mean temperature of the water column is near the temperature of maximum density. His work is particularly focused on the stirring of the water column shortly after ice formation.

Dr. Marjan Zare (since October 2018) is conducting laboratory and numerical experiments to investigate the rise of air bubbles through submerged Carbopol, as a proxy for the motion of methane bubbles through the fluid fine tailings and water cap of Base Mine Lake, Alberta.

Research Associates

Dr. Roger Pieters has been working for me since March 1995 on the study of vertical mixing in stratified flows. He has also conducted field studies of: the Burlington Ship Canal; Slocan and Harrison Lake; Coquitlam, Arrow, Kinbasket, Revelstoke, and Nechako reservoirs; and the Colomac, Equity Silver, Faro, Selbaie and proposed Ekati Mine Pit Lakes.

Dr. Sheng Li worked with me from February 2002 until November 2006 his expertise is in numerical modeling, coastal and estuary dynamics and hydrodynamic stability.

Dr. Edmund Tedford has worked for me as a Research Associate since July 2014. He has been investigating the evolution of Syncrude’s Base Mine lake and researching undular waves in sub-critical flow over an obstacle.

Visiting Professors Sponsored

2007  Prof. Josef Ackerman, Guelph University
2009  Prof. Alfred Wuest, EAWAG, Zurich
2009  Prof. Zhiyong Dong, Zhejiang University
2014  Prof. Anton Schleiss, EPFL, Lausanne

Continuing Education Activities

2012: Invited lecturer at International Summer School on Environmental Fluid Mechanics, Lucerne, Switzerland, June 2012 (six lectures).
2009: Guest Lecturer, Summer School in Estuarine and Coastal Fluid Mechanics, Friday Harbour Marine Laboratories, University of Washington, July 2009 (two lectures).
2009: Invited lecturer at International Summer School on Environmental Fluid Mechanics, Santiago, Chile, January 2009 (five lectures).
1999: Presented two lectures on the mixing and hydraulics of layered flows to the Fluid Dynamics Summer School at the University of Alberta, August 1999.
1998: Delivered six invited lectures at a week long advanced summer school in Environmental Fluid Mechanics at the International Centre for Mechanical Sciences in Udine, Italy.
9. SCHOLARLY AND PROFESSIONAL ACTIVITIES

(a) Brief description of areas of special interest and accomplishment

My research interests focus on the dynamics of density stratified flows and physical limnology. In particular the analysis of thermal discharge problems; flow instabilities, turbulence, chaos and mixing in density stratified flows; selective withdrawal from a stratified reservoir; stratified flow over obstacles and through contractions; lake dynamics; lake fertilization and rehabilitation; sediment suspension in tailings ponds; and the dynamics of water filled mine pits.

(b.1) (Research grants obtained competitively)

<table>
<thead>
<tr>
<th>Agency</th>
<th>Subject</th>
<th>$</th>
<th>Years</th>
<th>Principal Investigator</th>
<th>Co-Investigator(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSERC Discovery</td>
<td>Environmental Fluid Mechanics: Some Fundamental Problems and Their Practical Relevance</td>
<td>$55,000</td>
<td>20</td>
<td>G.A. Lawrence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$55,000</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$55,000</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$50,000</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$50,000</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSERC CRD</td>
<td>The Physical Limnology of Base Mine Lake</td>
<td>$194,000</td>
<td>19</td>
<td>G.A. Lawrence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$194,000</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$194,000</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$194,000</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min of Indian Affairs &amp; Northern</td>
<td>Site Monitoring - 2018/19 Federal Contaminated Sites - Data Collection -</td>
<td>$23,750</td>
<td>18</td>
<td>G.A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Development</td>
<td>Colomac Mine NWT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSERC CRD</td>
<td>The Effect of Reservoir Operation On Circulation, Turbidity and Productivity in Carpenter Reservoir, BC</td>
<td>$63,500</td>
<td>18</td>
<td>G.A. Lawrence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$57,200</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$57,200</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qatar National Research Fund</td>
<td>An assessment of present and future environmental impacts of major desalination plants in Qatar under changing climate</td>
<td>1,049,077 US</td>
<td>11-14</td>
<td>M. Mohamadian and G.A. Lawrence and four others</td>
<td></td>
</tr>
<tr>
<td>NSERC Discovery</td>
<td>Environmental Fluid Mechanics: Some Fundamental Problems and Their Practical Relevance</td>
<td>$27,000</td>
<td>11-16</td>
<td>G.A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>NSERC Discovery</td>
<td>Mixing in stratified fluids: some fundamental problems and their practical relevance</td>
<td>$52,700</td>
<td>06-11</td>
<td>G.A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>NSERC Northern Research Supplement</td>
<td>Physical limnology of water filled mine pits</td>
<td>10,000</td>
<td>10-11</td>
<td>G.A. Lawrence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10,000</td>
<td>09-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20,000</td>
<td>08-09</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20,000</td>
<td>07-08</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10,000</td>
<td>06-07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSERC CRD/BHP Billiton, Rescan</td>
<td>Meromixis and Circulation in Water Filled Mine Pits</td>
<td>25,900</td>
<td>12-13</td>
<td>G.A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Environmental</td>
<td></td>
<td>27,900</td>
<td>11-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25,800</td>
<td>10-11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSERC Research Grant - Individual</td>
<td>Classic Unresolved Problems in Internal Hydraulics and Their Practical Relevance</td>
<td>45,000</td>
<td>02-06</td>
<td>G.A. Lawrence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>per year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSERC Research Grant</td>
<td>Mixing Processes in Natural and Man-made Water Bodies</td>
<td>32,340</td>
<td>99-02</td>
<td>G.A. Lawrence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>30,800</td>
<td>98-99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td>Subject</td>
<td>$</td>
<td>Years</td>
<td>Principal Investigator(s)</td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>---------</td>
<td>----------------</td>
<td>-----------------------------------</td>
<td></td>
</tr>
<tr>
<td>NSERC Strategic Grant</td>
<td>Vertical Mixing and the Dynamics of Exchange Flows</td>
<td>95,541</td>
<td>97-98, 96-97, 95-96</td>
<td>G. A. Lawrence, P. F. Hamblin, and S. P. Pond</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>98,327</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>86,320</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment Canada</td>
<td>Fraser River Action Plan, Transport and Sedimentation of Contaminants in the Fraser River</td>
<td>15,000</td>
<td>97-98, 96-97, 95-96</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>35,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>40,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSERC Operating Grant</td>
<td>Hydrodynamic Stability and Mixing of Density Stratified Flows</td>
<td>24,700</td>
<td>94-98</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>per year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AES/NSERC</td>
<td>Science Subvention: Studies of Strong Outflow Winds in Howe Sound, B.C.</td>
<td>10,000</td>
<td>94-96, 93-94, 92-93, 91-92</td>
<td>S. E. Allen (Oceanography), G. A. Lawrence, D. G. Steyn (Geography)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>7,950</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UBC Killam Fellowship</td>
<td>The Impact of Diffuser Discharges on the Thermocline and Bottom Sediments of Lakes</td>
<td>3,000</td>
<td>94</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>BC Ministry of Environment</td>
<td>Operating Grant, Transport and Mixing in Inland and Coastal Waters</td>
<td>25,600</td>
<td>91-94</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>per year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BC Ministry of Environment</td>
<td>Habitat Conservation Fund, Chain Lake Water Quality Improvement</td>
<td>20,000</td>
<td>92-93</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>BC Ministry of Environment</td>
<td>Contribution Agreement, Kootenay Lake Surface Transport Field Experiment</td>
<td>31,820</td>
<td>92-93</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>DFO/NSERC</td>
<td>Science Subvention, The Mixing of Buoyant Effluents in the Fraser River</td>
<td>8,000</td>
<td>91-93</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>per year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BC Hydro/BC Ministry of</td>
<td>Contribution Agreement, Resonant Seiche Enhanced Mysis Export from Kootenay Lake</td>
<td>60,000</td>
<td>91-92</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>Environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BC Ministry of Environment</td>
<td>Habitat Conservation Fund, Point Source Lake Fertilization</td>
<td>8,960</td>
<td>91-92, 90-91</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>11,880</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSERC</td>
<td>Operating Grant, Three Dimensional Instabilities in Stratified Flows</td>
<td>17,000</td>
<td>88-91</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>per year</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b.2) Research grants obtained non-competitively

