

PAUL FERGUSON, Ph.D., P.Geo.

PRINCIPAL ENVIRONMENTAL GEOCHEMIST

**EDUCATION**

Ph.D., Earth Sciences, University of Ottawa, Canada, 2007

B.Sc., Earth Sciences, University of Victoria, Canada, 2002

PROFESSIONAL REGISTRATION

Professional Geoscientist, EGBC

SUMMARY

Paul has thirteen years of consulting experience at Robertson GeoConsultants Inc. in the fields of environmental geochemistry and hydrogeology and specializes in the prediction, characterization, and control of Acid Rock Drainage/Metal Leaching (ARD/ML) impacts to groundwater and surface water at mine sites.

Paul has a B.Sc. (Honours) in Earth Sciences and completed his Ph.D. in Earth Sciences in 2007 with a focus on isotope and trace element geochemistry. Paul has worked closely with regulatory agencies, mining companies, and other consulting firms during the pre-feasibility, active mining, and closure stages of mining projects in Canada, Chile, and Australia, so is well-versed in the permitting process and required regulatory interface during various stages of mining.

Paul is RGC's project lead for the Rum Jungle Rehabilitation Project and directs RGC's work at the Myra Falls Mine in western Canada, the former Bouchard Hebert mine in Québec, and the Sandy Flat Mine Site in Australia, amongst other projects. He has also worked at the former Mount Morgan Mine Site in Queensland (Australia), the Faro Mine Site in Canada's Northwest Territories, the Browns site in Australia's Northern Territory, as well as on several active mines in Chile.

PROFESSIONAL HISTORY

2015-present: Principal Environmental Geochemist, Robertson GeoConsultants Inc.
2008-2015: Senior Geochemist, Robertson GeoConsultants Inc.
2007-2008: Post-Doctoral Fellow, University of Ottawa
2002-2007: Ph.D. Candidate, University of Ottawa

PROJECT EXPERIENCE (SELECTED STUDIES)**MINE CLOSURE PLANNING*****Sandy Flat Mine Site, Australia (2020-present) for Northern Territory Government***

- Completed an Independent Data Review and Gap Analysis for the Northern Territory government to support ongoing closure and remediation planning

- Completed the Mine Waste Characterization Program for the site with EcOz Environmental Consultants and DR Jones Environmental Excellence
- Prepared a Conceptual Remediation Plan for the site with DR Jones Environmental Excellence

Former Rum Jungle Mine Site, Australia (2010-2020) for Northern Territory Government

- Contributed to Data Review and Gap Analysis in 2010 to assess groundwater and surface water quality impacts due to ARD/ML and develop a routine monitoring program for the site
- Outlined conceptual rehabilitation options and post-closure success criteria to be considered by the NT Department of Primary Industry and Resources and facilitated a Multiple Accounts Analysis (MAA) to select a preferred rehabilitation strategy
- Completed a comprehensive ARD/ML assessment of the WRDs and other contaminated areas of the site to develop a re-location strategy for sulphidic materials
- Directed the development of a numerical groundwater model and Water and Load Balance Model (WLBM) for the site to characterize current site conditions and predict future, post-rehabilitation groundwater conditions and water quality in the East Branch of the Finnis River
- Prepared the Inland Environmental Water Quality chapter of the Environmental Impact Statement (EIS) for the site

Myra Falls Mine, British Columbia (2013-2020) for Nyrstar

- Conducted an initial assessment of current groundwater and surface water quality conditions and developed a routine monitoring program for the site
- Completed a preliminary ARD/ML assessment of waste rock and tailings geochemistry via test pitting and drilling in the historic WRDs
- Developed a conceptual contaminant load balance model for the site for current conditions and conditions at closure
- Developed a Site-Wide ARD/ML Management Plan for the site, including the handling and disposal of waste rock underground and at surface
- Prepared the Surface Water and Groundwater Monitoring Plan for the site
- Prepared the Surface Water and Groundwater Monitoring Report for Effluent Permit PE-6858 and sections of Annual Reclamation Report since 2019

Former Bouchard Hebert Mine Site, Quebec (2018-2022) for Breakwater Resources Ltd.

