Dr. Wang is a Hydrogeologist with over 13 years of experience in the development and application of groundwater models for water-resource management. Dr. Wang has a Ph.D. degree from the University of Waterloo, focusing on the development of approaches to assist decision-makers and developers in assessing risks and benefits of a project from both environmental/engineering and financial perspectives.

Dr. Wang's expertise focuses on the interpretation of hydrogeologic data, analytical and numerical groundwater modeling for water resources development, protection and support for the design of remedial measures. Dr. Wang has extensive experience in developing maps of groundwater levels to evaluate the performance of the remedial measures and to supports the optimization of groundwater monitoring networks and remedy design. Dr. Wang also conducts model reviews and independent checks of model to provide internal quality assurance. Dr. Wang has extensive experience with wellfield characterization and the modification of regional models to simulate conditions at the scale of individual wellfields.

Education

- Ph.D. Earth and Environmental Sciences, University of Waterloo (2012)
- M.Sc. Water Resource Engineering and Management, University of Stuttgart (2007)

Project Experience

Interpretation of Hydrogeologic Data

Hydrogeologist, Regional Municipality of Waterloo Aquifer Tests, Ontario, Canada, 2014**
Interpreted aquifer tests for wells G7, G8 and wells in the Pinebush well field.

Hydrogeologist, Village of Richmond Pumping Tests, Ontario, Canada, 2014**
Interpreted pumping tests at wells TW1 10, TW2 12 and TW3 12 to support development of numerical groundwater model.

Hydrogeologist, Northwest Gasco Site Pumping Tests, Portland, Oregon, 2013**
Interpreted step pumping tests and made recommendations for redeveloping some of the wells.

Hydrogeologist, Parachute Creek Gas Plant Pumping Tests, Denver, Colorado, 2014**
Interpreted six constant-rate pumping tests.

Hydrogeologist, South Swift Creek Step- and Pumping Tests, McBee, South Carolina, 2013**
Interpreted step test and constant-rate pumping test for 16 wells.

Hydrogeologist, State Capitol Building Aquifer Tests, Denver, Colorado, 2013**
Interpreted six aquifer tests conducted on wells A 1 and A 2 in the Upper and Lower Arapahoe Aquifer, respectively.

Hydrogeologist, Timbro Ranch Aquifer Tests, Colorado, 2015**
Interpreted aquifer tests conducted on four wells for litigation support.

Hydrogeologist, Transco Eminence Mississippi Tests, Mississippi, 2016**
Interpreted aquifer tests conducted on 2 wells in 2015 and 8 wells in 2016.

Hydrogeologist, Hanford RUM tests, Washington, 2016**
Interpreted aquifer tests performed in 2009 and 2016 at the 100 HR 3 Operable Unit to characterize the first water bearing unit of the Ringold Formation Upper Mud (RUM).

Hydrogeologist, CN Copetown pumping tests, Copetown, Ontario, Canada, 2016**
Interpreted the PW1 and PW2 pumping tests at Dundas Mi. 9.1.

Hydrogeologist, Chehalem Mountain Vineyard pumping test, Stockton, California, 2016**
Interpreted Well No. 3 pumping test.

Hydrogeologist, Reilly Tar Site Tests, St. Louis Park, Minnesota, 2017**
Interpreted aquifer tests conducted at St. Louis Park pumping wells (SLP 4, SLP 15, SLP 10 and SLP 6) and Meadowbrook Golf Course 2 well (MGC 2).

Hydrogeologist, Alexo Mine, Haileybury, Ontario, Canada, 2022**
reviewed the groundwater modelling conducted for the Alexo Mine Project (AMEC Earth & Environmental, 2011) and re-analyzed the slug tests conducted as part of the AMEC (2011) investigations.

Analytical and Numerical Modeling of Groundwater Flow and Solute Transport

Groundwater modeller, Prairie Island Geothermal Modeling, Prairie Island, Minnesota, 2023**
conducted heat transport modelling to support the design of an open loop geothermal system for the Treasure Island Resort and Casino. Tasks included assessing the risk of thermal breakthrough between the injection and supply wells required for the open loop design.

Groundwater modeller, Kingscourt & King City Geothermal Modeling, Waterloo and King City, Ontario, Canada, 2022-2023**
conducted heat transport modelling to support the design of open loop well pairs for a geothermal district energy system for individual or industrial buildings at two locations, 416 Kingscourt Drive site in Waterloo and King City. Tasks included assessing the risk of thermal breakthrough between the injection and supply wells required for the open loop design.

