Calgary

Water Quality Specialist

Alison Snow joined Golder Associates Ltd. in May 2011, as a Water Quality Specialist. Her educational background includes a Bachelor of Science from Cape Breton University, a Bachelor of Environmental Engineering from Dalhousie University, and a Master of Applied Science in Biological/Environmental Engineering from Dalhousie University. Her responsibilities include training junior colleagues, developing models that simulate surface water flow and quality, summarizing large datasets containing water quality for input into water quality models, and preparing modeling reports and presentations.

Education

M.A.Sc. Biological/Environmental Engineering, Dalhousie University, Halifax, NS, 2007

B.Eng. Environmental Engineering, Dalhousie University, Halifax, NS, 2005

B.Sc. Biology, Cape Breton University, Sydney, NS, 2002

Languages

English – Fluent

Employment History

Golder Associates Ltd. – Calgary, AB

Water Quality Specialist (2011 to Present)

Responsibilities include training junior colleagues, developing models for surface water flow and quality, summarizing large datasets containing water quality for input into water quality models, and preparing modeling reports and presentations.

PROJECT EXPERIENCE – DEVELOPING DISCHARGE LIMITS

Public Services and Procurement Canada Giant Mine
NT, Canada

Calculated effluent quality criteria for Giant Mine. Roles involved identifying parameters for which effluent quality criteria should be developed; calculating effluent quality criteria; and, producing a report documenting the effluent quality criteria.

De Beers Canada Inc. Gahcho Kue Mine
NT, Canada

Calculated effluent quality criteria for the De Beers Canada Inc. Gahcho Kue Mine. Roles involved identifying parameters for which effluent quality criteria should be developed; calculating effluent quality criteria; producing a report documenting the effluent quality criteria; and, appearing at technical sessions and public hearings as an expert witness to present and explain the study findings.

Dominion Diamond Ekati Corporation Jay Project
NT, Canada

Calculated effluent quality criteria for the Dominion Diamond Ekati Corporation Jay Project. Roles involved identifying parameters for which effluent quality criteria should be developed; defining appropriate site-specific water quality objectives for Lac du Sauvage for each parameter; calculating effluent quality criteria; producing a report documenting the effluent quality criteria; and, providing support during the water licencing process.

De Beers Canada Inc. Snap Lake Mine
NT, Canada

Calculated effluent quality criteria for the De Beers Canada Inc. Snap Lake Mine. Roles involved identifying parameters for which effluent quality criteria should be developed; defining appropriate site-specific water quality objectives for Snap Lake for each parameter; calculating effluent quality criteria; producing a report documenting the effluent quality criteria; and, appearing at technical sessions and public hearings as an expert witness to present and explain the study findings.

PROJECT EXPERIENCE – WATER QUALITY MODELING

Public Services and Procurement Canada Giant Mine
NT, Canada

Modeled present-day arsenic loading to Baker Creek and Yellowknife Bay to provide support for the Baker Creek Post-Environment Assessment investigations for Giant Mine. Roles involve guiding the modeling of arsenic concentrations and loads to Baker Creek and Yellowknife Bay using GoldSim and producing a presentation and report explaining the study findings.

Modeled the mixing characteristics of water discharged from a water treatment plant to four locations on Yellowknife Bay for three outfall design options. Roles involve guiding the near-field modeling using CORMIX; calculating parameter concentrations at a distance of 200 m from the outfall; comparing parameter concentrations in Yellowknife Bay to relevant water quality guidelines; evaluating the sensitivity of model results to changes in model inputs; and, producing a presentation and report explaining the study findings.

Hydrodynamic and water quality modeling lead to support Baker Creek Post-Environmental Assessment investigations for Giant Mine. Roles involve guiding the modelling of water quality in Yellowknife Bay using GEMSS to predict the effects of remediation on bay water quality; producing a report explaining the findings. Constituents modeled included total dissolved solids, temperature, nutrients, major ions, and metals.

Teck Resources Ltd. Frontier Oil Sands Project
AB, Canada

Modeled water quality in a compensation lake as part of the Teck Resources Ltd. Frontier Oil Sands Project. Roles involved guiding the modeling of the compensation lake using GEMSS to estimate water circulation patterns, water temperatures, concentrations of total dissolved solids, biochemical oxygen demand, dissolved oxygen, total ammonia, nitrate, phosphate, chlorophyll a, and acute and chronic toxicity to understand if all areas of the lake were predicted to be suitable for fish; and, producing a report explaining the study findings.

Dominion Diamond Ekati Corporation Jay Project
NT, Canada

Hydrodynamic and water quality modeling lead to support the Dominion Diamond Ekati Corporation Developer's Assessment Report and Type A water licence application. Roles involved guiding the modelling of water quality in Lac du Sauvage and Lac de Gras using GEMSS to predict the effects of future mine developments on lake water quality; guiding the modelling of stratification potential in Jay Pit and Misery Pit lakes using CE-QUAL-W2; producing a report explaining the findings. Constituents modeled included total dissolved solids, temperature, nutrients, major ions, and metals.

De Beers Canada Inc. Snap Lake Mine
NT, Canada

Modelled the water quality of lakes downstream of Snap Lake to predict the effects of mining on lake water quality as a result of the De Beers Canada Inc. Snap Lake Mine water licence amendment and environmental assessment (EA1314-02). Roles involved guiding the modelling of lakes downstream of Snap Lake using GoldSim; and producing a report explaining the study findings.

Updated the Snap Lake water quality model that was developed in GEMSS to predict the effects of mining on lake water quality as part of the De Beers Canada Inc. Snap Lake Mine water licence amendment and environmental assessment (EA1314-02). Constituents modeled included total dissolved solids, temperature, oxygen, nutrients, major ions, and metals. Appeared at technical sessions and public hearings as an expert witness to present and explain the model results.

Seabridge Gold Inc. Courageous Lake Project
NT, Canada

Modeled the water quality of Courageous Lake using GEMSS to predict the impacts of future mine developments on lake water quality. Constituents modeled included total dissolved solids, temperature and water velocity. Produced a report explaining the study findings.

De Beers Canada Inc. Gahcho Kue Project
NWT, Canada

Modeled the water quality of Kennady Lake using GEMSS to predict the effects of future mine developments on lake water quality as part of the De Beers Canada Inc. Gahcho Kué Environmental Assessment. Constituents modeled included total dissolved solids, temperature, total suspended solids, dissolved oxygen, and nutrients. Produced reports explaining the study findings.

TRAINING

GoldSim Workshop
GoldSim Technology Group, June 26-28, 2012

CE-QUAL-W2 Version 3.7 Workshop
Portland State University Professional Development Center, June 11-15, 2012

3-Dimensional Hydrodynamic and Water Quality Modeling Using GEMSS
ERM Inc. - Surfacewater Modeling Group, May 23-25, 2011

ARTHUR COLE, M.Eng.,P.Eng.

Education

B.Sc., Earth Science, Memorial University of Newfoundland, NL, 1984

B.Sc. E. Geological Engineering, University of New Brunswick, NB, 1987

M.Eng. Environmental Engineering McGill University, QC, 1993

Professional Accreditations

Registered Professional Engineer, AB, NT/NU

PROFESSIONAL SUMMARY

Arthur Cole is a Principal and Senior Geological Engineer in the Edmonton office. Arthur's engineering background includes leading large environmental projects within the mining and oil and gas sectors. Throughout his career, Arthur has focussed on earth science studies, environmental permitting, environmental site assessment/remediation and risk management projects. He has managed multi-disciplinary projects, as well as led components including various aspects of subsurface investigation and assessment projects. He is experienced with coordinating and planning community information sessions and workshops and preparing documentation for distribution at public and specific stakeholder groups. He is also responsible for the technical and business management of environmental projects within northern Alberta and the NWT and provides technical guidance and senior review to a wide range of northern contaminated sites projects.

At Golder, Arthur has participated as a member of multi-disciplinary teams on mining projects throughout northern Canada during his career with Golder. His experience ranges initially as a project field engineer in Elliott Lake Ontario, where he gained experience in completing hydrogeological studies for tailings dam repair/expansion projects and closure planning in the late 1980s and early 1990s. In the mid-1990s, Arthur initially managed geotechnical and hydrogeological investigations associated with a wide range of component studies at Voisey's Bay.

His recent experience includes Technical Lead for the Contaminated Surficial Materials components of the Giant Mine Remediation Project. Given the 50-year operating life span of the former mine, the interpretation of historical information is a key aspect of field investigation planning. Soil quality investigations require careful scoping to address data gaps and allow remedial planning.

Arthur's relevant experience focusses on contaminated sites and hydrogeological investigation of both former and future mining operations throughout northern Canada. His career has progressed from roles as project engineer through to senior project lead. His relevant experience below describes his background with respect to providing client service and managing multidisciplinary teams.

RELEVANT EXPERIENCE

AECOM/PSPC Giant Mine Remediation Project - Contaminated Soils Lead (September 2013 to Present)

Yellowknife, NT, Canada

Senior technical lead for the Contaminated Soils component of the Giant Mine Remediation Project. This role is integrated with our project partner AECOM Canada and requires participation with the senior project leadership team in the development of both information to support both the detailed engineering design and the closure strategy. The contaminated soils component of the project is integrated with all aspects of the final surface design and developed in a manner consistent with future land use and remedial objectives.

Technical work at Giant Mine is currently focussing on supporting regulatory submissions, and planning the technical specifications and drawings associated with the remedial plan.

The multi-disciplinary Giant Mine Remediation Team includes component leads for soil, water, borrow, water, open pit closure, underground and tailings. As the Soils Component Lead, regular communication is maintained with the client (PSPC and CIRNAC) in order to track and coordinate project progress. Discipline specific bi-weekly conference calls with the client review scope, cost and schedule. The scope of investigation programs must consider linkages with other technical disciplines. Arthur regularly participates in conference calls, project technical meetings and consultation sessions for the purposes of communicating results of technical studies.

This role requires participation in the development of the potential alternative closure strategies. In cases where uncertainty exists, the historical site information/data is reviewed to identify potential technical data gaps which are subsequently investigated.

Arthur leads the development of field programs necessary for the collection of site characterization data. This includes leading the review/interpretation of site data and the reporting aspects of the various contaminated soil programs. These characterization programs have involved working in collaboration with Queen's University for the purposes of completing arsenic speciation characterization with respect to shallow soil quality within undisturbed areas of the Giant Mine site.

Arthur has led the application of softcopy mapping tools to help aid in providing detailed mapping of the landscape and incorporation regional soil quality data. Mapping at scales of 1:500 allows for delineation of terrain features such as soil material types, topography, slope, drainage and any geological processes (such as permafrost, landslides, seepage, gullying, etc.). This information is

combined with the soil chemistry data on a spatial basis to develop risk management plans.

Mandalay Resources, Lupin Gold Mine, Contaminated Soil Investigations (May to September 2017)
NU, Canada

Senior Lead responsible for the completion of contaminated soils investigations at the former Lupin Gold Mine. Operations at the mine had been suspended and the mine operator was in the process of closure planning. Work included the review of historical documentation, site assessments and the collection of soil and groundwater quality data.

Regular progress reporting was completed throughout the project. The work was required as part of the regulatory program associated with the development of a Closure and Reclamation Plan (CRP) for the mine. The results of the assessment were incorporated into the engineering and biophysical components of the CRP.

AECOM/PWGSC, Giant Mine Project Preliminary Design and Environmental Assessment Support (May 2009 to November 2012)
Yellowknife, NT, Canada

Task lead responsible for the preparation of Contaminated Soils Detailed Site Investigation and Preliminary Design Report (PDR). Arthur was responsible for the development of site investigation strategies associated with Contaminated Surficial Materials. Typical responsibilities included the development of remedial strategies and costs associated with the remediation of approximately 1,000,000 m^3 of arsenic affected surficial materials. Work also included participation in Technical Sessions hosted by MVLWB in support of the Environmental Assessment.

PWGSC, Former Terra Mine, Waste Characterization Study (May to October 2001)
NT, Canada

Responsible for the development of a strategy to assess management alternatives for several hundred drum of liquid waste. Following characterization of the waste materials, recommendations concerning disposal alternatives were presented.

Voisey's Bay Project, Preliminary Design and Environmental Assessment (April 1996 to December 1997)
NL, Canada

Project engineer responsible for developing and incorporating the tailings/mine rock design elements and water management plans into the Federal Environmental Assessment (EA) documentation. Lead engineer in the selection of mine waste management facilities. Participated in the open pit design and

water management plan preparation. Work included the interpretation of predicted water quality impacts and incorporation of engineering design features into EA documentation. Project lead for incorporating engineering components of the project into the Project Description documentation. Also participated in public consultation seminars and workshops in support of the EIA. Participated in the Federal panel hearings associated with the project, held in Goose Bay, NL.

Voisey's Bay Project, Engineering Feasibility Study, Teck Corporation (April 1994 to December 1996)
NL, Canada

Field engineer responsible for the collection of field data associated with the preliminary design of tailings management facilities, mine rock disposal areas and the open pit design. Field investigation included a variety of drilling and test pit investigation programs, including hydrogeological, geotechnical and geophysical investigations. Work included the supervision of the field investigation, and the preparation the mine waste components of the engineering feasibility study for the project. The completion of field investigation programs in a remote environment under northern climate conditions represented a significant challenge for the project.

Gays River Mine, Hydrogeological Investigation, Former Westmin Property (May 1990 to September 1990)
NS, Canada

Field engineer responsible for the supervision and coordination of hydrogeological investigation of the mine site. Field work included the assessment of potential sink holes which could provide pathways for the seepage of shallow groundwater and surface water into the mine workings. Field program included the drilling and installation of over 100 borehole and monitoring well installations within a karst terrain. Assisted in the preparation of the final hydrogeological investigation report.