- Completed a Data Review and Gap Analysis for the former mine site area to support closure and remediation planning
- Completed an ARD/ML assessment of the industrial area, including test pitting supervision and subsequent interpretive work and reporting
- Completed initial review of groundwater and seepage conditions near Dike 2 North and supported the conceptual design of a French drain to collect seepage
- Supervised the backfilling of the flooded pit in the industrial area with aglime-amended waste rock as part of ongoing rehabilitation of this area

Mount Morgan Mine Site, Australia (2009-2011) for Qld. Dept Natural Resources (Australia)

- Determined impacts by ARD/ML on groundwater and surface water and prepare a contaminant load balance model
- Completed an annual review of groundwater quality data and identify additional monitoring needs

McArthur River Mine, Australia (2016) for Northern Territory Government

- Reviewed geochemical and hydrogeological aspects of the Mine Closure Plan and Mine Management Plan
- Conducted initial assessment of current groundwater and surface water quality conditions

GROUNDWATER AND SURFACE WATER QUALITY CHARACTERIZATION**Faro Mine Complex, Yukon Territory (2012-present) for Yukon Government/CIRNAC**

- Prepared drain clogging assessment to support ongoing design of the Down-Valley Seepage Interception System near Cross Valley Dam
- Prepared Annual Groundwater Quality Review for Faro Mine Site and Grum and Vangorda Mine Sites from 2012 to 2015
- Completed a geochemical tracer study of ARD sources to Rose Creek alluvial aquifer from tailings and Faro Creek Seepage
- Reviewed North Fork of Rose Creek water quality impacts to identify potential metal sources to the creek
- Reviewed water quality conditions in Cross Valley Pond and Intermediate Pond in support of operational water management

Browns Mine Site, Australia (####-####) for Doe Run Australia NL

- Completed a review of seepage and groundwater quality near the TSF to characterize seepage impacts and identify potential remediation options
- Completed a preliminary ARD/ML assessment for a Pre-Feasibility Study of the Browns Underground Mine
- Completed a comprehensive review of groundwater and surface water quality in support of the 2018 Monitoring Plan for the Waste Discharge License and Water Management Plan

Beedie Site, Port Coquitlam (2009-2012) for NEXT Environmental Inc.

- Reviewed water quality results to characterize the extent of a cobalt plume downgradient of former metal refinery
- Derived site-specific retardation factors to support the development of a numerical flow model to simulate contaminant transport in groundwater

Prairie Creek Mine, Northwest Territories (2008-2009) for Canadian Zinc

- Designed and implemented a groundwater monitoring program at Prairie Creek Mine
- Prepared hydrogeological baseline study for Developer's Assessment Report application

RECENT TECHNICAL REPORTS

RGC (2022), Conceptual Hydrogeological Model and Site-Wide Water and Load Balance Model for Sandy Flat Mine Site, RGC Report No. 270003/1. February 2022.

RGC (2022), Conceptual Remediation Plan for Sandy Flat Mine Site, RGC Report No. 270002/2, November 2021.

RGC (2021), Mine Waste Characterization Report for Sandy Flat Mine Site, RGC Report No. 270002/1, October 2021.

RGC (2021), Monitoring Report for Effluent Permit PE-6858, Nyrstar Myra Falls, RGC Report No. 212019/2, March 2021.

RGC (2021), Annual Reclamation Report for Mines Act Permit M-26, Nyrstar Myra Falls, RGC Report No. 212019/1, March 2021.

RGC (2020), Water and Load Balance Model for the Rio San Francisco, RGC Report No. 219002/2. December 2020.

RGC (2020), Updated Contaminant Load Balance Model and Water Quality Predictions, Nyrstar Myra Falls. RGC Report No. 212018/2. December 2020.

RGC (2020), Future Contaminant Loads in Groundwater, Cross Valley Dam Area, RGC Report No. 118035/1. April 2020.

RGC (2020), Data Review and Gap Analysis for the Sandy Flat Mine Site, Northern Territory, Australia. RGC Report No. 270001/1. April 2020.

