SPECIALIZATION

Susan Wyman is a hydrologist and civil engineer who specializes in surface water and groundwater control, flow and contaminant transport modeling, water supply evaluation, and in the collection and analysis of geologic and hydrologic field data for water supply evaluation, permitting, and remediation. She has extensive experience in the both the technical and managerial aspects of preparing and implementing engineering design reports, Environmental Impact Statements, Environmental Assessments, Water Rights applications, Ground Water Discharge Permit applications, NPDES Permit applications, Discharge Monitoring Reports, Site Characterization reports, and Remedial Action plans.

EDUCATION

M.S., Hydrology, University of Idaho, Moscow, Idaho	1993
B.S., Geology, Lewis-Clark State College, Lewiston, Idaho	1990
ASTM Short Course "Ground Water Monitoring and Sampling Technology"	1993
CGWA Workshop "Ground-Water Flow in Low-Permeability Environments"	1995
Colorado School of Mines Workshop "Innovative Applications in Borehole Geophysics"	1997

PROFESSIONAL ACTIVITIES AND CERTIFICATION

Professional Engineer (P.E.) Colorado, Utah (Civil Engineering)
Professional Geologist (P.G.) Wyoming, Utah
OSHA 40-hour Hazardous Waste Operations Training
MSHA Surface & Underground Health & Safety Training
Colorado Groundwater Association, 1993 - present
National Groundwater Association, 1992 - present

WORK HISTORY

Whetstone Associates, Inc. Principal Hydrologist / Civil Engineer, 1999 – present

Adrian Brown Consultants, Inc. , Denver, CO. Principal Hydrogeologist, 1994 – 1999

Jacobs Engineering Group, Denver, CO. Hydrogeologist. 1993 – 1994

Idaho Water Resources Research Institute, Moscow, Idaho. Wellhead Protection Facilitator. 1992

Idaho Geological Survey, Moscow, Idaho. Cartographer. 1991 – 1993

Zortman Mining, Inc. Pegasus Gold Corp., Zortman, MT, 1990 – 1991

REPRESENTATIVE PROJECT EXPERIENCE

- *Taylor Ranch Project* – Designed and implemented baseline monitoring program for surface water, groundwater, and domestic wells. Developed database of historical and ongoing sampling results for water, soil, and air. Technical lead on water resource issues in public hearings and permitting applications for state and county environmental permits.
- *Blackfoot Bridge Mine, Idaho* – Designed baseline monitoring program for surface water. Conducted quarterly field sampling, evaluated data, and prepared summary reports in support of environmental impact analysis for an open pit phosphate mine, as a 3rd party EIS contractor to the US Bureau of Land Management.
- *North Rasmussen Ridge Mine, Idaho* – Evaluated potential geochemical impacts to surface water and groundwater from selenium and other constituents related to open pit phosphate mining, as a third party EIS subcontractor. Tasks included the analysis of climatological data, developing pit wall runoff predictions, modeling unsaturated flow through capped backfill using UNSAT-H and HELP3, assisting in the development of a groundwater flow model using Modflow and MT3D to assess the potential migration of COPCs in

groundwater, developing spreadsheet analytical models for surface water impact analysis, and preparing the Water Resources Technical Report for the US Bureau of Land Management.

