PACIFIC GROUNDWATER GROUP

PETER N. SCHWARTZMAN
Associate Hydrogeologist

EDUCATION

M.Sc. Hydrology (Hydrogeology), 1989
University of Arizona

B.A. Geology (Environmental Studies)
1984 Magna Cum Laude
University of Pennsylvania

PROFESSIONAL SOCIETIES

Washington Hydrologic Society
(Co-Founder)

National Society of Ground Water
Scientists and Engineers

PROFESSIONAL EXPERIENCE

Mr. Schwartzman has been involved in local hydrogeologic site assessments, regional groundwater resource evaluations, water-supply development, and contaminant hydrology for over nineteen years. His educational background in geology and hydrology is complimented by project experience in such areas as: characterization and computer modeling of groundwater flow systems; assessment of stream-aquifer interaction and saltwater intrusion; design/installation of water-supply and monitoring wells; aquifer testing; stream gauging; and contaminant delineation. Mr. Schwartzman has developed a variety of regional and local groundwater flow models, and is proficient in many computer applications to hydrogeology. He has modeled groundwater recharge based on climatic, soils and land-use factors; infiltration of recharge through the unsaturated zone; and a wide variety of saturated flow systems. In addition, he has co-instructed groundwater modeling courses and has contributed to the development of groundwater modeling software

REPRESENTATIVE PROJECT EXPERIENCE

Groundwater Modeling

- Developed a groundwater flow model of the Vancouver Lake lowland in Clark County, Washington to evaluate water supply capacity from a high yielding aquifer along the Columbia River. A local groundwater contamination plume may be the limiting factor for groundwater development in this shallow aquifer. Evaluated model scenarios for contemporaneous pumping and containment of the plume, and represented Clark Public Utilities to review an alternative groundwater flow model developed for the Port of Vancouver used for similar predictions. Based on PGG's review of the Port's model and the interest of all parties to develop a mutually acceptable model for evaluating plume containment and water-supply options, PGG is currently working with the Port's consultants to assist in developing a mutually agreeable model.

- Developed and calibrated both local and regional groundwater models to evaluate aquifer capacities to accept groundwater recharge via wastewater infiltration for the LOTT Alliance (a wastewater utility comprised of Lacey, Olympia, Tumwater and Thurston County). PGG subcontracted to Brown & Caldwell to perform this evaluation. Site scale modeling was first used to evaluate aquifer properties based on measured responses to infiltration tests at two sites. A regional model, currently in use by members of the LOTT Alliance, was refined for consistency with local hydrologic conditions, and then used to estimate the movement of infiltrated water and its affect on other hydrologic features. Telescopic mesh refinement, a method used to extract a detailed local-scale model from the regional model, was used to ensure consistency with the regional groundwater flow system *and* obtain reasonable accuracy for local infiltration predictions.

- Designed, constructed and calibrated a groundwater flow model for the Camas-Washougal vicinity along the Columbia River in support of an application for new water rights by the City of Camas. The model was used to estimate impacts of new pumping on baseflows in the Washougal River and to design a mitigation strategy to offset baseflow impacts. The City of Camas will forego diverting water from surface-water sources during critical months

for fish habitat in return for new water rights to pump groundwater. Modeling showed that the surface-water flow returned to the river system (and associated tributaries) will more than offset for the impact of additional groundwater pumping due to seasonal changes to the mode of connection between the Washougal River and the underlying aquifer.

- Updated and calibrated a groundwater flow model of a stratified groundwater flow system on the Olympic Peninsula to evaluate hydraulic continuity between streams and wells in various aquifers and to analyze the effects of reduced groundwater recharge associated with lining leaky irrigation ditches and/or substituting surface-water sources with groundwater sources. The model analysis was performed for Ecology and Sequim-Dungeness irrigators in order to evaluate conservation options recommended for the irrigation system to increase baseflow on the Dungeness River. Worked cooperatively with Montgomery Water Group (irrigation strategies), Clallam County (local data), and the USGS (ongoing hydrogeologic characterization). Model results provided insight into the effects of reduced irrigation recharge on shallow groundwater levels and stream baseflows. This model was further developed by other parties over the past few years. PGG is currently retained by Clallam County (under a grant from Ecology) to refine and improve the existing model in order to use it for evaluating aquifer storage opportunities.