Groundwater modeller, Crawford Groundwater Flow Model, Canada Nickel Company, Crawford, Ontario, Canada, 2023**
developed a groundwater model to support a Groundwater Permit to Take Water of a bulk sample (advanced exploration) for Canada Nickel Company. Tasks included estimating the likely groundwater inflows to bulk sample and assessing the effects of dewatering on surrounding groundwater levels and surface water features.

Groundwater modeller, West Cache Groundwater Flow Model, Explor Resource Inc., Bristol and Ogden Townships, District of Cochrane, Ontario, Canada, 2022-2023**
developed a groundwater model to support a Category 3 Groundwater Permit to Take Water for Explor Resources Inc. Tasks included estimating the likely groundwater inflows to mine development and assessing the effects of mine dewatering on surrounding groundwater levels and surface water features.

Groundwater modeller, Castle East Groundwater Flow Model, Canada Silver Cobalt Works, Castle East, Ontario, Canada, 2022**
developed a groundwater model to support a Category 3 Groundwater Permit to Take Water for Canada Silver Cobalt Works. Tasks included estimating the likely groundwater inflows to mine development and assessing the effects of mine dewatering on surrounding groundwater levels and surface water features.

Groundwater modeller, Stibnite Gold Project Hydrological Modeling Data Review (ongoing), U.S. Forest Service, Valley County, Idaho, U.S., 2022-2023**
undertaken a review of the hydrologic modeling analyses that have been conducted to support the proposed Stibnite Gold Project. Tasks included aquifer test audit, base data adequacy review and hydrologic numerical modeling audit.

Groundwater modeller, Durham Region Groundwater Flow Model, Region of Durham, Ontario, Canada, 2018-2021**
partnered with another firm to develop a groundwater flow model for the Regional Municipality of Durham. The model was calibrated at each of the eight wellfields and applied for delineating wellhead protection areas, delineating Cone of Influences, delineating Highly Vulnerable Aquifers, delineating Ecologically Significant Groundwater Recharge Areas and assessing aquifer vulnerability.

Groundwater modeller, St. George Groundwater Flow Model, St. George, Ontario, Canada, 2017**
Developed a groundwater flow model to support the assessment of current conditions and to predict how conditions may change for proposed alternative pumping scenarios.

Groundwater modeller, Celestica Lands Groundwater Flow Model, Toronto, Ontario, Canada, 2016**
Developed a groundwater flow model to assess the potential changes of construction of the Science Centre Station of the Eglinton Crosstown Light Rail Transit (LRT).to shallow groundwater conditions at the Site

Groundwater modeller, Dana Oakville Groundwater Flow Model, Oakville, Ontario, Canada, 2016, 2024**
Develop a groundwater model to support the assessment of potential effects of construction along Kerr St. on conditions at the Dana-Oakville Site.

Groundwater modeller, Eglinton Crosstown LRT Groundwater Flow Model, Toronto, Ontario, Canada, 2013**
For the proposed Bathurst station, developed an analysis of a three-dimensional transient numerical groundwater flow model to predict groundwater inflows to the station box excavation.

Groundwater modeller, Village of Richmond Regional Groundwater Flow Model, Ontario, Canada, 2014**
Modified an existing regional groundwater flow model to simulate groundwater flow conditions in the vicinity of the Richmond wells and to delineate the time-related capture zone based on the re-calibrated model.

Groundwater modeller, Colorado State Capitol Building Groundwater Flow Model Development, Denver, Colorado, 2014**
Developed a groundwater flow model for the extraction/injection system screened through the Upper and Lower Arapahoe aquifers to predict the net water flow between the two aquifers.

Groundwater modeller, Clean Harbors Lambton Facility Landfill Chloride Investigation, Ontario, Canada, 2013**
Calculated the advective and diffusive mass fluxes of chloride from the waste for different cells at the facility. Developed a numerical model to simulate chloride transport from the waste to the Contact Aquifer.

Groundwater modeller, Hanford Groundwater Modeling Support, Washington, 2014-2022**
Simulated different proposed Pump and Treat alternatives to support remedial designs at 100-HR and 200-W areas. Simulated Cr(VI)-contaminated column leaching experiments using MPNE1D simulator to support groundwater modeling of source cleanup alternatives. Assisted in running the groundwater flow and transport models for the 100-K, 100-H and 100 N Areas. Assisted in running particle tracking for 100-Area with particles placed in every month for 44 years and assessed the impact of river and pumping conditions on the hydraulic capture. Assisted in implementing the ZP-1 Optimizer on optimizing the Pump and Treat system design Groundwater modeller, for the 200-ZP-1 Area and documenting the ZP-1 Optimizer program.