- *North Rasmussen Ridge Mine, Idaho* – Evaluated the site hydrologic systems and regulatory framework and prepared the mine's Surface and Groundwater Monitoring Plan for submission to the Idaho Department of Environmental Quality.
- *Lisbon Valley Mine, San Juan County, Utah* – Located, designed, drilled, completed, and developed 5 industrial water supply wells capable of producing more than 1,200 gpm (630 MGY). Specified and installed high-capacity pumps and designed piping system for conveying well field water to 200,000 gallon storage tank.
- *Seminoe Road Pilot Project, Carbon County, Wyoming* – Designed, installed, and tested a water treatment system for the removal of iron, manganese and barium at 3 surface water discharge points associated with 18 coal bed methane (CBM) production wells. Designed piping, valves, aeration tanks, filter tanks, and surface water NPDES outfall, including pressurized and gravity-fed segments. Provided recommendations for erosion control at outfalls and in-channel drainage structures.
- *Kinross Gold K-2 Mine, Washington* – Designed a pumping and piping system to convey background mine water inflow from the 1290 level to a near-surface infiltration gallery. Evaluated water quality and potential water treatment requirements. Calculated friction losses and surge pressures, and specified pipe size and pump requirements for pressurized steel pipe system. Designed HDPE gravity piping system from the portal to the infiltration bed. Provided dimensions and specifications for infiltration bed components.
- *Kinross Gold K-2 Mine and Key Mill Site, Washington* – Designed three gravity-fed infiltration systems for above-ground and in situ bioremediation of underdrain water and mine water via denitrification and sulfate reduction. Engineered the infiltration systems, prepared design report, and wrote O&M manual for infiltration bed components.
- *Raton Basin, Colorado* – Provided expert testimony in a water rights case for landowners seeking beneficial use of CBM discharge water.
- *Raton Basin, Colorado* – Provided environmental consulting services to the Colorado Oil & Gas Conservation Commission (COGCC) on groundwater quality and quantity issues related to coal bed methane (CBM) production.
- *Petrogulf CBM Field, Raton Basin, Colorado* – Negotiated discharge standards with CDPHE, conducted monthly and quarterly inorganic and water effluent toxicity (WET) testing, prepared quarterly discharge monitoring reports (DMRs), conducted wellhead sampling, and developed strategies for compliance.
- *Schwartzwalder Mine, Colorado* - Designed and implemented a field investigation for surface water and groundwater flow and quality, evaluated non-tributary water rights, developed an extensive water quality database, designed and analyzed underground packer tests, evaluated post-closure water rights, developed a 3D finite element groundwater flow and transport model for the evaluation of engineering controls in support of closure of the underground uranium mine.
- *Rochester Mine, Nevada* – Developed a groundwater flow and transport model using Modflow and MT3DMS to evaluate cyanide fate and transport from the stage I heap leach pad. Evaluated pumping scenarios and remediation strategies for bedrock groundwater.
- *Big Elk Underground Coal Mine, Colorado* - Designed and implemented an investigation of the alluvial aquifer system, in support of the mine permit application.
- *Dry Valley Mine, Idaho* – Prepared the 2000 – 2006 annual surface water and groundwater monitoring reports, including statistical analysis and interpretation of geochemical conditions related to open pit phosphate mining.
- *Chiapetta Property, Colorado* – Designed a sanitary sewer tie-in for a private residence to the municipal system. Provided engineering design, cost estimates, and technical permitting support.
- *Mangino Property, Colorado* – Developed 100-year flood plain profiles using HEC-1, for submission to the county engineer and planning committee.
- *Brgosch Ranch, Colorado* – Evaluated pipe hydraulics and provided preliminary design recommendations for gravity-fed agricultural water distribution system.

