



**SCOTT JACKSON (M.Sc., P.GEO. BC, NU/NT)**

**SENIOR HYDROLOGIST**

### **EDUCATION:**

**M.Sc. (Hydrology)**  
University of Victoria

**B.Sc. (Physical Geography)**  
University of Victoria

### **PROFESSIONAL AFFILIATIONS:**

Engineers and Geoscientists of British Columbia (EGBC)  
Northwest Territories and Nunavut Association of Professional Engineers and Geoscientists (NAPEG)

### **EXPERIENCE**

Scott Jackson has 20-years of experience as a practicing hydrologist. His prior professional experience includes running a provincial snow pillow network, flood and water supply forecasting and as a technical regulatory specialist for the BC Ministry of Environment reviewing multiple environmental impact assessment applications for major mines in British Columbia. Scott's project work with Lorax has focused on the characterization, modelling and impact assessment of dozens of northern and high-elevation metal and coal mine sites, as well as for projects located in Central Asia, Indonesia and Central America, in all phases of mine development, operation and closure. Scott's research activities have led to publications in peer-reviewed journals, mainly in the field of snow hydrology and boundary layer climatology.

### **AREAS OF EXPERTISE**

- Northern/cold region hydrology and climate studies
- Environmental Assessment with a focus on hydrology and mine water management
- Design and implementation of baseline hydro-meteorology monitoring networks
- Watershed and mine site water balance/water quality modelling
- Mine site water management and adaptive management planning
- Climate change scenario impact assessment

## **REPRESENTATIVE PROJECTS**

### **MINE SITE WATER BALANCE AND WATER QUALITY MODELS**

#### **Meadowbank Mine Site-Wide Water Balance and Water Quality Closure Model**

##### **Agnico Eagle Mines, Baker Lake, Nunavut**

- Assembly and calibration of a site wide water balance and water quality model used to test various closure water management concepts related to tailings seepage, open pit lake stratification and blending, water treatment and effluent discharge
- Set up and calibrated the GR4J watershed model for multiple regional catchments inform impact assessments related to lake dewatering and drawdown

#### **Whale Tail Project Site-Wide Water Balance and Water Quality Model (Project Lead)**

##### **Agnico Eagle Mines, Baker Lake, Nunavut**

- Integrate the mine site conceptual model, hydro-climatic inputs, and mine water management plan into a daily time-step water balance and water quality model for use in a Nunavut Water Board water license amendment submission
- Run multiple sensitivities and mine plans to aid client with optimization of mine plan expansion within existing license conditions
- Respond to Information Requests from community groups and regulatory bodies

#### **Meliadine Project Site-Wide Water Balance and Water Quality Model (Project Lead)**

##### **Agnico Eagle Mines, Rankin Inlet, Nunavut**

- Integrate the mine site conceptual model, hydro-climatic inputs, and mine water management plan into a daily time-step water balance and water quality model for use in a Nunavut Impact Review Board submission, and subsequent Nunavut Water Board submission
- Run multiple sensitivities and mine plans to aid client with optimization of mine plan expansion within existing license conditions
- Respond to Information Requests from community groups and regulatory bodies
- Develop Operational water balance model, including multiple scenarios, to assist water management and mine planning activities

#### **LCO-Dry Creek Water Quality Assessment**

##### **Teck Resources Ltd. – Sparwood, B.C.**

- Evaluated hydrologic and geochemical processes responsible for sulphate, selenium and nitrate signature in Harmer and Dry creeks located downstream of mine spoil piles.
- Conduct review of relevant reports and undertook additional water and mass balance modelling exercises to assist with refinement of both the conceptual model, and the Regional Water Quality Model (RWQM).
- Developed a novel approach for the modelling of new and unsaturated coal spoils to assist with investigation into constituent of interest concentrations and loadings. This approach is now being used within the RWQM to inform mine planning and mitigation measure selection.

