

## **SPECIALIZATION**

Scott Effner, Principal Geochemist/Hydrogeologist for Whetstone Associates, specializes in groundwater hydrology, geochemistry, and water resource studies for mining, energy, and industrial projects. Mr. Effner has been involved with over 75 projects during the last 20 years in which groundwater hydrology, geochemical characterization, water quality monitoring, or numerical modeling were the focus of work. Mr. Effner has broad experience performing hydrologic and geochemical studies for mine permitting and construction, and is knowledgeable about water resource and geochemical issues related to NEPA studies. Mr. Effner's main areas of expertise are in hydrogeologic characterization and testing, design of water control systems, numerical modeling of aqueous geochemistry and groundwater flow, design of water quality monitoring networks, and preparation of geochemical characterization studies.

## **EDUCATION**

M.S., Geology, University of Idaho, Moscow, Idaho	1992
B.A., Geology, Western State College, Gunnison, Colorado	1988

## **PROFESSIONAL AFFILIATIONS AND CERTIFICATION**

Professional Geologist, Wyoming, Registration # PG-3434  
Professional Geologist, Idaho, Registration # 1077  
American Institute of Professional Geologists # MEM-1666  
International Mine Water Association, 1993 - present  
National Groundwater Association, 1998 to present  
MSHA 40-Hour Training for Surface and Underground Miners  
OSHA 24-hour Hazardous Waste Operations Training

## **WORK HISTORY**

**Whetstone Associates**, Principal Hydrogeologist/Geochemist, 1999 to present  
**TRC Hydro-Geo Consultants**, Lakewood, CO, Senior Geochemist/Hydrogeologist, 1993 to 1999  
**Empresa Minera Can-Mex**, Hermosillo, México, Geologist 1992 to 1993  
**Tenneco Minerals Company** Lakewood, CO, Geologist 1989 to 1991

## **REPRESENTATIVE PROJECT EXPERIENCE**

- *Monsanto Blackfoot Bridge Mine EIS, Idaho – Water Resources and Geochemistry Technical Lead* – Responsible for the design and implementation of baseline water resource and geochemical characterization studies for the Blackfoot Bridge Phosphate Mine Environmental Impact Statement (EIS). Project work included oversight of all technical aspects of the water resources and geochemical characterization studies, preparation of the EIS impact analysis, and numerical modeling of groundwater flow and contaminant transport. The project is in progress with an expected completion date in 2009.
- *Agrium, Rasmussen Ridge Mine EIS, Idaho – Water Resources and Geochemistry Technical Lead* – Responsible for the development of the water resources impact analyses and geochemical evaluation for the North Rasmussen Ridge Mine Environmental Impact Statement (EIS). Project work included the review and development of baseline characterization studies, analysis of hydrologic and geochemical data, numerical modeling (MODFLOW/MT3D) of contaminant fate and transport, and senior review of geochemical modeling (PHREEQCi).