- Developed numerical models for three tributary watersheds of the Yakima River to assist Department of Ecology in evaluating how proposed transfers of irrigation water rights would affect baseflows (low flows) in the tributary streams and mainstem Yakima River. In all cases, irrigation from the streams was predicted to contribute to groundwater recharge via field and ditch seepage loss, and ultimately support stream baseflow both during and after the irrigation season. The water rights (owned by Trendwest) would be transferred to instream flow under the Yakima River Trust program. While the transfers would increase streamflows during most of the irrigation season, periods were predicted (both during and after the season) when the transfers would result in reduced flows due to loss because subsurface return flow would have exceeded diversion quantities. MODFLOW modeling was applied to all three basins to estimate the rates and timing of discontinued return flows under the water rights transfer. Sensitivity analyses were included to evaluate reasonable ranges for hydrologic impacts.

- Developed a groundwater flow model to evaluate how reduced irrigation in the Klamath River Basin (Oregon) would affect stream baseflow both during and after the irrigation season. The model represented a sub-area of the river valley, surrounded by local streams, and depicted the effect of reduced irrigation recharge on a portion of this land area. Stream baseflow was predicted to increase during the irrigation season and reduce over the remainder of the year due to discontinued return flows from irrigation.

- Developed a series of vertical "slice models" across the SeaTac Third Runway embankment to evaluate how the thickness of embankment fill will affect groundwater baseflow ("low flows") in streams located below the embankment slope. Emplacement of a significant thickness of embankment fill was expected to alter the timing of natural recharge to the underlying shallow aquifer by spreading out the seasonal "recharge pulse" over more of the year and causing longer time delays for infiltration to reach the water table. The slice models combined predicted changes in the timing for natural recharge reaching the water table with estimation of lateral flow through the uppermost aquifer towards the receiving streams. Recharge transmission vertically downward through the vadose zone (e.g. various thicknesses of embankment fill) was simulated with Hydrus-2D, a finite-element, variably-saturated flow model. Lateral groundwater flow towards downgradient streams was simulated by developing an in-house, explicit finite-difference model that included multiple layers (a drain layer installed over the existing aquifer) and downward leakage through till at depth. The modeling was peer reviewed, and successfully used to evaluate changes in the streamflow regimes downgradient of the Third Runway embankment.

- Assessed the effects of excavating several hundred feet of unsaturated gravelly materials on groundwater levels and spring flows for a proposed gravel mine on Maury Island. Estimated recharge at the land surface under a variety of geologic and land-cover conditions using an in-house version of the USGS "Deep Percolation Model" (DPM). Performed unsaturated flow modeling with the USDA finite-element code HYDRUS-2D to assess how the thickness of the unsaturated zone affects lagging and dampening of the recharge infiltration from the land surface to the water table. Developed a multi-layer finite difference model of Maury Island with the USGS MODFLOW code

and calibrated to field data. Integrated the results of all three models to make hydrologic impact predictions. Represented client (Dept. of Ecology) in public review process.

- Developed and calibrated a multi-layer finite difference computer model to simulate groundwater flow in a complex glacial/alluvial aquifer system in the vicinity of Renton, Washington. Compiled and interpreted geologic and hydrologic data for model design and calibration. Applied GIS approach to estimate areal recharge from land-use information. Calibrated model to steady state and transient conditions. Used model to delineate three-dimensional capture zones for wellhead protection, predict transport of an existing groundwater contaminant, assess pumping regimes required to exclude contaminant from municipal wells, and evaluate stream-aquifer interactions.

- Developed a series of investigative groundwater flow models to evaluate the subsurface hydraulics supporting a major spring system located at the base of an uplands escarpment near Auburn, Washington. The models were used to better understand how various components of the groundwater flow system support inflow to infiltration galleries completed in more than one hydrostratigraphic unit. Flow conditions were evaluated during transient discharge tests, over seasonal variations, and through occurrence of drought. The models also included aquifer interaction with a nearby stream. The modeling was used to evaluate the sufficiency of existing conceptual models to predict availability of additional springflow (via pumping), as well as resulting impacts on a neighboring stream. The modeling showed that additional subsurface characterization would be needed to adequately explain the physical mechanisms contributing to spring discharge. Empirical approaches were used to estimate spring yields and the hydrologic impacts of increased pumpage at the springs.