Denison Mines, Hydrogeological Investigation (December 1988 to April 1989)
Elliot Lake, ON, Canada

Field engineer responsible for hydrogeological investigation associated with tailings dam repair and expansion. Field supervision included leading a team of engineers to carry detailed field investigation including core orientation studies, hydraulic conductivity testing of fractured bedrock, and deep piezometer installation in fractured bedrock. Participated in development of closure plans.

Golder Associates Ltd. – Vancouver

Björn Weeks, P.Eng., Ph.D. (Principal)

Dr. Weeks has 25 years of experience, and is currently Golder's global leader for mine closure services. His areas of expertise include closure and reclamation planning and cost development, cover system design, waste containment, earth/atmosphere interactions, and unsaturated soils. He is based in Vancouver, Canada, where he leads multidisciplinary teams providing closure services to a wide range of clients, and provides senior review as a project director for closure projects throughout the Americas.

He has managed the development of closure plans ranging from scoping and conceptual-level designs for new projects, through to prefeasibility studies, detailed design and execution of closure plans. He regularly leads the development of integrated closure plans and plan updates for large mines.

Dr. Weeks is recognized internationally for his experience in closure, and has provided guidance on closure planning and policy for mining companies and governments in various jurisdictions. Notable recent contributions to mine closure guidance include his role as lead author and project manager for the recently published guidance on closure policy from the Asia-Pacific Economic Cooperation (APEC), and major contributions to the development and finalization of the 2019 update to mine closure guidance from the International Council on Mining and Metals (ICMM).

He has worked on mine closures and closure-related projects in various countries, including Canada, Chile, Argentina, Peru, Uruguay, Brazil, Colombia, Spain, Australia, and the USA. This has encompassed closure work in a wide variety of climates, including permafrost and cold regions, as well as in temperate arid and high-rainfall zones. He has worked on closure projects for diverse clients including AngloGold Ashanti, Anglo American, Glencore-Xstrata, BHP Billiton, Barrick Gold, Codelco, AMSA, Minsur, Rio Tinto, Teck, and others, as well as for regulatory authorities.

Education

Ph.D. Mining Engineering, University of British Columbia, 2006

M.Sc. Environmental Engineering, University of Manitoba, 1994

B.Sc. Civil Engineering, University of Manitoba, 1993

Professional Affiliations

Registered Professional Engineer

BC, MB, NWT

Languages

English – Fluent

Spanish – Fluent

Employment History

Golder Associates – Vancouver

Principal (2015 to Present)

Senior geo environmental engineer, and technical lead in mine closure. Providing technical leadership and project management for mine closure projects globally, with a focus on project work in the Canadian North and in South America.

Golder Associates – Santiago, Chile

Mine Closure Technical Lead (2006 to 2015)

South America Regional practice area leader for mine closure, providing project direction and project management for mine closure and mine waste management related projects. Engineering Group Manger from 2010-2013, leading a group of 60 professionals providing advanced services in mine waste management.

Independent Consultant – Vancouver, British Columbia
Geoenvironmental Engineer (2000 to 2005)

Consultant engineer working in the mining sector, including the analysis of seepage for waste rock dumps, slope stability analysis for waste rock dumps, and the review of cover designs. Specialist in the areas of seepage and groundwater flow assessment.

KGS Group – Winnipeg, Manitoba
Geoenvironmental Engineer (1994 to 1999)

Engineer working on environmental and geoenvironmental projects, including the design, monitoring and closure plan design for solid waste disposal sites (municipal and industrial). Also involved in the design and implementation of projects for the remediation of hydrocarbon-contaminated sites. Other areas of work included the design of wastewater treatment facilities and the management of air quality and noise issues.

SELECT RELEVANT PROJECT EXPERIENCE

Closure PFS Study Confidential Client
Canada

Dr. Weeks is the project director and senior technical reviewer for a multi-million-dollar PFS study being conducted for a confidential international mining client. This PFS study involves the linkage of numerous scopes of work, including geotechnical studies, tailings management, evaluation of water treatment alternatives, water balance models, geochemical models, lake and pit lake water quality models, and predictions of environmental effects, as well as engineering designs and trade-off studies conducted using Multiple Accounts Analysis methodology. Development of the PFS includes addressing corporate requirements for technical review by external subject matter experts.

APEC Mine Closure Checklist for Governments,
Global

Dr. Weeks was lead author and project manager for the development of an international guideline on mine closure policy. This guideline was commissioned by the 21-nation APEC, and is intended to provide member governments with guidance on the key elements needed in mine closure policy. The guideline was developed with the input of multiple stakeholders, and incorporates experience in mine closure policy from jurisdictions around the world. It was one of the first international mine closure guidance documents to directly address climate change

ICMM Integrated Mine Closure Good Practice Guide,
Global

Dr. Weeks was a principal editor and major contributor to this document, authoring many of the sections including the Climate Change Toolkit included as an appendix to the guide. His work on the document included a detailed revision and update of the draft document, incorporating feedback from all committee members and external reviewers.The Integrated Mine Closure Good Practice Guide was a major update to ICMM's widely used 2008 Planning for Integrated Mine Closure Toolkit.

Giant Mine Remediation Project (GMRP), Yellowknife, Northwest Territories, Canada

Dr. Weeks is one of the technical directors for the Golder/AECOM team working to ensure the technical quality and consistency of design and deliverables for the billion-dollar GMRP. He is directly responsible for closure activities related to tailings disposal, dam rehabilitation, contaminated soils management and borrow development. This includes responsibility both for the technical work under these work streams, and coordination and communication the other technical directors to ensure delivery of a consistent overall design. Dr. Weeks has been involved in the GMRP since 2015.

Snap Lake North Pile Closure Design (De Beers), Northwest Territories, Canada

Dr. Weeks is the overall technical director for the detailed design of major closure works for the North Pile processed kimberlite storage facility at the Snap Lake Mine. This detailed design includes a team of technical experts working in an integrated plan to address geotechnical issues associated with excavation/reshaping of the facility, cover design, surface water management, and treatment of seepage/runoff with a passive water treatment system.

Ekati Mine Interim Reclamation and Closure Plan (ICRP) Update, Northwest Territories, Canada

Dr. Weeks is the technical director for the update of the Ekati Diamond Mine's ICRP, supporting Ekati in the development and technical integration of a major update to the project's closure plan, addressing a wide variety of northern issues, including appropriate consideration of climate change effects. Dr. Weeks has been working on closure-related issues with Ekati since 2015.

Corporate Closure Planning Evaluation Confidential Client Global

Dr. Weeks conducted a high-level evaluation of closure planning and provisioning processes for one of the 25 largest mining companies globally, reporting directly at a VP level. Study evaluated closure practices across the corporation, with a focus on the methodology used to estimate closure provisions (IFRS) and bonding requirements in various jurisdictions.

Codelco Closure Plan Update Chile

Project manager for the development of a transversal update of all conceptual/feasibility level closure plans for Codelco, the largest producer of copper in the world. In the context of new closure law in Chile, led a team working in close collaboration with our client to update all closure plans, and develop cost estimates to be used both in financial provisions (IFRS standards), and in the presentation of a closure guarantee to the state.

The work was motivated by the first implementation of bonding requirements for mine sites in Chile, and was focused on developing realistic, defensible estimates of closure costs for all 8 sites. Costing was developed based on databases of information for site conditions and access that varied significantly between sites, including differences in labour and fuel costs, distances to waste disposal sites, and other factors. The project included specialist work assessment of demolition issues at each of the sites, and consideration of scale issues that affected elements of the plans such as closure of a tailings facility with an area of over 6000ha, and one of the largest open pits in the world. All cost estimates were developed to a level of expected accuracy higher than ASCE Class 4, and were reviewed in detail and approved by both the client and the regulatory body.

This work was initiated in 2013, and has been the basis of an ongoing relationship of providing related closure services since that date.

Collahuasi Mine Closure Plan Updates
Chile

Director for the development of an updated site-wide conceptual closure plan, including closure cost estimating and development of financial provisions for closure in accordance with IFRS standards. The work included addressing closure measures to a conceptual or better level for the open pit, waste rock dumps, tailings facility, and mine infrastructure. Closure costs were estimated to a level of detail equal to or above AACE Class 4. Closure plan and cost estimate was reviewed and approved by regulatory authority. This 2013-2015 update built past closure planning work that Dr. Weeks provided for Collahuasi, starting in 2007

The site is a copper mine with a long term capacity of 500,000 t/year and located at approximately 4,000 masl in the arid interior of northern Chile (Region I).

SERNAGEOMIN (Chile's National Mining and Geology Service)
Chile

Led the development of a guide for the estimation of mine closure costs. This guide was developed to provide the regulator with a tool for approximating the cost to close a site, based on relatively small set of easily obtained site characteristics. The guide is for the use of the regulator in evaluating the sufficiency of financial guarantees proposed by miners in the context of the new Chilean closure law.

AMSA Closure Planning Guideline
Chile

Project director for the development of Antofagasta Minerals (AMSA) closure planning guideline. This guideline was developed to ensure that all of the mines that make up AMSA take a consistent and comparable approach to the development of closure plans, compliance with legal expectations in Chile, estimation of closure costs for bonding, and reporting of closure costs in accordance with IFRS standards.

Michilla, Pelambres (Client: AMSA)
Chile

Formed part of Antofagasta Minerals internal audit team as subject matter expert, leading the evaluation of site closure plans as part of a site-wide technical audit.

Alumbrera (Client: Glencore)
Argentina

Project Director and technical lead for the evaluation and detailed design of closure alternatives for key site facilities, including a large (over 1000 ha) tailings facility and waste rock storage facilities. Key aspects of the work include evaluation of cover alternatives with field trials, geochemical, hydrogeological and hydraulic modeling of alternative closure scenarios, and design of water management facilities. Nearly 10 years of continuous involvement through the evaluation of alternatives and development of design.

El Indio (Client: Barrick)
Chile

Director of team responsible for the detailed design of water management works for finalizing the site closure.

El Tambo Heap Leach Detailed Closure Design (Client: Barrick)
Chile

Cover design specialist for the detailed design of the soil cover system to be placed as part of the final closure of a heap leach pile at the El Tambo mine site. Responsible for review of the existing soils data, developing the cover profile to be constructed at the site, and integration of the cover design with the detailed design of surface water control works to be implemented at the site.

Cerro Colorado Closure Plan (Client: BHP Billiton)
Region I, Chile

Project manager for the preparation of a feasibility-level closure plan and cost estimate for the Cerro Colorado mine. The Cerro Colorado mine is a copper mine located at approximately 2,500 masl in the arid interior of northern Chile (Region I). Project manager for updates in 2010 and 2007.

Abandoned Mine Site Remediation Manual (Client: Sernageomin)
Chile

Golder Associates S.A was responsible for the development of a risk-based approach for the assessment and closure of abandoned mine sites, to be used by the national mining ministry (Sernageomin). In addition to assisting with the development of the risk-based portion of the work, lead the development of a manual for the evaluation of alternative closure technologies for a wide variety of mine works that may be present as part of an abandoned mine site.

Education

M.Sc. Geological Engineering (Rock Mechanics), University of Saskatchewan, 1998

B.Sc. Geological Engineering, University of Saskatchewan, 1992

Golder Associates Ltd. – Vancouver

Associate, Geotechnical Engineer

Darren is a geotechnical engineer in Golder Associates' Greater Vancouver office. He has 24 years of geotechnical consulting experience, primarily related to the delivery of rock mechanics and engineering services to underground mines, open pit mines, hydroelectric projects, and civil engineering projects through all phases of project development with recent focus on mine closure work. His involvement ranges from providing practical mine sequencing and backfilling advice, specialized numerical modelling studies, project management of large geotechnical characterization and mine feasibility studies, to providing advice and guidance related to underground ground control. He has worked throughout Canada, the United States, South America, and Australasia. He has also been an operational / functional manager for a group of up to seventy (70) mining rock engineers.

Employment History

Golder Associates Ltd. – Vancouver, BC

Mining Geotechnical Engineer (1995 to Present), Associate (After 2006), Principal (After 2017)

Mining Geotechnical Engineer involved in various mining, hydrogeological, and geotechnical engineering projects. Experience in design of ground support, mine access, stopes, pillars, portals, bulkheads, crown pillars, and pit slope configurations, numerical modelling techniques for assisting with both underground and surface mine design and gathering geotechnical and hydrogeological site investigation data. Experience in mine closure studies for physical hazard aspects.

University of Saskatchewan – Saskatoon, SK

Master of Science Candidate/Research Assistant (1992 to 1994)

Thesis entitled "Numerical Modelling Analysis of Excavations in Weak Rock at the Cigar Lake Test Mine". Research Assistant to Professor Doug Stead during Master's tenure. Research topics included numerical modelling techniques for use in design of engineering works in weak rock, the New Austrian Tunnelling Method (NATM), ground freezing, ground squeezing, and shotcrete.

Cigar Lake Mining Corporation – Saskatoon, SK

Geotechnical Engineer (1992)

Employed as an Engineer during construction of development heading in weak, faulted ground at a depth of 460 m. Duties included planning, installation, and monitoring of geotechnical instrumentation, quality control of tunnel excavation and ground support installation, geotechnical engineering mapping and core logging.