Groundwater modeller, Hanford Contaminated Sediment Flushing, Washington, 2014**
Conducted a conceptual level analysis of flushing through sediments contaminated with Cr(VI) using both the horizontal well and vertical well flushing systems.

Groundwater modeller, Hanford Simulated Transport of CR (VI), Washington, 2014**
Simulated the transport of Cr(VI) at the 100 BC area using the dual domain concept.

Groundwater modeller, St. George Modeling Review Support, St. George, Ontario, 2017**
Simulated pumping in a two-aquifer system with one aquifer is underlain by a significantly more transmissive unit to support the review of the modeling report at the Site.

Groundwater Modeling to Support Remedial Design and Evaluation

Groundwater modeller, Ott-Story-Cordova, Muskegon County, Michigan, 2016-2017**
assessed the extent of hydraulic capture under the current Pump-and-Treat remedial system and compared to the extent of groundwater contamination and evaluated the proposed remedial designs.

Groundwater modeller, Reilly Tar Site, St. Louis Park, Minnesota, 2017**
assessed the extent of hydraulic capture under the current Pump-and-Treat system for three aquifers, Drift, Platteville, and St. Peter. The widths of the capture zones were also estimated between 2011 and 2016 from the water level maps generated using KT3D-H2O.

Groundwater modeller, Pristine Inc., Reading, Ohio, 2017, 2018, 2020**
assessed the extent of hydraulic capture under the current Pump-and-Treat remedial system and predicted the plume migration based on the current delineation of the contaminant plume.

Groundwater modeller, Ottawa township flat glass superfund site, Naplate, Illionois, 2020**
mapping the water level elevation to assess the long-term influence of the mining operation.

Groundwater modeller, Polo Industrial de Camaçari, Camaçari, Estado da Bahia, Brazil, 2020-2024**
assessed the performance of hydraulic barrier at the Polo Industrial de Camaçari under the current Pump-and-Treat remedial system and to propose recommendations regarding the operation, monitoring and performance of the hydraulic barrier.

Modeling to Support the Design and Evaluation of Landfills

Groundwater modeller, Biggars Lane Landfill Site, Brant, Ontario, 2018**
estimated chloride concentration at the compliance boundary using analytical and numerical methods for the existing and proposed landfill extensions.

Geostatistics

Hydrogeologist, Ott-Story- Cordova, Muskegon County, Michigan, 2016-2017**
kriged water level elevations using multi event universal kriging (MEUK) and evaluated the hydraulic capture of the groundwater remedial system of the Site based on the interpreted capture zones.

Development of Groundwater Simulation Codes

Groundwater modeller

- Wrote a one-dimensional solute transport code DECAY for multiple species involving advection, dispersion, sorption, and first-order reaction along a straight or branching chain.
- Conducted benchmarking analyses using MODFLOW and FEFLOW to support the development of analytical solutions for groundwater flow and solute transport.
- Tested, debugged, and assisted in the development and documentation of a particle-tracking code to accompany the new USGS version of MODFLOW for unstructured grids.
- Assisted in developing a local refinement mesh generator (Quadtree and Quadmesh refinement).
- Set up an example to demonstrate the dispersion module of MODPATH developed by SSP&A.
- Assisted in developing a remedial optimization code, ZP 1 Optimizer, designed to demonstrate that a dynamic operation of the extraction and injection wells would improve mass recovery at the Hanford Site Operational Unit ZP-1.

Memberships and Associations

- Professional Engineers Ontario (P. Eng), Association of Professional Engineers Ontario
- International Association of Hydrogeologists, Canadian National Chapter (IAH CNC)

Publications

- Neville, C.J., Wang, X, 2024. Comment on “Numerical simulation of a managed aquifer recharge system designed to supply drinking water to the city of Amsterdam, The Netherlands”: paper published in Hydrogeology Journal (2023) 31: 1291–1309, by Pranisha Pokhrel, Yangxiao Zhou, Frank Smits, Pierre Kamps and Theo Olsthoorn. Hydrogeol J (2024). https://doi.org/10.1007/s10040-024-02818-7.
- Wang, X. and C. Neville, 2024. Analyses to Support the Design of Open-loop Geothermal Systems. Presentation at MODFLOW and More 2024, Princeton University, June 3, 2024.
- Wang, X. and C. Neville, 2019. A Semi-analytical Solution for the Transport of Solutes with Complex Sequences of First-order Reactions. Computers & Geosciences, Volume 123, pp. 121-136.
- Neville, C. and X. Wang, 2018. Analysis of Solute Transport from a Source with Finite Leachable Mass. Ground Water, vol. 56, no. 6, pp. 1002-1006. doi: 10.1111/gwat.12807.
- Wang, X., and C. Neville, 2017. Response to Pumping in a Two-aquifer System. Presentation at GeoOttawa 2017, Ottawa, Ontario, October 1 – October 4, 2017.

