

**Professor Ram Arora, PhD
HydroVision, Inc.
Duluth, GA**

Billing Rate: \$ 290 per hour

Round Table Group Assessment of Expertise:

Dr. Arora is a Registered Geologist with a concentration in Hydrogeology. Although he has taught classes at the graduate level, He has always been a practicing hydrogeologist. He has extensive expertise in the issues of earthquake faults, fractured rock, runoff from the local mountain ranges, as well as surface flows, sub-basins (or sub-units), subsidence, safe yield and recharge. Dr. Arora has served as an expert before and in that capacity has testified at trial and depositions. He is familiar with the Antelope Valley Basin.

Statement of Expertise:

1. Dr. Arora has a PhD degree in Geology (Hydrogeology) from Boston University and a Master degree in Applied Geophysics (earthquake related issues).
2. Dr. Arora taught at the University of Wisconsin (Oshkosh), Wayne State University (Detroit), and Georgia State University (Atlanta). At Georgia State he was full professor and director of Hydrogeology. He taught courses in hydrology (including States and Federal water laws), water resources management (including water rights, groundwater contamination, and inter-basin surface and groundwater transfer) and hydrogeology (including groundwater hydraulics). He was the first person in the country to develop (1986) and taught courses in fractured rock hydrology. He organized an international conference (1988) entitled “Fluid Flow in Fractured Rocks”.
3. For six years Dr. Arora managed the State of Georgia’s hydrology (Surface Water Basin and Ground water Basin) program.
4. Dr. Arora founded HydroVision, an Environmental Engineering Company and helped several private and governmental clients on issues related to hydrology/hydrogeology. He taught and performed aquifer tests to calculate subsidence rate, safe yield (including in fractured bedrocks) and recharge parameters to aquifers. On several hazardous waste sites, he routinely determines the local and bulk groundwater flow systems, their interaction with the surface water bodies, and impact of rocks movements by fluid (earthquake faults and fractured rock). He has worked on several projects to determine the source of contamination in fractured rocks environment where the geology and hydrogeology of surface and groundwater basin are interconnected by fractures.
5. Dr. Arora has experience testifying in depositions and at trial. He has been hired by clients to address issues related to contamination of groundwater from gas stations and Nike-Missile sites; and has provided interpretations of available information that helped his clients settle cases out of court.
6. Dr. Arora is aware of Antelope Valley (California) water resources management issues (i.e., both quantity/quality).

Resume Information:

Highlights

- Key consultant in solving groundwater related challenges in complex geologic environment for eight major projects. These solutions include:
 - Evaluation of Technical Impracticability (TI) waiver for TCE in fracture bedrock aquifer.
 - Interconnectivity of groundwater flow in fractures to surface water.
 - Designed, performed, and interpreted transmissive and storage properties of fractured bedrock aquifers.
- Conducted twenty seminars for government agencies, consulting companies, businesses, and academia: Examples of relevant seminars include:
 - 4 days – Fractured Hydrogeology (U.S. Army Corps of Engineers, Savannah District).
 - 2 days – Aquifer Tests and Slug Tests (Open to all, Oak Ridge, TN).
 - 2 days – Hydrogeology of Heterogeneous Formations- Crystalline and Carbonate Rocks (Open to all, Oak Ridge, TN).
 - 3 days – Hydrogeology Applicable to Today's Field Challenges in Porous and Fractured rocks.
- Taught Graduate level courses including fractured rock hydrogeology.
- Organized and chaired international conference on fluid flow through fractured rocks.
- Managed Georgia EPD Groundwater Program.

Total Years of Experience: 30

Education: Ph.D/1975/Geology

Registration: Professional Geologist

Professional Summary:

Dr. Arora is a Professional Geologist with over 30 years of experience managing, directing, and leading environmental projects and programs for Federal, state, and private industry clients. His experience includes positions in academia, as Assistant State Geologist for Georgia (EPD), and he founded the consulting company HydroVision in 1988. He has broad experience in hydrogeologic remedial investigations, delineating contaminant plumes, determining groundwater migration pathways, and developing practical groundwater remedial designs. Dr. Arora has specialized expertise in fractured rock hydrogeology. It is important to note that Dr. Arora's expertise is not limited to standard practices. Instead, he has developed and applied state-of-the-science methods and techniques not known or available to other hydrogeologists working in this field. This advantage is substantial.