PROJECT EXPERIENCE – UNDERGROUND CLOSURE AND REMEDIATION

	Involved in various aspects of mine closure and remediation studies including investigation, geotechnical and hydrogeological characterisation, crown pillar stability assessment, hazard assessment, end-land use discussion, development of backfill designs, writing specifications and tender documents for contractor work, and regulatory submittals for mine closure. Innovation in investigation and characterisation of abandoned mines with little or no safe underground access including interpretation of historical underground mine plans into useable 3D modelling tools, use of geophysical methods, laser and photogrammetry based void characterisation, use of unmanned drones, and sonar-based surveys of flooded cavities. Design of backfilling operations including using cemented paste tailings for stabilisation. Preparation of specifications and tender documents.
Three Sisters Mountain Village Canmore, Alberta Canada	Management of technical aspects related to assessment of undermining hazards associated with residential development on top of historical underground coal mines. Responsible for writing of undermining reports to standard required by province of Alberta and registration on land titles. Carried out pillar stability calculations and predictions of magnitude and extent of future subsidence. Planned investigations using drilling and geophysical techniques, assessed hazards, and designed mitigation including backfilling using cemented paste tailings and criteria for building foundation design.
Giant Mine Remediation Project CIRNAC Northwest Territories, Canada	Management of technical aspects related to underground and surface mine closure of Canada's largest mine remediation project over a seven-year period. Involved in risk assessment of underground entities and involved in strategies to mitigate underground risk and development of long-term closure strategies. Management of consultant effort during backfilling of underground voids to mitigate underground risk by contractor including development of tender specifications, tender package development, and quality control and cost control during backfilling work. Assisted with development of closure plan document and water licencing package.
Rossland Lands, Teck Metals Ltd., Rossland, BC, Canada	Technical management of ongoing assistance to Teck Metals Ltd. in assistance with managing hazards associated with historical underground gold mining in and around the town of Rossland, B.C. over a ten-year period. Work involves assessment of old mine plans and inspection of surface subsidence features to determine mitigation and remediation recommendations.
Holden Mine, Rio Tinto, Lake Chelan, Washington, USA	Assisted with ground control work for re-entry of abandoned mine workings for eventual installation of grouted pressure plug to reduce acid-mine drainage from abandoned mine.
Con Mine, Mirimar / Newmont, Yellowknife, NT, Canada	Developed stope caps and grading plans for remediation of unstable crown pillars for purposes of mine closure. Worked with client on end land uses and suitable mitigation designs to manage future hazards to the public.

PROJECT EXPERIENCE – UNDERGROUND MINE GEOTECHNICAL

	Design and implementation of geotechnical investigation programs aimed at characterization of the rock mass in a manner suitable for necessary rock mechanics design studies; assessment of suitable development opening and stope size, shape, and orientation; assessment of ground support requirements using empirical, analytical, and numerical analysis techniques for mine development, stope access openings, permanent shafts, ore passes, and stopes; input into development of ground control management plans; audits of ground control practices and compliance with ground control management plans; assessment of open pit / underground interaction; portal design; crown pillar stability assessment and design; pressure bulkhead design for closure studies and operating mines; and mine backfill design input.
Capstone Minerals, Minto Mine, Yukon, Canada	Involved in production mining rock mechanics pillar design, ground support and ground control, mine sequencing advice.
Eléonore Project, Les Mines Opinaca Ltés, Goldcorp Inc. Québec, Canada	Development of temporary and permanent shaft ground support requirements using detailed geotechnical core logging data, core photographs, and borehole televiewer imagery.
Meliadine Project, Comaplex Minerals Corp. Nunavut, Canada	Supervised underground geotechnical data collection program. Participated in geotechnical assessment of and provided input to underground mine design planning process with client team.
Diavik Diamond Mines, Rio Tinto Group Northwest Territories, Canada	Served as on-site Geotechnical Engineer during development of bulk sample drift in difficult, mixed ground conditions that included squeezing ground. Responsible for site investigation, ground support recommendations, advice on excavation / ground support installation sequence and trouble shooting during excavation of the drift.
Bingham Canyon, Kennecott Utah Copper Company Utah, USA	Responsible for geotechnical input to design of ground support in weak ground areas anticipated to be encountered in the Highland Boy drainage gallery being excavated into the Bingham Canyon Open Pit Mine. Provided external review for Ground Control Management Plan.
Resolution Project, Resolution Copper Company Arizona, USA	Responsible for geotechnical input to a pre-feasibility study for a large, deep, underground block caving operation. Management of the execution of geotechnical and hydrogeological characterization, ground support designs, water inflow estimates, development of ground control management plan, and stress measurement studies. Carried out numerical modelling studies to assess overall impact of cave on a far-field scale as well as behaviour of individual drifts at great depth. Responsible for technical and financial aspects of project, client communication and liaison, and reporting of activities to technical review board jointly with both Resolution Copper Co. staff and Rio Tinto Technical Services staff. Assisted project team with development of Ground Control Management Plan.

Pumpkin Copper Project, Nevada Copper Corp. Nevada, USA	Provided geotechnical input to pre-feasibility underground mine design team. Carried out site inspection including assessment of rock mass quality from available drillcore, geotechnical database, and core photos.
Cortez Hills J.V., Barrick Gold Corp. / Rio Tinto Group Nevada , USA	Managed and organized multidisciplinary team's participation in a hydrogeological / geotechnical site investigation for underground dewatering adits and mine infrastructure for the future Cortez Hills Mine. Managed staffing, scheduling, health & safety, and was key client contact during two months of drilling. Developed geotechnical logging procedures including integration of acoustic and borehole televiewer imagery.
Rodeo / Meikle Mine Complex, Barrick Gold Corporation Nevada, USA	Involved in ground support audits and development of three-dimmensional numerical model (Map3d) used for the prediction of the impact of mining on development of ground support performance over time due to changing ground stress conditions.
Cigar Lake Mine, Cameco Corporation Cigar Lake, SK, Canada	Provided technical advice, numerical modelling support, and supervision of junior engineering staff during numerical analysis of concrete tunnel lining and conventional ground support. Project involved utilisation of the FLAC finite difference numerical modelling package to determine potential ground loads on circular tunnel lining excavated in weak, frozen rock at a depth of approximately 500 m. Responsible for determination of suitable material properties for input to numerical models, and empirical determination of ground support requirements. Also involved in implementation of MAP3d (linear elastic) modelling to support permanent infrastructure studies.
Getchell Mine, Placer Dome North America Nevada, USA	Responsible for development of a geotechnical model for use by mine staff for planning purposes. Carried out on-site rock mass classification mapping (RMR) of underground openings and examination of geotechnical core logging database. Facilitated discussion between geological exploration staff and engineering planning to streamline development of geotechnical model.
Kensington Project, Coeur d'Alene Mining Alaska, USA	Involved in preliminary stope sizing and sequencing study for feasibility study run by Snowden Mining Consultants Inc. The study involved the prediction of stable stope sizes, potential backfill use, and the sequencing of pillar extraction to limit overstressed ground in active working areas.

PROJECT EXPERIENCE – SURFACE MINE GEOTECHNICAL

Design and implementation of geotechnical and hydrogeological investigation programs aimed at characterization of the rock mass in a manner suitable for necessary rock mechanics design studies; discontinuity mapping; assessment of stable bench design using kinematic approaches; application of numerical modelling approaches to the assessment of slope stability using FLAC, UDEC, and Phase2.

Gilbraltar Mine Williams Lake, BC	Carried out site visits to assess slope instability and suggest remedial options. Managed geotechnical and hydrogeological investigation to support slope syability studies on future push backs and final slope designs.

Red Dog Mine, Teck Alaska, USA	Project manager for mine geotechnical including geological interpretation, slope stability assessment, input to slope designs, set-up and supervision of on-site geotechnical engineering program, and geotechnical investigation program.
Elk Pit, Almaden Minerals Merritt, BC, Canada	Carried out pit slope design for pre-feasibility study of potential open pit mine in British Columbia. Responsible for overall project management, site investigation, and report writing.
Batu- Hijau Mine, Newmont Mining Corporation Sumbawa, Indonesia	Carried out extensive numerical modelling assessment of overall pit slope stability (using UDEC) for a large open pit porphyry copper/gold mine in Indonesia. Worked on site for several months and was responsible for mapping in the pit, working with mine staff to assess monitoring and instrumentation data, and numerical analysis.
Kumtor Mine, Kumtor Operating Company (Cameco) Kyrgyzstan	Using finite difference method (FLAC), carried out conceptual numerical modelling study on effects of dumping waste rock on active glacier. Study involved integration of dump plans and dump movement monitoring data, photographs of dump behaviour, and observations into the numerical model. Carried out several ongoing phases of waste dump stability studies.
Toquepala Mine, Southern Peru Copper Corporation Peru	Using distinct element method (UDEC), assisted with numerical modelling study of toppling instability at a large open pit mine. Study involved integration of mine geometry with geological structural details of pit slope into numerical model for use in ongoing stability analysis.
Fording River Mine, Fording Coal Sparwood, BC, Canada	Developed distinct element numerical model (UDEC) for design of footwall slope at open pit coal mine. Used numerical model to check for development of buckling and ploughing failure mechanism for various slope heights, rock types, and sedimentary bedding thickness.
Elkview Mine, Teck Sparwood, BC, Canada	Using finite difference method (FLAC), carried out conceptual numerical modelling study on up-dip coal mining method. Study involved integration of geological structure with mine geometry to assist in analysis of conceptual mining method.
NICO and Sue-Dianne Projects, Fortune Minerals Rae Lakes, NT, Canada	Carried out pit slope design for pre-feasibility study of potential open pit mine in the Northwest Territories. Responsible for overall project management, site investigation, and report writing.
Yanacocha Mine, Minera Yanacocha South America Peru	Developed numerical modelling analyses (using FLAC) for assessment of potential strain on PVC lining at base of large heap leach pad for open pit gold mine.
Meadowbank Project, Cumberland Resources Baker Lake, NU, Canada	Carried out oriented core drilling and geotechnical core logging for purposes of open pit slope stability analysis at advanced gold exploration project. Responsible for orientation of core during diamond drilling and oriented core geotechnical logging.

CanNorth

Canada North Environmental Services Limited Partnership

A First Nation Environmental Services Company

Harriet Phillips, Ph.D., QP_{RA}

Risk Assessment Division Manager

EXPERTISE

Project Management

Human Health and Ecological Risk Assessments

Radiological Risk Assessments

Toxicology

Community Health Assessments

EDUCATION

Ph.D., Chemical Engineering, University of Waterloo
1991

M.Eng., Chemical Engineering, McGill University
1984

B.Sc. (Hon.) Biochemistry
University of Western Ontario
1981

AFFILIATIONS

Society of Risk Analysis

EMPLOYMENT HISTORY

Apr 2016–Present
Risk Assessment Division Manager
Canada North Environmental Services
Markham, ON

1996–2015
Senior Specialist Risk Assessment and Toxicology
SENES Consultants Limited (acquired by ARCADIS 2013)
Richmond Hill, ON

1991-1996
Research Associate and Sessional Lecturer
University of Waterloo
Waterloo, ON

Harriet Phillips is a senior risk assessor at CanNorth with 22 years of experience in human health and ecological risk assessments (HHERAs). She has managed many complex risk assessment (RA) projects involving many disciplines. She is designated as a Qualified Person for Risk Assessment (QP_{RA}) under the Ontario Regulation 153/04. Dr. Phillips has extensive experience on HHERAs for a number of different sectors including smelters, mining operations (development, operation and decommissioning), coal mines, natural gas-fired generating stations, coal and nuclear generating stations, and contaminated and industrial sites. She has evaluated the impacts of environmental contamination on community health for a number of projects. She has been the senior risk assessor in many RAs, both ecological and human health, involving exposure to metals, dioxins, volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), benzene, toluene, ethylbenzene and xylene (BTEX) compounds, and polycyclic aromatic hydrocarbons (PAHs).

She has wide-ranging experience on human health assessments in Canada including British Columbia, Saskatchewan, Northwest Territories, Yukon, Nunavut, Manitoba, Nova Scotia, New Brunswick, and Ontario. In addition, she has carried out RAs internationally in the United States, Germany, Mongolia, South America, and the Caribbean. Dr. Phillips also has experience in liaising with regulators such as Health Canada, Environment Canada, Canadian Nuclear Safety Commission (CNSC), and Provincial agencies, and has peer review experience on many RAs on behalf of First Nations, lawyers, regulatory agencies, and the private sector.

PROJECT EXPERIENCE

Human Health and Ecological Risk Assessment

- Senior technical lead on the risk assessment for the preferred remedial option at Giant Mine site. The project involves taking the information from the numerous studies conducted at the site and Yellowknife area and integrating into the HHERA.
- Senior technical lead on a project for the Government of the Northwest Territories evaluating off-site legacy impacts from Giant and Con Mines.
- Developed and evaluated site-specific criteria for PHC for remedial activities at Sawmill Bay, NWT.
- Senior technical lead for assessment of potential impacts from seepage from expansion of the Triangle Lake TMF at Seabee, Saskatchewan.
- Lead risk assessment specialist for a human health and ecological risk assessment for former uranium Mill site in Spokane Washington.
- Project manager and senior risk assessor for numerous risk assessments conducted at the abandoned Keno Hills Mine site in the Yukon including a district-wide HHERA, a human health risk assessment for Keno City, and the development of risk-based target levels for post remediation. Involved in the preparation of all the reports. Liaised with the client on a regular basis to keep them abreast of the progress and findings. Presented the results of the numerous assessments to the residents of Mayo, Keno City, and the Medical Officer of Health. Currently involved in the development of risk-based target levels as well as the development of the HHERA for the preferred remedial alternative.