- Designed and assisted in development of a three-dimensional groundwater flow model of a highly stratified aquifer system in the vicinity of Auburn, Washington. The layered flow system is truncated by alluvial valley sediments and discharges to two major rivers. GIS approaches were used to estimate the distribution of recharge and define occurrence of hydrostratigraphic units. The model will be used to evaluate coupling between the rivers and groundwater flow system, assess artificial recharge opportunities, delineate wellhead protection capture zones, and evaluate contaminant transport scenarios (if necessary).

- Developed and applied numerous local scale groundwater flow models for prediction of aquifer response to pumping, stream impacts associated with groundwater development, and contaminant transport pathways under both natural and pumping conditions.

- Performed technical review of previously developed groundwater flow models within the Portland Basin. Models developed for the entire basin (USGS), the Portland Wellfield vicinity, and the Blue Lake Aquifer were examined. Approaches to improve existing model configurations (through revised discretization, refined geologic characterization, and additional calibration) were suggested.

Water Rights Assistance and Expert Witness Testimony

- Currently assisting Ecology with water rights analysis, processing and preparation of reports of exam (ROE's) for the City of Northbend's application for new groundwater rights. PGG has been instrumental in developing a technical approach to assess the impacts of proposed pumping, including recommending models used for estimation of baseflow depletion and developing spreadsheets to estimate the capacity of existing mitigation sources based on model results. Technicalities of the project have been reviewed by external parties such as the Tulalip Tribe and the Center for Environmental Law and Policy (CELP).

- Assisted Ecology with water rights analysis, processing and preparation of reports of exam (ROE's) for Trendwest's Mountainstar development near Cle Elum Washington. Managed a team of technical and policy consultants to perform the hydrologic analyses required to evaluate the water right requests. Performed the groundwater and stream-aquifer interaction technical analyses as part of the technical evaluation. The work was performed under Ecology's cost reimbursement program.

- Currently assisting Ecology with processing of the City of North Bend's water right request under the cost reimbursement program. Reviewed technical analyses provided by the applicant's consultant in support of their

water right application. Reviewed water rights policies relevant to the proposed water use. Advised Ecology on policy and technical issues associated with processing the water right application.

- Provided expert witness testimony for a water-rights dispute regarding potential impacts to streamflows in the vicinity of a proposed gold mine in Okanogan County, Washington. Evaluated hydrologic characterization and model predictions prepared by the proponent to assess accuracy of estimated streamflow depletion. Assessed adequacy of proposed mitigation plan to offset streamflow reduction. Assisted attorneys with technical aspects of the water-rights appeal.

- Submitted expert witness testimony in a homeowner–developer dispute regarding potential impacts on groundwater quality associated with land-use activities. Characterized site hydrogeology and evaluated the potential for water-quality impacts within the capture zone of a public water system well.

- Provided technical assistance to support water rights sought and obtained by the City of Sequim. Reviewed historic water-right correspondence to define current status; facilitated certification of water rights based on evaluation of wellfield performance; represented City to Department of Ecology to obtain supplemental rights for a new wellfield with reduced hydraulic continuity to the Dungeness River; performed technical evaluation to set action-levels and conditions on wellfield operation.

- Characterized water-right allocations in four hydrologic basins as part of Initial Watershed Assessments of the Snohomish, Deschutes, Walla Walla, and Kitsap Water Resource Inventory Areas (WRIA's). Defined the spatial distribution of surface-water and groundwater rights, distribution by type of use, and the historic increase in water-rights over time. Compared water-right allocations to estimates of actual consumption to address implications of potential effects of full water right utilization.

- Performed countless assessments of predicted hydraulic impact associated with proposed groundwater withdrawals, as required by Department of Ecology for water right permitting. The assessments typically addressed the potential for impairment to: senior water-right holders (interference drawdown); baseflows in streams and the potential for saltwater intrusion.

Groundwater Resource Evaluation and Development

- Co-authored and edited Initial Waterhed Assessments of the Deschutes, Snohomish and Walla Walla Basins as a part of Ecology's Water Resource Inventory Area (WRIA) studies. Investigated the hydrogeology and reported water-rights allocations and water use for each basin. Coordinated an interdisciplinary team of scientists in order to incorporate evaluations of climate, stream flow, water quality and fisheries into each study.

- Co-authored the Stage 1 Technical Assessment for WRIA 17, a comprehensive hydrologic study covering mst of Jefferson County and portions of Clallam County. The Technical Assessment has been described as one of the most comprehensive prepared in Washington State. Evaluated and described: groundwater hydrology, groundwater/surface-water interaction, groundwater recharge and withdrawals, groundwater quality (including saltwater intrusion), and water rights.