- *FMC, Dry Valley Mine, Idaho – Project Manager* – Prepared surface water, groundwater and aquatic monitoring plans, groundwater and surface water mitigation plans, and quality assurance project plans. Project work included negotiation of sampling sites and monitored parameters with agencies, preparation of SOP's, and development of text for the South Extension Mitigation Plan. Particular emphasis was placed on the selenium and sediment issues in Dry Valley Creek which is listed as a 303(d) impaired stream.
- *Cotter Corporation, Swartzwald Mine, Colorado – Senior Geochemist* – Hydrologic characterization report for the closure of the Swartzwald Uranium Mine. Project work included analysis of the rate and projected level of mine flooding, geochemical modeling (PHREEQci) to predict discharge water quality, and preparation of recommendations for monitoring and mitigation of impacts to water quality.
- *Southern Perú Copper Corporation, Perú – Project Manager* – Environmental audit. Reviewed and audited surface and groundwater monitoring network for Toquapala and Cuajone mines, related tailings facilities and smelter and port facilities. Presented short courses for design of groundwater monitoring networks, groundwater modeling (MODFLOW/MT3D), and geochemical modeling (PHREEQC/MINTEQA2).
- *Dudley and Associates, Seminole Road Project EIS, Hanna Basin Wyoming – Senior Hydrogeologist* – Prepared numerical groundwater flow model (MODFLOW) for the Seminole Road Coal Bed Methane Project Environmental Impact Statement. The model was used to evaluate potential drawdown impacts in the Hanna Basin caused by pumping from over 1,200 wells which will be installed at full production. The model was also used to evaluate impacts caused by injection of produced water into the Dad sandstone of the Lewis Formation.
- *Dudley and Associates, Seminole Road CBM Pilot Project, Hanna Basin Wyoming – Senior Geochemist* - Geochemical modeling (PHREEQC/MINTEQA2) to support design of water treatment facility for discharge from coal bed methane wells.
- *Agapito Associates, Mountain Coal Dear Creek Mine, Colorado – Senior Hydrogeologist* - Hydrogeologic investigation for the # 4 shaft at the Deer Creek Mine. Project work include field permeability testing of the shaft pilot borehole and preparation of an inflow analysis to support shaft sinking.
- *Agapito Associates, Dominion Power Roanoke Rapids Dam, North Carolina – Senior Hydrogeologist* - Permeability study for the Roanoke Rapids Dam. Project work include field permeability testing of the dam and bedrock contact and analysis to support rehabilitation engineering study.
- *Nicolet Minerals Company, Crandon Project, Wisconsin – Senior Hydrogeologist* – Hydrologic characterization and permeability testing to support numerical modeling of groundwater for the Crandon Mine Environmental Impact Statement (EIS). Project work included the development and implementation of field testing programs, data analysis, and preparation of supporting documents for the EIS.
- *Nicolet Minerals Company, Crandon Project, Wisconsin – Senior Hydrogeologist* - Grouting feasibility study and pilot testing program. Project work included the design and implementation of a pilot test to evaluate the feasibility of a large-scale grouting program to control groundwater inflow to the proposed underground mine.
- *Minera San Xavier, Cerro San Pedro Mine, San Luís Potosí, México – Project Manager* - Hydrologic characterization study for open-pit mine and leach pad. Project work included the installation and testing of a monitoring well network, preparation of groundwater and storm water monitoring plans, and development of mitigation measures to prevent the release of ARD from the pit and waste rock facilities.
- *Nicolet Minerals Company, Crandon Project, Wisconsin – Project Manager* – Developed an analysis to relate weathering intensity, fracture frequency and aperture dimensions to hydraulic conductivity and groutability to evaluate the reductions in permeability that could be achieved by a large-scale grouting program.
- *Lac Minerals U.S.A., Ortiz Mine, New Mexico – Senior Hydrogeologist* - Designed and installed a grout curtain below an acid rock drainage (ARD) interceptor system to reduce seepage in fractured bedrock. Laboratory testing and geochemical modeling (PHREEQE) were performed to evaluate grout resistance to chemical attack.