### **Bralorne Gold Mine**

#### **Avino Silver and Gold Ltd.**

- Developed a calibrated watershed model to estimate flows emanating from the underground workings using regional climate data, for input to the site-wide water balance and water quality model

### **Trend-Roman Water Balance Water Quality Model**

#### **Anglo American PLC, Dawson Creek, British Columbia**

- Compilation of site and regional hydro-climatic data for input to site-wide WBWQM completed in support of a permit amendment application
- Calibration of a watershed model to daily discharge data for the receiving watercourse

### **Equity Silver – Water and Mass Balance Modelling**

#### **Goldcorp - Houston, British Columbia**

- Developed a linked monthly time-step water balance model for the tailings impoundment (ESTP) and Main Zone Pit to allow the back-calculation of allowable maximum constituent concentrations in the tailings pond, to remain within permitted effluent discharge quality limits, and in support of mass balance investigations
- Provided client with allowable parameter concentration limits, and water quality dependent pump volume limits to ensure permit compliance and water management flexibility

### **San Martin Passive Water Treatment System Design**

#### **Goldcorp – Honduras**

- Characterization of existing site hydro-meteorological regime
- Development of climate series for input to a daily time-step water balance model for a waste rock facility
- Water balance modelling of waste rock facility to predict long-term variation in contact water outflows to inform treatment system design (passive wetland)
- Peak flow estimates for water management infrastructure design

### **Michel Coal Project Water Balance and Water Quality Modelling**

#### **North Coal Ltd. – Sparwood, British Columbia**

- Re-created the water quality model developed in support of the Elk Valley Water Quality Management Plan (EVWQP), for the area specific to the Loop Ridge Project
- Objective was to place potential effects resulting from development of this project within the context of the *Environmental Management Act (EMA)* limits set following the EVWQP
- Evaluated potential reductions in loadings of parameters of concern from waste management strategies, in the context of the current valley-wide water quality permit
- Co-ordinated development of the site-wide water balance and water quality model for use in mine planning, Environmental Assessment Application and permitting processes
- Provided input to water management infrastructure design and plan

**Kumtor Gold Mine TMF Cyanide Mass Balance modelling**  
**Centerra Gold – Kyrgyzstan**

- Mass balance modelling of WAD cyanide concentrations in the TMF in support of the registration with the International Cyanide Management Code

**REPRESENTATIVE PROJECTS**  
**HYDRO-METEOROLOGICAL CHARACTERISATION**

**Kemess Underground Hydrometeorology Baseline**  
**Centerra Gold - Smithers, British Columbia**

- Baseline hydro-climate characterization and reporting
- Rating curve development, construction of discharge time-series.
- Creation of long-term synthetic hydrographs using the Empirical Frequency Pairing method for use as input to the water balance and water quality models used in the EA submission
- Generated recurrence interval estimates for high-magnitude rainfall (scaled for elevation), mean-annual runoff, low-flows, etc.
- Baseflow separation analysis
- Creation of synthetic daily precipitation record (scaled for elevation)
- Impact assessment of potential Project effects on the baseline streamflow regime

**Sukunka River Initial Dilution Zone Study**  
**Conuma Resources, Chetwynd, British Columbia**

- Conducted an initial dilution zone study for the confluence of a mine impacted tributary with a large watercourse using Rhodamine WT as a tracer
- Augmented with aerial drone photography, flow measurements, delineation of gaining and losing reaches via tracer mass loss experiments and dilution zone calculations

**Fording River Travel Time Study**  
**Teck Coal Ltd., Sparwood, British Columbia**

- Assessed travel times at various discharge levels in the Fording River to determine ideal sampling window at compliance monitoring location following a potential water treatment plant recirculation event
- Determined degree of flow gains/losses along 12 km study reach
- Field work conducted over the course of several site visits in all seasons, utilizing Rhodamine WT as the primary tracer
- Conducted supplementary work using the same methods on the Kilmarnock Creek system, including the Clean Water Diversion
- Participated in technical workshops to discuss findings, assemble the conceptual model of the surface and groundwater system

**Hudette Coal Project****Conuma Coal Resources, Chetwynd, British Columbia**

- Installation of full baseline surface water quality and quantity monitoring network, including 17 stations, 6 with continuous discharge monitoring.
- Training of site environmental staff in discharge measurement techniques, and preparation of site-specific monitoring SOPs.
- Compile, QA/QC and analyze baseline hydro-meteorological data, generate key metrics (e.g., recurrence interval analyses, low flows, peak flows)
- Draft baseline hydro-meteorological report

**Ojolali Water Management Study****PT. Batutua Way Kanan Minerals – Jakarta, Indonesia**

- Developed site-specific estimates of rainfall, temperature and local streamflow for a gold-silver heap leach extraction project in Southern Sumatra.
- Developed site water balance model in GoldSim, and evaluated multiple water management scenarios, including contact water volumes, treatment rates and heap leach makeup requirements and supply.