<table>
<thead>
<tr>
<th>Agency</th>
<th>Subject</th>
<th>$</th>
<th>Years</th>
<th>Principal Investigator(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MITACS Inc./Accelerate</td>
<td>Modelling large-scale behaviour of hybrid macro-scale response agents for use in mitigation of marine oil spill impacts</td>
<td>$33,334</td>
<td>19</td>
<td>Richard Cunningham (MASc student)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$16,666</td>
<td>18</td>
<td>G.A. Lawrence (Supervisor)</td>
</tr>
<tr>
<td>Synrcrude Canada Ltd.</td>
<td>Annual Assessment and Report on the Physical Limnology of Syncrude’s Base Mine Lake</td>
<td>$290,500</td>
<td>19</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$290,500</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$290,500</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td>Subject</td>
<td>$</td>
<td>Years</td>
<td>Principal Investigator</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>------------</td>
<td>-------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Syncrude Canada Ltd.</td>
<td>The Physical Limnology of Base Mine Lake</td>
<td>$150,000</td>
<td>19</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$150,000</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$150,000</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$150,000</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Ministry of Indian Affairs and Northern Development</td>
<td>Assessment of the stratification and physical stability of Colomac Zone 2 Pit-Lake</td>
<td>$111,875</td>
<td>18</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$111,875</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Limnotech Research and Development Inc.</td>
<td>The Effect of Reservoir Operation on Circulation, Turbidity and Productivity in Carpenter Lake</td>
<td>$119,040</td>
<td>18</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$108,800</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$108,800</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>MetroVancouver</td>
<td>Processes controlling Turbidity in Coquitlam Reservoir: North Basin Flushing and Cedar Creek</td>
<td>$35,625</td>
<td>19</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$47,500</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$47,875</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$49,375</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$51,250</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$56,250</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$48,000</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Syncrude Canada Ltd.</td>
<td>The Physical Limnology of Base Mine Lake and the Potential for Meromixis</td>
<td>$200,000</td>
<td>16</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$200,000</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$200,000</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>BC Hydro &amp; Power Authority</td>
<td>CLBMON-3 Kinbasket and Revelstoke Ecological Productivity: Physical Processes</td>
<td>$50,000</td>
<td>20-21</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$52,500</td>
<td>19-20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$52,500</td>
<td>18-19</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$52,500</td>
<td>17-18</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$52,500</td>
<td>16-17</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$56,500</td>
<td>15-16</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$52,500</td>
<td>14-15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$52,500</td>
<td>13-14</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$52,500</td>
<td>12-13</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$56,250</td>
<td>11-12</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$52,500</td>
<td>10-11</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$43,750</td>
<td>09-10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$35,000</td>
<td>08-09</td>
<td></td>
</tr>
<tr>
<td>BC Hydro &amp; Power Authority</td>
<td>CLBMON-56 Kinbasket and Revelstoke Ecological Productivity: Moorings</td>
<td>$35,000</td>
<td>20-21</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$50,000</td>
<td>19-20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$50,000</td>
<td>18-19</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$50,000</td>
<td>17-18</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$50,000</td>
<td>16-17</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$50,000</td>
<td>15-16</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$50,000</td>
<td>14-15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$50,000</td>
<td>13-14</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$50,000</td>
<td>12-13</td>
<td></td>
</tr>
<tr>
<td>ERM-Rescan</td>
<td>Meromixis and water quality in water filled mine pits</td>
<td>$3,120</td>
<td>2015</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>BC Ministry of Lands and Natural Resource Operations</td>
<td>Arrow Lakes Reservoir nutrient restoration program hydrologic review and data analysis</td>
<td>$9,600</td>
<td>17-18</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$10,000</td>
<td>16-17</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$7,280</td>
<td>13-14</td>
<td></td>
</tr>
<tr>
<td>MetroVancouver</td>
<td>Effect of north basin flushing on turbidity in Coquitlam Reservoir</td>
<td>$54,000</td>
<td>2012</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$42,000</td>
<td>2011</td>
<td></td>
</tr>
<tr>
<td>Agency</td>
<td>Subject</td>
<td>$</td>
<td>Years</td>
<td>Principal Investigator</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>---------</td>
<td>----------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Rescan Environmental Services Ltd.</td>
<td>Meromixis and Circulation in Water Filled Mine Pits, Additional Funding</td>
<td>$15,080</td>
<td>11-12</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>UBC</td>
<td>UBC NSERC Emergency Grant</td>
<td>$16,000</td>
<td>11-12</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>SRK Consulting</td>
<td>Physical Limnology of Selbaie Pit-Lake</td>
<td>$35,950</td>
<td>10-11</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>NSERC CRD Program</td>
<td>Meromixis and Circulation in Water Filled Mine Pits</td>
<td>$79,600</td>
<td>12-13</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>Rescan Environmental Services Ltd.</td>
<td>Meromixis and Circulation in Water Filled Mine Pits</td>
<td>$70,000</td>
<td>09-13</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>GVRD</td>
<td>Monitoring Turbidity at Potential Intake Sites in Coquitlam Reservoir</td>
<td>$37,700</td>
<td>2010</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>B.C. Ministry of Environment</td>
<td>Residence time of Arrow Lakes Reservoir</td>
<td>$3,000</td>
<td>08-09</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>Metro Vancouver</td>
<td>Assessment of lake processes and basin-scale turbidity in Coquitlam Reservoir</td>
<td>$41,250</td>
<td>09-10</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>B.C. Ministry of Environment</td>
<td>Summer residence time of Upper Arrow Reservoir, 2006 and 2007</td>
<td>$3,000</td>
<td>07-08</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>B.C. Ministry of Environment</td>
<td>Arrow Lakes Reservoir nutrient budget, 2004</td>
<td>$1,200</td>
<td>07-08</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>INAC (Indian &amp; Northern Affairs Canada)</td>
<td>Evaluation of the Dynamics of Zone 2 Pit Lake and Tailings Lake</td>
<td>$71,930</td>
<td>07/08</td>
<td>G.A. Lawrence, R. Pieters</td>
</tr>
<tr>
<td>Nechako Enhancement Society</td>
<td>Hydrothermal characteristics of the Nechako Reservoir</td>
<td>149,000</td>
<td>06-07</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>GVRD</td>
<td>Coquitlam Reservoir Circulation</td>
<td>35,000</td>
<td>05-06</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>District of Campbell River</td>
<td>John Hart Lake pilot hydraulic study</td>
<td>5,000</td>
<td>03-04</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>NSERC CRD Grant with 6 companie</td>
<td>Improving Management of Mine Site Pit Lakes</td>
<td>125,000</td>
<td>03-04</td>
<td>T. F. Pedersen</td>
</tr>
<tr>
<td>Columbia Basin Fish and Wildlife Compensation Program and BC Ministry of Environment, Lands and Parks</td>
<td>Arrow Reservoir Physical Limnological and Nutrient Budget</td>
<td>12,000</td>
<td>03-04</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>Fraser Valley Regional District Dayton &amp; Knight</td>
<td>Harrison Lake Monitoring</td>
<td>31,610</td>
<td>02-03</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>Agency</td>
<td>Subject</td>
<td>$</td>
<td>Years</td>
<td>Principal Investigator</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td>-------</td>
<td>-------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Eco-Logic Ltd.</td>
<td>Circulation, nutrient dynamics and productivity in BC lakes and reservoirs</td>
<td>3,080</td>
<td>03-04</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,600</td>
<td>02-03</td>
<td></td>
</tr>
<tr>
<td>BHP/Island Copper</td>
<td>Evolution of the Island Copper Mine Pit Lake</td>
<td>4,200</td>
<td>02-03</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,400</td>
<td>01-02</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9,950</td>
<td>00-01</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>19,380</td>
<td>99-00</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>875</td>
<td>98-99</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>5,996</td>
<td>97-98</td>
<td></td>
</tr>
<tr>
<td>Ktunaxa/Kinbasket Tribal Council</td>
<td>Slocan Lake Limnological Assessment</td>
<td>3,200</td>
<td>01-02</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3,200</td>
<td>00-01</td>
<td></td>
</tr>
<tr>
<td>Environment Canada, Brenda Mines</td>
<td>Physical Processes in Brenda Mines Pit Lake</td>
<td>12,000</td>
<td>94-95</td>
<td>G. A. Lawrence</td>
</tr>
<tr>
<td>Mines Inc. and CANMET</td>
<td></td>
<td>25,000</td>
<td>94-95</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>42,000</td>
<td>94-95</td>
<td></td>
</tr>
<tr>
<td>Environment Canada</td>
<td>Model of Mixing and Overturn in Water-Filled Mining Pits</td>
<td>15,000</td>
<td>93-94</td>
<td>G. A. Lawrence</td>
</tr>
</tbody>
</table>

(b.3) (Grant in support of teaching obtained competitively)

<table>
<thead>
<tr>
<th>Agency</th>
<th>Subject</th>
<th>$</th>
<th>Years</th>
<th>Principal Investigator</th>
<th>Co-Investigator(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible Learning Initiative/UBC</td>
<td>Development of Instructional Videos and Online Resources for CIVL and IGEN Engineering Laboratory Courses</td>
<td>36,000</td>
<td>14-15</td>
<td>N. Yonemitsu</td>
<td>G. A. Lawrence and 10 others</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>13-14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(b.4) Equipment grants

