

**Education**

*M.Sc. Fish Health, Simon
Fraser University, Burnaby,
BC, 1992*

*B.Sc. Biology, Simon
Fraser University, Burnaby,
BC, 1986*

Golder Associates Ltd. – Burnaby**Employment History*****Golder Associates Ltd. – North Vancouver then Burnaby, BC***

Principal / Senior Environmental Scientist (2007 to Present)

Senior Environmental Scientist responsible for managing, directing, and undertaking projects related to Risk Assessment, environmental toxicology, environmental monitoring, environmental impact assessment, and other related disciplines.

Golder Associates Pty Ltd. – Melbourne, Australia

Associate/Principal Environmental Scientist (2006 to 2007)

Senior Environmental Scientist involved in ecological and human health risk assessment. A one-year assignment within Golder to help grow the Australian risk assessment practice area.

Golder Associates Ltd. – North Vancouver, BC

*Associate/Senior Environmental Scientist/Risk Assessment Practice Leader
(2004 to 2006)*

Risk Assessment Group Practice Leader for BC Ecological and Human Health Risk Assessment services. Responsible for coordinating risk assessment and other projects and maintaining quality control of work completed by Risk Assessment Group. Senior Environmental Scientist responsible for managing, directing, and undertaking projects related to Risk Assessment, environmental toxicology, environmental monitoring, environmental impact assessment, and other related disciplines. Lead business development, research/project proposals, business planning, and management of professional human resources.

EVS Environment Consultants – North Vancouver, BC

Senior Environmental Scientist, then Managing Director (2001 to 2004)

Environmental scientist responsible for managing, directing, carrying out, and guiding numerous projects related to contaminated sites, risk assessment, environmental monitoring, ecological damage assessment, environmental toxicology, environmental impact assessment, permitting, and fish habitat. As Managing Director, was responsible for operations of the company, including consulting practice and environmental toxicology laboratory services. Oversaw a successful corporate merger of EVS Environment Consultants and Golder Associates Ltd.

Fisheries and Oceans Canada – New Westminster, BC

Water Quality Section Head (1992 to 2001)

Responsible for managing, directing, and carrying out department's pollution program in habitat management unit for Fraser Basin, Burrard Inlet, and Howe Sound. Responsibilities included review of contaminated sites risk assessments, development of sector-wide and agency-integrated compliance promotion programs, administration of habitat provisions of the Fisheries Act, internal-to-



government training programs, undertaking and/or supporting investigations, acting as expert witness for Fisheries and Oceans as well as various other federal and provincial agencies, and directing and undertaking field programs in support of DFO's mandate.

Capilano College – North Vancouver, BC

Instructor, Environmental Toxicology (1994 to 2002)

Developed and delivered curriculum for post-baccalaureate course in environmental toxicology. Laboratory and field component included collection of samples, laboratory toxicological analyses of those samples, and interpretation of results.



PROJECT EXPERIENCE – ENVIRONMENTAL MANAGEMENT, MONITORING AND IMPACT ASSESSMENT

**Port of Gladstone
Expansion Project -
Review of
Environmental
Assessment on behalf
of Australian
Government**
Gladstone, QLD,
Australia

Undertook a review of dredging method selection, turbidity modelling and effects on seagrasses of a proposed port expansion and channel deepening project. A review report was provided outlining gaps and deficiencies in the environmental assessment carried out, with particular focus on the potential environmental effects of the project and the incorporation of international best practice.

**Port of Newcastle -
Hunter River Dredging**
Newcastle, NSW,
Australia

As part of a redevelopment project for the Port of Newcastle, the South Arm of the Hunter River is being dredged to increase access for larger vessels. Adjacent to the former Steelworks within the South Arm, the sediments of the Hunter River are contaminated. Served as a reviewer of the environmental management program on behalf of the Department of Environment, Heritage, and the Arts including the risk-based criteria set to assess contaminated and acceptable (for disposal at sea) sediments and to review a changes to the agreed dredging protocols and water quality monitoring plan through the project.