**Elan Project Pre-Feasibility Study****Atrum Coal, Blairmore, Alberta**

- Regional hydro-meteorological characterization to define inputs to pre-feasibility study water balance and water quality modelling

**Kearl East Pit Expansion****Imperial Oil Limited, Fort McMurray, Alberta**

- Senior oversight and planning of baseline hydrometric network installation
- Time-series analysis of water level data, compilation of rating curves, regional characterization and reporting in support of submission to regulatory agencies

**Quinsam Coal Mine Permit Amendment****Quinsam Coal Corporation – Campbell River**

- Installation of new hydrometric stations and maintenance and upgrades of legacy stations (transducer installs, weir maintenance, etc.)
- Development of a water balance and sulphate load model for a lake system to evaluate relative proportional loading sources, influence of lake dynamics (overturn, density and concentration gradients) and impacts of decommissioning treatment system.

**Kutcho Copper Project****Kutcho Copper Corporation – Dease Lake, British Columbia**

- Installation of new hydrometric stations in northern, high-elevation catchments, and tipping bucket rain gauges

**Coffee Gold Project Hydrometeorology Baseline and Water Balance Model****Goldcorp - Dawson, Yukon**

- Compilation of regional climate and hydrometric records, and scaling runoff indices to the project site (peak and low flow metrics)
- Characterization of surface water regime and active layer melt influence on low-flows in a discontinuous permafrost zone

- Generation of storm event intensity-duration-frequency estimates for design purposes, including PMP estimates (water management infrastructure)
- Creation of synthetic long-term climate and streamflow time-series using the Empirical Frequency Pairing methodology
- Set-up, parameterization and calibration of a site-wide water balance model to support EA and permitting applications and reporting
- Impact assessment of potential Project effects on the baseline streamflow regime
- Modelling work to predict potential stream channel morphology changes resulting from Project
- Assemble Water Management Plan, Meteorology and Hydrology Monitoring Plans, and an Adaptive Management Plan for licensing application and use by site staff
- Regular technical interactions with regulatory agencies and First Nations technical reviewers, including responses to Information Requests
- Training for site environmental staff on flow measurement techniques, hydrometric station installation, and development of supporting SOPs

### **Eagle Gold Project – Hydro-meteorology Baseline**

#### **Victoria Gold – Yukon Territory**

- Characterization and reporting of existing hydro-climatic regime for an operating open pit and heap leach operation in the Yukon
- Development of a long-term, reconstructed daily climate record scaled by elevation for use as input to the heap leach facility and site-wide water balance models
- Creation of long-term synthetic hydrographs using the Empirical Frequency Pairing method for use as input to the site-wide water balance model
- Assisted site staff with the analysis of flow monitoring data in support of Water Use License reporting requirements, and provided support for site monitoring activities

### **Mount Nansen Hydrometeorology Baseline Reporting**

#### **Assessment and Abandoned Mines – EMR, Yukon Government**

- Characterization and reporting of existing hydro-climatic regime for a proposed open pit and heap leach operation in the Yukon
- Creation of long-term synthetic hydrographs using the Empirical Frequency Pairing method for use as input to the site-wide water balance model

## **REPRESENTATIVE PROJECTS**

### **SITE INVESTIGATIONS**

#### **EVO Harmer and Dry Creek Water Quality Assessment**

##### **Teck Resources Ltd. – Sparwood, B.C.**

- Evaluate hydrologic and geochemical processes responsible for sulphate, selenium and nitrate signature in Harmer and Dry creeks located downstream of mine spoil piles.
- Conduct review of relevant reports and additional mass balance modelling exercises to assist with refinement of both the conceptual model, and the Regional Water Quality Model.

**Willow Creek Coal Mine  
Conuma Resources Ltd.**

- Several water quality assessments of mine site discharges during care and maintenance and operational phases, in support of permit reporting requirements, including discharge and loading assessments.
- Site review of monitoring locations and practices, training of site staff in flow measurement methods.
- Development of peak flow estimates using SCS Method for water management infrastructure design.