PROJECT EXPERIENCE CONTINUED

- Project manager and senior scientist involved in the risk assessments for the Rayrock Mine Site, NWT as input to the remedial options analysis for the site.
- Project manager and senior risk assessor for numerous risk assessments conducted at the Faro Mine Complex. This project involved the integration of information from various disciplines such as water quality, vegetation, wildlife and fish and fish habitat, water treatment and management into the risk assessment. Public consultation with First Nations communities and other affected communities was an integral part of these projects as well as liaising with regulators.
- Project manager and senior scientist involved in the risk assessments for the Mount Nansen Mine Site, Yukon as part of the overall remedial strategy for the site. This project involved the integration of information related to various disciplines such as water quality, pit water quality, water management, vegetation, and wildlife. Public consultation with Little Salmon/Carmacks First Nation was an integral part of these projects as well as liaising with regulators.
- Project manager on the Health Impact Assessment (risk assessment) and development of site specific remedial criteria in support of the Environmental Assessment (EA) for the Gunnar Mine Site in Northern Saskatchewan. This project involved the evaluation of the health impacts due to air emissions, noise and water emissions associated with the development of remedial options at the Gunnar Mine Site. It also involved the review and input into the three volumes of documentation for the EA and liaising with the Saskatchewan Research Council and the preparation of presentation material. Currently involved in risk assessment in support of remedial alternatives for waste rock and other site aspects.
- Senior risk assessor for evaluation of the remedial options at the Gunnar Mine site. This involved risk calculations for the options for the Gunnar pit, waste rock, acid plant, and other debris.
- Senior risk assessor on the development of an innovative risk assessment strategy to evaluate the human health and ecological risks related to exposure to petroleum hydrocarbons and metals at dozens of sites along the 370 km corridor of the former Canol pipeline. The assessment used the Health Canada framework, combined with a Monte Carlo framework that was developed for calculating spatially averaged exposure point concentrations and a framework for assessing the human health and ecological risks. Public consultation with First Nations communities and other affected communities was an integral part of this project as well as liaising with regulators. Provided input from the risk assessment into the remedial plan development.
- Project Manager and Senior Risk Assessor on screening level human health and ecological risk assessments performed on twelve mine sites (Giant, Colomac, Faro, Mount Nansen, Clinton Creek, Discovery, Port Radium, Tundra, Silver Bear, United Keno, Contact Lake, and Roberts Bay) and thirteen former military sites (Resolution Island, Cape Christian, Radio Island, Sarcpa Lake, Atkinson Point, Bear Island, Padloping Island, Axe Point, Simpson Lake, Clifton Point, Ekalugad Fjord, Tunnuk, and Bray Island) in the Yukon, Northwest Territories, and Nunavut. This work was undertaken for Indian and Northern Affairs Canada to characterize the relative risks presented by the sites for input to a process for prioritizing reclamation funding.
- Project manager and senior risk assessor on several HHERAs in Northern Saskatchewan including McClean Lake, Rabbit Lake, Cigar Lake, Beaverlodge and Cluff Lake operations. These projects involved fate and transport modelling, probabilistic risk assessments, the use of CSA N288.6, and liaising with CNSC and other regulators.
- Senior risk assessment specialist on the Technical Advisor team on the Giant Mine Remediation Project for Aboriginal Affairs and Northern Development Canada (AANDC). Senior risk assessor for three separate HHERAs on the project involving options for long-term management of arsenic trioxide dust stored in underground mine workings/chambers, reclamation of contaminated surface soils and buildings, remediation of Baker Creek (which flows through the mine site), and treatment of mine water with discharge to Yellowknife Bay. Providing support on the health effects to workers due to exposure from arsenic in air due to remediation activities. This involved calculations of urinary arsenic levels and extensive review of sources of arsenic exposure.
- Senior technical lead on the ecological risk assessment for the Darlington New Build and the Darlington Refurbishment Projects in support of the Environmental Assessment. This involved reviewing the field sampling plan and taking the results from numerous technical support documents for the projects and conducting the ERA as well as providing inputs and advice into the EA. Participation in the CNSC hearings.

PROJECT EXPERIENCE CONTINUED

- Project manager and senior scientist for several HHERAs on mining projects in the Northwest Territories and the Yukon including: risk assessments for a number of mine sites on, Great Bear Lake, the Silver Bear Mine sites, El Bonanza Mine site, Contact Lake Mine site, Indore Hottah Mine site, and North Inca Mine site; assessment of arsenic exposure at the Tundra Mine site, assessment of treatment alternatives and discharge of tailings water from the Colomac gold mine; evaluation of the Port Radium uranium/radium/silver mine; assessments of remedial alternatives at the Anvil Range lead/zinc mine, and Mount Nansen in Yukon.
- Project manager and senior technical risk assessment lead on the development of risk-based target levels for residential, parkland, and commercial exposures at the site of a former heavy water plant in Glace Bay, Nova Scotia. These target levels were then used within the soils management plan to manage all the soils on site, saving Public Works and Government Services Canada (PWGSC; formerly Enterprise Cape Breton Corporation) millions of dollars. In addition oversaw the development of a closure report for the site.
- Senior risk assessor for a number of coal mining properties in Nova Scotia, including the Lingan, Dominion 11, Franklin, and Dominion 6 mine sites. This involved the preparation of a class RA for sites without waterbodies for the Cape Breton Development Corporation (CBDC), as well as involvement in a committee for the development of a screening and risk assessment methodology for all CBDC sites.
- Senior risk assessor on estimating the potential risks from exposure to gamma fields at the Beaverlodge properties based on spatial considerations, land use, and measured gamma radiation levels. Part of the project involved conducting a survey in the nearby town of Uranium City to determine how the Beaverlodge properties are being used since decommissioning has been completed at the sites. In additional, the project involved recommendations for future remediation work to achieve an acceptable risk level so the properties could be transferred over to the Institutional Control Program administered by the Government of Saskatchewan.
- Project manager and senior risk assessor on behalf of Atomic Energy of Canada Ltd. on the development of clean-up criteria for uranium in soil in Port Hope, Ontario. The project involved developing the risk-based criteria and presenting the results and report to various regulators such as the Ontario Ministry of the Environment and the CNSC.
- Senior risk assessor for a number of gas-fired generating stations in Ontario on behalf of TransCanada including Portlands Energy Center, Halton Hills, and Oakville. Assessments were also done for other clients in Manitoba. These projects involve obtaining information from the air quality specialists and biologists and integrating this information into a risk assessment framework. Public presentations and liaising with regulators was an integral part of these projects.
- Senior risk assessor for an HHERA related to a transportation corridor in the Windsor area (the Detroit River International Crossing [DRIC], or Windsor-Essex Parkway). This project involved a human health risk assessment to help interpret the potential for overall adverse effect of the proposed parkway as compared to the “No Build” scenario (i.e., the roadway in its current configuration), including potential adverse effects to people in the immediate area surrounding the proposed roadway. In addition a risk assessment was carried out for construction workers carrying out the road building.
- Senior risk assessor for assessing the risks of emissions from the rice and saw mill industries on behalf of the Guyana Environmental Protection Agency (EPA).
- Project manager and senior scientist for an HHERA for an aluminium smelter in Trinidad and Tobago, which also involved liaising with the Environmental Management Authority.
- Project manager on the development of the human health risk assessment associated with the Country Foods Study for the Beaverlodge Mine Area (near Uranium City) and the Athabasca Basin Area, in Northern Saskatchewan. These projects involved the compilation of data from different foods collected by other teams and conducting a risk assessment for metals including uranium, molybdenum, and selenium as well as radionuclides using consumption patterns derived for Uranium City residents and the Hatchet Lake Dietary Survey.

Brownfields Risk Assessments

- Senior technical reviewer of RAs under Ontario Regulation 153/04 on behalf of the Ontario Ministry of the Environment and Climate Change. One aspect of the project is to review toxicity data and approach to ensure that the assessment has been done in accordance with the current regulations.
- Senior risk assessor for six (6) due diligence risk assessments involving petroleumhydrocarbons, VOCs, PAHs and metals in Ontario for Brownfield sites carried out in the spirit of O.Reg 153/04.

PROJECT EXPERIENCE CONTINUED

- Project manager for the development of a reference tool for completing Community Assessment Reports (CARs), including the completion of a jurisdictional review of existing programs and procedures, on behalf of the Ontario Ministry of the Environment and Climate Change.
- QP_{RA} and senior risk assessor for the redevelopment of former industrial lands in downtown Hamilton for commercial/retail land uses conducted under O. Reg. 153/04 in order to obtain a Record of Site Condition (RSC). The RA addressed metals and PHCs including non-aqueous phase liquids (NAPL) in the groundwater present at the site. Property specific standards were developed which incorporated risk management measures to mitigate potential exposure opportunities, and an RSC was obtained.
- Senior risk assessor on the preparation of numerous human health and ecological risk assessments for the Concord Adex Developments Corp. for 22 ha of former CN railway lands situated west of the Roger's Centre in downtown Toronto. The human health and ecological risk assessment and developed risk management measures allowed for some 750,000 m^3 of soil exceeding MOECC residential standards to be used in raising grades to meet municipal design objectives below the non-residential components (parks and road alignments) of the proposed development. This MOECC and City of Toronto accepted approach resulted in realized cost savings of over $60 million.
- Project manager and senior scientist in several HHERAs for various contaminated sites in the Port Industrial area of Toronto and other areas in Ontario.
- Senior risk assessor for a site specific risk assessment to determine the potential impacts to human health and ecological receptors exposed to PAH contamination from coal tar in the soil at the Thompson Groceries site in Toronto.
- Project manager and senior scientist involved in an RA and toxicological evaluation of Smithville Site in Ontario which is contaminated with PCBs; for the Ontario Ministry of the Environment.
- Involved in several human health risk assessment and ecological risk assessment have been carried out for several properties owned by the National Capital Commission (NCC). These sites are generally used for parkland (either natural areas or active use urban parks). The contaminants include metals, polycyclic aromatic hydrocarbons (PAHs), petroleum hydrocarbons (PHCs), chlorinated solvents, PCBs as well as others.

Community Health

- Senior scientist for two air pollution studies for the City of Toronto and the City of Hamilton whereby conducted a health impact assessment using air pollution data. The studies considered recent air pollutant concentration levels as well as updated data on health risks from air pollutants obtained from literature. To provide additional context, calculations were also carried out with the Ontario Medical Association's Illness Cost of Air Pollution (ICAP) model as well as with the Health Canada's Air Quality Benefits Assessment Tool (AQBAT) model.
- Project manager and senior scientist for a human health risk assessment evaluating the impacts of a smelter and other industrial facilities on a community in Northern New Brunswick. The results were linked to a community health status assessment for New Brunswick Health and Welfare.
- Project manager and senior scientist on a team involved in updating the Canadian blood lead guidance for Health Canada. This project involved the development of a guidance document for physicians and public health practitioners and consultation with Medical Officers of Health as well as Public Health units. A handout was developed for physicians and health practitioners.
- Project manager and senior technical lead on the development of scientifically defensible and critically evaluated probabilistic estimated daily intake rates (EDIs) by the Canadian population for 14 chemicals for Health Canada. This involved a comprehensive literature review of peer-reviewed studies on concentrations of the chemicals in ambient air, indoor air, indoor settled dust, soil, water, breast milk, and food, followed by critical evaluation of the studies in order to select data for the derivation. These EDIs were used for updating Soil Quality Guidance.

Peer Review

Dr. Phillips has carried out numerous peer reviews on behalf of various clients including the Alberta Government, Nunavut Government, the Ontario Ministry of the Environment and Climate Change, Public Works, First Nations, and industrial clients. Some of the projects are listed below.

- Reviewed a number of ecological risk assessments related to natural enhanced radioactivity on behalf of the World Nuclear Association.

PROJECT EXPERIENCE CONTINUED

- Peer review of the draft United States EPA Selenium Aquatic Life Guidelines.
- Performed for the Atomic Energy Control Board of Canada a critical literature review of the status of biological dosimeters for assessing exposure to ionizing radiation.
- Carried out a review of the human health risk assessment sections for the Shell JackPine EIA and the Suncor Voyager South Mine as a third party review on behalf of Alberta Environment.
- Led Peer Review of Health Impact Assessment (air quality and noise) for Billy Bishop Airport in Toronto. The supporting documents on were reviewed, and the methodology and findings were analyzed to determine accuracy and bias.

Other Projects

- Project manager and senior scientist on a Jurisdictional Review and Guidance Manual for Green Chemistry on behalf of the Ontario Ministry of the Environment. This project involved carrying out a world-wide jurisdictional review on green chemical substitution and the development of a guidance tool for industries to consult when changing their process chemicals to a greener alternative. Liaison with the client through bi-weekly meetings and several face-to-face meetings as well as a presentation to industry representatives.
- Senior technical lead on a review of the sulphur dioxide ambient air quality objective for Metro Vancouver. The project included a review and summary of established ambient air quality criteria in other jurisdictions in North America and other parts of the world, a review of recent SO_2 human health science assessments, a review of current SO_2 ecosystem health science, and a review of sulphur emissions from natural environments that can contribute to ambient sulphur dioxide concentrations.
- Technical lead in the development of numerous species sensitivity distributions (SSDs) for aquatic toxicity for site-specific application, including for Rabbit Lake Operation (SK), McClean Lake Operation (SK), and Great Slave Lake Mines (NT).
- Project manager and senior scientist involved in the development of a Radiological Risk Assessment Manual for Health Canada.
- Senior scientist involved in assessing the fate and significance of selected contaminants in sewage sludge biosolids applied to agricultural land for the Ontario Ministry of the Environment.
- Project manager and senior scientist for a study involving epidemiological studies of trihalomethanes in drinking water on behalf of Health Canada.
- Project manager and senior toxicologist involved in the assessment microbes and chemicals for treatment options for wastewater disinfection as well as senior scientist participating in a risk-based decision model for Community Water Systems. A novel risk and decision model was developed for the Ministry of Health in British Columbia to assess the presence of microbes/chemicals in drinking water.
- Senior scientist on presentation of Emergency Management training for Point LePreau. Involved in developing a workshop for and presenting to the Health Department.