**Renewable Power
Corporation – Tyson
Creek Hydro Project**
Sechelt, BC, Canada

The Tyson Creek Hydro project draws water from a mountainous lake in the Tzoonie River watershed. As the water level was drawn down, glacial deposits in the lake eroded and caused highly turbid water to enter the penstocks and subsequently the downstream waters. As a result of this turbidity exceeding water quality guidelines downstream of the facility, the power facility was ordered to shut down. Through an examination of the functional uses of the downstream habitat and the anticipated duration of discharge, an interim site-specific water quality criterion for suspended sediments was derived, along with environmental management recommendations. The water quality criterion allowed the facility to restart production.

**South Fraser Perimeter
Road Landfills -
Treated Leachate
Effluent Impact Study**
Delta, BC, Canada

The South Fraser Perimeter Road will traverse several Demolition, Land Clearing and Construction landfills in north Delta, BC. To adjust grades and to enable development of adjacent land, the waste materials will be excavated and used as lightweight fill. Samples of existing leachate and simulated leaching studies demonstrated that the predicted leachate quality would require treatment prior to discharge into the adjacent Fraser River. A study was undertaken to evaluate the potential environmental impacts of treated effluent discharge from the treatment plant as well as risks from emergency bypasses. Computer simulated effluent dilution modelling predicted that ambient water quality guidelines would be met at the initial dilution zone. Evaluation of ammonia speciation under prevailing seasonal conditions also indicated that the effluent would not be acutely toxic. A technical assessment report was prepared to support the granting of an effluent permit under the Waste Disposal Regulation.



**Bailey Landfill -
Expansion Project**
Chilliwack, BC, Canada

Environmental Manager for a design-build project to expand the capacity of an existing landfill site. Responsibilities included environmental permitting amendments, environmental protection plan development and oversight of environmental monitoring.

**Epcor Acid Rock
Drainage Water
Treatment Plant**
Britannia Beach, BC,
Canada

Epcor operates an acid rock drainage water treatment plant in the community of Britannia Beach, BC. The effluent was discharged under a provincial permit with stringent manganese limits. Treatment to those limits required the addition of additional manganese in the form of permanganate. A review of the effluent permit limits was carried out in the context of a review of seawater toxicity of manganese. A supporting rationale was provided to remove the manganese limits from the effluent permit.

**Dredging and Sea
Dumping Expert
Review Panel -
Australian Federal
Environment Agency
(DEWHA)**
Australia

Appointed to a review panel to assist the Australian Department of Environment, Water, Heritage and the Arts (DEWHA) in their review of environmental assessments of port dredging projects, sediment characterization, ocean disposal and other areas related to port development projects.

**Melbourne Convention
Centre**
Victoria State, Australia

Seepage in the underground workings of the Melbourne Convention Centre was found to have elevated selenium chemistry and the Victoria EPA restricted discharge of the seepage water into the Yarra River and required a risk assessment to be carried out. A site history was compiled and presented along with a detailed evaluation of the chemistry of selenium analysis. Selenium is prone to false positive results when a high salt content is present, as was the case in the surrounding groundwater. The samples were re-analysed using analytical methods not subject to interference. Based on the presentation of site history, soils chemistry, details on the analytical methods for selenium analysis and a re-analysis of samples, a costly risk assessment was avoided and the EPA provided their consent to the discharge.

**South Fraser Perimeter
Road - Landfill Closure
Plan**
Delta, BC, Canada

Directed and oversaw the development of a Landfill Closure Plan for road corridor across several demolition, land clearing and construction waste landfills located near the Burns Bog ecologically sensitive area. The landfill closure plan included cover design and drainage, fire prevention planning and control, collection and treatment of leachate from the landfills.

**Science World -
Shoreline
Reconstruction**
Vancouver, BC

Participated as a member of the architectural design team to develop and evaluate habitat impacts of several shoreline development concepts for the reconstruction and redevelopment of the Science World shoreline in Vancouver's False Creek

**Capital Regional
District - Baseline
Water Quality Program**
Victoria, BC, Canada

Project Director for a Spring baseline water quality monitoring program in the Strait of Juan DeFuca and Haro Strait in support of effluent permitting for the Capital Regional District's planned sewage treatment upgrades.