<table>
<thead>
<tr>
<th>Agency</th>
<th>Subject</th>
<th>$</th>
<th>Year</th>
<th>Principal Investigator</th>
<th>Co-Investigator</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSERC RTI</td>
<td>High accuracy temperature, depth and conductivity recorders for lakes, estuaries and man-made water bodies</td>
<td>67,425</td>
<td>2010</td>
<td>G.A. Lawrence</td>
<td>R. A. Pawlowicz (EOS)</td>
</tr>
<tr>
<td>NSERC RTI</td>
<td>A vessel for oceanic and limnological research</td>
<td>99,428</td>
<td>2010</td>
<td>R.A. Pawlowicz (EOS)</td>
<td>G.A. Lawrence and 12 others</td>
</tr>
<tr>
<td>NSERC RTI</td>
<td>Laser for flow visualization</td>
<td>86,125</td>
<td>2009</td>
<td>G.A. Lawrence</td>
<td>S.E. Allen</td>
</tr>
<tr>
<td>NSERC</td>
<td>Autonomous vertical profiler for natural and man-made water bodies</td>
<td>108,920</td>
<td>2006</td>
<td>G.A. Lawrence</td>
<td>R. A. Pawlowicz (EOS)</td>
</tr>
<tr>
<td>NSERC</td>
<td>Eyes for UBC-Gavia robotic submersible</td>
<td>48,536</td>
<td>2006</td>
<td>B. Laval</td>
<td>G.A. Lawrence and 6 others</td>
</tr>
<tr>
<td>NSERC</td>
<td>Stratified Towing Tank</td>
<td>105,000</td>
<td>2005</td>
<td>Zhu, D.</td>
<td>G.A. Lawrence and 2 others</td>
</tr>
<tr>
<td>NSERC</td>
<td>Lake Monitoring Observatory</td>
<td>48,003</td>
<td>2005</td>
<td>B. Laval</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>NSERC</td>
<td>Modular exchange flow facility</td>
<td>106,120</td>
<td>2005</td>
<td>G.A. Lawrence</td>
<td>R. A. Pawlowicz (EOS)</td>
</tr>
<tr>
<td>NSERC</td>
<td>High Speed Camera</td>
<td>74,901</td>
<td>2005</td>
<td>C. Ventura</td>
<td>G.A. Lawrence and 4 others</td>
</tr>
<tr>
<td>Agency</td>
<td>Subject</td>
<td>$</td>
<td>Year</td>
<td>Principal Investigator</td>
<td>Co-Investigator</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>---------------------------------------------------</td>
<td>--------</td>
<td>------</td>
<td>--------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Canada Foundation for Innovation and B.C. Knowledge Development Fund</td>
<td>Environmental Fluid Mechanics Instrumentation</td>
<td>300,520</td>
<td>2002</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
<tr>
<td>NSERC</td>
<td>Refrigerated Micro Centrifuge</td>
<td>10,715</td>
<td>2001</td>
<td>G. A. Lawrence</td>
<td>K.J. Hall, and P.H. Harrison</td>
</tr>
<tr>
<td>NSERC</td>
<td>Calibration Bath</td>
<td>24,475</td>
<td>2001</td>
<td>R. A. Pawlowicz</td>
<td>G.A. Lawrence</td>
</tr>
<tr>
<td>NSERC</td>
<td>Bench Salinometer</td>
<td>26,852</td>
<td>2001</td>
<td>R. A. Pawlowicz</td>
<td>G.A. Lawrence, J. Dower, and C. A. Suttle</td>
</tr>
<tr>
<td>NSERC</td>
<td>Four-Channel Nutrient Analyzer</td>
<td>129,095</td>
<td>2001</td>
<td>P. H. Harrison</td>
<td>G.A. Lawrence, and 3 others</td>
</tr>
<tr>
<td>NSERC</td>
<td>Flow Cytometer for Field and Laboratory Use</td>
<td>89,822</td>
<td>2001</td>
<td>C. A. Suttle</td>
<td>G.A. Lawrence, and 7 others</td>
</tr>
<tr>
<td>Canada Foundation for Innovation</td>
<td>Centre for Environmental Research in Minerals Metals and Materials</td>
<td>3,268,527</td>
<td>2000</td>
<td>J. A. Meech</td>
<td>G. A. Lawrence, and others</td>
</tr>
<tr>
<td>Canada Foundation for Innovation</td>
<td>Bamfield Marine Station: Infrastructure for Studies in Biodiversity and Bioenvironmental Fluid Dynamics</td>
<td>3,046,752</td>
<td>2000</td>
<td>A. Spencer</td>
<td>G. A. Lawrence, and others</td>
</tr>
<tr>
<td>NSERC</td>
<td>Field Fluorometer</td>
<td>24,171</td>
<td>1999</td>
<td>E. R. Hall</td>
<td>G.A. Lawrence, and others</td>
</tr>
<tr>
<td>NSERC</td>
<td>Image Processing for Fluid Mechanics Experiments</td>
<td>73,661</td>
<td>1992</td>
<td>G. A. Lawrence</td>
<td>M. C. Quick and M. Isaacson</td>
</tr>
<tr>
<td>UBC/NSERC</td>
<td>Equipment Grant</td>
<td>25,000</td>
<td>1987</td>
<td>G. A. Lawrence</td>
<td></td>
</tr>
</tbody>
</table>

Invited Presentations

<table>
<thead>
<tr>
<th>Title</th>
<th>Audience/ Venue</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waves and Currents: Hawking Radiation in the Hydraulics Laboratory</td>
<td>School of Naval Architecture, Ocean and Civil Engineering, Shanghai Jiao Tong University</td>
<td>2 Aug 2018</td>
</tr>
<tr>
<td>Instabilities in Stratified Shear Flows</td>
<td>Department of Civil Engineering, Lanzhou University, China</td>
<td>21 July 2018</td>
</tr>
<tr>
<td>Remediation of Lakes from a Canadian Perspective</td>
<td>Department of Civil Engineering, Lanzhou University, China; Sino-Canada Joint R&amp;D Centre for Water and Environmental Safety, Nankai University, Tianjin, China</td>
<td>22 July 2018; 27 Mar 2018</td>
</tr>
<tr>
<td>Physical Limnology of Base Mine Lake</td>
<td>Syncrude – Base Mine Lake Technical Meeting, Edmonton</td>
<td>21 Jan 2018</td>
</tr>
<tr>
<td>Title</td>
<td>Audience/ Venue</td>
<td>Date</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Wave Current Interactions: Where Environmental Hydraulics and Black Hole Physics Overlap</td>
<td>Symposium on Hydro-environment Research for Smart Cities in Honour of Professor Joseph Hun-wei Lee, Hong Kong University of Science and Technology</td>
<td>13 Dec 2017</td>
</tr>
<tr>
<td>Decades of Dabbling in Diffuser design</td>
<td>International Symposium on Outfall Systems, 2016, Ottawa, Canada</td>
<td>12 May 2016</td>
</tr>
<tr>
<td>Stratification and Mixing in Brackish Lakes Subject to Ice Cover</td>
<td>22nd Annual BC/MEND Metal Leaching/Acid Rock Drainage Workshop, Simon Fraser University Harbour Centre, Vancouver, BC</td>
<td>3 Dec 2015</td>
</tr>
<tr>
<td>Kootenay Lake: Impact of Dams and other Human Activities</td>
<td>Brock House Society, Vancouver</td>
<td>2 June 2015</td>
</tr>
<tr>
<td>Physical Factors Affecting Water Quality in Natural and Man-Made Lakes in Canada</td>
<td>Physics of Aquatic Systems laboratory, EPFL, Lausanne</td>
<td>1 May 2014</td>
</tr>
<tr>
<td>Some Physical Processes Affecting Water Quality in Lakes and Reservoirs</td>
<td>RES'EAU-EAWAG workshop, Zurich</td>
<td>30 Apr 2014</td>
</tr>
<tr>
<td>Waves and Currents: Hawking Radiation in the Hydraulics laboratory</td>
<td>The Eighth Edwards Lecture, Oregon State University</td>
<td>19 Mar 2013</td>
</tr>
<tr>
<td>Hawking Emission in a Laboratory Flume</td>
<td>Workshop on Effective Gravity in Fluids and Superfluids, Trieste, Italy</td>
<td>11 July 2012</td>
</tr>
<tr>
<td>Turbidity in Coquitlam Reservoir: Toward siting a second drinking water intake</td>
<td>International Conference on Drinking Water Safety, Security and Sustainability, Hangzhou, China</td>
<td>10 Oct 2011</td>
</tr>
<tr>
<td>Discharge into Morrison Lake: Dilution Calculations</td>
<td>Canadian Environmental Assessment Agency, Vancouver</td>
<td>25 Jan 2011</td>
</tr>
<tr>
<td>Dispersion of Greywater from Houseboats into Shuswap Lake</td>
<td>Shuswap Lake Integrated Planning Process Meeting</td>
<td>16 June 2010</td>
</tr>
<tr>
<td>Mixing in Density Stratified Shear Flows</td>
<td>2010 Ocean Sciences Meeting: From Observation to Prediction in the 21st Century</td>
<td>26 Feb 2010</td>
</tr>
<tr>
<td>Water Channel Experiments and Black-Hole Physics</td>
<td>Emergent Gravity IV, UBC</td>
<td>27 Aug 2009</td>
</tr>
<tr>
<td>Stratified Flows</td>
<td>Environmental Fluid Mechanics Summer School, Santiago, Chile</td>
<td>Jan 2009</td>
</tr>
<tr>
<td>Holmboe’s Instability</td>
<td>Centre for Water Research, University of Western Australia</td>
<td>23 July 2008</td>
</tr>
<tr>
<td>Physical Limnology: Canadian Style</td>
<td></td>
<td>27 Aug 2008</td>
</tr>
<tr>
<td>Holmboe’s Instability and Beyond</td>
<td>PIMS Workshop on Waves in Atmosphere and Ocean, SFU</td>
<td>25 Apr 2008</td>
</tr>
<tr>
<td>Holmboe’s Instability</td>
<td>Environmental Fluid Mechanics and Hydrology, Stanford University</td>
<td>6 Mar 2007</td>
</tr>
<tr>
<td>Holmboe’s Instability</td>
<td>Sixth International Symposium on Stratified Flows, University of Western Australia</td>
<td>11 Dec 2006</td>
</tr>
<tr>
<td>Title</td>
<td>Audience/ Venue</td>
<td>Date</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Physical Processes and Meromixis in Pit-Lakes</td>
<td>13th Annual British Columbia MEND ML/ARD Workshop, Simon Fraser University,</td>
<td>29 Nov 2006</td>
</tr>
<tr>
<td></td>
<td>Vancouver</td>
<td></td>
</tr>
<tr>
<td>Exchange Flows in the Laboratory, Computer and Field</td>
<td>Department of Earth and Ocean Sciences, University of Victoria</td>
<td>25 Nov 2002</td>
</tr>
<tr>
<td>Physical Processes in Island Copper’s Mine Pit Lake</td>
<td>Colloquium in Environmental Science and Engineering, University of Northern</td>
<td>1 Nov. 2002</td>
</tr>
<tr>
<td></td>
<td>British Columbia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The First Annual CERM3 Workshop</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Symposium, UBC Robson Square Campus</td>
<td></td>
</tr>
<tr>
<td>Fluid Mechanics and the Effectiveness of Water Covers</td>
<td>8th Annual British Columbia Metal Leaching and ARD Workshop, Simon Fraser</td>
<td>29 Nov. 2001</td>
</tr>
<tr>
<td></td>
<td>University Harbour Centre</td>
<td></td>
</tr>
<tr>
<td>Evolution of the Island Copper Mine Pit Lake</td>
<td>Department of Environmental Engineering, University of Western Australia</td>
<td>10 Aug. 2001</td>
</tr>
<tr>
<td>Vertical Mixing in Density Stratified Flows</td>
<td>Department of Civil Engineering, University of Canterbury</td>
<td>3 May 2000</td>
</tr>
<tr>
<td>The Hydraulics of Layered Flows</td>
<td>Fluid Dynamics Summer School, University of Alberta</td>
<td>18 Aug. 1999</td>
</tr>
<tr>
<td>Mixing in Density Stratified Flows</td>
<td></td>
<td>19 Aug. 1999</td>
</tr>
<tr>
<td>The hydraulics and mixing of two-layer flows</td>
<td>Institute for Hydromechanics, University of Karlsruhe, Germany</td>
<td>30 June 1998</td>
</tr>
<tr>
<td>Some problems in Environmental Fluid Mechanics</td>
<td>Department of Civil Engineering, University of Hong Kong</td>
<td>9 Jan. 1998</td>
</tr>
<tr>
<td>The exchange of water and oxygen between the two basins of Amisk Lake.</td>
<td>Natural Resources and Environmental Studies Research Colloquium, University of</td>
<td>21 Mar 1997</td>
</tr>
<tr>
<td></td>
<td>Northern British Columbia</td>
<td></td>
</tr>
<tr>
<td>Near field transport and fate of pulp mill effluents</td>
<td>Fraser River Action Plan 3rd Research Workshop, Simon Fraser University,</td>
<td>20 Feb 1996</td>
</tr>
<tr>
<td></td>
<td>Vancouver</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Limnology, Broome, Western Australia</td>
<td></td>
</tr>
<tr>
<td>Internal dynamics of the Nechako Reservoir and the operation of the</td>
<td>B.C. Hydro/Mr. John Allen, Deputy Minister, Environmental Assessment Office,</td>
<td>11 May 1995</td>
</tr>
<tr>
<td>The hydraulics and mixing of density stratified flows: In search of</td>
<td>Applied Physics Laboratory, University of Washington</td>
<td>4 May 1995</td>
</tr>
<tr>
<td>Holmboe’s instability.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The hydraulics and mixing of two-layer flows.</td>
<td>Centre for Water Research, University of Western Australia</td>
<td>27 April 1994</td>
</tr>
<tr>
<td>Hydrodynamic instabilities in density stratified flows</td>
<td>Workshop on Waves in the Ocean, Mathematical Sciences Research Institute,</td>
<td>10 Feb. 1994</td>
</tr>
<tr>
<td></td>
<td>University of California, at Berkeley</td>
<td></td>
</tr>
<tr>
<td>Mixing in stratified flows</td>
<td>Workshop on stratified flows, University of Washington</td>
<td>19 May 1992</td>
</tr>
<tr>
<td>In search of Holmboe’s instability.</td>
<td>University of Victoria</td>
<td>24 Feb. 1992</td>
</tr>
<tr>
<td>Title</td>
<td>Audience/ Venue</td>
<td>Date</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Two-layer gravitational exchange through a contraction: can mixing be predicted using internal hydraulics?</td>
<td>Institute of Hydromechanics and Water Resources, Federal Institute of Technology, Zurich</td>
<td>21 July 1989</td>
</tr>
<tr>
<td>Can mixing in gravitational exchange flows be predicted using internal hydraulics?</td>
<td>NATO/ONR Workshop on the Physical Oceanography of Sea Straits, Les Arcs, France</td>
<td>13 July 1989</td>
</tr>
<tr>
<td>The hydraulics and mixing of two-layer flow over an obstacle</td>
<td>Fluid Mechanics seminar, University of Washington</td>
<td>29 April 1988</td>
</tr>
<tr>
<td></td>
<td>Lorenz G. Straub Award Presentation, University of Minnesota</td>
<td>8 Oct. 1987</td>
</tr>
<tr>
<td>What is happening at the Strait of Gibraltar?</td>
<td>University of Southern California</td>
<td>24 Feb. 1987</td>
</tr>
<tr>
<td>The hydraulics and mixing of two-layer flow over an obstacle</td>
<td>Seminar series on Environmental Fluid Dynamics, California Institute of Technology Department of Civil Engineering, University of Canterbury IUTAM Symposium on Mixing in Stratified Fluid, Margaret River, Western Australia</td>
<td>1 May 1986 20 Sept. 1985</td>
</tr>
<tr>
<td>Mixing in two-layer flow over topography</td>
<td>Water Resources Seminar, Stanford University</td>
<td>6 May 1985</td>
</tr>
</tbody>
</table>