RGC (2020), Annual Groundwater and Surface Water Monitoring Report for Nyrstar Myra Falls, RGC Report No. 212019/1.

RGC (2020), Phase I Conceptual Geochemical and Hydrogeological Model for the Bouchard Hebert Mine Site, RGC Report No. 217012/3. March 2020.

RGC (2020), Case Study Review for DV-SIS Design and Trade-Off Study, RGC Report No.118035/1, January 2020.

RGC (2019), Data Review and Gap Analysis for Water and Load Balance Model for Rio San Francisco, RGC Report No. 219001/1

RGC (2019), Site-Wide Groundwater Model and Surface Water Modeling Report for the former Rum Jungle Mine Site, Northern Territory Australia. RGC Report No 183008/1. November 2019.

RGC (2019), Physical and Geochemical Characteristics of Mine Waste and Contaminated Materials at the former Rum Jungle Mine Site. RGC Report No. 183006/7. November 2019.

RGC (2019), Data Review and Gap Analysis for Industrial Area, Bouchard Hebert Mine Site, RGC Report No. 217012/2. July 2019.

RGC (2019), Phase II Kinetic Testing Results for Tailings, El Torito Tailings Impoundment, RGC Report No. 189011/5. May 2019.

RGC (2018), ARD/ML Management Plan for Nyrstar Myra Falls. Internal Report.

RGC (2018). Preliminary ARD/ML Assessment for the Browns Oxide Mine Site, Northern Territory, Australia. December 2018.

RGC (2018), Initial (Phase I) Review of Seepage and Groundwater Conditions near the Tailings Storage Facility at Bouchard Hebert, RGC Report No. 217012/1, July 2018.

RGC (2018), Cross Valley Pond Water Quality Review and Load Balance Assessment, RGC Report No. 118035/1. March 2018.

RGC (2018), Water Quality Review and Load Balance Assessment for Browns Mine Site, RGC Report No. 256003/1. March 2018.

RGC (2017), North Fork of Rose Creek Water Quality Review, Faro Mine Site. RGC Report No. 118034/1. June 2017.

RGC (2017), Assessment of Groundwater Discharge near the Cross Valley Dam, Faro Mine Complex. RGC Report No. 118032/1. March 2017.

RGC (2017), Site-Wide Groundwater Quality Review for the Faro Mine Site, RGC Report No. 118029/1. January 2017.

RGC (2016), Contaminant Load Balance Model for Current and Future Conditions at Myra Falls, RGC Report 212010/1.

RGC (2016), Desktop ARD/ML Assessment for the Canal de Nicaragua, RGC Report No. 238001/1. August 2016.

RGC (2015), Preliminary Assessment of Tailings and Waste Rock Geochemistry, Myra Falls Mine, Report No. 212001/7. December 2015.

RGC (2015), AMP Event 1 Review and Contaminant Breakthrough Study for Cross Valley Dam Reach, Faro Mine Complex. RGC Report No. 118028/1. March 2015.

RECENT CONFERENCE PRESENTATIONS

28th B.C. MEND ARD/ML Workshop, Ferguson P., C. Wels, S. Downs, J. Woollard and D. Jones. Remediation Planning for the Sandy Flat Mine Site, Northern Territory, Australia. 28th Annual BC MEND Metal Leaching/Acid Rock Drainage Workshop. Vancouver, BC. December 2021. <https://bc-mlard.ca/files/presentations/2021-7-FERGUSON-ETAL-remediation-planning-sandy-flat.pdf>

27th B.C. MEND ARD/ML Workshop, Wels C., P. Kuranov, A. Trapp, P. Ferguson, M. Miller, A. Bhabra and S. Jensen. Down-Valley Seepage Interception System, Rose Creek Valley, Faro Mine Remediation Project. December 2020 <http://bc-mlard.ca/files/presentations/2020-1-WELS-ETAL-down-valley-seepage-interception.pdf>

25th B.C. MEND ARD/ML Workshop, P. Ferguson, C. Wels, D. Jones and G. Farrer., ARD/ML Impacts and Rehabilitation Planning for Rum Jungle. November 2018.