Capital Regional District Victoria, BC, Canada	Led the development of a Stage 1 Environmental Impact Assessment for two new outfall locations anticipated as part of the Capital Regional District sewage treatment upgrades. The Stage 1 EIS relied upon existing data and computer simulation modelling of effluent plume dilution to provide predicted exposure conditions for aquatic resources.
Port of Melbourne Corporation Melbourne, VIC, Australia	Prepared a framework for dredged material management as part of the Port of Melbourne Corporation's Channel Deepening Project. The evaluation framework was developed around a detailed examination of statutory and policy requirements and was based on the physical, chemical, and biological properties of the material and resulted in dredged material management recommendations for some 26 million m3 of contaminated and uncontaminated aquatic sediments.
Port of Melbourne Melbourne, VIC, Australia	Served as an expert witness for an environmental assessment hearing for the Channel Deepening Project. The testimony included the presentation of a human health risk assessment related to the dredging of contaminated sediments and answering questions during cross examination on that study.
City of St. Albert St. Albert, AB	Provided litigation support to the City of St. Albert at a former landfill site. The City was under investigation by Environment Canada. A history of the work that had been carried out by the city was compiled and the technical information was assembled in the context of due diligence under the Fisheries Act.
Britannia Bay Properties Ltd. Britannia, BC	Environmental impact assessment and permitting for flood control/bank stabilization work along Britannia Creek. Bank revetment was installed to stabilize soils along Britannia Creek, which is subject to flashy hydrology and occasional debris torrents. Worked with Department of Fisheries and Oceans to obtain consent for the project and provided environmental monitoring services related to the control of metal-rich suspended sediments.
Environment Canada Summerland, BC	Carried out studies on the toxicity of acid rock drainage originating from a highway cut. Chemical and toxicological assessments were carried out including an evaluation of the effectiveness of a passive treatment system that was being used in an attempt to mitigate the ARD. An "expert witness" statement was prepared as part of a prosecution under the Canada Fisheries Act.
Ministry of Environment Fraser Valley, BC	Undertook an assessment of the impacts of a biosecurity program involving a viricidal disinfection barrier surrounding the Fraser Valley poultry farming industry and depopulation program following an outbreak of the avian influenza virus (bird flu). The project involved rapidly assembling environmental and chemical data for a viricide selected as the disinfecting agent, evaluating environmental sensitivities of the biosecurity zone and evaluating potential exposure pathways. Based on this information and toxicity reduction laboratory studies involving bioassays, countermeasures were developed at the disinfection stations to contain and de-activate the environmentally damaging properties of the viricide. Monitoring of the effectiveness and potential environmental impacts was then undertaken to confirm the success of the measures used.



**Homestake Canada
Inc.**
Smithers, BC

Participated as the lead writer of a "white paper" on the regulation of (metal-enriched) suspended sediments originating from mining effluents under the Metal Mining Effluent Regulation (MMER). The foundations of the MMER and where it fits as an environmental statute were examined. The approach used and the degree of TSS regulation proposed was examined through an analysis of the underlying regulatory rationale, the relationship of TSS control to control of other substances and the desired outcomes of regulating TSS.

Various Mines
British Columbia and
Yukon Territory

Lead Assessor for numerous Environmental Impact Assessments for proposed, abandoned, and existing mine developments throughout British Columbia and the Yukon Territory. Environmental Impact Assessment experience pre-dates the enactment of the Canadian Environmental Assessment Act and includes the preparation of the first EIA report from the Pacific Region of a large mining project.

**Department of
Fisheries and Oceans**
Vancouver, BC

Designed and conducted a Dioxin, Furan, and Polychlorinated biphenyl monitoring program. The study determined levels of these contaminants in the tissues of Dungeness crab in the Greater Vancouver area to determine risks to human consumers.