**REPRESENTATIVE PROJECTS  
THIRD PARTY AUDITS and TECHNICAL REVIEW**

**Brule Mine  
Conuma Coal Resources, Chetwynd, British Columbia**

- Conducted a third party audit of the hydrometric monitoring program for site effluent discharges, receiving watercourse flows, with a focus on station integrity and siting and rated structure effectiveness
- Provided a summary of findings and recommendations for improvements to the monitoring network

**Snow Survey Network – 3<sup>rd</sup> Party Review  
Teck Coal Ltd., Sparwood, British Columbia**

- Conducted a third party review of a recently implemented snow survey program (n = 22 stations), data collected, and the final report summarizing the network and data collected to confirm that the objectives of the snow survey network were being met
- Conduct a site visit of all locations, working in tandem with the client and the consultant tasked with implementing the monitoring program
- Developed a work plan for the following year, focusing on improvements to measurement methods, survey locations and infilling any identified gaps in the monitoring program

**Minto Mine Management, Environmental Audit  
Capstone Mining Corporation – Yukon**

- Conducted a technical review of environmental protection plans, Operational Adaptive Management Plan and Environmental Monitoring Plan in accordance with License Requirements.

**Elkview Operations  
Teck Resources Ltd. – Sparwood, British Columbia**

- Provided technical review of water balance and water quality model assembled to assess water treatment operations for a large coal mine.
- The review resulted in many substantial changes to the model.

**Mount Polley Permit Amendment Reviews Short Term Effluent Discharge Permit  
Amendment Review  
BC Ministry of Energy and Mines and BC Ministry of Environment**



- Project manager for the duration of the review process for all applications, requiring liaison with government, First Nations and company representatives to support the technical review.
- Conducted technical reviews of hydro-climate characterization, water balance and water quality model setup, inputs, parameterization, calibration and predictions on behalf of the provincial regulatory agencies for various permit amendment submissions following the TSF breach in 2014 and subsequent return to operations, for the following amendments:
  - Limited and Full Restart *Mines Act* Permit Amendments
  - Short-term Effluent Discharge Plan (under the *Environmental Management Act*)
  - Long-Term Water Management Plan Technical Assessment Report
  - Reclamation and Closure Plan

#### **Murray River EA review**

##### **BC Ministry of Energy and Mines**

- Technical review of hydrology and water balance modelling work

#### **Harper Creek EA review**

##### **BC Ministry of Energy and Mines**

- Technical review of hydrology and water balance modelling work

### **PREVIOUS RELEVANT EXPERIENCE**

#### **Technical Reviews of Applications for Environmental Assessment Certificates and Effluent Discharge Permits**

##### **Province of British Columbia**

- Banks Island Gold *EMA* Permit Application Review
- Bell Mine *EMA* Permit Amendment Application Review
- Dome Mountain *EMA* Permit Amendment Application Review
- Huckleberry Mine *EMA* Permit Amendment Application Review
- Premier Mine *EMA* Permit Amendment Application Review
- Red Chris Mine *EMA* Permit Application Review
- KSM Mine Environmental Assessment Application Review
- Kitsault Mine Environmental Assessment Application Review

#### **Streamflow Trend Analysis**

##### **Province of British Columbia**

- Trend and change point analysis of 23 seasonal hydrologic parameters of interest for the Skeena Region
- Publicly available report and data-set to be used by proponents to better define the potential impacts of a changing streamflow regime on a project's water balance

#### **Expert Witness**

##### **Province of British Columbia**

- Development of a simple watershed model without benefit of a site visit (by court order) in support of an Environmental Appeal Board hearing related to infractions under the Water Act



- Attended a hearing and was cross-examined on the inputs, assumptions and conclusions resulting from the modelling effort

## **Flood Forecasting**

### **Province of British Columbia**

- Flood event modelling and response, analysis and reporting in support of a provincial public safety program, including media briefings and interviews
- Development of methods and automated routines for the analysis of hydro-climatic data, including bias correction, time-series and trend analyses, multiple regression modelling, etc.

