Reynold Chow, Ph.D., P.Geo.

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CAREER SUMMARY

Dr. Chow is a hydrogeologist with 9+ years of relevant work experience in hydrogeological site investigations, including core logging, packer testing, monitoring well installations, potable water treatment, and hydraulic response testing (i.e., slug tests, pumping tests). He has worked for mining companies with projects in Northern British Columbia, Northern Ontario, the Alberta Oil Sands, Yukon Territory and Alaska. Mr. Chow is also specialist in numerical groundwater modelling, and has comprehensive knowledge of MODFLOW (Visual MODFLOW & Groundwater Vistas), Surfer, and Grapher in addition to experience using FeFlow, Watflow, and HydroGeoSphere. His research interests include quantifying and reducing hydrogeological model uncertainty to enhance their credibility and usefulness for decisions.

QUALIFICATIONS AND CORE SKILLS

- Professional Geoscientist (ON, BC)
- Certified Small Drinking Water Systems Operator
- Comprehensive knowledge of Microsoft Office Suite, Visual MODFLOW, Groundwater Vistas, HydroGeoSphere, Surfer, MATLAB, & Fortran

EDUCATION

University of Tübingen, Tübingen, Germany

Doctor of Natural Sciences in Earth Sciences — *Oct. 2015 – May. 2019*

University of Waterloo, Waterloo, Canada

Master of Science in Earth Sciences — *Jul. 2009 – Jun. 2012*

University of Waterloo, Waterloo, Canada

Bachelor of Science in Earth Sciences, Hydrogeology Specialization, Co-operative Program, (Dean's Honours List)
Sep. 2003 - Dec. 2008

PROFESSIONAL EXPERIENCES

Swiss Federal Institute of Aquatic Science and Technology (Eawag), Switzerland

Postdoctoral Researcher — *Apr. 2019 – Present*

- Developed methods to identify statistically significant temporal trends of pesticide related risks to aquatic organisms from in-stream monitoring data.
- Developed conceptual rainfall-runoff models of catchments within the Swiss plateau to simulate in-stream pesticide concentrations.
- Reviewed literature on assessing longer-term trends in water quality to evaluate the effectiveness of diffuse agricultural pollution mitigation.

University of Tübingen and Stuttgart, Germany

Research Associate — *Oct. 2015 – May 2019*

- Developed numerical surface water-groundwater models at the catchment and river-reach scale to evaluate predictive uncertainty of simulated surface water-groundwater interactions.
- Presented research in the form of oral and poster presentation at international scientific conferences.
- Published research as peer-reviewed journal articles.
- Prepared and graded exam questions for Environmental Fluid Mechanics, a Masters level engineering course at the University of Stuttgart.
- Led tutorials on MATLAB coding for Environmental Modelling 1, a Masters level science course at the University of Tübingen.
- Spent two months as a visiting researcher at the University of Guelph, Canada in Prof. Beth Parker's G^{360} Institute for Groundwater Research.

- Coordinated the hiring and interviewed potential University of Waterloo undergraduate students as research assistants at the Universities of Tübingen and Stuttgart.
- Supervised four undergraduate research assistants from the University of Waterloo, Canada over 20 months.
- Supervised two Master of Science theses within the Water Resources Engineering and Management program at the University of Stuttgart:
    - Diego Fernando Motavita Medellin (Completed Dec. 2016). Thesis Title: Data and parameter uncertainty quantification of hydrological models via Bayesian updating: Comparison between five Bavarian catchments.
    - Hao Wu (Completed Sep. 2017). Thesis Title: Sensitivity of simulating hyporheic exchange to river bathymetry.

BGC Engineering Inc., Vancouver, BC

Hydrogeologist and Numerical Modeller *Jul. 2012 – Aug. 2015*

Relevant Projects

Groundwater Modelling

Spanish Mountain Gold Ltd., Quesnel Lake, BC - Open Pit Hydrogeological Assessment
Developed a three-dimensional groundwater model to simulate the pre-mining groundwater conditions for the project site at a regional scale. The model was used to estimate the groundwater inflows into the interim and ultimate pit designs. Open pit pore pressure distribution was simulated under different depressurization scenarios to make dewatering recommendations.

Barrick Gold, Pueblo Viejo, DR - Assessment of Filter Blankets for Dam Design
Developed a two-dimensional groundwater model to evaluate the upward seepage velocities at the dam toe. Updated hydraulic conductivity database, which provided the ranges used for sensitivity analysis.