- *Akzo-Nobel Salt, Hampton Corners Mine, New York*– Senior Hydrogeologist - Hydrologic characterization for shaft sinking. Project work included the design and implementation of a drilling and packer permeability testing program for the shaft site and calculation of the anticipated groundwater inflow during sinking.
- *Coeur Alaska, Kensington Mine, Alaska* – Senior Hydrogeologist – Hydrologic characterization study. Reviewed existing studies and data to characterize hydrologic conditions for the Kensington underground mine. Mine dewatering and water handling recommendations were made, and a geochemical evaluation (PHREEQC/MINTEQA2) was performed to evaluate the potential long term water quality in the mine.
- *Cyprus Minerals Company, Cerro Verde Mine, Peru* – Senior Hydrogeologist - Hydrogeologic characterization of a site for the construction of a copper heap leach facility. Project work included geologic evaluation and mapping, installation and testing of monitoring wells, packer permeability testing, and infiltration testing of unconsolidated sediments. Seepage estimates from the facility were prepared along with recommendations for facility monitoring.
- *McIntosh Redpath Engineering, Monarch Mine, Venezuela*– Project Manager - Hydrogeologic characterization for shaft sinking. Project work consisted of underground drilling and packer permeability testing, calculation of inflow to the shaft during sinking and preparation of recommendations for water control and handling.
- *Getchel Gold Corporation, Turquoise Ridge Mine, Nevada* – Senior Hydrogeologist - Hydrologic characterization and water control study for the Turquoise Ridge Mine. Performed and evaluated pumping tests, and developed a numerical groundwater flow model (MODFLOW) to predict inflow to the shafts during construction.
- *Sociedad Minería El Brocal, El Brocal Mine, Peru* - Senior Hydrogeologist – Numerical modeling of pit dewatering. Developed a finite-difference groundwater flow model (MODFLOW) to predict inflow to the planned open pit. The effectiveness of using surface extraction wells to dewater the mine was evaluated along with the potential impacts to surface water resources.
- *Meridian Gold, Bear Track Mine, Idaho* – Senior Hydrogeologist – Hydrologic characterization and dewatering study. Project work included the design, installation and testing of dewatering wells for the south pit, and spreadsheet modeling of groundwater flow.
- *Meridian Gold, Beartrack Mine, Idaho* – Senior Hydrogeologist – Pit Filling Study. Performed analytical calculation of flooding for South Pit at the cessation of dewatering.
- *Fluor Daniel, Alumbrera Project, Argentina* – Senior Hydrogeologist – Construction of water supply well field. Developed a groundwater supply well field for the construction and operation of a large copper porphyry mine in northern Argentina. Project work included evaluation of groundwater potential, field exploration for groundwater, the installation and testing of 7 large diameter (16-inch) production wells, and numerical modeling (MODFLOW) of the water supply well field.
- *Fluor Daniel, Alumbrera Project, Argentina*– Senior Hydrogeologist – Construction of a seepage capture well field for the Minera Alumbrera tailings facility. Project duties included the design, installation, and testing of a well field to capture bedrock seepage. Work performed for the project included on-site management of a two million dollar drilling program to locate, construct, and test nine large diameter (12-inch) extraction wells to depths of 200 meters.
- *Fluor Daniel, Alumbrera Project, Argentina* – Senior Hydrogeologist – Hydrogeologic investigation and evaluation of bedrock for tailings dam foundation. Project work included the design and installation of monitor wells, implementation of a packer permeability testing program, and evaluation of the hydrologic characteristics of bedrock.
- *Agrium, North Rasmussen Ridge Mine, Idaho* – Project Manager – Prepared Surface Water and Groundwater Monitoring Plan and Quality Assurance Project Plan for Annual Water Quality Sampling Program.