- Provided hydrogeologic assistance to the PUD #1 of Jefferson County for design, installation, and testing of their new (2005) Four Corners Well, located at the Jefferson County Airport. Prepared drilling specifications, oversaw drilling activities, designed and conducted aquifer testing, estimated sustainable yield for the well, characterized the local hydrogeologic framework (thus providing new information to modify the framework delineated by the U.S. Geological Survey), generated a numerical groundwater flow model of the Tri-Area vicinity to evaluate hydrologic impacts associated with pumping.

- Reviewed and provided technical evaluation of a proposal by Fred Hill Materials (FHM) to excavate a new gravel mine ("Wahl Pit") near Thorndyke Creek in Jefferson County. Evaluated hydrogeologic characterization performed by FHM's consultants and estimated hydrologic impacts associated with the proposed excavation. Provided comments to Jefferson County Department of Community Development. PGG's comments resulted in

modifying the County's approval for the Wahl Pit to a phased expansion approach and incorporating a monitoring plan to assess hydrologic impacts during the first phase of excavation.

- Provided hydrogeologic assistance to the Jefferson County Department of Public Works for design, installation and testing of their Quilcene Community Test Well. Managed drilling activities, designed and conducted aquifer testing, estimated sustainable yield for the well, characterized the local hydrogeologic framework, and estimated hydrologic impacts associated with pumping.

- Assumed the lead role in evaluating hydrogeologic conditions within the McAllister Springs Geologically Sensitive Area (Thurston County, WA) to facilitate design of a wellhead protection network. Developed a work plan for test well installation, aquifer testing, and monitoring. Coordinated Wellhead Protection Program (WHPP) field investigations, prepared WHPP characterization report and developed recommendations for ongoing WHPP activities.

- Performed a regional water resource evaluation of a fractured rock flow system in rural Skamania County. Assessed streamflow, recharge, groundwater flow patterns, aquifer properties, potential well yields, and water quality. Performed a regional water budget and evaluated potential impacts of future development. Assisted the client in setting up a monitoring network, field locating wells with GPS, and developing a database of well logs, groundwater levels, and water quality data.

- Provided hydrogeologic assistance to the City of Sequim regarding development and operation of their Silberhorn and Port Williams wellfields. Activities include geologic characterization, well installation and testing, wellfield performance and optimization analysis, evaluation of impacts associated with pumping, development and implementation of monitoring plans, installation of electronic monitoring instrumentation, and representing the City in water rights negotiations with Ecology and other parties.

- Analyzed pumpage, well performance, and aquifer response data for a major water purveyor in Clark County, Washington to formulate wellfield optimization strategies. Recommended strategies to minimize impacts on streamflow. Investigated new water-supply alternatives, developed drilling strategies based on assessment of local and regional geology, and supervised drilling of boreholes. Designed, installed, and tested successful production wells.

- Evaluated hydrologic impacts to rivers and lakes associated with developing a high capacity wellfield as the City of Olympia's primary source of supply. The new wellfield is preferred because it is less susceptible to groundwater contamination than existing sources. Mitigation approaches were developed to prevent lake-level declines and enhance riparian plant communities along lakes. Contributions of a habitat biologist and surface-water hydrologist were integrated into the project.

- Evaluated groundwater conditions and hydraulic consequences of a proposed large-scale wetland creation designed to mitigate wetland loss associated with highway construction. Major issues included: rising groundwater levels on adjacent properties associated with decommissioning of drainage ditches and alteration of the flow regime of a stream which borders the site (e.g. change in flood frequency). Recommended monitoring strategies to evaluate background conditions and the performance of the installed wetland.

- Assessed hydrostratigraphy and saltwater intrusion conditions on the Omani coast for the USAID WASH project in the Middle East. Developed recommendations and technical specifications to further define the hydrogeology and extent of saltwater intrusion. Evaluated and addressed the appropriateness of alternative well technologies as a means of reducing saltwater intrusion.

- Developed a methodology to monitor and evaluate aquifer susceptibility to saltwater intrusion for the Jefferson County Department of Environmental Health. Provided the client with a database to store well, groundwater levels, and water quality information. Designed analytical tools for the client's use in assessing relative degree of susceptibility, as required in the County's critical areas ordinance. Provided ongoing support in assessing saltwater intrusion.