## **Database Management**

### **Province of British Columbia**

- Plan, develop and maintain databases, software, processes and provide support for the download, transfer, QA/QC and storage of real-time data from the snow pillow and other provincial and federal climate networks, weather forecast models, etc.
- Design and implementation of real-time data acquisition and analysis processes, including coding in VBA, Python, and UNIX shell scripts

## **Provincial Snow Pillow Network**

### **Province of British Columbia**

- Solely responsible for the maintenance of the provincial automatic snow pillow network (37 high elevation stations) – including instrumentation testing, field deployment, troubleshooting and repair, and planning of network upgrades and standardization

## **KSM Glacial Mass Balance**

### **Seabridge Gold/Rescan**

- Update of a glacial mass balance baseline report for six glaciers located upstream of the project
- Estimated rates of retreat and down-wasting from field data, as well as surface velocities and distributed seasonal mass balances

## **Sub-basin Contributions to Mackenzie River Discharge**

### **Environment Canada**

- Developed routing models to determine sub-basin contributions to the Mackenzie River discharge into the Beaufort Sea on a daily time-step
- Trend analysis of multiple hydrograph parameters, and statistical linkages to large scale climate oscillations (e.g., ENSO, PDO)
- Contributed to a larger hydro-climatic study of climate forcing mechanisms on the variation in freshet timing and magnitude
- Trend analysis of all major rivers flowing to the Arctic Sea

## SELECTED PUBLICATIONS & PRESENTATIONS

1. **S. Jackson**, S. Momeyer, J. Stockwell, N. Francoeur. 2023. A Flexible Approach to Modelling Seepage From Coal Mine Waste Rock. Proceedings of the International Mine Water Association Annual Conference. July 16-21, 2023, Newport, Wales.
2. E.K. Skierszkan, S.K. Carey, **S.I. Jackson**, M. Fellwock, C. Fraser, M.B.J. Lindsay. 2023. Seasonal controls on stream metal(loid) signatures in mountainous discontinuous permafrost catchments. *Science of the Total Environment*.  
<https://doi.org/10.1016/j.scitotenv.2023.167999>
3. Fraser, C. and **S. Jackson**. 2018. Shifts in air temperature and high-magnitude winter precipitation events in coastal North America: Implications for environmental assessment and management. *Integrated Environmental Assessment and Management*. 14-2: 185-188.
4. Fraser, J. Gjertsen, **S. Jackson** and J. Scott. 2017. A Changing Climate: Environmental Assessment for a Proposed Mine in Yukon, Canada. IAIA17 Conference Proceedings. 37<sup>th</sup> annual Conference of the International Association for Impact Assessment. April 4-7, 2017, Montreal, Canada.
5. **Jackson, S.** 2014. Streamflow Trends in the Skeena Region. September 2014.  
<http://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=43821>
6. **Jackson, S.I.**, Prowse, T.D. and Bonsal, B.R. 2014. Linkages between snow ablation and atmospheric boundary-layer conditions in a semi-arid basin of Western Canada. *Journal of Hydrology*. 517: 949-962.
7. Ahmed, A. and **Jackson, S.** 2013. Inventory of Streamflow in the Skeena Region. October 2013, Knowledge Management Branch, British Columbia Ministry of Environment, Victoria, BC.  
<http://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=40801>
8. BC Ministry of Environment. 2012. Water and Air Baseline Monitoring Guidance Document for Mine Proponents and Operators. *Contributing author - Surface Water Hydrology section*.
9. **Jackson, S.I.**, Prowse, T.D. 2009. Spatial Variation of Snowmelt and Sublimation in a High-Elevation Semi-Desert Basin of Western Canada. *Hydrological Processes*. 23: 2611-2627.
10. **Jackson, S.I.**, Laxton, S.L., and Smith, D.J. 2008. Dendroglaciological evidence for Holocene glacial advances in the Todd Icefield area, northern British Columbia Coast Mountains. *Canadian Journal of Earth Sciences*. 45, 83-98.
11. Reyes, A.V., Wiles, G.C., Smith, D.J., Barclay, D.J., Allen, S., **Jackson, S.**, Larocque, S., Laxton, S., Lewis, D., Calkin, P.E. and Clague, J.J. 2006. Expansion of alpine glaciers in Pacific North America in the first millennium A.D. *Geology*. 34(1), 57-60.