**Department of
Fisheries and Oceans**
Lumby, BC

Conducted a study of a chlorinated phenol-contaminated site. Investigations included study of the ecological interactions at the groundwater/receiving environment interface, toxicity testing, as well as contaminant bioconcentration in different trophic levels and life stages. The study was used for the purposes of litigation under the Fisheries Act.

**BC Ministry of
Environment**
Squamish, BC

Conducted a study of various environmental media contaminated by mercury from a former chlor-alkali plant. The study involved sampling mercury concentrations in sediments, biota, and water in relation to the local mercury source.

Environment Canada
Chetwynd, BC

Lead Scientist for an extensive benthic invertebrate monitoring and impact assessment following a spill of crude oil into a large northern Canadian river. Provided scientific advice on analytical parameters and oil spill cleanup measures.

**People's Government
of QUFU**
People's Republic of
China

Principle Investigator for an environmental impact assessment at an ancient mausoleum in the People's Republic of China. The project involved the development of tourism and interpretive facilities in an area with cultural relics dating back to 6,000 years ago.

**Canadian National
Railway**
Wabamun, AB

Senior Project Scientist for the assessment of environmental impacts and remediation requirements following a major oil spill originating from a train derailment. Duties included the design of short-term and long-term monitoring programs, liaison with regulatory agencies, and briefing of senior company executives. (Ongoing)



**Shanghai Municipal
Government**
People's Republic of
China

Conducted a Strategic Environmental Assessment (SEA) of a Cultural Development Policy study for the City of Shanghai. The project identified the future environmental changes anticipated from the implementation of a new cultural development policy in Shanghai. Those changes were evaluated against Shanghai's strategic environmental action plan as well as other indicators identified for this project and opportunities to enhance environmental sustainability or the restoration of previously damaged ecological habitats were identified.

**Department of
Fisheries and Oceans**
Fraser River, BC

Principle Investigator for a study of fish and water contamination levels resulting from a large chemical spill on the Fraser River. Provided advice and guidance to fishery managers during an intensive and concurrent aboriginal and commercial fishery.

**Burrard Inlet
Environment Action
Program**
Vancouver, BC

Project Manager for the development of a data management framework, design of a relational database, and the population of that database with sediment and upland soil and groundwater environmental data. The project focus was an industrialised coastal inlet and brought together numerous disparate studies into a risk-based framework to enable management decisions to be made.

**Hashemite Kingdom of
Jordan**
Jordan

Project Manager and Marine Team Leader for an ecological damage assessment of the 1990 Iraqi invasion of Kuwait. Working for the Hashemite Kingdom of Jordan, ecological damages arising from the 1990 Gulf War were quantified and monetarily valued for terrestrial, wetland, and marine ecosystems of Jordan. This was accomplished through the review of available data and through the use of forensic tools to assess past damage. The project also included the development of a relational, geo-referenced database to manage the environmental and population dynamics data for the entirety of the damage claim. The information was used as part of a United Nations Compensation Commission process in support of a damage claim filed by the Kingdom of Jordan against the Republic of Iraq.

**Ministry of Sustainable
Resource Management**
Britannia, BC, Canada

Project Manager and Lead Scientist for an environmental impact study to support an effluent permit for treated Acid Rock Drainage effluent. The effluent originates from the former Britannia Mine and, without treatment, is highly toxic to various aquatic organisms due to the presence of toxic heavy metals such as copper and zinc. As part of a remedial strategy, the effluent will be collected and treated in a high density sludge treatment process. The treated effluent has high total metals chemistry as a result of the treatment process but low bioavailability and toxicity as identified through the use of computerised chemical speciation modelling and toxicity tests. The project required the prediction, a priori, of the anticipated impacts from the effluent. The study was used to support the granting of an effluent permit.