(d) Other Presentations

(e) Conference Participation
Keynote Speaker
International Symposium on Outfall Systems, Ottawa, Canada, 12 May 2016.
International Water Association Symposium on Lake and Reservoir Management 2015, Pembroke, Virginia, USA, 4 August 2015.
International Conference on Drinking Water Safety, Security and Sustainability, Hangzhou, China, 10 Oct 2011.
Sixth International Symposium on Stratified Flows, University of Western Australia, December, 2006.

Conference Chair
Fifth International Symposium on Stratified Flows, UBC, July, 2000. This symposium is held only once every 6 – 8 years, ensuring that it is the premier meeting for scientists and engineers engaged in the study of density stratified flows.

Organizing Committee
37th IAHR World Congress, Kuala Lumpur, Malaysia, August 2017
10. **SERVICE TO THE UNIVERSITY**

(a) **Memberships in committees, including offices held and dates**

(i) Departmental

- **Departmental Mentorship Committee**
  - 2019 - present
- **Departmental ARPT Committee**
  - 2019 - present
- Co-chair: **Working Group on Undergraduate Environmental Engineering Program**
  - 2017-2019
- **Faculty Awards Committee**
  - 2017 - present
- **Graduate Student Awards Committee**
  - 2017
- **Search Committee for Environmental Faculty**
  - 2015-16
- **Working Group on Undergraduate Environmental Engineering Program**
  - 2014-2017
- **Group Leader – Hydrotechnical Engineering**
  - 2015-2016
- **Group Leader – Hydrotechnical Engineering**
  - 2013-2014
- **ARPT Sub-committee**
  - 2012-2013
- **Cost Recovery Committee**
  - 2009-2014
- **Group Leader – Hydrotechnical Engineering**
  - 2010-2012
- **Applied Science Representative to the Faculty of Science**
  - 2009-2012
- **Chair Appointments Reappointments Promotions and Tenure Committee**
  - 2004-2005
- **Board of Study, Joint UBC/UNBC Undergraduate program in Environmental Engineering**
  - 2001-2005
- **ARPT Committee**
  - 2002-2005
- **Chair Search Comm. for Faculty Member in Transportation Eng.**
  - 2003
- **Search Committee for Environmental Fluid Mechanics Faculty**
  - 2001
- **Search Committee for Hydrotechnical Faculty Member**
  - 1998
- **Hydrotechnical Group Leader**
  - 1996-2000
- **Search Committee for Hydrotechnical Faculty Replacements**
  - 1995-96
- **Head's Advisory Committee**
  - 1995-96
- **Curriculum Committee Chairman**
  - 1995-99
- **Departmental Profile Committee**
  - 1993-95
- **Committee for Search for Construction Management Position**
  - 1992-93
- **Departmental Environmental Engineering Initiative Committee**
  - 1991-93
- **Responsible for Teaching Assistantships and Awards**
  - 1990-93
- **Department Open House Co-Chairman (with A. Filiatrault)**
  - 1989-90
- **Departmental Committee to Study Word Processing and Graphics**
  - 1989-90
- **Member of Departmental Curriculum Committee**
  - 1988-90

(ii) Other

- **Co-director – Undergraduate Environmental Engineering Program**
  - 2019-
- **Co-director - Master of Engineering Leadership in Integrated Water Management**
  - 2016-2019
- **UBC Nomination Committee for NSERC Steacie Fellowships**
  - 2017
- **UBC Senior Appointments Committee**
  - 2015-2016
- **Co-director - Master of Engineering Leadership in Integrated Water Management**
  - 2015-2016
- **UBC CRC Interdisciplinary Adjudication Committee**
  - 2014-2015
- **Dean's Advisory Committee, Selection of Head for Civil Engineering**
  - 2014
- **Faculty of Applied Science ARPT Committee**
  - 2013-2014
- **Faculty of Applied Science ARPT Committee**
  - 2009-2012
- **Faculty Association Advisory Committee on Retirement Planning**
  - 2008-9
- **Faculty of Applied Science ARPT Committee**
  - 2005 - 2007

**Member of the Board of Governors**
- **2001- 2008**
- **Internal Vice-Chair of the Board of Governors**
  - 2002- 2008
- Chair Learning and Research Committee 2002-2008
- Management Resources and Compensation Committee 2002-2008
- Finance Committee 2001-2008
- Learning and Research Committee 2001-2002
Member of the Cecil Green Visiting Professors’ Committee 2003-2005
Member of the Engineering Mathematics Program Committee 2003
Member of the Nominations Committee of the Faculty Association of UBC 2002
President’s Advisory Committee, Selection of Head for Civil Engineering 2002
Applied Science Curriculum Committee 1995-1999
UBC Open House Co-ordinator for Engineering 1995-96
Advisory Committee for the Institute of Applied Mathematics 1993-present

(b) Other service, including dates
1991 Participated in design considerations for the Faculty Housing Assistance Rental Project.
1991 Participated in review of proposed UBC Faculty Housing Assistance Program.