- Wang, X., and C. Neville, 2015. Benchmarking mod-PATH3DU for Complex Problems. Presentation at MODFLOW and More 2015, International Groundwater Modeling Center, Colorado School of Mines, Golden, CO, May 31 – June 3, 2015.
- McAlary, T., X. Wang, A. Unger, H. Groenevelt, and T. Górecki, 2014. Quantitative Passive Soil Vapor Sampling for VOCs, Part 1: Theory. Environmental Sciences: Processes and Impacts v. 16, no. 3, pp. 482-490.
- Wang, X., A. J. A. Unger, and B. L. Parker, 2014. Risk-Based Characterization for Vapour Intrusion at a Conceptual Brownfields Site: Part 1. Data Worth and Prediction Uncertainty. Journal of Civil Engineering and Science 3(3): 152-172.
- Wang, X., A. J. A. Unger, and B. L. Parker, 2014. Risk-Based Characterization for Vapour Intrusion at a Conceptual Brownfields Site, Part 2: Pricing the Risk Capital. Journal of Civil Engineering and Science, v. 3, no. 4, pp. 189-208.
- Neville, C.J. and X. Wang, 2013. Analysis of Inter Aquifer Flows in a Geothermal System. Presentation at S.S. Papadopulos & Associates, Inc. Technical Development Seminar, Bethesda, MD. October 2013.
- Wang, X., A. J. A. Unger, and B. L. Parker, 2012. Simulating an Exclusion Zone for Vapour Intrusion of TCE from Groundwater into Indoor Air. Journal of Contaminant Hydrology 140-141: pp. 124-138.
- Neville. C.J., and X. Wang, 2012. Superposition in Action: Unit Plumes. Presentation at S.S. Papadopulos & Associates, Inc. Technical Development Seminar, Bethesda, MD, October 2012.
- Wang, X., A.J. Unger, and B. Parker, 2012. Development of an Optimal Financial Strategy for a Brownfields Redevelopment Project. Presentation at the University Consortium for Field-Focused Groundwater Contamination Research Program Annual Progress Meeting, Guelph, Ontario, Canada, June 12-14, 2012.
- Wang, X., A.J.A. Unger and B. Parker, 2012. A Least-Cost Strategy for Evaluating a Brownfield Redevelopment Project Subject to Indoor Air Exposure Regulations. Presentation at the TOUGH Symposium 2012, Berkeley, CA: September 17-19, 2012.
- Wang, X., A.J.A. Unger, and B. Parker, 2011. A Least-cost Strategy for Evaluating a Brownfields Redevelopment Project. Presentation at Geohydro, Quebec City, August 28–31, 2011.
- Wang, X., A.J.A. Unger and B. Parker, 2011. A Least-cost Strategy for Evaluating a Brownfields Redevelopment Project Subject to Indoor Air Exposure Regulations. Presentation at the University Consortium for Field-Focused Groundwater Contamination Research Program Annual Progress Meeting, Guelph, Ontario, Canada. June 1-3, 2011.
- Wang, X., A.J.A. Unger, and B. Parker, 2010. Development of an Optimal Financial Strategy for a Brownfields Redevelopment Project. Presentation at the 2010 Farvolden Symposium and Lecture, Waterloo, Ontario, Canada. October 22, 2010.
- Wang, X., A.J.A. Unger, and B. Parker, 2010. Development of an Optimal Financial Strategy for a Brownfields Redevelopment Project. Presentation at the University Consortium for Field-Focused Groundwater Contamination Research Program Annual Progress Meeting, Guelph, Ontario, Canada. May 19-21, 2010.

Additional Training

- Workplace Hazardous Materials Information System (WHMIS)
- AODA: Integrated Accessibility Standards
- MODFLOW-USG course, Bethesda, MD, USA
- Introduction to Visual Basic 2005
- MODFLOW-USG: Theory, Application, and Implementation of CLNs
- PFAS, virtual seminar with Grant Carey
- CGS-SOS groundwater aspects of underground construction in the GTA
- The 2023 PEST conference, The Path from Data to Decisions, La Jolla, CA
- IAH-CNC, Challenges of PFAS Environmental Releases, Current Guidelines & Standards, and Potential Treatment Options, Guelph, ON