Gibraltar Mine Ltd., McCleese Lake, BC - Stage V Pushback Slope Design
Developed a three-dimensional groundwater model to simulate the groundwater conditions at an operating mine site. The model was used to estimate pore pressures in the pit slopes and estimate inflows into the ultimate pit design. Simulated pore pressure distributions for different pit stages were used for slope stability modelling.

Donlin Gold, Aniak, AK – Conceptual Hydrogeological Model
Updated conceptual hydrogeological model with more recent hydrogeological and climatological data including results from packer tests, pumping test, slug tests, laboratory tests and hydraulic head vs. time records. The conceptual hydrogeological model formed the basis of the numerical hydrogeological model developed for the project.

Donlin Gold, Aniak, AK – Contact Water Treatment, Scoping Level Assessment
Estimated scoping level water quality for contact water during operations using a conservative mixing model. This work was incorporated in water management activities proposed for the construction, operations, and closure periods of the proposed project.

Coal Valley Resources Inc., Robb, AB - Open Pit Hydrogeological Assessment
Developed a two-dimensional groundwater model incorporating anisotropy along bedding planes to evaluate pit slope pore pressures under different vertical well and horizontal drain dewatering scenarios.

Syncrude Canada Ltd., Fort McMurray, AB - Closure Plan Numerical Groundwater Flow Model
Developed a three-dimensional groundwater model to evaluate groundwater movement in the closure landscape. The model was used to plan regional-scale wetland locations and extents by simulating groundwater recharge and discharge patterns. The model was also used to evaluate water management plans for in-lease containment of process-affected seepage.

Goldcorp Inc. Red Lake Gold Mines, Balmertown, ON – Cochenour Dam Seepage Analysis
Developed a two-dimensional groundwater model of an earth fill dam with a partially penetrating sheet pile to evaluate erosional problems at the toe of the dam and piping failure potential.

Ontario Power Generation, Darlington, ON - Excavation Dewatering Volume Estimates
Used analytical solutions to estimate dewatering volumes for various excavations, under various site conditions. Dewatering volumes were used as part of a permit to take water application and to size dewatering equipment.

Gibraltar Mine Ltd., McCleese Lake, BC - Connector Pit Slope Design
Updated a three-dimensional groundwater model to simulate the groundwater conditions at an operating mine site. The model was used to estimate pore pressures in the pit slopes of a potential Connector pit situated between two non-operational pits. The model incorporated interactions between pit lakes and was used estimate inflows into the Connector pit design. Simulated pore pressure distributions for different pit scenarios were used for slope stability modelling.

KGHM Ajax Mining Inc., Kamloops, BC – Environmental Assessment Numerical Groundwater Flow Model
Developed a three-dimensional groundwater model to evaluate groundwater movement during mine operations and closure. The model was used to estimate the timing, baseflows, and flows of process-affected groundwater to environmentally sensitive receptors in operations and closure. The model was also used to estimate groundwater inflows to the open pit and time required for the pit lake to fill.

Geotechnical/Hydrogeological Field Investigations

Donlin Gold, Aniak, AK - Crooked Creek Pumping Tests
Performed step tests to evaluate maximum sustained pumping rates for pumping tests. Performed three pumping tests which included the monitoring of water levels manually, downloading and compensating level logger data, and water sampling for geochemical parameters. Analyzed water level drawdown and recovery in monitoring and pumping wells to evaluate the hydrogeological characteristics of shallow alluvium, shallow weathered bedrock, and underlying competent bedrock zones.

Gibraltar Mine Ltd., McCleese Lake, BC - Connector Pit Geotechnical Drill Program
Performed packer tests to determine hydraulic conductivity of select intervals of bedrock. Logged rock core for weathering, alteration, joints, faults, and other geotechnical properties. Used information from field investigation to update geologic contacts for slope stability and hydrogeological modelling.

Kaminak Coffee Gold, Carmacks, YK - Project Baseline Environmental Assessment
Logged rock core for hydrogeological characteristics (i.e. faults, weathering, gouge). Performed pneumatic and hydraulic packer tests to determine hydraulic conductivity of select intervals of bedrock. Installed 150m to 200 m deep bedrock monitoring wells. Performed slug tests on completed wells.