SELECTED PUBLICATIONS AND CONFERENCE PRESENTATIONS

Thackeray, N., H. Phillips, K. Woolhouse, and S. Fernandes. 2018. An Approach to Scoring Toxicity Data for the Development of Wildlife TRVs. Presented at SETAC Laurentian, Kingston, June 2018.

Phillips, H., S. Fernandes, C. Lucas, N. Thackeray, R. Froess, J. Amphlett and E. Nyyssonen. 2018. Development of a Country Foods Dietary Survey and Collection of Voluntary Country Food Samples in Support of the Giant Mine Risk Assessment. Presented at RPIC May 2018.

Lucas, C., N. Thackeray, K. Woolhouse, S. Fernandes and H. Phillips. 2017. The Development of Regional Background Concentrations with Consideration of Naturally Elevated Areas. Presented at SETAC Laurentian, Oshawa, June 2017.

Thackeray, N., K. Woolhouse, H. Phillips and S. Fernandes. 2017. An Approach to Deriving Criteria for Elements with Insufficient Available Toxicity Data. Presented at SETAC Laurentian, Oshawa, 2017.

Phillips, H. 2017 Human Health and Ecological Risk Assessment of Proposed Alutrint Project on the La Brea Community in Aluminium Smelting: Health, Environmental and Engineering Perspectives. Aluminum Health Environmental and Engineering Perspectives. Ian Randle Publishers. May 2017.

Phillips, H., and L. Leon. 2016. Using Inputs from an Indigenous Community in Evaluating Remedial Options at a Large Mine Site. Presented at the Canadian Ecotoxicity Workshop, Edmonton, September 2016.

Phillips, H., L. Leon and S. Fernandes. 2015. Risk Evaluation of Country Foods Study Near Decommissioned Beaverlodge Mine. Presented at the Canadian Ecotoxicity Workshop, Saskatoon, October 2015.

Phillips, H., S. Fernandes, and K. Woolhouse. 2014. How to develop and fit species sensitivity distributions for use in risk assessments. Presented at the Society for Environmental Toxicology and Chemistry (SETAC) North America 35th Annual Meeting, Vancouver, British Columbia, November 2014.

Phillips, H., M. Tokarek, and J. Hoyt. 2014. Risk assessment of the Canol Trail: a complex linear corridor. Presented at Real Property Institute of Canada Federal Contaminated Sites National Workshop, Ottawa, Ontario, April 2014.

Fernandes, S., H. Phillips, and L. Leon. 2013. Challenges of human health risk assessment for contaminated sediment. Poster presented at SETAC North America 34th Annual Meeting, Nashville, Tennessee, November 2013.

Fernandes, S., H. Phillips, M. Tai, and K. Woolhouse. 2013. Use of species sensitivity distributions in risk assessment. Presented at Laurentian SETAC Annual General Meeting, Hamilton, Ontario, June 2013.

Phillips, H., S. Fernandes, B. Halbert, C. Hamer, and M. Webster. 2013. Contaminant transport and pathways model for assessment of current and future risks in Beaverlodge Lake area, Canada. Presented at Laurentian SETAC Annual General Meeting, Hamilton, Ontario, June 2013.

Chambers, D.B., H. Phillips, S. Fernandes, and A. Garva. 2008. Radioactivity. In: Encyclopedia of Ecology, Elsevier B.V., 2008.

Education

M.Sc. Zoology , University of Alberta, Edmonton, AB, 1995

B.Sc. Biology , University of Regina, Regina, SK, 1992

Years of Experience

With Golder: 20
With other firms: 3

Golder Associates Ltd. – Whitehorse, YT

Hilary Machtans is a Senior Fisheries Biologist with 20 years of experience in fisheries, water quality, and environmental research. She was based in Yellowknife for 17 years (1997 to 2014) and is now living in Whitehorse, Yukon.

Hilary's experience includes water and sediment sampling programs, fish habitat relationships, fish health, and contaminant assessment in relation to industrial effluent, fish population estimates, and habitat compensation planning. She also provides senior technical direction, project management, and regulatory advice. She has authored several technical reports on fish, and Environmental Effects Monitoring and Metal Mining Effluent Regulations programs.

Hilary is currently working on environmental assessment at Faro Mine in the Yukon, water quality in the Eagle Plains area of the Yukon, water quality objectives and discharge criteria for Giant Mine in Yellowknife as well as leading an Aquatic Effects team for a diamond mines. Her responsibilities have included project management, study design and review, sampling plan preparation, conducting field sampling, data analysis, report preparation and presentation of results, and acting as a public, university, and regulatory liaison.

SELECTED EXPERIENCE ON SIMILAR PROJECTS

DeBeers Canada Mining Inc. – Snap Lake Mine
NT, Canada
1999-2018

Technical manager for the Snap Lake Aquatic Effects Monitoring Program. Lead a multidisciplinary team with design and implementation of an extensive field program including twelve years of monitoring. Includes special studies with university and government partnerships. Provide regulatory and technical support for Environmental Assessment and Water License process. Led a team to develop the approved Aquatic Effects 'Response Framework' (under NWT Land and Water Board Guidance for Adaptive Management Plans) for Aquatic Environment including actions, triggers and responses for water, sediment, toxicity, fish, benthos, plankton.

Leads a team working on a Downstream Watershed Special Study examining extent of treated effluent in the receiving environment, determination of natural variability in the receiving lakes, and assessment of Adaptive Management actions and triggers to be set in receiving lakes downstream of the mine.

Miramar Mining – Con Mine
NT, Canada
1998-2018

Project manager and biologist for design and implementation of the Con Mine Environmental Effects Monitoring (EEM) Study Designs and interpretative reports submitted to Environment Canada from 2003 to 2018. Included water, sediment, effluent, benthic invertebrate, toxicity and fisheries components to evaluate risk of effluent to fish and fish habitat. Developed Standard Operating Procedures for mine including water quality and toxicity samples and comparison to guidelines and standardization of field procedures and quality assurance programs. Currently project director for combined groundwater and surface water monitoring program in relation to mine closure.

AANDC – Colomac Mine
NT, Canada
2009-2010

Project manager and scientist for water quality study of historic tailings ponds at the abandoned mine.

GNWT Transboundary Waters
NT, Canada
2009

Prepared a summary of the current state of knowledge on aquatic ecosystem health for the GNWT intends to use in the development of a suite of aquatic ecosystem indicators as well as to select important areas/locations to monitor ecosystem health. Included benthic communities, fish populations, waterfowl, fur-bearing aquatic species, vegetation, riparian and in-stream habitats, contaminants in fish and fish health. Identified and developed criteria for assessment and future use in adaptive management as triggers/action levels.

Giant Mine – Public Services and Procurement Canada
NT, Canada
1999-2018

Managed site-specific water quality objectives study (2014 to 2017). Included water chemistry analyses and modelling of on-site waters and receiving environment. Involved water management underground and on surface and in receiving environment to set criteria for discharge.

Leading development of Final Closure and Reclamation Plan including development of criteria for closure and 'Adaptive Management' components of the required Water Management Plan, Aquatic Effects Monitoring Plan and the dust monitoring plan.

Designing long-term environmental monitoring programs for on-site at mine and in receiving environment for upcoming regulatory water license process.

Project Manager (2011 to 2013) for sediment quality assessment in Baker Creek on the mine site. Included extensive database work and water quality and sediment quality data review. Managed sediment study, and water and sediment sampling program for off-lease areas of the mine (2014 to 2015). Coordinated with universities for arsenic speciation methods.

Manager and technical lead (2011). Designed and implemented a water and sediment sampling program. Reported on sediment release at the mine. Worked on Adaptive management solutions to freshet water management. Analysed risks to environment, and liaised with government, regulators, and public on sampling results.

Technical resource for Giant Mine Environmental Assessment hearing and information responses related to fisheries and water quality (2011-2012).

Indian and Northern Affairs: Faro Mine
YT, Canada
2016- present

Technical lead for the environmental assessment and permitting for Faro Mine closure including focus on water and downstream environment. Includes development of forthcoming Adaptive Management Plan for the Project Proposal to YESAB.

RECENT RELEVANT PUBLICATIONS AND PRESENTATIONS

Barrett, T., K. Hille, K. Harris, R. Sharpe, H. Machtans, S. Usvyatsov, and P. M. Chapman. 2015. Quantifying natural variability as a method to detect environmental change: definitions of the normal range for a single observation and the mean of *m* observations. Environ. Toxicol. Chem. 34(5): 1185-1195

Sharpe, R. L., T. J. Barrett, H. M. Machtans, P. M. Chapman and A. Hood. 2015. Adaptive management in Canada's Northwest Territories: A case study of the application of prediction intervals to quantify natural variability. Proceedings of the Canadian Ecotoxicology Workshop, October 4-7, 2015, Saskatoon, SK, Canada.

Sharpe RL, James CT, Jaeger MD, Barrett TJ, Coulton D, Machtans HM, Hildebrand, L, Chapman PM, Peters M, Hood, A. 2015. Adaptive Management in Canada's Northwest Territories: A Glimpse into the Snap Lake Diamond Mine's Fisheries Monitoring Program and Special Studies. Poster presented at: 6th Annual Diamond Route Research Conference; 2015 October 20-21; Ormonde, Johannesburg.

Sharpe R., H. Machtans, J. Crowe, P.M. Chapman, R. Connell and E. Daniels. 2010. Investigation of cause at a closed goal mine: The insight, implications and consequences of conducting an IOC study in a year without effluent. Presented at the 31st Annual Meeting of the Society of Environmental Toxicology and Chemistry, Portland, OR, USA.

Golder Associates Ltd. – Edmonton

Senior Water Resources Engineer

Dr. Nathan Schmidt has worked on mining projects across Canada, with an emphasis on the North. His scopes of practice include baseline hydrology, water management planning, design and environmental impact assessment. Nathan has played a key role in several northern EIAs and providing design services for these and other projects.

Nathan has extensive experience in the north, including mine water management, hydrotechnical analysis and design, fish habitat compensation, water supply for ice road construction and erosion and sediment control. His recent work includes involvement with the Dominion Diamond Jay and Lynx projects, De Beers Gahcho Kué diamond project, the Giant Mine and Faro Mine remediation projects, the Agnico-Eagle Meliadine and Meadowbank gold projects, the Fortune Minerals NICO project, and other projects for the GNWT Department of Transportation and Northwest Territories Power Corporation.

Nathan is registered as a professional engineer in Alberta, British Columbia, Yukon and the Northwest Territories and Nunavut. He is the former chair of the APEGA Environment Committee and has served five terms on NSERC Grant Selection Committees. Nathan is a Certified Professional in Erosion and Sediment Control.

Education

Ph.D. Civil Engineering - Fluid Mechanics, University of Canterbury, 1998

M.Sc. Civil Engineering - Water Resources, University of Alberta, Alberta, 1992

B.Sc. Civil Engineering - Co-op Program, With Distinction, University of Alberta, Alberta, 1990

Applied Fluvial Geomorphology, Dave Rosgen/Wildland Hydrology, 2001

Affiliations

Association of Professional Engineers and Geoscientists of Northwest Territories

Association of Professional Engineers and Geoscientists of Alberta

Association of Professional Engineers and Geoscientists of British Columbia

Association of Professional Engineers of Yukon

Erosion and Sediment Control Association of Canada (CPESC)

Canadian Institute of Mining, Metallurgy and Petroleum (Environment Section)

Employment History

Golder Associates Ltd. – Edmonton, AB

Associate then Principal, Senior Water Resources Engineer (2002 to Present)

Consultant and Project Manager on projects related to river engineering, hydrology, water management, and environmental impact assessment in the mining, water resources, power, forestry, and transportation market sectors.

Golder Associates Ltd. – Calgary, AB

Senior Water Resources Engineer (1997 to 2002)

Consultant and Project Manager on a variety of projects. Highlights included managing the climate and hydrology component of the Regional Aquatics Monitoring Program for five years, leading the surface water hydrology components of the CNRL Horizon Oil Sands Project EIA and Suncor Firebag In Situ Oil Sands Project EIA, and leading the Functional Design, Hydrology, and Hydraulics components of the Iron Ore Company Wabush Lake Tailings Management Project.

University of Canterbury – Christchurch, New Zealand

Research/Teaching Assistant, Fluid Mechanics (1993 to 1997)

Alberta Transportation & Utilities – Edmonton, AB

Bridge Planning Engineer (1992 to 1993)

University of Alberta – Edmonton, AB

Research/Teaching Assistant, Water Resources Engineering (1990 to 1992)

Stanley Associates Engineering Ltd. – Edmonton, AB

Hydrotechnical Engineer (1990 to 1990)

PROJECT EXPERIENCE – NORTHERN MINING

Giant Mine Remediation Project
Yellowknife, NT, Canada

Component lead for surface drainage and Baker Creek components of this mine closure and remediation project. Prepared preliminary design reports for the two components, including preliminary engineering designs and Class B cost estimates suitable for presentation to the Treasury Board of Canada for funding applications. Participated in public hearings for the project in support of the DAR. Subsequently led investigations in support of advanced project design while participating in the Surface Design Engagement with regulators and stakeholders. Lead author of Baker Creek and surface drainage section of Closure and Reclamation Plan in support of the project water licence.

Faro Mine Remediation Project
YT, Canada

Project director for development of the Project Proposal (Environmental Assessment) of the Faro Mine Remediation Project. The work entails working with the mine closure design team to identify valued ecological components, develop appropriate mitigation measures and prepare a submission to the Yukon Environmental and Socio-economic Assessment Board (YESAB). Also served as senior reviewer for hydrology component of the project proposal.