**Ministry of Agriculture
and Lands**
Britannia, BC, Canada

Project Manager and Lead Scientist for a multi-year integrated monitoring program and contaminated site risk assessment at the former Britannia Mine. The program involves a multivariate study design and employs chemical, toxicological, and ecological analyses to assess impacts, likely causes, remedial targets, and effectiveness of remediation methods employed. The multi-year project will also incorporate monitoring data into an aquatic and terrestrial risk assessment for the site.



**McDonald
Development
Corporation**
Britannia, BC

Conducted an environmental impact study for a proposed sewage discharge from a new sewage treatment plant for the existing and future community of Britannia Beach. Other services provided included regulatory permitting for bank revetment work along Britannia Creek, bridge crossings over Britannia and Mineral Creeks, stream habitat mapping and setback determinations, and various other environmental permitting services related to the planned development in the community of Britannia Beach.

**Newgen Harrison
Developments**
Kent, BC

Conducted an environmental impact study for a proposed sewage discharge to the Fraser River. The discharge will service a new +300-home community at Mt. Woodside. The study involved identification of site-specific ecological uses and computerised plume dispersion modelling to support exposure and effects assessment within the effluent plume and at the edge of the initial dilution zone.

**Greater Vancouver
Regional District**
North Vancouver, BC

Conducted an environmental impact study for a proposed effluent discharge to the North Shore of Burrard Inlet. The effluent originates from a drinking water treatment process and the discharge contains iron and aluminum-based flocculants and coagulants as well as proprietary organic polymers for which toxicity data and water quality guidelines are not available. Analysis of the potential effluent impact required the derivation of ecological effects endpoints based on the toxicology testing conducted in our laboratory as well as the predicted effluent dilution. This work is part of the environmental impact assessment that will be used to support application to the Burrard Environmental Review Committee for the installation of an outfall.

City of Vancouver
Vancouver, BC

Environmental Impact Assessor for a major shoreline redevelopment of a brownfields site adjacent to a marine inlet. The project includes remediation of contaminated sediments, shoreline redevelopment, construction of compensatory fish habitat, and the development of the 2010 Winter Olympic Athletes' Village.

Legacy Pacific
Chilliwack, BC

Negotiated with senior agencies, developed mitigation procedures, and undertook environmental monitoring on behalf of a developer to facilitate approvals for the installation of a transport-truck design capacity stream crossing in a major salmon stream that also supports Species at Risk (SAR). Provided design work for the development of compensatory fish habitat. The project had to be conducted after the in-stream work window was closed.

**Insurance Corporation
of British Columbia**
Quesnel, BC

Project Director and Project Scientist for an impact assessment in a provincially significant river system following a diesel fuel spill from a tanker truck accident. Impacts were assessed following a risk-based framework that allowed environmental decision-makers to base remedial decisions on sound science and data as well as the environmental impacts of remedial works.



**Braul Environmental
Law Corporation**
Belcarra, BC

Environmental Impact Assessment of a boat moorage facility in an area of eelgrass beds. The Burrard Environmental Review Committee had imposed a moratorium on the development of moorage facilities due to eelgrass beds. Through the use of computer modelling, a site-specific solar shading analysis was completed that assessed the potential impact of a modified moorage facility configuration on eelgrass beds. The shading analysis took into account local topography and the maximum sunlight pathlength/water depth relationships to demonstrate that eelgrass growth would not be adversely impacted by the construction of the facility.

PROJECT EXPERIENCE – FISH HEALTH AND AQUACULTURE

**Taito Co. Ltd. and
Simon Fraser
University**
Taito Co. Ltd. and Simon
Fraser University

Principle Inventor of a method of enhancing the potency of a fish vaccine and of a method for boosting the immune system of fish. The method involves the use of a naturally occurring immunomodulatory substance to influence the nature of the immune response to a fish vaccine. The other aspect of this work developed a veterinary biological that could be administered to fish by incorporating it into steam-pelleted feeds to stimulate their immune system and provide broad-spectrum enhanced immunity to a variety of infectious agents. The results of this research were put into commercial use in net pen culture of fin fish and resulted in the granting of Canadian, American, and other international patents.