- *Agrium, North Rasmussen Ridge Mine, Idaho – Project Manager* – Installation and design of deep wells (>1,000 ft.) for compliance monitoring.
- *FMC, Dry Valley Mine, Idaho – Senior Geochemist* – Geochemical modeling and evaluation of chemical loading and transport in ground and surface water from proposed waste rock dumps for the Dry Valley Mine
- *Astaris, Dry Valley Mine, Idaho – Project Manager* – Prepared annual surface and groundwater monitoring reports for submittal to IDEQ for the years 1998 through 2008.
- *Astaris, Dry Valley Mine, Idaho – Project Manager* – Installation and design of deep wells (>1,000 ft.) for baseline and compliance monitoring of the C and D panel expansions.
- *Hecla Mining Company, Rosebud Mine EA, Nevada – Senior Geochemist* – Geochemical characterization study for the Rosebud Mine Environmental Assessment (EA). Project work included geochemical characterization of waste rock and ore (ABA testing, humidity cell, meteoric water mobility tests), hydrogeologic characterization of the project area, and evaluation of the potential impacts to groundwater quality from underground mining. A geochemical model (PHREEQE) was developed to evaluate changes in groundwater quality that would be caused by the project.
- *Hecla Mining Company, Rosebud Mine, Nevada – Senior Hydrogeologist* - Water supply study. Project work included the design and implementation of a groundwater exploration program, installation and testing of production wells in fractured bedrock.
- *Coeur Alaska, Kensington Mine, Alaska – Senior Geochemist* – Developed geochemical characterization program for cemented paste backfill containing flotation and cyanide tailings which incorporated column testing, acid-base accounting, NMWMT testing.
- *ENSR, Three Oaks Mine EIS, Texas – Senior Hydrogeologist* - Review and sensitivity analysis of “Brazos Region G” and “Three Oaks” numerical groundwater flow models (MODFLOW) for the Three Oaks Mine Environmental Impact Statement (EIS).
- *Sociedad Contractual Minera El Abra, Chile – Senior Hydrogeologist* – Third party review and hydrogeologic/geochemical characterization study for 180 mt. ROM Dump Leach facility. Project work included the review of previous hydrologic studies and the development of an integrated hydrogeologic model for the site. Leaching and attenuation studies for substrate materials were also performed using synthetic PLS. The main focus of the study was for permitting of the facility and to determine potential impacts to downstream users.
- *Kinross, Kettle River Operations, Washington – Senior Hydrogeologist* – Prepared numerical groundwater flow and contaminant transport model (MODFLOW/MT3DMS) to evaluate mitigation strategies for groundwater contamination at the Key Mill Tailings Facility. The model incorporated multiple contaminant sources, and was calibrated to 14 years of water quality and water level data.
- *Arch Coal, Carbon Basin, Wyoming – Project Manager* – Geochemical characterization study. Prepared geochemical evaluation for D-5 permit application and developed stratigraphic correlation for acid producing potential and constituents of concern.
- *Minera Hecla, La Choya Mine, Mexico – Senior Geochemist* - Designed and supervised sampling program for waste rock and spent ore to characterize material for site closure. A review of the existing geochemical data was performed to determine adequacy for mine closure.
- *Barrick Goldstrike Mine, Nevada – Senior Geochemist* – Geochemical modeling (PHREEQC/MINTEQA2) of sorption and mineral precipitation/dissolution reactions for the Betze-Screamer Pit Lake. Particular emphasis was placed on modeling the sorption behavior of arsenic to precipitating ferrihydrite using the program PHREEQC and a modified MINTEQA2 thermodynamic database.
- *CESEL Ingenieros, Cerro de Pasco, Peru – Project Manager* – Review and preparation of closure alternatives for Quiulacocha tailings facility and Excelsior waste rock dump, senior review of geochemical and hydrologic characterization programs, design of water quality monitoring program, numerical modeling (UNSAT-H) of seepage for cap/cover design.