Relevant Field Experience:

Senior Hydrogeology Consultant, Camp Ellis Military Reservation, Table Grove, Illinois. Responsible for providing the technology in integrating geologic, hydrogeologic, contaminant data for former army base at Camp Ellis. Responsible for collecting, interpreting, and integrating geophysical data for unexploded ordnance (UXO). The Site Conceptual model will be developed to identify data gaps and plan for UXO remediation.

Senior Hydrogeology Consultant, Nike C-70 Site, Naperville, Dupage County, Illinois. Responsible for providing the technical direction for groundwater investigation at Nike C-70 Site. The Site Conceptual Model (SCM) was developed by integrating site geology, hydrogeology and contamination migration data. Four contaminated residential wells were identified solutions were submitted to technical and legal team at the USACE Louisville. The contamination issue was resolved to the satisfaction to all parties.

Senior Fractured Rock Hydrogeology Consultant, Dobbins Air Force Base, Atlanta, Georgia. Responsible for providing the technical direction for contaminant site characterization/remediation in a complex geologic environment. Responsible for integrating data from drilling, field geology, hydrogeology, and geophysics; and for providing the analysis and interpretation of contaminant distribution in fractured bedrock.

Technical Director, Spring Contamination Study, Cedartown, Georgia. Responsible for managing a study to determine the geologic factors controlling groundwater movement and spring discharge within a region dominated by karst terrain. A spring that supplies water to Cedartown was contaminated with low concentrations of hydrocarbons, including benzene, and the source of contamination was unknown. Dr. Arora made recommendations for a hydrogeological and geochemical testing and monitoring program to determine the source of contamination based upon the and presence and orientation of fractures and lineaments in the complex geologic setting.

Program Manager, Fractured Rock Hydrogeology Remedial Investigation, Charlotte NAD, North Carolina. Responsible for managing the technical aspects of a remedial investigation of the former Charlotte Naval Ammunition Depot (NAD) site. This site is in the Piedmont geologic province, a complex fractured-rock environment. Groundwater was contaminated with trichloroethylene (TCE), but the TCE distribution in the groundwater was not readily explain using a simple model of downgradient migration. A conceptual model of the site was developed by Dr. Arora to explain the hydrogeologic factors controlling the TCE migration. He recommended that surface geophysics (electromagnetic and seismic), test drilling and rock coring, borehole geophysical logs (electromagnetic, caliper logs, and digital acoustic televiewer logs to measure number and orientation of fractures, and downhole flowmeter logs to describe hydraulic properties of the fracture zones), and aquifer interconnectivity tests be conducted. Results explained that a partially weathered rock zone was the primary pathway for migration. Within this zone, bedrock topography, thickness of the weathered rock zone, and orientation of anisotropic hydraulic parameters were the primary controls on the contaminant migration, Dr. Arora determined.

Program Manager, Fractured Rock Hydrogeology Remedial Investigation, Former Auto Parts Manufacturing Site, Newnan, Georgia. Responsible for a remedial investigation of a contaminated groundwater site in Newnan, Georgia. The site is located in a watershed that recharges fractured rock aquifers of the Piedmont Province in the area. TCE contaminated

groundwater was present in this heterogeneous hydrogeologic environment. Several methods were used to evaluate the migration of TCE into bedrock. Rock cores were collected to determine attitude of fracture planes, and the number, location and size of water-bearing fractures. Packer tests were performed to determine hydraulic characteristics of individual fracture zones. A seismic geophysical survey indicated a trough-like feature on top of bedrock. A lineament trace analysis and fracture pattern analysis indicated that a series of joint sets transect the site. The deeper weathering profile of this joint set system had formed a trough at the top of bedrock, which primarily controls the migration of TCE into fractured rock at the site. The field site was thus characterized.

Academic Experience

1988-1996 Professor of Geology and Director of the Center for Hydrogeology, Georgia State University, Atlanta, Georgia – As Professor and Director of Hydrogeology at Georgia State University, Dr. Arora developed and taught several graduate courses in groundwater hydrology including the only graduate level course in fractured rock hydrogeology offered in the United States.

Co-author of *Testing Hydrogeologic Parameters for Hazardous Waste Facility in Fractured Rock Media*, First U.S.A./U.S.S.R., International Conference on Hydrology and Hydrogeology, Leningrad, USSR, 1990.

Authored Proceedings on *International Conference on Fluid Flow in Fractured Rocks*, U.S. Geological Survey Publication, 1989.

Organized and chaired the International Conference on *Fluid Flow in Fractured Rocks* in Atlanta, Georgia, 1988.