Pottinger Gaherty Ltd., Prince George, BC – Surface Water Baseline Assessment
Compared surface water sample concentrations with regulatory water quality guidelines spatially and temporally. The objective was to characterize the surface hydrology and water quality baseline conditions for the proposed project in support of an Environmental Assessment Certificate application.

Other Relevant Work Experience

University of Waterloo, Waterloo, ON

Teacher's Assistant for Groundwater Modelling Course – Prof. E.O. Frind *Sep. 2010 – Dec. 2010*
& for Flow through Porous Media Course – Prof. J.P. Jones *Sep. 2009 – Dec. 2009*

- Prepared and instructed tutorials
- Created, tested and evaluated student assignments
- Answered students' questions and provided guidance

University of Waterloo, Waterloo, ON

English Instructor for Visiting PetroChina Employees – Prof. M.B. Dusseault *Jun. 2010 – Jul. 2010*

- Planned and prepared daily English language lessons (e.g., vocabulary, grammar)
- Evaluated student presentations and provided student feedback
- Created and carried out conversational role-playing exercises

Water and Earth Science Associates (WESA), Sudbury, ON

Groundwater Field Technician *Apr. 2009 – Jun. 2009*

- Monitoring well installation and development
- Purged and sampled monitoring wells at various mine sites
- Tested water for various geochemical parameters

Vale Inco - Mines Technical Services, Creighton Mine, ON

Geologist in Training *Jan. 2009 – Mar. 2009*

- Mapped and interpreted underground geology and structures
- Conducted geophysical probing of underground stopes and open pit mines
- Digitized historical geological mapping using Auto CAD

University of Waterloo, Waterloo ON

URSA NSERC Hydrogeology Field/Laboratory Technician – Prof. J.F. Barker *Sep. 2008 – Dec. 2008*

- Sampled groundwater for petroleum contamination (BTEX and MTBE)
- Prepared groundwater samples for gas chromatography analysis
- Analyzed and entered gas chromatography results

Vale Inco - Mines Technical Services, Copper Cliff, ON

Geologist Summer Student *May 2008 – Aug. 2008*

- Completed acid-base assessment project on waste rock
- Audited FNX mines sample tower on a weekly basis
- Utilized Datamine & Auto CAD to evaluate stopes and geological contacts

Sudbury Indoor Tennis Centre, Sudbury, ON

Tennis Instructor (Ontario Tennis Association Certified) *May 2007 – Aug. 2007*

- Directed games and drills to improve technique and consistency
- Applied progressive tennis program to lessons
- Taught basic rules, etiquette, scoring and strategies

Infrastructure Services Department, Sudbury, ON

Water/Wastewater Project Assistant *Jan. 2007 – Aug. 2007*

- Performed vulnerability assessment of facilities
- Developed tender documents
- Populated Ontario Ministry Benchmarking Initiative (OMBI) database

YMCA Camp Kitchikewana, Honey Harbour, ON

Water Systems Operator *May 2006 – Sep. 2006*

- Performed daily chlorine and turbidity tests
- Prepared samples for laboratory testing
- General maintenance and upkeep of facilities

Trow Associates Inc. (EXP Services Inc.), Markham, ON

Structural Engineering Field Technician *Aug. 2005 – Dec. 2005*

- Certified by CSA as a concrete testing technician
- Completed concrete and asphalt tests
- Laboratory testing and report writing
- Soil sampling and water well monitoring

University of Waterloo, Waterloo ON

Hydrogeology Research Assistant – Prof. Beth Parker & John Cherry *Jan. 2005 – Apr. 2005*

- Assisted research staff with data management
- Fulfilled laboratory and field activities
- Aided staff during drilling, sampling events, equipment installations, and data reduction

PUBLICATIONS

- **Chow, R.**, Bennett, J., Dugge, J., Wöhling, T. and Nowak, W. (2019). Evaluating subsurface parameterization to simulate hyporheic exchange: The Steinlach River Test Site. Groundwater.
- Motavita, D.F., **Chow, R.**, Guthke, A., and Nowak, W. (2019). The Comprehensive Differential Split-Sample Test: A stress-test for hydrological model robustness under climate variability. Journal of Hydrology.
- **Chow, R.**, Wu, H., Bennett, J., Dugge J., Wöhling, T., and Nowak W. (2018). Sensitivity of simulated hyporheic exchange to river bathymetry: The Steinlach River Test Site. Groundwater.