Dominion Diamond Ekati – Jay Project
Lac de Gras, NT, Canada

Directed and senior reviewed baseline hydrology studies for this new pit development, including an intensive first baseline on the Lac du Sauvage watershed. Directed and senior reviewed the hydrology section of the Developer's Assessment Report and participated in public information and technical sessions. Later contributed to development of the Aquatic Effects Monitoring Program and served as senior reviewer of post-EA hydrometric monitoring programs.

De Beers Canada Gahcho Kué Diamond Project
Kennady Lake, NT, Canada

Responsible for the hydrology components of the Environmental Impact Statement, water licence application and construction/operational monitoring and regulatory advice for a diamond mine located east of Yellowknife. Tasks included baseline data collection and preparation and submission of a baseline hydrology report and Environmental Impact Statement for submission to the Wek'èezhìi Land and Water Board, as well as federal regulatory agencies

Agnico Eagle Meliadine Gold Project
Rankin Inlet, NU, Canada

Senior reviewer for baseline hydrology and hydrometeorology studies for this project. Managed an annual hydrometric program and completion of the climate and hydrology components of an aquatic baseline synthesis report, including historical data and hydrological modeling to characterize long-term baseline conditions. Contributed to a draft environmental impact statement to the Nunavut Impact Review Board. Performed site reconnaissances of potential fisheries offsetting plans, and served as a senior advisor for development of a mine water management plan.

Dominion Diamond Ekati – Lynx Project
Lac de Gras and Lutselk'e, NT, Canada

Senior reviewer for baseline hydrology and associated components of water licensing for the Lynx expansion at the Ekati Project. Provided regulatory input for the Lynx Pit water licence and responsible for baseline study and participated in technical sessions with stakeholders and regulators. Responsible for working with project fisheries biologists to develop fish passage remediation works on Pike Creek, near Lutsel K'e, to serve as fisheries offsetting for the Lynx project. This included site visits and consultation with the Lutsel K'e Dene First Nation.

De Beers Snap Lake Project Snap Lake, NT, Canada	Managed the baseline hydrology study, including acquisition and processing of local snowpack, stream discharge and water level data. Later participated in various water management activities, including developing and operational water management plan and downstream flow model.
Miramar Doris North Project West Kitikmeot, NU, Canada	Responsible for the hydrology components of the Environmental Impact Statement for a proposed gold mine on the Hope Bay Belt. This included an assessment of effects on a local lake due to withdrawals for water supply, development of a hydrological design basis for a fisheries compensation (No Net Loss) plan, and provision of input data for a tailings facility water balance. Done in conjunction with supplemental climate and hydrology data collection.
Sabina Back River Project Back River, NU, Canada	Managed the installation and operation of one continuous and two manual stream discharge and lake level monitoring stations at the Dundee Precious Metals George and Goose (Back River) Project. Later responsible for senior review of a hydrology field program and development of a hydrological model for the site to provide a basis for fish habitat mitigation.
PWGSC Tundra Mine Remediation Mackay Lake, NT, Canada	Component lead for hydrological modeling at the Tundra Mine site, for a remediation project funded by Public Works and Government Services Canada. Developed a water balance model to evaluate the effects of remediation alternatives and design parameters on refilling duration and water yields in an evaporation-dominated, subarctic environment. Later served as senior reviewer for post-remediation hydrological monitoring program.
Diavik Diamond Project Lac de Gras, NT, Canada	Project engineer responsible for developing a water balance model, calibrated to baseline site hydrological conditions, to quantify changes to Lac de Gras caused by the Diavik Diamond Mine. Conducted an impact analysis to quantify the incremental hydrologic impacts of the Diavik Diamond Mine project and the cumulative impacts of the Diavik and BHP projects. Analyzed climatic, snow survey and local stream gauging data to determine snowmelt and seasonal runoff coefficients from small watersheds on the east island and adjacent mainland in the Lac de Gras basin.
Fortune Minerals NICO Project Whatì, NT, Canada	Senior reviewer for the erosion and sediment control plans for this Gold-Cobalt-Bismuth-Copper mine. Contributed to the surface water related components of the water licence application. Senior reviewer for hydrological monitoring program.
Agnico Eagle Meadowbank Project Kivalliq, NU, Canada	Senior reviewer for design of site water management infrastructure. Project components included a mine surface water management plan and a submerged diffuser-style wastewater outfall. Design documents were used to support a Type A Water License application to the Nunavut Water Board. Senior reviewer for fish habitat compensation works design, developed to compensate for mine and access road development. Compensation measures included submerged reef structures in a lake environment and spawning riffles in an arctic river. Senior reviewer for hydrology and water balance studies for the Whale Tail expansion.
Areva Kiggavik Project Kivalliq Region, NU, Canada	Senior reviewer for the hydrology baseline study at the proposed Areva Kiggavik uranium mine project, located in western Nunavut.

PROJECT EXPERIENCE – OTHER NORTHERN PROJECTS

GNWT Sahtu Region, NT, Canada	Project director and senior reviewer for a surface water and groundwater baseline study of the Central Mackenzie Valley in the Sahtu region. The project involved an intensive review of scientific and traditional knowledge, including a field camp to validate findings with local First Nations.
GNWT Liard River Basin, NT, Canada	Project director and senior reviewer development of a Learning Plan for the Liard-Petitot River system in Yukon, British Columbia, Alberta and the Northwest Territories. The project involved an intensive review and synthesis of scientific and traditional knowledge.
GNWT Mackenzie Valley, NT, Canada	Project director and senior reviewer for hydrotechnical assessments of 17 culverts on Highways 1, 3, 5 and 7. These included hydrology, hydraulic modelling and sizing recommendations for replacement.
GNWT Hill Creek, NT, Canada	Project director and senior reviewer for fish passage remediation of an existing culvert at Hill Creek, approximately 70 km west of Yellowknife. The work included a feasibility assessment, hydrological assessment, hydraulic modelling, detailed design, construction supervision and post-construction monitoring.
GNWT Mackenzie Valley, NT, Canada	Project director and senior reviewer for development of erosion and sediment control plans for proposed Mackenzie Valley Winter Road crossings of Bob's Canyon and Strawberry Creek.
GNWT Sahtu Region, NT, Canada	Provided hydrological data collection and analysis for eighteen watercourses along the Mackenzie Valley Winter Road to assess their viability for winter water supply. These watercourses are regulated by the Mackenzie Valley Water Board and Fisheries and Oceans Canada to prevent harm to aquatic life. The study considered site-specific data collected for the project and for previous studies, including the Mackenzie Gas Project (2002-2004) and Arctic Gas Project (1972-73), as well as long-term regional data collected by Environment Canada.
Northwest Territories Power Corporation Prosperous Lake, NT, Canada	Developed erosion and sediment control plans for construction of a new dam and removal of the existing dam at the Bluefish Hydro project on the Yellowknife River, north of Yellowknife. The plan was submitted to regulatory authorities as part of the approval process and updated throughout construction. Provided expert advice for post-construction hydrological monitoring.
Jivko Engineering Fort Providence, NT, Canada	Hydrology component lead for environmental impact assessment, including study of effects of ferry crossing decommissioning on sediment deposition into the Mackenzie River and effects of bridge pier and approach causeway construction on physical habitat characteristics.
Timberworks Road Impact Assessment South Slave, NT, Canada	Senior reviewer for hydrological assessment of a proposed forestry road network located in the South Slave region of the Northwest Territories. The assessment was based on the 20-year harvest plan for the area, and fed into an assessment of potential wildlife impacts.
DFO Nulahugyuk Creek Fish Study Bernard Harbour, NU, Canada	Undertook a field reconnaissance and provided hydrology and geomorphology input to a study of an Arctic stream, to determine reasons why the historic Arctic char spawning run has not occurred in recent years and to develop remedial measures.

Anadarko Liard Pipeline Project Liard Region, NT, Canada	Project manager for hydrology component of the project. Tasks included a field reconnaissance to identify stream crossing locations, field program to measure geomorphologic data, regional hydrology study and design of pipeline sagbend and burial depths.
Mackenzie River Ice Breakup Study Fort Providence, NT, Canada	Observed and collected field data during the period of ice breakup to be used in a study to identify factors influencing the date of river breakup. Relevant data included river stage, ice characteristics and water temperatures.
Hodgson Creek Bridge Hydrotechnical Wrigley, NT, Canada	Project director and senior reviewer for a bridge hydrotechnical study (preliminary engineering design) for a relocated crossing of Hodgson Creek at Wrigley. The project involved preliminary desktop studies and a field program (completed) followed by preliminary design of the bridge and highway alignment based on site hydrology, topography and hydraulic modelling (pending).
Northwest Territories Power Corporation Jackfish Lake, NT, Canada	Project director and senior reviewer for hydrological component of the Jackfish Lake 2018 environmental monitoring program, intended to provide a basis for a water licence renewal application.
Lake Geraldine Water Balance Study Iqaluit, NU, Canada	Provided senior technical advice into the approach and methods for this study, which examined water supply alternatives for the City of Iqaluit at Lake Geraldine.
Char River Water Balance Study Rankin Inlet, NU, Canada	Project director and senior reviewer for a hydrological and water balance study of the Char River, Nipissar Lake and Lower Landing Lake at Rankin Inlet. The study included data review and compilation, field investigations of the three waterbodies, water balance analyses incorporating potential climate change scenarios, and development of a water supply forecasting tool to facilitate selection of appropriate mitigation measures.
GNWT Tlicho All Season Road Permitting Whati, NT, Canada	Project director and senior reviewer for hydrological component of the post-Environmental Assessment permitting support for the Tlicho All Season Road.
Meldon Developments Whitehorse, YT, Canada	Project manager for a hydrological assessment of a proposed RV storage facility in the City of Whitehorse. The assessment included a literature review, site reconnaissance and drainage modelling to identify sensitivities of adjacent properties and waterbodies to development.
Yukon Government Whitehorse, YT, Canada	Senior advisor/reviewer for a terrain assessment of a proposed development in the City of Whitehorse. The assessment was intended to determine whether previous characterization of the property as a fen wetland was accurate.

AECOM

Rudy Schmidtke, M.Sc., P.Eng.

Regional Practice Lead, Remediation and Geosciences

Education

M.Sc., Civil Engineering, University of Manitoba, 1986

B.Sc., Geological Engineering, University of Manitoba, 1983

Years of Experience

With AECOM: 33
With Other Firms: 0

Professional Affiliations

Association of Professional Engineers and Geoscientists of British Columbia

Association of Professional Engineers and Geoscientists of Alberta

Association of Professional Engineers and Geoscientists of Northwest Territories and Nunavut

Association of Professional Engineers of Yukon

Association of Professional Engineers and Geoscientists of Saskatchewan

Association of Professional Engineers and Geoscientists of Manitoba

Summary

Mr. Rudy Schmidtke is the Remediation and Geosciences Practice Leader for AECOM's environmental business line in Canada. Rudy is responsible for managing a staff of over 150 people, overseeing budgets, coordination, scheduling and resource management. Rudy's engineering background includes geotechnical engineering, geology, and mining. He has established himself as an effective leader, providing a high level of service and exercising open and honest communication.

Rudy has been a key member on multidisciplinary teams in delivering the remediation of many military projects in the Arctic and mining projects in the Arctic and Canada over his 33 years with AECOM. He has served as senior project manager and technical advisor on such projects as: preliminary design for the remediation of Giant Mine, design and specification preparation for the Great Bear Lake Mine properties remediation on Great Bear Lake, project principal for resident and quality assurance services for the Colomac Mine and Tundra Mine closure, Discovery Mine borrow pit outflow channel, and project principal for resident and quality assurance services for the FOX C - Ekalugad Fiord Intermediate DEW Line site remediation. Rudy is currently the senior project manager for the design of remedial activities at the Giant Mine in Yellowknife, NWT.

He has also participated as senior technical reviewer for landfill remedial design and specifications for civil and mining projects in the prairie provinces, the Yukon and the Northwest Territories.

Project Experience

Oil/Gas

West Ells Access Road – Chevron Canada Resources. Senior geotechnical lead for the selection and evaluation of several access road alignments including identification of water crossings, borrow and environmental constraints in the Fort McMurray area. A terrain analysis was completed for each option and typical road sections were developed for each terrain unit identified. Conceptual material quantities and infrastructure designs were developed for cost estimating to determine preferred alignments for further assessment.

MacKay River SAGD Commercial Project Plant Site – MacKay Operating Corporation. Project director and senior technical review responsibilities for the development of the plant site. The scope of work included: geotechnical investigations, evaluation of muskeg characteristics preliminary and detailed grading design for the central plant, infield well pads and roads, main access road and resident engineering including QA/QC support during construction. In addition, well pad settlement was estimated and reviewed with the drilling companies to optimize performance pad performance.

Hangingstone SAGD Development – Athabasca Oil Corporation. Project director and senior technical review responsibilities for the preparation of engineering design specifications and construction packages for the main access road from Highway 63 to the plant site, plant site, camp site, well pads and infield roads.

MacKay River SAGD North-South Artery – MacKay Operating Corporation. Project director and senior technical review responsibilities for 10 km of all-weather road from the pilot plant to the Southern Pacific access road. The scope of work included: borrow material assessment, resident engineering including QA and spot QC checks, reporting on work progress, responding to RFIs and monitoring the contractor compliance with design and erosion control plan.

Dover North SAGD Commercial Project North Access Road – Brion Energy Corporation. Project director and senior technical review responsibilities for the geotechnical investigation and design of 100 km roadway. Given the short timeframe to complete the work, obtaining regulatory approvals could not be done. A very low impact geotechnical investigation was conducted to meet project objectives and provide sufficient information for bid purposes. The scope of work included engineering design for the central plant grading, infield roads and the main access road, route selection, bridge and bridge culvert design and technical specification preparation.

Birch SAGD Access Road Project – Athabasca Oil Corporation. Project director and senior technical review responsibilities for the development of a 33 km long access road. The scope of work included: geotechnical investigations, borrow identification, water and pipeline crossing design, detailed road and structure design and preparation of technical specifications.