- Evaluated the hydrogeology of a natural embankment of glacial materials directly downstream from the City of Seattle's Chester Morse Lake reservoir. Groundwater conditions in the embankment vary as a function of water level maintained in the lake, and respond quickly to changes in lake-levels. The stability of the embankment is threatened at levels. Historic lake-level, groundwater level, streamflow, and spring discharge data were analyzed to assess hydrogeologic properties of the embankment. Improved understanding of flow-system responses at various lake levels yielded recommendations for system operation and further study.

- Conducted a regional hydrogeologic evaluation of a southeastern Arizona watershed which characterized aquifer parameters, groundwater occurrence and flow patterns, river baseflow, surface water - groundwater interactions; water quality; and projected impacts of groundwater development.

- Developed recharge potential and aquifer vulnerability maps for Clark County, Washington based on digitization of topographic, climatic, and hydrogeologic data.

- Designed and installed numerous water-supply and monitoring wells. Activities included: preparation of technical specifications, geologic logging, well installation and development, aquifer testing, yield assessment for wells and wellfield optimization.

Groundwater Pollution Monitoring and Control

- Developed and applied a groundwater flow model to evaluate contaminant transport near a major wellfield completed in hydraulically connected deltaic and valley-fill (alluvial) deposits. The wellfield was overlain by dense, urban development. Assessed existing concentrations, contaminant pathways, and pumping regimes required to prevent contaminant from entering municipal wells. Evaluated groundwater flow patterns to evaluate possible locations of contaminant release.

- Assessed the distribution of groundwater contamination beneath an eastern Washington landfill site. Applied knowledge of site hydrogeology to discern possible contaminant transport pathways, and assisted in designing and installing a monitoring system to detect further contamination.

- Developed a monitoring plan for a proposed commercial development in eastern Jefferson County in order to detect and respond to potential groundwater quality impacts associated with a stormwater infiltration facility. The plan specified the design and location of monitoring wells, sampling schedules, detection "action" levels, statistical methods for analyzing water-quality data, and an enforcement plan to respond to potential water-quality degradation.

- Evaluated the groundwater flow system beneath a major central Washington landfill site. Logged multiple borehole installations, performed and interpreted aquifer tests, delineated groundwater occurrence and flow patterns, and estimated groundwater fluxes and water-budget components. Installed a system of monitoring wells to evaluate background quality and provide capability to detect potential future contamination. Collected and maintained water quality data for the site.

- Evaluated a dewatering system for cutoff of contaminated groundwater underflow in an alluvial aquifer influenced by complex tidal conditions.

- Implemented RCRA part B monitoring requirements at a major western Washington oil refinery. Managed field monitoring of soils, pore water, and groundwater.

- Evaluated and monitored a vadose zone neutron logging system designed for leak detection in the vicinity of hazardous waste holding ponds at a major Tucson aircraft manufacturing plant.

PUBLICATIONS

"A Hydrogeologic Resource Assessment of the Lower Babocomari Watershed, Southern Arizona", by P. N. Schwartzman, thesis presented to the University of Arizona in partial fulfillment of requirements for the degree of Master of Science in hydrology, September, 1989.

"Hydrology of the Upper San Pedro Basin", by P. N. Schwartzman, University of Arizona Water Resource Research Center, In-house Technical Paper, June, 1987.

COURSE INSTRUCTION

Principals of Groundwater Flow and Transport Modeling. Co-Instructor in a course offered by the University of California Cooperative Extension / Groundwater Hydrology Program over a dozen times between 1997 and 2008.

PRESENTATIONS

"Evaluation of Streamflow Reduction from Cessation of Irrigation Return Flow". AWRA Groundwater/Surface-Water Interaction Conference, Keystone, Colorado, July 2002.

"Evaluation Of Streamflow Impacts from an Upland, Wet Pit Gravel Mine". AWRA Groundwater/Surface-Water Interaction Conference, Keystone, Colorado, July 2002.

"An Initial Watershed Assessment of the Snohomish Water Resource Inventory Area". Washington Hydrologic Society. 1996.

"Hydraulic Continuity Between Groundwater and Surface Water". Law Seminars International. March, 1996.

"Basin Assessments: A Necessary Ingredient for Basin Planning". Law Seminars International. March, 1996.

"Hydrogeology of Jefferson, Clallam and Kitsap Counties - A Local Perspective". Washington State University Extension short course on water resources. Realtors workshop - 1996, 1997, 1998.