24th B.C. MEND ARD/ML Workshop, P. Ferguson, C. Wels and N. Pesonen., [Previous Mine Waste Disposal and ARD/ML Management at Nyrstar Myra Falls, British Columbia](#). November 2017.

24th B.C. MEND ARD/ML Workshop, P. Ferguson, C. Wels and N. Pesonen., [Current Site Conditions and Water Quality Predictions for Myra Creek, Nyrstar Myra Falls, British Columbia](#). November 2017.

9th Annual Australian AMD Workshop, P. Ferguson, C. Wels, D. Jones, and T. Laurencont, Rehabilitation planning at the former Rum Jungle mine site in northern Australia Environmental Performance Assessment for the Preferred Rehabilitation Scenario. <https://amdworkshop.com.au/amd-2017>

P. Ferguson, C. Wels, D. Rainey, and C. Gillis, ARD Impacts to Rose Creek, Faro Mine Complex, Proceedings of 2017 Tailings and Mine Waste, November 2017.

SELECTED CONFERENCE PAPERS

Jones, D. Ferguson. P., and T. Laurencont (2017), Rehabilitation Planning at the former Rum Jungle Mine Site. Part 1. Geochemical Characteristics of Mine Wastes and Inferred Post-Rehabilitation Source Terms. 2017 AMD Workshop, Tasmania.

Ferguson. P., C. Wels., D. Jones, and T. Laurencont (2017), Rehabilitation Planning at the former Rum Jungle Mine Site. Part 2. Environmental Performance Assessment for the Preferred Rehabilitation Strategy. 2017 AMD Workshop, Tasmania.

Jones, D., P. Ferguson, and J. Hartnett (2020), Characterisation of Secondary Minerals to Minimise Post Rehabilitation Downstream Water Quality Issues at Legacy Mine Sites, 2020 Mine Water Solutions Proceedings, New Zealand.

Ferguson, P., M. Hussein, C. Wels, and N. Pesonen (2020), Current Acid Rock Drainage Impacts and Seepage Interception Strategies at the Myra Falls Mine Site, Proceedings of Tailings and Mine Waste 2019, November 2019.

Hussein, M. P. Ferguson, C. Wels, and N. Pesonen (2020), Numerical Modelling of Groundwater Flow and Contaminant Transport at the Myra Falls Mine Site, Proceedings of Tailings and Mine Waste 2019, November 2019. P. 755.

PEER-REVIEWED PUBLICATIONS

Ferguson, P.R. and J. Veizer, 2011, "Fluvial carbon fluxes under extreme rainfall conditions: Inferences from the Fly River, Papua New Guinea", *Chemical Geology*. 281 (2011), 283-292

Ferguson, P.R. and J. Veizer, 2007, "Inferred coupling of water vapor and carbon dioxide fluxes between the terrestrial biosphere and atmosphere based on regional-scale estimates of plant transpiration", *Journal of Geophysical Research-Atmospheres*, 2007JD008431.

Ferguson, P.R., Weinrauch, N., Wassenaar, L., Mayer, B. and J. Veizer, 2007, "Isotope constraints on water, carbon, and heat fluxes from the northern Great Plains region, North America", *Global Biogeochemical Cycles*, GB2023, doi:10.1029/2006GB002702.

Freitag, H., Ferguson, P.R., Dubois, K., Hayford, E.K., von Vordzogbe, V. and J. Veizer, 2007, "Water and carbon dioxide fluxes from a savanna-dominated ecosystem: the Volta River watershed, West Africa", *Global and Planetary Change*, 61(1), 3 – 14.

Wels, C., L. Smith, and T.T. Vandergraaf, 1996. "The Influence of Specific Surface Area on Transport of Sorbing Solutes in Fractures: An Experimental Analyses", *Water Resources Res.* 32: 4943-4954.

Wels, C. and L. Smith, 1994. "Retardation of Sorbing Solutes in Fractured Media", *Water Resources Res.* 30: 2547-2563.

Wels, C., R.J. Cornett, and B.D. LaZerte, 1991. "Hydrograph Separation: Comparison of Isotopic and Chemical Tracers", *J. Hydrology* 122:253-274.