- **Chow, R**. (2018). Nature's water purifier: Surface water-groundwater interactions. Scisnack.
- **Chow, R.**, Frind, M.E., Frind, E.O., Jones, J.P., Sousa, M.R., Rudolph, D.L., Molson, J.W. and Nowak, W. (2016). Delineating baseflow contribution areas for streams–A model and methods comparison. Journal of Contaminant Hydrology, 195, pp.11-22.
- **Chow, R.**, Frind, E.O., Sousa, M.R., Jones, J.P., Rudolph, D. and Molson, J. (2011). Delineating capture zones for environmentally sensitive features – a model comparison. Peer reviewed conference paper and poster presented at International Association of Hydrogeologists Conference, Quebec City, Quebec Canada. Aug. 28-31.

Other scientific contributions

- **Chow, R.**, Scheidegger, R., Doppler, T., Fenicia, F., and Stamm, C (Nov. 2019). Under what conditions can we detect long-term pesticide concentration trends in surface waters? Poster presentation at Zhydro Seminar, ETH Zurich.
- Reviewer for Hydrology and Earth System Sciences, Open-Access Journal of the European Geosciences Union.
- **Chow, R.**, Wu, H., Bennett, J., Dugge J., Wöhling, T., and Nowak W. (Sep. 2019). Surface water-groundwater exchange: Nature's water purifier. Oral presentation given at Brazil-Germany Symposium, Stuttgart, Germany
- Thoms, A., **Chow, R.**, Steelman, C.M., Nowak, W., and Parker, B.L. (*2018*). Quantifying Bedform-Scale Hyporheic Exchange in Bedrock Rivers: The Eramosa Bedrock River Field Site. Poster presentation at American Geophysical Union Fall Meeting, Washington D.C., US.
- **Chow, R.**, Wu, H., Bennett, J., Dugge J., Wöhling, T., and Nowak W. (2018). Sensitivity of simulated hyporheic exchange residence times to river bathymetry. Poster presented at European Geosciences Union General Assembly, Vienna, Austria.
- **Chow, R.**, Wöhling, T., Parker, B. and Nowak W. (2018). Evaluating predictive uncertainty of hyporheic exchange modelling. Poster presented at Integrated Hydrosystem Modelling Conference 2018, Tübingen, Germany.
- **Chow, R.**, Bennett, J., Dugge J., E., Wöhling, T., and Nowak W. (2017). Evaluating predictive uncertainty of hyporheic exchange. Oral presentation given at American Geophysical Union Fall Meeting, New Orleans, US.
- **Chow, R.**, Bennett, J., Dugge J., McLaughlin, E., Wöhling, T., and Nowak W. (2017). Integrated modelling of meander-driven hyporheic exchange. Poster presented at European Geosciences Union General Assembly, Vienna, Austria.
- **Chow, R.**, Bennett, J., Dugge J., McLaughlin, E., Wöhling, T., and Nowak W. (2017). Evaluating hyporheic exchange transit time through a river bend. Oral presentation given at International HydroGeoSphere User Conference, University of Bayreuth, Bayreuth, Germany.
- **Chow, R.**, Frind, M.E., Frind, E.O., Jones, J.P., Sousa, M.R., Rudolph, D.L., Molson, J.W. and Nowak, W. (2016). Comparing models and methods for the delineation of stream baseflow contribution areas. Oral presentation given at American Geophysical Union Fall Meeting, San Francisco, US.

AWARDS & ADDITIONAL ACTIVITIES

- Active member of the Swiss Young Researchers Network and Eawag Postdoctoral Scientists Association, 2019
- Coordinator of University of Waterloo Co-op, Canada – Universities of Tübingen/Stuttgart, Germany exchange program, 2016 - 2018
- A2.1 German language proficiency, 2016
- Vice President of Public Relations for Toastmasters BGC Engineering, 2014
- 1st place finisher at the 5km Transplant Trot in Waterloo Ontario, 2012
- Let's Talk Science Outreach Volunteer at the University of Waterloo, 2012
- Water Institute Graduate Section Vice-Chair Social Committee, 2011
- University of Waterloo President's Graduate Scholarship, 2010
- NSERC Alexander Graham Bell Canada Graduate Scholarship, 2010
- NSERC Undergraduate Research Awards Program, 2008
- Recipient of J.P. Bickell Foundation Mining Scholarship, 2007, 2008 & 2009