Telephone Lake SAGD Project Access Road – Cenovus Energy Inc. Project director and senior technical review responsibilities for detailed engineering services of the 46 km long all weather main access road. The scope of work included: review of road alignment, development of road sections over muskeg terrain, detailed engineering of the road and civil infrastructure, preparation of technical specifications and bid support. The use of geogrid and limestone aggregate was incorporated into the design to improve performance over muskeg terrain and use local aggregate resources to reduce cost.

Canadian Natural Resources Ltd., Project Horizon. Project team member to provide design basis memorandum (DBM) level cost estimates for the on-site and off-site development of Project Horizon. Activities include review of subsurface conditions at the water intake, recycle and raw water ponds, utility corridor, and airstrip.

Athabasca Northern Railway, OPTI Nexen's Long Lake, Alberta. Completed a route location study for the proposed rail line to access OPTI Nexen's Long Lake project. Aerial photograph interpretation techniques were used to identify several routes. The selected routes were traversed and investigated and the most cost-effective route was selected based on capital and maintenance costs.

Public Works and Government Services Canada (PWGSC), Giant Mine Remediation Preliminary Design, Site Stabilization and Environmental Assessment Support, NWT. Project Principal and Contract Integration Manager for remedial activities including tailings rehabilitation, contaminated soils, borrow sources, water treatment, surface water management, underground, Highway 4 re-alignment, demolition and debris, open pits, mine openings to surface, and the arsenic chamber/stope freeze program and construction cost estimate. In addition, support is provided for risk assessment, project scheduling/work package linkage identification, cost estimating, strategic planning, environmental assessment coordination, procurement planning and value engineering and option analysis. In his role as principal, Rudy was responsible for sub-consultant management resource planning, meeting chair, monitoring of service quality and deliverables. He was also the first point of contact for all task authorizations and financial control and reporting. Rudy provided support during the environmental assessment and participated in technical sessions and public information sessions, and public hearings as part of the MVLWB review process. In addition, Rudy provided technical expertise during the surface design engagement process conducted in 2015 and 2016.

PWGSC, Colomac Mine Remediation Project, NWT. Project Manager and Senior Technical Engineer for design and tender document preparation for remedial activities including shoreline and stream restoration demolition, hydrocarbon excavation and treatment, landfill construction, disposal cell cover and site grading. In addition, provided resident engineering services to relieve staff. Acted as project principal for the management of petroleum hydrocarbon in fractured bedrock and was a member of the Colomac Advisory Committee during remediation.

PWGSC, Great Bear Lake Mine Properties, Closure Plan, NWT. Project Manager for the preparation of remedial design, specifications and cost estimate for the closure of nine mine sites on Great Bear Lake for PWGSC.

PWGSC, Venus Mine Remediation Yukon Region. Provided senior technical review for the development of the design and technical specifications for debris clean-up, mine opening closure and demolition of mine infrastructure. Professionally sealed the issued for construction drawings and provided senior technical support during construction.

PWGSC, Tundra Mine Remediation. Project Principal for site remediation resident, contract management, and quality assurance services including bituminous liner tailings cover, contaminated soil excavation and treatment and water treatment. Responsible for identification and assignment of resources. Completed design reviews and professionally sealed the issued for construction drawings. Participated in the review of the Tundra Mine project with the Independent Peer Review Panel for all aspects of mine closure.

Site Remediation

Great Bear Lake Mine Properties – Closure Plan – Public Works and Government Services Canada.
Project manager for the preparation of remedial design, specifications and cost estimate for the closure of nine mine sites on Great Bear Lake for PWGSC.

Giant Mine Remediation Preliminary Design and Environmental Assessment Support, PWGSC. (July 2009 to present).
Senior project manager for remedial activities including tailings rehabilitation, contaminated soils, borrow sources, water treatment, surface water management, underground, Highway 4 re-alignment, demolition and debris, open pits, mine openings to surface, and the arsenic chamber/stope freeze program and construction cost estimate. In addition, support is provided for risk assessment, project scheduling/work package linkage identification, cost estimating, strategic planning, environmental assessment coordination, procurement planning and value engineering and option analysis. In his role as senior project manager, Rudy was responsible for sub-consultant management resource planning, meeting chair, monitoring of service quality and deliverables. He was also the first point of contact for all task authorizations and financial control and reporting. Rudy provided support during the environmental assessment and participated in technical sessions and public information sessions, and public hearings as part of the MVLWB review process.

Giant Mine Data Gap Identification and Analysis – Public Works and Government Services Canada.
Project Manager and Senior Engineer. The main objective of this project is to collect and review existing reports, list and summarize existing site information, and provide a data gap identification and analysis report. This is an extremely important work task that will build the foundation for the Giant Mine Implementation Plan for the closure of the Giant Mine site in Yellowknife, NWT. A work plan was developed based on assumptions of the time required to complete this work. A large amount of information was reviewed and compiled in a systematic manner.

Colomac Mine Remediation Project – Public Works and Government Services Canada.
Project manager and senior technical engineer for remedial activities including shoreline and stream restoration demolition, hydrocarbon excavation and treatment, landfill construction, disposal cell cover and site grading.

Yukon Region, Abandoned Mine Site Assessment – Indian and Northern Affairs Canada.
Update of Phase II Site Assessments and Remedial Option Development. The site assessment work included a site reconnaissance to review the statues of physical/chemical hazards and issues of environmental concern at the abandoned Hayes, Kalzas Twins, Samovar, Tinta Hill and Casino mine sites. The main objective was to document changes since assessments that were conducted in 1996, develop remedial options for site infrastructure, ARD, trench/adit, open pits, waste rock piles and hazardous materials, and prepare Class C cost estimates for site remediation.

Venus Mine Remediation Yukon Region - Public Works and Government Services Canada.
Provided senior technical review for the development of the technical specifications for debris clean-up, mine opening closure and demolition.

FOX-C, Ekalugad Fiord Site Remediation Monitoring Services – Public Works and Government Services Canada.
Project manager and site resident relief engineer for the construction of remedial works at the former FOX-C intermediate DEW Line site. Key duties include: Conformance to the statement of work; update and control engineering costs; and preparation of task authorizations for engineering services under potential additional work. Other services provided on site included identification of additional borrow areas, review of PCB amended paint on asbestos material, design modifications as required and participation in contractor safety meeting.

Mining

Colomac Mine, NWT – Public Works and Government Services Canada.
Completed the cost estimate for the annual care and maintenance program. Assisted with identifying the risks associated with the scope, site conditions, external resources, and government. Also assisted with the implementation plan to support future mine remedial activities.

Tundra Mine Remediation – Public Works and Government Services Canada.
Project principal for site remediation resident and contract services including bituminous liner tailings cover, contaminated soil excavation and treatment and water treatment.

Jericho Mine Project – Indian and Northern Affairs Canada.
Participated in the review of the Final Environmental Impact Statement for the Jericho Project by the Tahera Corporation (now Tahera Diamond Corporation) for the Government of Nunavut. Responsibilities included the review and provision of comments on the hydrogeology and tailings management.

Engineering Geology

Athabasca Northern Railway.
Completed a route location study for the proposed rail line to access OPTI Nexen's Long Lake Project. Aerial photograph interpretation techniques were used to identify several routes. The selected routes were traversed and investigated and the most cost effective route was selected based on capital and maintenance costs.

Canadian National Railway.
Managed and provided technical assistance for railway grade stabilization in mountainous terrain as a result of washouts, slope failures, and rock falls. Stabilization measures including shot tie-back retaining walls, stabilization berms, horizontal and trench drains, riprap erosion protection and environmental habitat, restoration and creation have been implemented on the BC south line between Jasper and Vancouver and the north line between Jasper and Prince Rupert.

Canadian National Railway.
Currently manages the production of railway ballast and riprap at four quarries in BC. Activities include quality control, quantity surveys, and development plans.

Syncrude Canada Ltd.
Completed preliminary cost estimates for pipeline construction and road upgrading based on typical cross-sections for various terrain units.

Boise Cascade.
Completed the siting and field verification of 300 km of logging road and an airstrip in north-western Ontario. Ground truthing was also completed to verify the interpreted terrain units.

Athabasca Northern Railway.
Completed a terrain assessment, route location and preliminary cost estimate for the development of a rail line extension from Lytton across the Athabasca River west of Fort McMurray. Typical cross-sections were developed over various terrain units and unit costs applied.

Meadow Lake OSB Inc.
Completed the test pitting program and assisted with the development of an interceptor/dewatering system for a 10 metre deep excavation at the OSB Plant in Meadow Lake. An innovative approach using a sand interceptor ring around the excavation was implemented instead of conventional dewatering wells as proposed by others.

Department of National Defence.
Team leader for site investigations at three DEW Line sites in the Canadian Arctic. Project Engineer for the design of remedial strategies for site clean-up. In addition, provided construction support to the DND site inspector at the BAR-4 Nicholson Peninsula site.

Completed the route selection of approximately 350 kilometres of timber haul road and identified potential borrow sources for road construction in north-western Ontario using aerial photograph interpretation techniques. Each route was field located and terrain conditions verified.

Tyndall Stone.
Evaluated the quality and quantity of dolomitic limestone at several locations in the Garson, Manitoba area. The evaluation consisted of a diamond drilling program and physical testing of drill core including uniaxial compressive and Brazilian (splitting) strength testing according to ASTM procedures.

CP Rail's Dyment Ballast Quarry.
Investigated geological and hydrogeological conditions near Dryden, Ontario. Main activities included detailed geologic mapping of the exposed quarry walls and outcrop within the limits of the quarry lease, NQ size diamond drilling to explore lithology, stratigraphy, determination of insitu rock permeability using a double packer system, and installation of piezometers.

CP Rail's Dyment Ballast Quarry.
Produced development plans for excavation or rock. The site plans were developed which detailed mining blocks, product quantities and quarry operational aspects including layout, stockpile location and loading of ballast and reject.

Atomic Energy of Canada.
Performed mechanical tests including uniaxial compressive strength, tensile strength, Brazilian and static fatigue on crystalline and carbonate rocks as part of research work.

Performed evaluation and ASTM testing of several potential granite building stone sites in southern Manitoba.

Canadian National Railways.
Completed geologic assessments at the CN Watacomb and CN Payuk ballast quarries.

City of Winnipeg.
Supervised the collection and completed petrographic examinations of concrete cores from the Shoal Lake Aqueduct rehabilitation assessment.

Conducted an assessment of dolomite and limestone for use as concrete aggregate.

Engineering Geophysics

Conducted an electromagnetic survey (EM31) at three potential lagoon sites on a northern Indian reserve to determine overburden thickness and permafrost areas.

Completed a hammer seismic and electromagnetic (EM34) survey to define a potential tailings disposal site. Overburden thickness within the potential tailings basin and beneath the proposed dyke centreline was determined.

Conducted an electromagnetic survey (EM34) to determine the overburden thickness as a potential hazardous waste disposal site and to direct and reconnaissance drilling program.

Completed a hammer seismic survey to determine the depth of bedrock beneath a proposed residential development. The bedrock surface was relatively shallow and would result in costly underground service excavations.

Hydrogeology

Canadian Natural Resources Ltd.
Currently part of the project team to provide design basis memorandum level cost estimates for the on-site and off-site development of Project Horizon. Activities include the review of subsurface conditions at the water intake, recycle and raw water ponds, utility corridor and airstrip.

Atomic Energy of Canada.
Conducted hydrogeologic investigations in the Atikokan, Ontario area. The project included diamond drill rig supervision, core logging, multi-level piezometer installation and groundwater sampling.

Lagoon Expansion Site, Eastern Manitoba.
Assessment of hydrogeological conditions at a lagoon expansion site. Recommendations to position the lagoon floor elevation were made to prevent lagoon floor instability because of excessive upward groundwater pressure.

Inco.
Reviewed existing information and developed a piezometer installation program to investigate the suspected high groundwater levels beneath hot metal areas in the Inco complex in Sudbury, Ontario.

Oak Hammock Marsh.
Conducted groundwater investigations for a fire protection water supply for a proposed building in the Oak Hammock Marsh area.

Completed review of existing data and subsequent groundwater exploration program to determine the potential of the underlying confined sandstone aquifer to supply a domestic water supply for a proposed resort complex.

Pine Ridge Golf Club.
Investigated soil and groundwater conditions beneath the soft and wet eighth fairway. Recommendations were made to improve the ground stability.

Landfill Expansion, Winnipeg.
Evaluated the hydrogeologic conditions for a major landfill expansion in Winnipeg. Test drilling and piezometer installations were completed to define the stratigraphy, and horizontal and vertical groundwater gradients.

Soil and Groundwater Remedial Investigations

Completed remedial investigations around a diesel fuel tank farm in Tuktoyaktuk to determine the lateral and vertical extent of diesel fuel affected soil. Hand-augered test holes and small diameter monitoring wells were installed to characterize soil and groundwater conditions at the site.

Environmental Assessment at Four Former U.S. Military Camps in the Yukon Territory.
The environmental assessment included the identification of contaminants through the collection and analysis of soil and surface water samples, an evaluation of the potential for contaminant migration, a qualitative assessment of health and environmental risks and the recommendation for additional detailed assessment or remediation at each site.

Mathias Colomb First Nation.
Investigated diesel fuel contamination in soil on Mathias Colomb First Nation land. Screening of soil samples with a photoionization detector provided direction for the drilling and soil sampling program to define the magnitude and extent of contamination.

Conducted a hydrogeological study at a former landfill site at an abandoned radar base in Saskatchewan. The study was completed to characterize the site hydrogeology and to identify if any soil or groundwater had been affected because of the landfilling operations.