11. SERVICE TO THE COMMUNITY

(a) Memberships in scholarly societies, including offices held and dates
2017- Member of the Canadian Geophysical Union
2016- Member of the Australasian Fluid Mechanics Society
2013- Fellow of the Canadian Society for Civil Engineering
2012- Fellow of the Canadian Academy of Engineering
1993- Member of the American Society of Civil Engineers
1990- Member of the Association of Professional Engineers and Geoscientists of B.C.
1990-2013 Member of the Canadian Society for Civil Engineering
1986- Member of the American Physical Society
1986- Member of the International Association for Hydraulic Research
1986- Member of the American Society of Limnology and Oceanography
1984- Member of the American Geophysical Union
1984-93 Associate Member of the American Society of Civil Engineers

(b) Editorships
2013- Editorial Advisory Committee, Engineering and Computational Mechanics
2012- Associate Editor, Canadian Journal of Civil Engineering
2009-11 Guest Associate Editor, Canadian Journal of Civil Engineering
2006-10 Associate Editor, Journal of Hydraulic Engineering, ASCE

(c) Memberships in other societies, including offices held and dates
1993 Member of the Community Advisory Committee UBC Hazardous Waste Program

(d) Memberships in scholarly committees, including offices held and dates
2011-14 NSERC Civil, Industrial and Systems Engineering Grant Selection Committee
1995- Member of the Fluid Mechanics Committee of the International Association of Hydraulic Research
2003-05 Selection Committee for Camille Dagenais Award (for outstanding contributions to Hydrotechnical Engineering in Canada)
1999-02 Selection Committee for the Lorenz G. Straub Award (for best English language PhD thesis worldwide in Hydraulic Engineering or a closely related field).
1995-98 Okanagan Lake Scientific Advisory Panel.
1989-90 ASCE Hydromechanics Task Committee on Entrainment in Hydraulic Jumps.

(e) Memberships in other committees

(f) Reviews & Appraisals

(i) Peer review
- Member of two-person Site Visit Committee for appraisal of graduate program in Civil Engineering and Environmental Engineering at the University of Western Ontario, London, September 2008. Review carried out for Ontario Council for Graduate Studies (OCGS).
- Member of peer review committee for the Swiss Federal Institute for Water Resources and Water Pollution Control (EAWAG), Zurich, Sept – Oct 2003.

(ii) Regular reviews (at least one per year on average)
Canadian Journal of Civil Engineering
Journal of Environmental Engineering, ASCE (Recipient of 2001 Editor’s Award)
Journal of Fluid Mechanics
Journal of Hydraulic Engineering, ASCE
NSERC (Natural Sciences and Engineering Research Council - Canada)
Limnology and Oceanography
Physics of Fluids

(iii) Occasional reviews (less than one per year on average)
American Geophysical Union
Australian Research Council
AXA Insurance
BC Science Council
University of California Energy Institute
Canadian Aeronautics and Space Journal
Canada Foundation for Innovation
Canadian Journal of Fisheries and Aquatic Sciences
Centre of Scientific Culture “Alessandro Volta”, Italy
Coastal Engineering
Coastal and Estuarine Studies Series - American Geophysical Union
Computers & Fluids
Dynamics of Atmospheres and Oceans
Estuaries
European Journal of Mechanics - B/Fluids
Experiments in Fluids
FCAR (Quebec)
Geophysical Research Letters
Great Lakes University Research Fund
Japanese Journal of Limnology
Journal of Environmental Engineering and Science
Journal of Geophysical Research – Oceans
Journal of Offshore Mechanics and Coastal Engineering, ASME
Journal of Physical Oceanography
Journal of Volcanology and Geothermal Research
Journal of Waterway, Port, Coastal and Ocean Engineering, ASCE
Nature
National Science Foundation (USA)
Proceedings of the National Academy of Sciences (USA)
Scientia Sharif
### External Examiner

<table>
<thead>
<tr>
<th>Student</th>
<th>Degree</th>
<th>Date</th>
<th>University</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anton Baglaenko</td>
<td>Ph.D.</td>
<td>Dec. 15</td>
<td>U. of Waterloo, Canada</td>
<td>Mathematics</td>
</tr>
<tr>
<td>Manuel Schmid</td>
<td>M. Eng.</td>
<td>July 15</td>
<td>EPFL, Switzerland</td>
<td>Environmental Engineering</td>
</tr>
<tr>
<td>Aidin Jabbari Sahebari</td>
<td>PhD</td>
<td>May 15</td>
<td>Queens University, Kingston, Ontario</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Tobias Sommer</td>
<td>PhD</td>
<td>June 14</td>
<td>ETH Zurich</td>
<td>Biogeochemistry and Pollutant Dynamics</td>
</tr>
<tr>
<td>Christina Silva</td>
<td>PhD</td>
<td>Nov 13</td>
<td>U. of Western Australia</td>
<td>Centre for Water Research</td>
</tr>
<tr>
<td>Amber Holdsworth</td>
<td>PhD</td>
<td>Dec 12</td>
<td>U. of Alberta</td>
<td>Department of Earth and Atmospheric Sciences</td>
</tr>
<tr>
<td>Sally Williams</td>
<td>PhD</td>
<td>Feb 11</td>
<td>U. of Sydney</td>
<td>Graduate School of Engineering &amp; IT</td>
</tr>
<tr>
<td>Kenny Lim</td>
<td>PhD</td>
<td>Dec 09</td>
<td>U. of Western Australia</td>
<td>Environmental Systems Engineering</td>
</tr>
<tr>
<td>Patricia Nicole Okely</td>
<td>PhD</td>
<td>Sept 09</td>
<td>U. of Western Australia</td>
<td>Centre for Water Research</td>
</tr>
<tr>
<td>Vadim Anohin</td>
<td>Ph.D.</td>
<td>Jan 07</td>
<td>U. of Western Australia</td>
<td>Centre for Water Research</td>
</tr>
<tr>
<td>Rocio Fernandez</td>
<td>PhD</td>
<td>Oct 06</td>
<td>U. of Western Australia</td>
<td>Centre for Water Research</td>
</tr>
<tr>
<td>M. El Kamash</td>
<td>PhD</td>
<td>April 05</td>
<td>U. of Alberta</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Julianne Trelleberg</td>
<td>MS</td>
<td>Oct. 04</td>
<td>U. of Northern BC</td>
<td>Environmental Science</td>
</tr>
<tr>
<td>Frank Gerdes</td>
<td>PhD</td>
<td>Nov. 02</td>
<td>University of Victoria</td>
<td>Earth and Ocean Sciences</td>
</tr>
<tr>
<td>Andrew Hogg</td>
<td>PhD</td>
<td>Jan. 02</td>
<td>U. of Western Australia</td>
<td>Environmental Engineering</td>
</tr>
<tr>
<td>T. Finnigan</td>
<td>Ph.D.</td>
<td>May 00</td>
<td>U. of Western Australia</td>
<td>Environmental Engineering</td>
</tr>
<tr>
<td>N. Schmidt</td>
<td>Ph.D.</td>
<td>April 98</td>
<td>U. of Canterbury</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>A. F. Etemad-Shahidi</td>
<td>Ph.D.</td>
<td>Feb. 98</td>
<td>U. of Western Australia</td>
<td>Environmental Engineering</td>
</tr>
<tr>
<td>B. Bohrer</td>
<td>Ph.D.</td>
<td>Feb. 96</td>
<td>U. of Western Australia</td>
<td>Environmental Engineering</td>
</tr>
<tr>
<td>R. Anaraki</td>
<td>Ph.D.</td>
<td>May 95</td>
<td>U. of New South Wales</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>R. Stephens</td>
<td>M.Eng.Sci.</td>
<td>Oct. 94</td>
<td>U. of Western Australia</td>
<td>Environmental Engineering</td>
</tr>
<tr>
<td>M. Jameel</td>
<td>Ph.D.</td>
<td>Aug. 91</td>
<td>U. of Calgary</td>
<td>Mechanical Engineering</td>
</tr>
<tr>
<td>N. Yonemitsu</td>
<td>Ph.D.</td>
<td>June 91</td>
<td>U. of Alberta</td>
<td>Civil Engineering</td>
</tr>
</tbody>
</table>

### University Examiner for Doctoral Examinations (since 2018)

<table>
<thead>
<tr>
<th>Student</th>
<th>Date</th>
<th>Title</th>
<th>Supervisor</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xiaoyu Zheng</td>
<td>Feb. 18</td>
<td>Sludge Reduction by Mixed Liquor Ozonation</td>
<td>Eric Hall</td>
<td>Civil Engineering</td>
</tr>
<tr>
<td>Maria Elgueta</td>
<td>Mar. 18</td>
<td>Effects of Episodic Sediment Supply on Channel Adjustment of an Experimental Gravel Bed</td>
<td>Marwan Hassan</td>
<td>Geography</td>
</tr>
<tr>
<td>Student</td>
<td>Date</td>
<td>Title</td>
<td>Supervisor</td>
<td>Department</td>
</tr>
<tr>
<td>---------------</td>
<td>-------</td>
<td>----------------------------------------------------------------------</td>
<td>------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Thomas Aubry</td>
<td>Apr. 18</td>
<td>Interactions between Climate and the Rise of Explosive Volcanic Plumes: A New Feedback in the Earth System</td>
<td>Mark Jellinek</td>
<td>EOAS</td>
</tr>
<tr>
<td>Ali Etradi</td>
<td>9 Aug 18</td>
<td>Displacement Flow of Miscible Fluids with Density and Viscosity Contrast</td>
<td>Ian Figaard</td>
<td>Mechanical Engineering</td>
</tr>
</tbody>
</table>