- *North Rasmussen Ridge Mine, Idaho* – Evaluated regional groundwater flow system and potential geochemical impacts to groundwater and surface water from selenium and other constituents related to open pit phosphate mining, as a third party EIS subcontractor. Analyzed climatological data, developed pit wall runoff predictions, modeled unsaturated flow through capped backfill using UNSAT-H and HELP3, assisted in the development of a groundwater flow model using Modflow and MT3D to assess the potential migration of COPCs in groundwater, developed spreadsheet analytical models for surface water impact analysis, prepared the Water Resources Technical Report for the US Bureau of Land Management.
- *Toeroek Associates, Confidential Project Sites.* Provided technical expertise on the fate and transport of chlorinated solvents (PCE, TCE, cis-DCE, VC) in groundwater and soil, in support of EPA enforcement and PRP identification.
- *Rosebud Mine, Nevada* - Prepared the Final Permanent Closure Plan for closure of the underground gold mine and surface facilities. Evaluated the groundwater monitoring program and prepared recommendations for submission to NDEP for modifications to the post-closure monitoring plan.
- *Arch Coal Hanna Project, Carbon County Wyoming* - Prepared geologic cross sections and assisted with overburden geochemical evaluation for the Mine Permit Application to Wyoming DEQ.
- *Envirocare Clive Facility, Utah* - Conducted vadose- and saturated-zone flow and contaminant transport modeling of hazardous and radioactive constituents in support of several Utah Ground Water Discharge Permits. Used the UNSAT-H and HELP3 codes to evaluate infiltration through closed cell covers and moisture content in the subsurface profile. Used PATH-EPA code to evaluate potential exposure to radionuclide, metal and organic constituents at a point-of-compliance well over time. Preparation and submission of reports, and follow-up support with UDEQ.
- *Envirocare Clive Facility, Utah* - Performed slug testing and data analysis to develop hydraulic conductivity values for shallow hydrostratigraphic units. Developed techniques to account for borehole storage and performed statistical analyses of results.
- *Envirocare Clive Facility, Utah* - Developed a Modflow model to assess drawdown effects from pumping for water supply.
- *Envirocare Clive Facility, Utah* - Evaluated runoff from disposal cells and potential for infiltration and groundwater mounding, based on 5-, 10-, and 100-year recurrence interval storms. Performed unsaturated flow modeling to determine acceptable runoff and excavation areas, for permitting engineering design.
- *Johnson Camp Mine Project, Arizona* – Evaluated mine dewatering and water supply well locations, potential yield, and preliminary pump selection for Burro Pit dewatering and process water supply. Prepared hydrologic study plan for the Aquifer Protection Permit Application.
- *Lisbon Valley Copper Project, Utah* – Modeled groundwater flow and geochemical transport systems using finite element and robust spreadsheet models. Prepared hydrogeologic reports in support of the EIS, evaluated water supply potential and open-pit dewatering requirements, prepared documents in support of the Water Rights Application to the Utah State Engineer, prepared and submitted facility-wide Ground Water Discharge Permit Application, performed field aquifer testing and water quality sampling for permitting. Maintained close client contact and worked with permitting agencies on a variety of groundwater-related issues.
- *Lisbon Valley Copper Project, Utah* – Prepared semi-annual groundwater sampling reports for submission to state and federal agencies (1999 – 2006). Developed strategies for water rights implementation for open pit copper mining.
- *Dry Valley Mine, Idaho* – Prepared Quality Assurance Project Plans (QAPPS) and supporting documentation for Surface Water and Groundwater Monitoring and Mitigation Plan. Prepared Annual Surface and Groundwater Monitoring Reports for 2000 - 2002.
- *Golden Sunlight Mine, Montana* - Third party review of vadose zone modeling. Evaluated the HELP3 results for percolation through reclaimed waste rock dumps, for the purpose of estimating post-closure ARD generation potential. Worked with Montana BLM, BOM, and several consulting firms.