Conducted the site selection, design and preparation of technical specifications to construct and operate a landfarm facility in northern Manitoba to treat petroleum hydrocarbon-contaminated soil.

Completed and managed subsurface investigations (Phase II) to delineate soil contamination and monitor the excavation of the contaminated soil at several industrial plants and (leaky) underground storage tank sites. Qualitative risk assessment/site sensitivity analyses were conducted in support of remediation recommendations.

Conducted remedial investigations to delineate petroleum hydrocarbon contamination in the soil and groundwater resulting from the burning of hydrocarbons as part of fire fighting training exercises at the former CFS – Alaska.

Manitoba Hazardous Waste Management Corporation.
Participated in the development and implementation of a baseline/construction environmental monitoring program at the Montcalm site. The monitoring program established background levels of selected environmental media. Environmental media included air, soil, snow, groundwater, surface water, agricultural products and biota.

Winnipeg Landfill.
Developed and completed a drilling and sampling program involving angled drill holes to investigate the potential migration of wastes detonated in trenches at the special waste area at a landfill in Winnipeg. Representative soil and porewater samples were collected and analyzed to confirm or deny the presence of contamination.

Completed hydrogeological investigations within a proposed truck route, which bordered a former creosote plant. Horizontal and vertical hydraulic gradients were determined from water level measurements in the installed piezometers. Slug tests were also conducted in the piezometers to determine the insitu hydraulic conductivity of the soil. Polynuclear aromatic hydrocarbon analyses were performed on the collected soil and groundwater samples.

Completed the sampling of groundwater and assessment of water quality data for the monitoring well network surrounding a tailings management area in northern Manitoba. The sampling and data assessment has continued since 1984.

Education

B. Sc. Environmental Science (Chemistry), University of Calgary, 2000

Calgary

Associate, Senior Water Quality Specialist

Tasha is an Associate, Senior Water Quality Specialist with Golder Associates in their Calgary office and has over 18 years of experience in water quality assessment. The majority of Tasha's work since joining Golder has involved water quality assessments for mining projects and working with public sector groups in the Northwest Territories and Alberta to set locally relevant water quality objectives and discharge limits. Tasha specializes in developing effluent quality criteria and water licence components for active and proposed developments. Tasha has worked as a technical director, component lead, and senior technical advisor for projects involving the design and execution of environmental baseline and aquatic effects monitoring programs, environmental impact assessments, regulatory risk management, model verification, spill response, and development of discharge limits for municipal and industrial water licence applications.

Employment History

Golder Associates Ltd. – Calgary, Alberta

Water Quality Specialist (2001 to Present)

Responsible for water quality baseline and environmental impact assessments, water quality assessments using model-based approaches, discharge limit development, project management, providing expert advice on regulatory applications (i.e., technical sessions and public hearings) and report preparation and presentation.

University of Calgary – Calgary, Alberta

Research Positions (1997 to 2000)

Environmental Engineering - Determination of hydrocarbon substrate utilization coefficients, nutrient uptake, and growth rates for bacterial cultures capable of degrading Alberta sweet mix crude oil.

Geology - Assisted with groundwater sampling and monitoring program to determine the effects of continuous manure application on agricultural land near Lethbridge, AB.

Chemistry - Investigation of interactions between the amino acid tryptophan and the anaesthetic dibucaine using fluorescence resonance energy transfer.

Ecology - Comparison of pre- and post-season pheromones using gas chromatography analysis, fieldwork in forest areas, maintenance of pheromone traps, and collection of data.

PROJECT EXPERIENCE – ENVIRONMENTAL BASELINE STUDIES AND ENVIRONMENTAL MONITORING

Snap Lake Aquatic Effects Monitoring Program (AEMP)
Northwest Territories, Canada

Baseline monitoring began in 1999 prior to permitting and construction for the Mine. Once discharge began in 2004, a multi-disciplinary monitoring program began to assess changes in Snap Lake due to project-related activities. Tasha prepared the baseline water quality report and has provided on-going water quality support to the Snap Lake AEMP in terms of design of the field program, data analyses, field work coordination, statistical and trend analysis and technical review. The Mine went into Care and Maintenance in 2015. Tasha oversaw the re-design of the water quality monitoring program reflecting the change in Mine status.

Tundra Mine
Northwest Territories, Canada

Senior reviewer and technical oversight for the water quality portion of the Surveillance Network Program, as well as monthly and annual water quality assessments. Golder used EQuIS database software for water quality data management for this project (surface water, seepage, groundwater). Water quality data were validated using a multi-step process, tabulated and graphed. Data were analyzed for seasonal and annual trends, including comparison to applicable Canadian water quality guidelines for protection of aquatic life.

Terra X Minerals Inc.
Northwest Territories, Canada

Senior advisor for the 2016 sampling program to establish open water and ice-cover baseline conditions in target zones lakes near the exploration camp. At each site, a water quality sample and corresponding water quality profile was collected according to Golder Technical Procedures, based on approved Environment Canada methods.

Giant Mine - Baker Creek Overflow Monitoring Program
Northwest Territories, Canada

The Baker Creek overflow monitoring program characterized water and sediment quality at various locations in Baker Creek and Yellowknife Bay during and after an overflow event where the creek was diverted through a historic tailings storage area as a result of icing in the upper reach. It resulted in re-suspension and transport of tailings impacted sediments through lower Baker Creek to Yellowknife Bay. Water quality data were evaluated by comparing concentrations with water quality guidelines for the protection of aquatic life and human health, and to the limits outlined in the Metal Mining Effluent Regulations (MMER). Tasha provided senior guidance and review on the data assessment and reporting.

Shell Jackpine Mine
Alberta, Canada

Responsible for the organization and completion of the environmental baseline study completed for Shell Canada Limited's Jackpine Mine - Phase 1. Also involved in the preparation of the water quality component of the environmental impact assessment. Assisted in the implementation of the Hydrological Simulation Program - Fortran (HSPF) model to determine effects of Shell Canada Limited's Jackpine Mine - Phase 1 on small streams in the Muskeg River watershed.

Regional Aquatics Monitoring Program (RAMP) Alberta, Canada	Member of a multi-disciplinary team monitoring the effects of oil sands development in the Athabasca River watershed. Responsibilities included the execution of the water and sediment monitoring program, data analysis and preparation of annual reports and budgets. This work includes the RAMP Five-Year summary report which required detailed statistical and trend analyses.
Suncor Project Millennium Alberta, Canada	Data analysis and interpretation of water quality information collected from Shipyard Lake and McLean Creek diversion, as part of fish habitat compensation and monitoring activities as specified in the Fisheries and Oceans Canada (DFO) Fisheries Act Authorization No. AB97-051-2 for Project Millennium.
Special Areas Water Supply Project Alberta, Canada	Developed a surface runoff monitoring program and follow-up charting tool using Microsoft Excel and Visual Basic Programming. On-going monitoring information is stored within this tool, which conveniently automates charting, guideline comparisons, and summary statistics.
Suncor South Tailings Pond Project Alberta, Canada	Involved in the organization and completion of the environmental baseline study completed for Suncor's South Tailings Pond Project.

PROJECT EXPERIENCE – DEVELOPING DISCHARGE LIMITS AND WATER QUALITY OBJECTIVES

Giant Mine Northwest Territories, Canada	During remediation at Giant Mine, mine groundwater, infiltration and tailings runoff will be collected and directed to a new water treatment plant prior to discharge to Yellowknife Bay. Treated water will be discharged through a proposed effluent outfall, the location of which will be determined through design analysis and public consultation. Tasha guided a team that is deriving effluent quality criteria (EQC) for the new Water Treatment Plant.
Con Mine Northwest Territories, Canada	Technical advisor to the aquatics team, related to development of an EQC package, design of a short-term threshold for chloride, delineating a mixing zone boundary, and aligning applicable monitoring programs (i.e., SNP, AEMP, MMER).
Snap Lake Mine Northwest Territories, Canada	Responsible for guiding the development of (EQC) for the Snap Lake Mine. Project involved identifying parameters of potential concern for which EQC should be developed, defining site-specific water quality objectives for Snap Lake for the parameters of potential concern, deriving water quality-based EQC, producing a study report documenting the water-quality based EQC, along with recommendations with respect to their implementation, responding to information requests from stakeholders, and appearing at a public hearing as an expert witness to present the study findings.
Dominion Diamond Resources Corporation - Jay Project Northwest Territories, Canada	Developed EQC that can be achieved and are protective of water uses in the receiving environment. This work was completed as part of the application for an operational Water Licence. Tasha provided senior technical guidance on focused water quality modelling, benchmarks and COPC(s) selection, delineation of mixing zone boundaries, back-calculation of effluent limits based on dilution factors and assimilative capacity in Lac du Sauvage under various conditions.

Gahcho Kué Project
Northwest Territories, Canada

As above. Developed effluent quality criteria for consideration during the water licence permitting phase in 2013/2014. Responded to information requests, and presented technical material and multi-stakeholder sessions.

Battle River
Alberta, Canada

Assisted AENV in developing reach-specific water quality objectives for identified reaches in the Battle River in 2011. Golder worked with AENV and an Advisory Committee to define the overall approach for setting objectives and work through the process of setting objectives for a sub-set of water quality indicators.

PROJECT EXPERIENCE – WATER QUALITY MODELLING AND ASSESSMENT

Giant Mine – Outfall Modelling
Northwest Territories, Canada

Treated water will be discharged through a proposed effluent outfall, the location of which will be determined through design analysis and public consultation. Tasha guided a modelling team that derived near-field mixing estimates for several potential outfall locations, and anticipated dilution factors achieved at various distances from the outfall

Capital Power Corporation – Wastewater Minimization Study
Alberta, Canada

Project Director for the Wastewater Minimization Study in support of the Capital Power Corporation's Environmental Protection and Enhancement Act (EPEA) Approval requirements for the Genesee Generating Station. The study included compiling data and characterizing waste minimization options, completing water quality modelling for the cooling pond makeup and blowdown waters, and calculating the resulting changes in water quality concentrations downstream in the North Saskatchewan River.

City of Calgary Bow River Impact Study
Alberta, Canada

Member of the project team devoted to the water quality modelling study that characterized existing and future conditions in the Bow River, downstream of the City of Calgary. Project involved implementing a water quality model capable of representing the complex aquatic plant - nutrient - dissolved oxygen interactions that occur in the Bow River within and downstream of the City of Calgary.

Town of Drayton Valley WTP Impact Study
Alberta, Canada

Project manager for an impact study on the North Saskatchewan River. Assessed the potential impact of the Town of Drayton Valley's water treatment plant effluent on water quality in the river. Tasks included field coordination, communication with the Town, data analysis and interpretation, completing a dilution factor analysis and reporting results.

Alberta Infrastructure
Alberta, Canada

Assessment of dissolved oxygen and ammonia concentrations in the tailwaters of the Little Bow Reservoir. Assisted in making recommendations regarding possible improvements in ammonia concentrations due to a revised diversion plan. Used a steady-state stream water quality model (Qual2E) to predict changes in ammonia concentrations with distance downstream of the Little Bow Reservoir.

Keephills/Sundance Thermal Power Plants
Alberta, Canada

Used a mass balance approach to predict water quality in TransAlta's Keephills cooling pond during various development scenarios and assessed impacts of cooling pond discharge to the North Saskatchewan River.

Burnco Industrial Pit Closure Plans
Alberta, Canada

The impacts of closure options for a gravel extraction operation were evaluated using BATHTUB, a water quality model developed by the USACE Waterways Station.

Suncor South Tailings Pond Project
Alberta, Canada

Responsible for completing the small streams modelling, End Pit Lakes assessment and Athabasca River modelling for this Oil Sands project. Tasks included: configuration of the water quality components of the models, calibration of selected water quality parameters, and simulation of water quality in McLean Creek and the Athabasca River.

Special Areas Water Supply Project
Alberta, Canada

Salinity modelling for the proposed Special Areas Water Supply Project. 30 year simulation of salinity in an interconnected system of over 40 interconnected reservoirs using a user-developed GoldSim model. Responsible for all of the modelling quality in the system, major tasks including: configuration of the water quality model, calibration of selected water quality parameters, simulation and study of water quality effects; work also involved result and report generation, and conveying results to the stakeholders.

Suncor Voyageur Project
Alberta, Canada

Responsible for assessing potential surface water quality impacts resulting from the development of the Suncor Voyageur Project. Project involved using a combination of computer models to accurately assess potential changes to water quality in the North Steepbank Pit Lake, Unnamed Creek, and the Steepbank and Athabasca rivers. Both local and cumulative effects were considered.

PROFESSIONAL AFFILIATIONS

Association of the Chemical Profession of Alberta

PUBLICATIONS

Other

Cramb DT, Carnini A, Duchscherer TM, Ha A, and SC Wallace. 2001. Dibucaine-ion-channel interactions in model systems: a study using fluorescence resonance energy transfer. Journal of Photochemistry and Photobiology A: Chemistry 2001, 138(1): 41-49.

Hall T and TJ Barrett. 2015. Uncertainty in Health Canada's drinking water aesthetic classifications. Integr Environ Assess Manage 11(3): 514-515.

Hall T, van Geest J and J Love. 2016. Long-Term Field Dataset Supports the Chloride-Dependent Nitrite Guideline. Integr Environ Assess Manage 12(4):824-826.

Love J, Humphries A and T Hall. 2016. Nitrate and Nitrite Holding Time Study Completed For a Northern Canadian Mine. Integr Environ Assess Manage 12(4):823-824.

Wong JE, Duchscherer TM, Pietraru G, and DT Cramb. 1999. Novel fluorescence spectral deconvolution method for determination of critical micelle concentrations using the fluorescence probe PRODAN. Langmuir. 15(19): 6181-6186.