(i)  *External Examiner for MSc Defense (since 2018)*

<table>
<thead>
<tr>
<th>Student</th>
<th>Date</th>
<th>Title</th>
<th>Supervisor(s)</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jacquie-Lee Epstein</td>
<td>Apr. 18</td>
<td>The Impact of Internal Tide Mixing Parameterizations in an Eddy-Permitting Model of the Arctic Ocean</td>
<td>Stephanie Waterman and Paul Myers</td>
<td>EOAS</td>
</tr>
</tbody>
</table>

(j)  *External Examiner for MSc and PhD Proposal Defenses (since 2018)*

<table>
<thead>
<tr>
<th>Student</th>
<th>Date</th>
<th>Title</th>
<th>Degree</th>
<th>Supervisor(s)</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melanie Chanona</td>
<td>May 18</td>
<td>Spatial and Temporal Variability of Internal Waves and their Effect on Turbulent Mixing in the Canadian Arctic Ocean</td>
<td>PhD</td>
<td>Stephanie Waterman</td>
<td>EOAS</td>
</tr>
<tr>
<td>Nicolaos Simantiris</td>
<td>May 18</td>
<td>The Importance of Multicomponent Diffusion as a Transport Mechanism in the Ocean</td>
<td>MASc</td>
<td>Richard Pawlowicz</td>
<td>EOAS</td>
</tr>
</tbody>
</table>

(k)  *Second Reader for MASc Theses (since 2018)*

<table>
<thead>
<tr>
<th>Student</th>
<th>Date</th>
<th>Title</th>
<th>Supervisor(s)</th>
<th>Department</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abhishek Agrawal</td>
<td>May 18</td>
<td>Modelling Forced Outage in Hydropower Generating Units for Operations Planning Model</td>
<td>Ziad Shawwash</td>
<td></td>
</tr>
</tbody>
</table>

(l)  *Consultancies*

<table>
<thead>
<tr>
<th>Nature of work</th>
<th>Organization</th>
<th>Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elk/Beaver Lake Restoration</td>
<td>Northwest Hydraulics Consultants</td>
<td>2019</td>
</tr>
<tr>
<td>Assessment of the behavior of Chlorinated Water Released from the Greater Vancouver Water District Lulu Island Main Drinking Water Pipeline into Deas Slough.</td>
<td>Hunter Litigation</td>
<td>2018</td>
</tr>
<tr>
<td>Physical Limnology of Bingham Pit Lake</td>
<td>Rio Tinto</td>
<td>2017-present</td>
</tr>
<tr>
<td>Assessment of Physical Stability of Zone 2 Pit Lake</td>
<td>Indian and Northern Affairs, Canada</td>
<td>2009-present</td>
</tr>
<tr>
<td>Analysis of Faro Pit Lake Stratification</td>
<td>CH2M</td>
<td>2016</td>
</tr>
<tr>
<td>Analysis of Proposed Back River Meromictic Lake</td>
<td>SRK Consulting</td>
<td>2015</td>
</tr>
<tr>
<td>Nature of work</td>
<td>Organization</td>
<td>Dates</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>-----------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Review of Suncor’s End Pit Lake Research and Development Plan</td>
<td>Golder Associates</td>
<td>2014</td>
</tr>
<tr>
<td>Comments on Possible Chain Lake Winter Aeration System</td>
<td>Ken Ashley &amp; Associates</td>
<td>2014</td>
</tr>
<tr>
<td>Review of Base Mine Lake Monitoring Plan</td>
<td>BCG Engineering</td>
<td>2014</td>
</tr>
<tr>
<td>Report on Tyson Lake Turbidity</td>
<td>Borden, Ladner, Gervais LLP</td>
<td>2013</td>
</tr>
<tr>
<td>Base Mine Lake Research Planning Workshop</td>
<td>Syncrude</td>
<td>2013</td>
</tr>
<tr>
<td>Diffuser for Quintette Coal Project?</td>
<td>Klohn Crippen Berger</td>
<td>2013</td>
</tr>
<tr>
<td>Evaluation of the impact of wastewater discharge into Morrison Lake</td>
<td>Klohn Crippen Berger</td>
<td>2009-2017</td>
</tr>
<tr>
<td>Review of Proposed Stratification Monitoring Plan for Base Mine Lake Demonstration</td>
<td>Syncrude</td>
<td>2012</td>
</tr>
<tr>
<td>Analysis of Nechako Reservoir water temperature</td>
<td>Surespan Construction Ltd.</td>
<td>2012</td>
</tr>
<tr>
<td>Peace River suspended sediment dispersion modelling</td>
<td>Knight Piesold Ltd.</td>
<td>2010-2012</td>
</tr>
<tr>
<td>Design of aerator tubes for Langford Lake</td>
<td>Northwest Hydraulics</td>
<td>2012</td>
</tr>
<tr>
<td>Fuzzy Cognitive Mapping workshop for Syncrude’s end pit lake</td>
<td>Syncrude</td>
<td>2012</td>
</tr>
<tr>
<td>Limnological predictions for Gacho Kue diamond mine</td>
<td>Hatfield Consultants</td>
<td>2011-2012</td>
</tr>
<tr>
<td>Logan Lake Aerator Outlet Tube Redesign</td>
<td>BC Habitat Conservation Foundation</td>
<td>2011</td>
</tr>
<tr>
<td>Environmental impact study for outfall discharging treated wastewater into Lower Arrow Lake</td>
<td>Ward Engineering and Land Surveying</td>
<td>2008-2012</td>
</tr>
<tr>
<td>Environmental impact study for outfall discharging treated wastewater into the west arm of Kootenay Lake</td>
<td>Ward Engineering and Land Surveying</td>
<td>2008-2012</td>
</tr>
<tr>
<td>Review of greywater management, Shuswap Lake</td>
<td>Fraser Basin Council</td>
<td>2009-2010</td>
</tr>
<tr>
<td>Assessment of stratification in the proposed Taseko Prosperity pit-lake</td>
<td>Taseko Mines Ltd.</td>
<td>2009</td>
</tr>
<tr>
<td>Environmental impact study for outfall discharging treated wastewater into the south arm of Kootenay Lake</td>
<td>Ward Engineering and Land Surveying</td>
<td>2008-2010</td>
</tr>
<tr>
<td>Assessment of potential for aeration to remediate Henderson Lake, Vancouver Island</td>
<td>Ashley and Associates</td>
<td>2008</td>
</tr>
<tr>
<td>Assessment of proposed marinas on water quality at intakes in Okanagan Lake</td>
<td>Northwest Hydraulic Consultants</td>
<td>2008</td>
</tr>
<tr>
<td>Assessment of stratification in the proposed NorthMet West pit-lake.</td>
<td>SRK Consulting</td>
<td>2008</td>
</tr>
<tr>
<td>Nature of work</td>
<td>Organization</td>
<td>Dates</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Evaluation of suitability of aeration to stimulate productivity in Henderson Lake</td>
<td>Northwest Hydraulics Laboratories</td>
<td>2008</td>
</tr>
<tr>
<td>Environmental impact study for outfall discharging treated wastewater into the west arm of Kootenay Lake</td>
<td>Ward Engineering and Land Surveying</td>
<td>2007 - 2008</td>
</tr>
<tr>
<td>Evaluation of the impact of a discharge of fresh water into Neroutsos Inlet</td>
<td>Sigma Engineering Ltd</td>
<td>2007</td>
</tr>
<tr>
<td>Evaluation of the potential for meromixis in proposed Ekati pit-lakes</td>
<td>Rescan Environmental Services</td>
<td>2006-2008</td>
</tr>
<tr>
<td>Review of modeling of end pit-lakes for the oil sands industry</td>
<td>Cumulative Environmental Management Authority</td>
<td>2004-07</td>
</tr>
<tr>
<td>Evaluation of the Physical Stability of the Faro, Grum and Van Gorda Pit Lakes, Yukon</td>
<td>SRK Consulting</td>
<td>2003-07</td>
</tr>
<tr>
<td>Design of an oxygenation pilot test for the remediation of Onondaga Lake, Syracuse, New York</td>
<td>Parsons</td>
<td>2004-05</td>
</tr>
<tr>
<td>Design of an outfall for the discharge of treated wastewater into Kootenay Lake at Greensword</td>
<td>Ward Engineering and Land Surveying</td>
<td>2004-05</td>
</tr>
<tr>
<td>Assessment of need for analysis, field data and numerical modeling for the design of the proposed cold water release facility at Kenney Dam (Nechako Reservoir)</td>
<td>Nechako Enhancement Society</td>
<td>2004-05</td>
</tr>
<tr>
<td>Mooring Plan and Implementation Design for Colomac Zone 2 Pit</td>
<td>Public Works and Indian and Northern Affairs, Canada (INAC)</td>
<td>2004</td>
</tr>
<tr>
<td>Evaluation of the Physical Stability of Tailings Lake and Zone 2 Pit Lake, Colomac Mine Site, NWT</td>
<td>Indian and Northern Affairs, Canada</td>
<td>2003-04</td>
</tr>
<tr>
<td>Impact of nitrogen Loadings to Okanagan Lake from Waste Water Treatment Plants</td>
<td>Habitat Conservation Trust Fund</td>
<td>2002-03</td>
</tr>
<tr>
<td>Prediction of Possible Landslide Generated Wave Amplitudes in the Aquas Claras Mine Pit Lake</td>
<td>Robertson Geoconsultants Inc.</td>
<td>2002</td>
</tr>
<tr>
<td>Design of an Outfall for the Discharge of Treated Wastewater from the Michel Trudeau Kokanee Glacier Alpine Cabin</td>
<td>Ward Engineering and Land Surveying</td>
<td>2002</td>
</tr>
<tr>
<td>Numerical Modeling of Dissolved Oxygen Concentrations in the Island Copper Mine Pit Lake</td>
<td>Rescan Environmental Services</td>
<td>2002</td>
</tr>
<tr>
<td>Design of Outfalls for the Discharge of Treated Wastewater into Kootenay Lake at Ainsworth</td>
<td>Ward Engineering and Land Surveying</td>
<td>1999-2002</td>
</tr>
<tr>
<td>Prediction of Impact of Methanol Releases into Rivers</td>
<td>Methanex</td>
<td>2000-02</td>
</tr>
<tr>
<td>Movement of a Weighted Bag and a Human Body in Alouette Lake</td>
<td>RCMP</td>
<td>2001</td>
</tr>
<tr>
<td>Estimation of Water Storage Volumes at Britannia Mine</td>
<td>Environment Canada</td>
<td>2001</td>
</tr>
<tr>
<td>Nature of work</td>
<td>Organization</td>
<td>Dates</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------</td>
<td>---------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Review of Analysis of TGP Mixing in Rivers</td>
<td>B. C. Hydro</td>
<td>2001</td>
</tr>
<tr>
<td>Assessment of impact of reservoir operations on water quality in Carpenter and Seton Reservoirs</td>
<td>B. C. Hydro</td>
<td>2000-01</td>
</tr>
<tr>
<td>Experimental study of mine tailings discharge into tailings ponds</td>
<td>Shell Canada</td>
<td>1999-2001</td>
</tr>
<tr>
<td>Transport characteristics of a jet in the Percy Priest lake</td>
<td>Richard Speece, Vanderbilt University</td>
<td>1999</td>
</tr>
<tr>
<td>Analysis of settling basin solvent emissions</td>
<td>Shell Canada</td>
<td>1998</td>
</tr>
<tr>
<td>Derivation of a stage-discharge relationship for the corroded V-notch weir on Pyrrhotite Creek</td>
<td>Environment Canada</td>
<td>1998</td>
</tr>
<tr>
<td>Advisor for the modelling of sediment/turbidity concentrations in the Capilano Reservoir</td>
<td>Klohn-Crippen Consultants</td>
<td>1998-99</td>
</tr>
<tr>
<td>Analysis of the design of a water intake structure</td>
<td>Ward Engineering and Land Surveying</td>
<td>1997</td>
</tr>
<tr>
<td>Impact of the disposal of sulphide concentrates in the Detour Lake mine’s open pit</td>
<td>Placer Dome</td>
<td>1997</td>
</tr>
<tr>
<td>Design of an outfall for the discharge of treated wastewater into Upper Arrow Lake</td>
<td>Levelton Engineering</td>
<td>1997</td>
</tr>
<tr>
<td>Review of a report by Hay &amp; Co. on the design of tailings ponds to provide water cover for acid rock drainage control</td>
<td>Placer Dome</td>
<td>1996</td>
</tr>
<tr>
<td>Evaluation of the impact of treated effluent discharge from the proposed Porteous Condominium development</td>
<td>Ward Engineering and Land Surveying</td>
<td>1996-99</td>
</tr>
<tr>
<td>Design of an outfall for the discharge of treated wastewater into Crawford Bay</td>
<td>Levelton Engineering</td>
<td>1996</td>
</tr>
<tr>
<td>Investigation of limnological processes in Lake Okanagan and their impact on the Cryptosporidium outbreak</td>
<td>City of Kelowna</td>
<td>1996</td>
</tr>
<tr>
<td>Analysis of the potential for the formation of a permanent halocline in a proposed man-made lake</td>
<td>Syncrude Canada</td>
<td>1995-96</td>
</tr>
<tr>
<td>Preliminary evaluation of the physical limnology of the Sooke Lake Reservoir, Vancouver Island</td>
<td>Greater Victoria Water District</td>
<td>1995</td>
</tr>
<tr>
<td>Evaluation of the feasibility of mine tailings discharge into Kitsault Lake, B.C.</td>
<td>Rescan</td>
<td>1994</td>
</tr>
<tr>
<td>Nature of work</td>
<td>Organization</td>
<td>Dates</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------</td>
<td>---------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Expert witness in the B.C. Utilities Commissions hearings on the Kemano Completion Project</td>
<td>Rivers Defense Coalition</td>
<td>1994</td>
</tr>
<tr>
<td>Evaluation of the feasibility of hypolimnetic withdrawal from Dunn Lake, B.C.</td>
<td>Department of Fisheries and Oceanography, Canada</td>
<td>1993-94</td>
</tr>
<tr>
<td>Design of a multiport aeration system to oxygenate Camanche Reservoir</td>
<td>East Bay Municipal District, California</td>
<td>1992-93</td>
</tr>
<tr>
<td>Investigation of the possible discharge of Brenda Mine site runoff into Lake Okanagan</td>
<td>Rescan</td>
<td>1992</td>
</tr>
<tr>
<td>Evaluation of dye studies of the Kelowna and Westbank outfalls</td>
<td>Dayton and Knight</td>
<td>1991-92</td>
</tr>
<tr>
<td>Analysis of oxygen transport between the two basins of Amisk Lake, Alberta</td>
<td>Environment Canada</td>
<td>1991</td>
</tr>
<tr>
<td>Advice on limnological studies of Capilano and Seymour Lakes, North Vancouver</td>
<td>Limnotec</td>
<td>1991</td>
</tr>
<tr>
<td>Prediction of physical limnology of a proposed water body in Betze Pit, Nevada. There is concern that toxic arsenic compounds will form in the proposed water body</td>
<td>Adrian Smith Consultants Inc.</td>
<td>1991</td>
</tr>
<tr>
<td>Review of Kemano Completion Projects hydrothermal modelling of the Nechako Reservoir. Used as a case study in CIVL 541 (Environmental Fluid Mechanics)</td>
<td>B.C. Ministry of Environment</td>
<td>1991-93</td>
</tr>
<tr>
<td>Advice on the modelling of the sediment plume from the Tsitika river, and its potential impact of the killer whale rubbing beaches.</td>
<td>Hay and Company</td>
<td>1991</td>
</tr>
<tr>
<td>Design of a multiport aeration system to oxygenate Newman Lake</td>
<td>Spokane County, Washington</td>
<td>1990-91</td>
</tr>
<tr>
<td>Analysis of the potential impact of the discharge from a proposed pulp mill on the dissolved oxygen concentrations in the Nechako River</td>
<td>Peter Ward and Associates</td>
<td>1990</td>
</tr>
<tr>
<td>Design of multiport diffusers</td>
<td>Norecol Environmental Consultants</td>
<td>1989</td>
</tr>
<tr>
<td>Research into the wind-wave induced re-suspension of mine tailings sludge in disposal ponds. Used as a case study in CIVL 417 (Coastal Engineering). Uses most of the techniques taught in that class</td>
<td>Syncrude Canada</td>
<td>1988-94</td>
</tr>
<tr>
<td>Analysis of pollutant flushing at Pier 39, San Francisco Bay.</td>
<td>Hugo B. Fischer, Inc.</td>
<td>1982</td>
</tr>
</tbody>
</table>