**Department of
Fisheries and Oceans**
British Columbia

Investigated the causes of chronic mortalities of large sturgeon in the Fraser and Harrison Rivers of BC. The investigations involved broad-scale sampling of river water quality, detailed inspection of operating records and facility condition of effluent dischargers, necropsy of affected sturgeon, and analyses for contaminant residues and pathogens. These mortalities were determined to have been caused by a bacterial fish pathogen.

**Department of
Fisheries and Oceans**
Vancouver Island, BC

Conducted a survey of plasma antibody levels in rockfish and ling cod. This survey compared antibody levels from fish collected in the vicinity of salmon farm net pens and fish collected distant from them as a marker of potential exposure to farmed-fish pathogens.

**Department of
Fisheries and Oceans**
New Westminster, BC

Histological study of the response of a salmonid to a municipal potable water disinfectant. The results of the study demonstrated differences in the pathology between two different drinking water disinfectants. The results of the study were used to assist in making environmental decisions about drinking water disinfectant choices.

PROJECT EXPERIENCE – MARINE AND FRESHWATER BIOLOGY

IAMGOLD Niobec Mine
St. Honoré-de-
Chicoutami, QC, Canada

Conduct limnological studies in mine effluent treatment and polishing ponds where excessive algal growth was resulting in elevated total suspended solids measurements. The limnological studies were in support of a treatment options analysis and involved the collection of water chemistry samples and zooplankton tows.



**Department of
Fisheries and Oceans**
Port Moody, BC

Investigated a mass-mortality of fish in a coastal inlet. Collected samples for phytoplankton identification and abundance, toxicity determinations, as well as physical/chemical oceanographic data. The mortality was determined to have been caused by a “red tide” formed by the alga *Heterosigma carterae*.

**Department of
Fisheries and Oceans**
British Columbia

Conducted numerous macroinvertebrate stream surveys across BC, including an assessment of the potential effects of fish hatchery effluent on a small coastal stream. The study was initiated in response to concerns raised by provincial environment officials. The results of this study demonstrated that there were no harmful effects from the hatchery effluent to the benthic community structure.

**Burrard Inlet
Environment Action
Program**
Burnaby, BC

Chaired a Task Group dealing with a thermal power generating station in a coastal inlet. The generating station was discharging effluent into a confined inlet where water temperatures were a concern. Guided the study design and implementation of a multi-year, multi-component study design that assessed the thermal inputs and losses into the inlet, and assessed the effects on fish behaviour, health, and sublethal impacts of thermal effluent discharge including issues of gas supersaturation.

**Department of
Fisheries and Oceans**
Vancouver, BC

Designed integrated pollution prevention programs. These programs were designed to address specific recurrent pollution problems and involved the integration of environmental education, environmental enforcement, emergency response, and compliance monitoring programs into cohesive plans. Provided ongoing senior advice through the delivery of these programs.

**Vancouver Port
Authority**
Vancouver, BC

Directed and oversaw the emergency disinfection and subsequent dechlorination of ballast water from a chemical tanker calling on the Port of Vancouver. The Vancouver Port Authority does not allow vessels that have not undergone a deep sea ballast water exchange to discharge ballast water in Vancouver Harbour for biosecurity reasons. A vessel entered Vancouver Harbour but could not return to deep sea due to winter storms and berthage schedules. Dosages were identified, taking into account practical constraints and dynamics of disinfectant mixing as well as differing marine pest species sensitivities to chlorine. Chlorine dosages were calculated based on known volumes of ballast water tanks. Following administration of the disinfectant, the chlorine residuals attained were measured on-board the vessel using a portable laboratory. Due to the potential for environmental effects from chlorine, a dechlorination system was devised using equipment available on board the vessel and sodium thiosulphate sourced from a local chemical supplier. Analytical results confirmed that target dosages and contact times were attained and that the potential impacts were mitigated through the dechlorination process developed.

PROFESSIONAL AFFILIATIONS

Registered Professional Biologist (R.P.Bio. #601)

College of Applied Biology