"Hydrologic Monitoring: Groundwater Levels, Streamflows, and Seawater Intrusion". Washington State University Extension. Water Watchers Program - 1996, 1997.

"Hydrogeology 101 and Local Conditions". Washington State University Extension. Water Watchers Program – 2008.

Bullet Point List for Peter Schwartzman's Testimony at the M3 Water Rights Hearing
FINAL VERSION: November 25, 2008

1. I was the Pacific Groundwater Group (PGG) project manager and chief modeling expert in developing the 4 PGG reports (titles below). I directly supervised three members of PGG's staff in: developing and calibrating the model, conducting Geographic Information System (GIS) analyses for water budget assessments of recharge, canal leakage and delineation of aquifer positions, and in running the simulations of future pumping and change-in-recharge scenarios for the M3 project. The 4 PGG reports are:
    a. "M3 Groundwater Flow Model and Analysis of Pumping Impacts, First Year Progress Report," June 4, 2008
    b. "Technical Memorandum: Transient Calibration to the SVR #7 Pumping Test (M3 Eagle Groundwater Flow Mode)," July 26, 2008
    c. "Technical Memorandum: 50-Year Drawdown Simulation with Proposed NPW wells (M3 Eagle Groundwater Flow Model)," September 22, 2008
    d. "Technical Memorandum: Model Refinement and Recalibration; Re-simulation of 50-year Drawdown; and Assessment of Affects of Reduced Canal Leakage (M3 Eagle Groundwater Flow Model)," November 14, 2008
2. I have personally designed, developed, calibrated, run simulations and/or managed/overseen at least 22 ground water flow models over the past 19 years as a hydrogeologic consultant. I have also reviewed models developed by outside parties and served as an expert witness presenting the results of my review.
3. I have worked extensively with, and am experienced with, the USGS-developed groundwater flow modeling software "Modflow," and the graphical interface package "Groundwater Vistas" developed by Environmental Simulations, Inc., and have taught groundwater modeling at nationally recognized courses.
4. I played an intimate role in the translation of the hydrogeologic data into the computer input files used in the Modflow model of the greater M3 Eagle vicinity. I worked closely with HLI to ensure that the Modflow model represents the conceptual model of the groundwater flow system developed by HLI, and concur that the model is realistic in its representation of groundwater flow within the Pierce Gulch Sand Aquifer as characterized by HLI, within the model domain presented in the 4 modeling reports.
5. The calibration of the model to existing conditions (i.e. "steady-state" water levels of summer-2007) is within generally accepted, statistically valid level of accuracy. In order to address hydrogeologic uncertainties (that are inherent in characterization of *all* groundwater flow systems), PGG developed two versions of the model which represent a range of possible sub-surface conditions that is jointly consistent with the available hydrogeologic information. Along with the successful steady-state calibration of both versions to summer-2007 conditions, the model(s) were also calibrated in transient mode to several major aquifer tests. Specifically, the "Hmatch" model version showed good calibration to 3 major aquifer tests, and the "Tmatch" model showed good calibration to one major aquifer test and poor calibration to a second aquifer test (Eaglefield #2 aquifer

test). This Eaglefield #2 test may have been influenced by outside conditions not represented by the model, or the calibration may indicate that local conditions (in the immediate vicinity of the test) were not represented in the model, which was designed to represent regional (rather than local) hydrogeologic conditions.

6. The calibrated model groundwater flow contours show that a portion of the groundwater with the Pierce Gulch Sand Aquifer flows to the Payette River Valley and that a portion remains in the Boise River Valley. The calibrated model groundwater flow contours are consistent with the characterization of groundwater flow patterns developed by HLI in the focus area consisting of the M3 property, the cities of Eagle and Star and the nearby environs. Farther away from this focus area, modeled groundwater flow contours are likely to be less accurate.

7. The predictions of drawdowns in the Pierce Gulch Sand Aquifer made by the model, even in its most-conservative version (the Hmatch model calibrated with the higher total pumping rates) are realistic representations of impacts that are likely to occur in the vicinity of the M3 project and the City of Eagle.

8. I have read the *M3 Eagle, LLC Second Amended Application for Water Right Permit* and believe that the model adequately represents the average annual amount of water requested for the project.

9. The model indicates that the Pierce Gulch Sand Aquifer beneath the M3 property can adequately supply the long-term annual average amounts of water requested in the water rights application.