A Guest Editorial – 1996:

ARE CONSULTING AND GOOD SCIENCE COMPATIBLE?

by

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In a perfect world, every consultants' work is the best possible, and data gathered and results and conclusions derived are "fair." Ideally, no consultant would advocate a given position, idea, or result, good or bad, no matter what the outcome for the client. This begs the question: are good science and consulting compatible? In the current business climate there are more consultants than jobs. Jobs are so competitive that there is enormous pressure on firms to get and promote jobs. One way to keep business is to remember "the customer in always right," and the outcome the client wants is paramount. This may bias the procedures and methodologies used by the consultant to develop and interpret the data. But what about good science: multiple working hypotheses, testing hypotheses against data, observation and interpretation of data, gathering more data to resolve questions, and scientific objectivity? Do they have a place in this business market?

Our answer is yes, but...! The “but” will include cost and time restrictions imposed on the consultant by clients and regulations. The typical result is a compromise between science, cost, and time. Another answer is: we don't need to do this, it's not in the regulations and protocols we're following. In most cases, these are an engineering "cookbook" of required tasks, some decades old, with little or no room for science, new ideas, or techniques. If the consultant gathers the data for each task according to the book, there is no need for further interpretation or data gathering. We would submit that this is disingenuous on the part of consultants and regulators. In reality the data may be sparse in time and space, and little effort or money will be spent in critically looking at the data or gathering additional data unless required by regulators or litigation. This checklist approach to consulting fulfills the letter of the law with no need to question or interpret the data. But is the result honest and ethical to science and society?

It is not unusual for a client to spend the cost of consultant fees defending the data before regulators or adversaries. Three factors are at work: 1) regulations may require minimal or specific spatial and temporal data to characterize a project/site; 2) the more data gathered, the greater the probability of finding some characteristic detrimental or fatal to project/site performance: and 3) we are a litigious society. For example, low-level radioactive waste sites only require one year of data, yet some conclude that five years of background and regional data are needed.

Many projects have little initial data. Most clients will drill only the minimum number of wells (3) at the site to characterize and monitor it. Yet, federal regulations indicate there is no set number or limit to the number of wells needed to characterize the site geology and hydrology. In regions with little extant data, the consultant may conclude from limited data that regional flow is down valley, but a neighboring valley, with hundreds of data points, exhibits cross-valley flow. Good science indicates one or two additional data points might be useful. Will client money, regulators, and time permit additional wells, or could new data be fatal to the project? Finally, lawyers can put constraints on or stop additional data gathering; they can make data gathering an adversarial process; and in most cases their clients have other, nonscientific, goals.

Currently, it seems that too much project/site characterization is model driven with not enough thought given to geologic and hydrologic heterogeneity. Many models have tenuous initial assumptions and interpretations of aquifer homogeneity, Transmissivity, discharge, and recharge, along with the selective use of input data, which leads to inadequate investigations of complex physical and chemical properties and processes. In too many instances the consultant needs to assume the aquifer is a "homogeneous heterogeneous aquifer," i.e., one that can be modeled on minimal data points. Yet, the real geology consists of a heterogeneous, complex system of sedimentary deposits or fractured hard rock of disparate ages and sources. Alluvial and fluvial deposits exhibit enormous vertical and horizontal variability, ranging from sinuous paleochannel sands to discontinuous overbank clays. Hard rocks also display enormous variability with as many as five different rock types in 1,000 meters, all displaying different fracture and weathering patterns. These all affect ground water flow and chemistry.

In many cases, the unsaturated zone is considered one dominated by uniform percolation and recharge rates. In few cases are preferred recharge pathways (fractures, unstable wetting fronts, and geologic heterogeneity) ever considered or studied; these pathways may have rates 10 to 1,000,000 times those assumed or measured at a single site. The poor quality input data (recharge, geology, saturated or unsaturated zone parameters, or water chemistry) that result render many interpretations and models dubious at best.

Good science and consulting have been and can be compatible, but they conflict in some instances. Occasionally, the desire for a predetermined outcome by the client and the need for continued jobs by a consultant will override good science. But more important is the insidious degradation of good scientific investigations by consultants and regulators to project engineering-driven site testing and characterization that grants little room for scientific thought or interpretation. Consequently, scientific truth-testing in the public interest is left to the lawyers. This incipient scientific degradation bodes poorly for the future of consultants, science, and society.