- *Barrick Goldstrike Mine, Nevada* - Wrote/implemented two work plans / field programs in support of a constructed wetlands facility for mine water discharge, prepared drill contractor bid document and contract, supervised field program of deep auger drilling, surficial soil sampling, soil profiling, and groundwater sampling, arranged for laboratory analysis, performed statistical analyses and reported results.
- *Diamond Airport Parking Facility, Utah* – Performed field investigation of subsurface chlorinated hydrocarbon occurrence in shallow groundwater and soils, developed remediation strategies and cost estimates, developed statistical methods for evaluating clean up criteria, authored the Site Characterization and Remediation Proposal, in support of litigation and under a Voluntary Cleanup Agreement with the State of Utah.
- *Alta Gold Copper Flat Project, New Mexico* - Drilled, packer-tested, and completed bedrock wells peripheral to an open pit copper mine. Conducted aquifer pumping tests in alluvial wells, as well as sampling of groundwater wells and surface water bodies.
- *Alta Gold Copper Flat Project, New Mexico* – Developed and calibrated a regional 3D finite element groundwater flow model to predict the effects of well field pumping and open pit mining on local and regional hydrology. Three decades of historical project data were compiled for the development of the model. Modeling results were incorporated into the EIS for new mine operation. Assisted with presentation and defense at public hearings before the state board.
- *COGEMA Resources Midwest Project, Saskatchewan* - Conducted geologic borehole logging, performed and analyzed numerous down-hole (straddle packer) hydraulic conductivity tests, supervised well completion, and collected groundwater samples from deep wells in the Athabasca sandstone. Compiled the results of the field investigation and them incorporated into the EIS supporting document on the hydrogeology of the ore deposit.
- *COGEMA Resources Midwest Project, Saskatchewan* – Developed a 3D Modflow model of hydrogeologic system, which included phased freezing, mining, backfilling, and thawing of the proposed underground uranium mine. Results were incorporated into the EIS supporting document on the hydrogeology of the ore deposit.
- *Kennecott Utah Copper* - Designed and tested 1,000 gpm production well, assembled hydraulic conductivity data and provided oversight in support of 3D Modflow groundwater model, designed remedial extraction well for low-pH high-sulfate groundwater.
- *Lamefoot Project, Washington* – Performed analyses of packer test data in extremely low conductivity materials, in support of underground mine expansion.
- *Diamond Shamrock #646,Colorado* - Conducted and analyzed rising- and falling-head slug tests, for the evaluation of groundwater flow and contaminant transport.
- *Finsch Mine, South Africa* - Modeled mine water inflow for a 640-meter deep underground diamond mine, using radial and 3D steady-state finite-element models.
- *Zortman/Landusky Mines, Montana* - Evaluated surface water and groundwater geochemical and flow system. Investigated the probable sources of ARD-related constituents to a single water supply well, in support of remedial action.
- *Confidential Client, California* - Evaluated fate and transport of chromium in groundwater and soils, in support of litigation. Work product included mass balance calculations and evaluation of geochemical processes, field data collection, forensic water supply reconstruction, and general litigation support.
- *Cobre Mines, New Mexico* - Evaluated EIS contractor's approach and technical work products on behalf of the proponent, for a proposed open-pit copper mine expansion project.
- *Rocky Flats Environmental Technology Site, Colorado* – Evaluated environmental impacts associated with building foundation drains, developed work plans and sampling protocol for radionuclides associated with Operable Unit (OU) 14.
- *Shemya Air Force Base, Alaska* - Designed aquifer remediation and treatment systems, drilled, installed and sampled monitoring wells, managed analytical databases, predicted contaminant plume migration, evaluated groundwater monitoring programs, wrote technical reports.

- *Idaho Water Resources Research Institute* - Co-wrote manual, prepared slides and illustrations, conducted five workshops across the state of Idaho educating agency personnel and interested citizens about the Idaho Wellhead Protection Plan.
- *Idaho Geological Survey, Idaho* - Digitized and edited geologic maps using AutoCAD and Generic CADD, for publication and sales.
- *Zortman/Landusky mines, Montana* - Conducted mineral exploration peripheral to mine, and on other Montana properties. Supervised 6-person soil crew, collected soil samples, maintained geochemical database, logged drill cuttings, performed geologic field mapping, surveyed geophysical (IP) lines, drafted maps and assay results.

PUBLICATIONS

Schuler, Susan A. Wyman, 1990. Particle size analysis of Mt. Mazama Ash. Idaho Academy of Science Abstracts

Wyman, Susan A., 1993. "The potential for heavy metal migration from sediments of Lake Coeur d'Alene into the Rathdrum Prairie aquifer". M.S. Thesis, University of Idaho, Moscow, Idaho (in conjunction with Idaho Water Resources Research Institute and IDH, Panhandle Health District.)

Brown, Adrian and Susan A. Wyman, 1995. "Packer testing of very low-permeability rocks", International Association of Hydrology, International Mine Water Association Conference, Denver Colorado.

Brown, A., Callendar, J.C., and Wyman, S.A., 1998. "Influence of tectonic displacement barriers on alluvial aquifer behavior", National Ground Water Association 50th Annual Meeting and Exposition, December, 1998.

Wyman, S.A., Brown, A., and Bauer, C.F., 1998. "Hydrogeologic controls on recharge to the deep regional aquifer, Lisbon Valley, Utah", National Ground Water Association 50th Annual Meeting and Exposition, December, 1998.

Wyman, Susan A., 2001. "Performance Assessment of Class A Low Level Radioactive Waste Disposal Using the Discrete-Dispersed Source Method for Fate and Transport in Groundwater", Waste Management 2001 Conference, Tuscon Arizona, February, 2001.

Wyman, Susan A., 2003. "Coal Bed Methane Groundwater Discharge in Huerfano County, Colorado", presentation to the general membership of the Colorado Ground Water Association, Denver, Colorado, April, 2003.