- *Fluor Daniel, Batu Hijau Project, Indonesia, - Senior Hydrogeologist* – Numerical modeling of groundwater flow. Developed a finite difference groundwater model (MODFLOW) to simulate a pumping well field in a shoestring alluvial aquifer. The model was used to design a water supply well field for the mine and to predict the effects of pumping on surface water resources. The potential for sea water incursion into the aquifer was also evaluated.
- *Minera Alumbraera, Alumbraera Mine, Argentina – Senior Geochemist* – Prepared standard operating procedure manual for groundwater and surface water monitoring program.
- *American Electric Power, Windsor Mine, W. Virginia – Senior Hydrogeologist* – Prepared Probable Hydrologic Consequences (PHC) document for C-Panel expansion. Project work included the design and installation of a water quality/quantity monitoring network for the C-Panel area, determination of PHC's, and preparation of permitting document.
- *American Electric Power, 44 Hollow Mine, W. Virginia – Senior Hydrogeologist* – Prepared Probable Hydrologic Consequences (PHC) document for the proposed underground fine refuse disposal in the 6 East Panel, 44 Hollow Mine. Project work included the development of site hydrogeology, evaluation of mine flooding and seepage, and preparation of PHC document.
- *Cyprus Foidal Creek Coal Mine, Colorado– Senior Hydrogeologist* – Prepared study of long wall mining operation on surface and groundwater resources, including permit to mine under an alluvial valley floor.
- *Cyprus Twentymile Coal Company, Colorado – Senior Hydrogeologist* – Prepared salt loading evaluation of mine spoils on local drainages tributary to the Yampa River.
- *LAC Minerals U.S.A., Ortiz Mine, New Mexico – Senior Geochemist* - Developed a predictive geochemical model (PHREEQE) for the Ortiz Pit Lake. Equilibrium methods were used to identify and constrain geochemical controls of the pit lake water composition. The model incorporated humidity cell, acid-base accounting, XRD, microprobe and limnologic data to estimate the long-term water quality. Chemical profiles were developed from samples collected at various depths to investigate the potential for stratification of the lake.
- *LAC Minerals U.S.A., Coliseum Mine, California – Senior Geochemist* - Developed a predictive geochemical model (PHREEQE) for closure of the Coliseum Pit Lake. The model used equilibrium methods to identify and constrain geochemical controls of pit lake water quality, and incorporated humidity cell, acid-base accounting, and whole rock geochemical data. Chemical profiles were developed to investigate the potential for stratification of the lake.
- *Echo Bay Minerals Company, Key West Mine, Washington – Senior Geochemist* - Developed a predictive geochemical model (PHREEQE) for the Key West Pit Lake. Equilibrium methods were used to identify and constrain geochemical controls of pit lake water quality. The study incorporated humidity cell, acid-base accounting, and whole rock geochemical data.
- *Echo Bay Minerals Company, Key West Mill Site, Washington – Senior Hydrogeologist* – Hydrologic study and impact evaluation for the Key Mill near Republic Washington. The study incorporated analysis of the physical and chemical impacts to ground and surface water from milling operations and tailings disposal at the site.
- *Envirocare Clive Facility, Utah – Senior Geochemist* – Developed soil partition coefficients ( $K_d$ s) for organic constituents and radionuclides for the 11e.(2) and Western Low Activity Radioactive Waste (LARW) disposal cells.
- *Canyon Resources, Briggs Project, Nevada – Senior Hydrogeologist* – Developed Standard Operating Procedures Manual for groundwater and surface water sampling the mine. Prepared a statistical analysis of baseline water quality data to determine regulatory levels for constituents of concern.
- *Tenneco Minerals, Goldstrike Mine, Utah – Geologist/Geochemist* - Characterized the spatial distribution of trace metals in relation to structural features and ore-grade gold mineralization in the Humbolt Pit. The study included the design and implementation of the sampling program, laboratory characterization of wall rocks, and statistical analysis of trace metal correlation with gold.

- *Minera Yanacocha, La Quinoa Pit, Perú – Project Geochemist* – Performed mixing and pH calculations for pit dewatering discharge and receiving surface waters.
- *Coeur, Rochester Mine, Nevada – Senior Hydrogeologist* – Installation and hydrologic testing of a 14-inch water supply well to a depth of 1,000 feet.
- *Coeur, Rochester Mine, Nevada – Senior Hydrogeologist* – Numerical modeling of groundwater flow a contaminant transport (MODFLOW/MT3D) for the Stage I Heap Leach Facility.

## **PUBLICATIONS**

- Effner, S., Straskraba, V., Vandersluis, G., 1995. Pressure Grouting of Fractured Bedrock to Control Acid Mine Drainage. Proceedings of the 1995 Annual Meeting of The American Institute of Hydrology and the International Mine Water Association, Water Resources at Risk.
- Straskraba, V. and Effner, S., 1998. Water Control in Underground Mines - Grouting or Drainage?, Proceedings of the 1998 Annual Meeting of The American Institute of Hydrology and the International Mine Water Association, Water Resources at Risk.
- Vandersluis, G., Straskraba, V., and Effner, S., 1995. Hydrogeological and Geochemical Aspects of Lakes Forming in Open Pit Mines, Proceedings of the 1995 Annual Meeting of The American Institute of Hydrology and the International Mine Water Association, Water Resources at Risk.