*(m) Other service to the community*

2000-2001 Analyzed water movements in Allouette Lake for the RCMP in the Heather Thomas abduction/murder investigation.

1993-96 Tours of the Hydraulics lab to female and Native Indian high school students and high school teachers as part of the “Engineering as a Career” program.

1992-93 Lecture on Environmental Fluid Mechanics to the Shad Valley program.

1993-94 Representative for Thames Court on the Community Advisory Committee for the UBC Incinerator Replacement Project.

1993 Presentation at the graduation ceremonies of the North Surrey Secondary School.
1993 Participated in the Central Okanagan Career Program's "Day in Engineering" with Dr. Sidney Mindess.

1991-95 Obtained funding for and supervised the design, installation and operation of a hypolimnetic withdrawal system in Chain Lake (40 km north of Penticton) to alleviate a severe algae problem.

1991 Supervised Edmund Low of Killarney Secondary in laboratory and field work as part of the Vancouver School Board career preparation program.

(n) Expert Witness

Feb. 1994 Appeared at the B.C. Utilities Commission’s hearings on the Kemano Completion Project on behalf of the River’s Defense Coalition.

12. AWARDS AND DISTINCTIONS

2019 UBC Civil Engineering Club 2nd Year Student Appreciation Award for commitment to fairness, communication, and quality teaching.

2018 UBC Civil Engineering Club 2nd Year Student Appreciation Award for commitment to fairness, communication, and quality teaching.

2016 Visiting Research Fellow School of Civil, Environmental and Mining Engineering at the University of Western Australia

2014 UBC Civil Engineering Club 2nd Year Student Appreciation Award for commitment to fairness, communication, and quality teaching.

2013 Elected Fellow of the Canadian Society for Civil Engineering

2012 Elected Fellow of the Canadian Academy of Engineering

2011 Camille Dagenais Award for contributions by a Civil Engineer to the development and practice of Hydrotechnical Engineering in Canada.

2010 Premiers Award – Partnershship Category, for contributions to the Shuswap Lake Integrated Planning Process.

2008 Gledden Visiting Senior Fellowship from the University of Western Australia

2001 Tier I Canada Research Chair in Environmental Fluid Mechanics

2001 Journal of Environmental Engineering, ASCE, Editor’s Award. First awarded in 2001 for sustained excellence as a journal reviewer.