Author of *Study of Transmissive Fractures of Crystalline Rocks in Georgia*, *International Symposium on Groundwater Monitoring and Management*, Dresden, Germany, 1987.

Developed and taught the following university courses in Applied Hydrogeology: Introduction to Hydrogeology, Applied Geophysics, Well Hydraulics and Aquifer Testing, Vadose Zone Hydrology, Fractured Rock Hydrogeology.

1976-1980 Assistant Professor of Geology, Wayne State University, Detroit, MI

1974-1976 Assistant Professor of Geology, University of Wisconsin, Oshkosh, WI

Non-Academic Positions

1980-1986 Assistant State Geologist (Hydrology Program Manager), Georgia Department of Natural Resources, Atlanta, GA. As Assistant State Geologist, Dr. Arora directed a staff of approximately 40 professionals providing technical support for Georgia Environmental Protection Division permitting programs under RCRA, CERCLA, USTs, industrial landfills, and water resources. He also served as Program Manager for the State of Georgia programs in Hydrology, Floodplain Protection, Underground Injection Control, Water Well Drilling, Sanitary Landfills, and Wellhead protection.

FIGURE 1

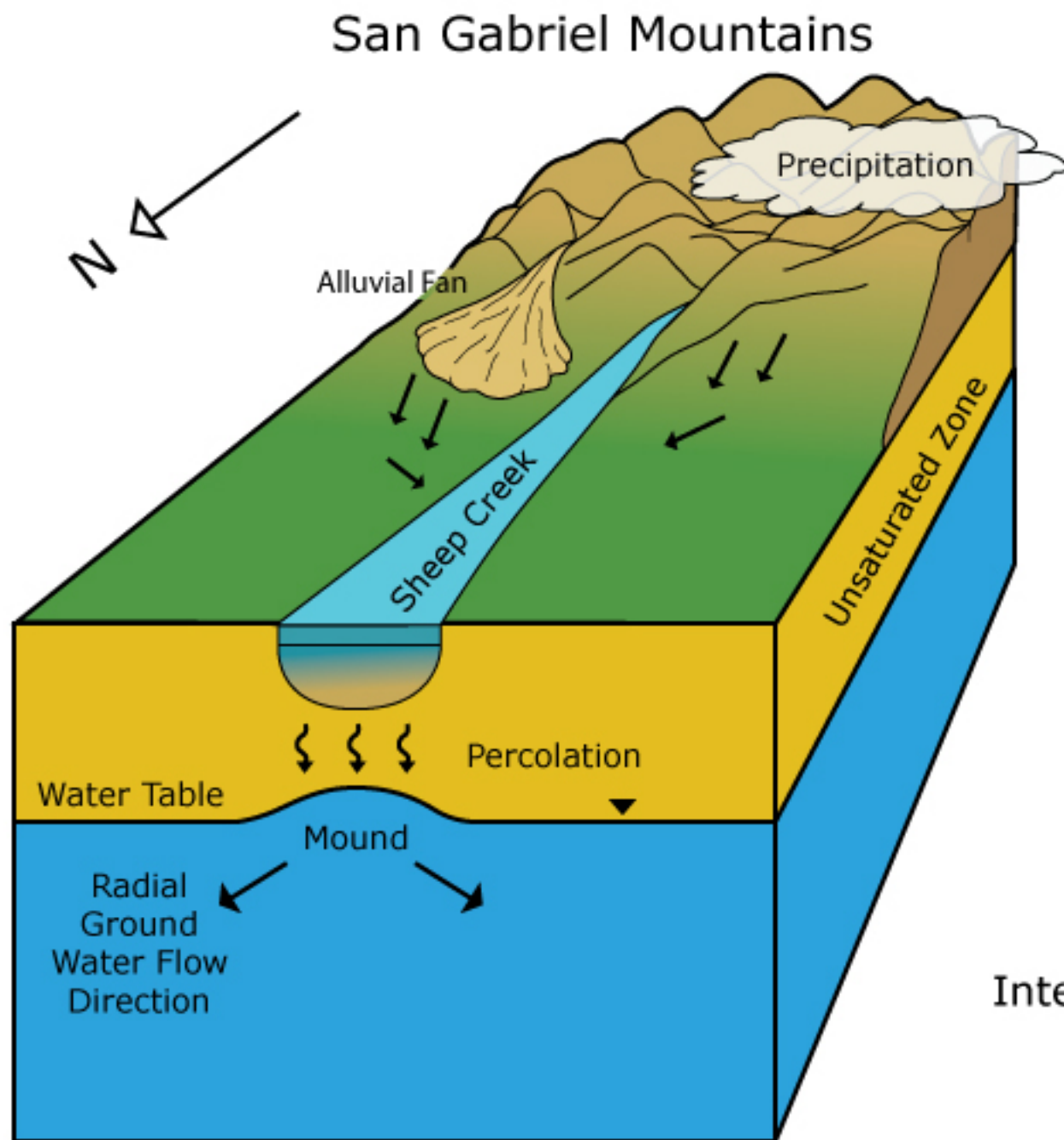


Fig. 1
Interaction of Groundwater
and Surface Water

FIGURE 2

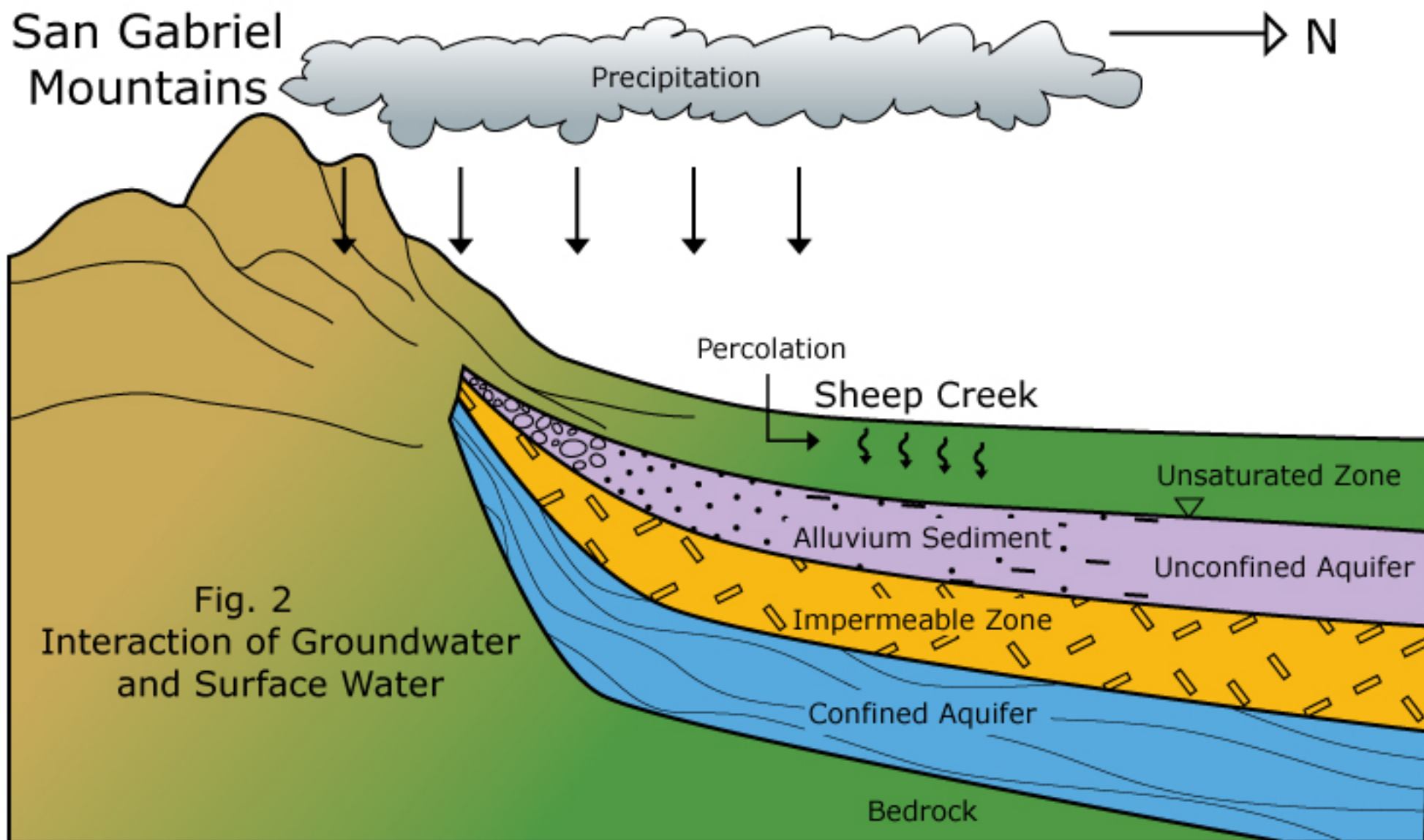


Fig. 2
Interaction of Groundwater
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