1993-94 Gledden Visiting Senior Fellowship from the University of Western Australia

1993-94 UBC Izaak Walton Killam Faculty Research Fellowship


1987 Lorenz G. Straub Award. Awarded annually by the University of Minnesota for the best English language doctoral thesis worldwide in Hydraulic Engineering or a closely related field.

1984 University of California Nonresident Tuition Scholarship.

1984 University of California Regents Fellowship

1982-83 Hans Albert Einstein Memorial Fellowship - for the most promising PhD candidate in Hydraulic and Coastal Engineering at the University of California, Berkeley.

1979-82 Hackett Overseas Studentship awarded by the University of W. Australia

1977 O. F. Blakey Memorial Prize - for the best presentation by a recent graduate to the W. Australian Division of the Institute of Engineers, Australia.

1976 Winzar-Telford Prize - for the best thesis in Civil Engineering at the University of W. Australia.

1975 G.W. Nunn Prize in Surveying (shared)
1972 IBM Mathematics Prize
1971-72 Australian Commonwealth Secondary Scholarship

13. OTHER RELEVANT INFORMATION

(a) Affiliation with other UBC Departments and Institutes

2003 - present  Associate Faculty Member of the Atmospheric Science Program.
1996 - present  Associate Faculty Member of the Dept. of Earth, Ocean and Atmospheric Sciences
1989 - 1996  Associate Faculty Member of the Department of Oceanography.
1988 - present  Member of the Institute of Applied Mathematics.
Publications Record
The University of British Columbia - Department of Civil Engineering

Date: 31 Mar 2016

Initials: [Signature]

SURNAME: Lawrence
FIRST NAME: Gregory
MIDDLE NAME(S): Allan

REFEREED PUBLICATIONS

Journal Papers (students and researchers working under my supervision are underlined)


2 Featured article. Also included in the 2018 Physics of Fluids Calendar of Covers featuring the cover images of each issue of Physics of Fluids published in 2016.


---

3 Chosen as an “Editor’s Selection” in Physical Review Letters. This paper has been reported on in New Scientist, Physics Today, Science Direct and various other scientific and lay news outlets.


---

4 Chosen as a paper of note by the American Meteorological Society; see *Bulletin of the American Meteorological Society*, 88(7): 1020.


**Journal Papers Submitted** *(students and researchers supervised are underlined)*

**Journal discussions and closure**


**Book Chapters**


**Refereed Conference Papers**


**Refereed Conference Abstracts** (*presenters name underlined*)


90. Zhao, K., Tedford, E.W., Zare, M. and Lawrence, G.A. 2019. Laboratory experiments on air bubbles rising through Carbopol capped by water. 72nd Annual Meeting of the American Physical Society Division of Fluid Dynamics, Nov. 23-26, 2019, Seattle, WA.


NON-REFEREED PUBLICATIONS

Review


Conference/Workshop


Technical Reports


**Consulting Reports**


**Design Guide**


**Book Edited**


**Films**


**Theses Written**


1. Lawrence, G. A. 1976. *Withdrawal of a Density Stratified Fluid from a Triangular Tank*. Honours Thesis, Department of Civil Engineering, University of Western Australia. *(Awarded the Winzar-Telford Prize - for the best thesis in Civil Engineering at the University of W. Australia.)*

**PhD Theses Supervised**


**Masters Theses Supervised**


ROGER PIETERS
Department of Earth, Ocean and Atmospheric Sciences
University of British Columbia
6339 Stores Road, Vancouver, B.C.  V6T 1Z4
Tel: (604) 822-4297
rpieters@eos.ubc.ca

PROFESSIONAL EXPERIENCE
1994-present  Research Associate, Earth, Ocean and Atmospheric Sciences, UBC
Environmental fluid mechanics, physical and chemical limnology
1991-1993  Programmer, Department of Oceanography, UBC
Coastal modelling, numerical methods
1988-1990  TESOL Teacher, Hefei Teacher's College, Anhui, China
English language teacher, curriculum development
1982, 1983  NSERC Summer Research Assistant
Viscous polymer flow
1979, 1980  NSERC Summer Research Assistant
Synthesis and characterization of novel sulphur-nitrogen compounds

EDUCATION
1988  Ph.D., Physics, University of California, Santa Barbara
Numerical modelling of sidebranching in dendritic solidification
1982  B.Sc., Chemistry and Physics (First Class Honours), University of Calgary

AWARDS
* Alberta Sir James Lougheed Award of Distinction 1986, 1987
* NSERC 1967 Science Scholarship 1982-1985
* Seven Undergraduate Awards 1979-1982

RESEARCH ACTIVITIES
Carpenter Reservoir (2015-present)
• Effect of turbidity and reservoir operation on productivity in a hydroelectric reservoir.
Revelstoke and Kinbasket Reservoirs (2008-present)
• Assess the effect of flow on ecological productivity in two hydroelectric reservoirs.
Colomac Zone 2 Pit (2004-present)
• Investigate evolution of stratification during pit lake filling.
Coquitlam Reservoir (2004-present)
• Investigate circulation and turbidity to evaluate alternate drinking water intake sites.
Nechako Reservoir (2005-2008)
• Assess the volume of cool water available for proposed Cold Water Release Facility.
Northern Mine Pit-Lakes (Faro, Ekati and other sites) (2003-present)

- Assess the stratification of existing and proposed water-filled mine pits in the Yukon and Northwest Territories.


- Joint geochemical and physical investigation of the water quality and remedial options for two adjacent water filled mine pits.

Harrison Lake (2000-2002)

- Lake surveys to evaluate circulation and turbidity for potential drinking water supply.

Slocan Lake (2000-2001)

- Analysis of CTD data, hydrology and nutrient data and their impact on fisheries.

Arrow Lakes Reservoir (1997-present)

- Part of a multidisciplinary research team to investigate the decline and monitor recovery of native kokanee fish stocks in Arrow Lakes Reservoir (1997-2003).
- Estimate transport through Arrow Lakes Reservoir (2003-present).


- Managed a large field program (deploying $600,000 of equipment) examining the density driven exchange through the Burlington Ship Canal.


- Apply a 2-D laterally averaged model of the Navier-Stokes equations to coastal inlets; detailed comparison with extensive field data; evaluate mixing schemes.
- Identify and characterize numerical ‘diffusion’ resulting from discretization errors.
- Set up box model of Burrard Inlet/ Indian Arm for contaminant fate modelling.


- Computer simulation and analytical modelling and of dendritic solidification.

**PUBLICATIONS**

Refereed journal papers


**Conference proceedings**


**Non-refereed conference proceedings**


Technical reports


Consulting reports


Editor
SHAHID AZAM, Ph.D., P.Eng.

Professor
Environmental Systems Engineering
Faculty of Engineering and Applied Science
University of Regina
Regina, SK, S4S 0A2, Canada

RESEARCH EXPERIENCE

My research positively impacts sustainable (cost effective, environmentally friendly, socially viable) economic growth by focusing on natural resources and civil infrastructure. I have devised practical methods to address local issues while advancing scientific knowledge that is globally applicable. For example, results on tailings dewatering (funded by NSERC-Cameco CRD) were used to design operation, closure, and reclamation plans at the Key Lake uranium mine. Likewise, the ongoing work on soil deformations (funded by NSERC-SaskEnergy CRD) is important for managing natural gas pipeline networks in southern Saskatchewan. The salient features of my research are summarized as follows:

- Secured more than $2.7 million in external funding from NSERC, MITACS, CFI, and industry
- Established state-of-the-art facilities for monitoring, testing, and modeling
- Trained more than 40 graduate and undergraduate students, post-doctoral fellows, and engineers
- Co-authored 136 technical articles in journals, conferences, books, and newsletters
- Received the Geoenvironmental Award from the Canadian Geotechnical Society in 2012
- Delivered numerous invited lectures and keynote addresses

PROFESSIONAL AFFILIATIONS

1999 – To Date   Canadian Geotechnical Society
1999 – To Date   International Society of Soil Mechanics and Geotechnical Engineering
1999 – To Date   International Association of Engineering Geology and the Environment
2008 – To Date   Canadian Institute of Mining, Metallurgy and Petroleum
SELECTED INDUSTRIAL PROJECTS

2015 – 2016
**Canadian Pacific Railway, Canada**
Analyzed laboratory and field data for construction for the 30 km long Belle Plaine Spur Line.

2007
**Harbor Inn Condominium Incorporated, Canada**
Evaluated on-site seepage in the residential colony by Lake Diefenbaker for developing dewatering strategies.

2004 - 2006
**Golden Sunlight Mine, United States**
Developed a physical model for flow through waste rock dumps based on field and laboratory study of an exposed face.

2004 - 2006
**Questa Mine, United States**
Characterized the hydrological behavior and shear strength properties of selected waste rock samples.

2004 - 2006
**Antamina Mine, Peru**
Conducted field investigations to select waste rock samples and potential sites for small-scale dumps.

2004
**Gibraltar Mine, Canada**
Designed a 30 m high embankment over the existing 105 m to store 160 x 10^6 tonnes of additional tailings materials.

2003 – 2004
**Escondida Mine, Chile**
Developed improved tailings dewatering methods for the Laguna Seca impoundment using natural and chemical agents.

2003 – 2004
**Bisha Mine, Eriteria**
Designed alternative layout options for constructing a tailings containment facility.

1999-2003
**Daynatec Corporation, Canada**
Characterized laterite ore and processed slurries from Cuba, Indonesia, Australia, and Phillips and developed polymer-modification methods.

1998
**King Fahd University of Petroleum and Minerals, Saudi Arabia**
Assessed deterioration issues of a storm water retention basin for long-term structural rehabilitation.

1997
**Saudi-Aramco, Saudi Arabia**
Determined seabed sediment properties through cone penetration testing for Universal Modular Platform installation in the Arabian Gulf.