Flawed Geoscience in Forensic Environmental Investigations

Part III: How Daubert is a Surrogate for Ethical Questions Regarding Expert Opinions

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**** The discussions and conclusions presented in this paper: a) are solely the present opinions of the authors, b) may change as additional information becomes available, and c) may not reflect the views of the companies with whom they are affiliated.**

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Abstract

Over the past few years, with the reduction in the enforcement budgets of environmental agencies, there has been an increase in environmental tort litigation, and numerous geoscientists are being asked to testify regarding various related issues. Many are being asked to testify in areas for which they have little or no academic training and for which their opinions are based primarily on their experience and beliefs. This paper discusses how speculation and beliefs affect our predisposition to opinions and differentiates between opinions that are speculation and those that are well founded on fact and are legitimately based on sound scientific grounds. This paper discusses some of the different legal standards applied to testifying expert opinions. This paper also provides some examples of expert opinions from various case studies and discusses the ethical considerations of when it is or is not appropriate to offer opinions for which the primary basis is belief and not science.

Examples of plaintiff and defense Daubert challenges and recent court rulings are provided to examine whether ethics requires a higher standard than the guidance provided by recent rulings, given the limitations inherent in judges with poor technical backgrounds to serve as effective gatekeepers of misleading opinions. Examples of misleading opinions that are ethically and legally based on past precedents are summarized and discussed in order to provide a basis for a general ethical standard that attorneys and experts may find helpful in the future in deciding the scope of their opinions and what is required in terms of site-specific evidence for those opinions to be offered.

The ethics of typical opinions will be discussed for some of the areas about which experts may or may not be qualified to provide expert testimony. These areas include: ground-water supplies and the threats to such supplies, site investigation methods and procedures, their effectiveness and limitations, allocation of sources among contributing parties, natural attenuation, plume stability, uses and limitations of plume modeling, disclosure of confidential information and resulting jury contamination, among other topics.

I. Introduction

Over the past few years, with the reduction in the enforcement budgets of environmental agencies, there has been an increase in environmental tort litigation, and numerous geoscientists are being asked to testify regarding various related issues. Many are being asked to testify in areas for which they have little or no academic training and for which their opinions are based primarily on their experience and beliefs. This paper is the third in a series dealing with how the landmark *Daubert* Supreme Court decision is affecting the work of geoscientists. See Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579 (1993). The primary focus of this paper is on the ethics involved in scoping and offering expert opinions. This paper discusses how speculation and beliefs affect experts' potential predisposition to opinions, and differentiates between opinions that are speculation from those that are well founded on fact and legitimately based on sound scientific grounds.

A primary area of ethical concern has been the tendency of scientists and engineers to testify as to peripheral aspects of their practice where it is evident, from their opinions, that they are unqualified and have been ill-advised to offer such opinions. Because of the inherent multi-disciplinary nature of environmental and natural resource practices, many geoscientists and geological/geotechnical engineers develop broad knowledge and expertise in many aspects of matters that could be at issue in tort (i.e., damage) claims. The ethics of typical opinions will be discussed for some of the areas about which experts may or may not be qualified to provide expert testimony to illustrate when experts have gone beyond what they could reasonably know. These areas include: ground-water supplies and the threats to such supplies, site investigation methods and procedures, their effectiveness and limitations, allocation of sources among contributing parties, natural attenuation, plume stability, uses and limitations of plume modeling, disclosure of confidential information and resulting jury contamination, among other topics.

This paper will first discuss some of the different legal standards applied to testifying expert opinions and then give some examples of opinions that have been excluded and not admitted from various cases. These cases will be used to identify some ethical issues a potential testifying expert should consider before offering expert opinions. Specifically, this paper attempts to give guidance as to when it is or is not appropriate to ask for or offer opinions for which the primary basis is belief and not science. Then case studies are presented as examples of some typical opinions and their fallacies noted in asking whether ethics requires a higher standard than the guidance provided by recent U.S. Supreme Court rulings. Subsequent to the U.S. Supreme Court rulings many state supreme courts have issued similar decisions that establish a new set of standards for when expert testimony is both relevant and reliable; yet most courts find it difficult to decide whether to let in testimony that could be used to support tort claims and, in particular, personal injury claims. Fairness calls for a fair trial based on the available evidence. Nonetheless, courts have recognized that misleading and unreliable expert testimony can unjustly sway a jury or bias a court record. At the federal level, trial courts are obligated by the Federal Rules of Evidence and by the *Daubert* decision to serve as gatekeepers to keep out such evidence. But do judges usually have the technical background to assess the reliability of expert opinions in highly technical and complex cases?

It is particularly important that experts promote and adhere to a higher standard of ethics than is reflected in the modern media and social interactions. Is it realistic to expect that judges with poor technical backgrounds can be effective gatekeepers in excluding misleading opinions and

testimony? Should it not be a shared responsibility with the geoscience professions to promote the adherence to the *Daubert* ethos of experts utilizing intellectual rigor in the application of sound scientific principals and methods? It is the authors' hope that the examples of misleading testimony and opinions that will be summarized and discussed in this paper can provide a basis for some general ethical standards that attorneys and experts may find helpful in deciding the scope of expert opinions and what is required of the supporting (site-specific) evidence for those opinions to be scientifically sound and ethically grounded.

II. Summary of *Daubert*-Related Standards for Expert Testimony to be Admissible

As discussed in Parts I and II of this series of papers (i.e., Campbell, *et al.*, 2004, and Bost, *et al.*, 2005, respectively), the following are standards typically applied to assess whether expert opinions meet the requirements of being both relevant and reliable:

1. **"Relevance" or "Fit"**

Can the reasoning or methodology underlying the testimony be properly applied to the facts of the case." *See Daubert,* 509 U.S. at 593.

a. Scientific. An opinion is scientific when its derivation applies a grounding in the methods and procedures of science. *Id. a*t 590. In other words, a testifying expert should be required to explain how the data were gathered and analyzed and how they were used to develop and test the expert's hypotheses, and how alternative explanations were eliminated.

b. Knowledge. An opinion based on subjective belief or unsupported speculation is without foundation. *Id*. In other words, a testifying expert should be required to explain more than subjective belief or unsupported speculation and must demonstrate knowledge of the subject and provide a basis for knowing that the experts conclusions are valid.

c. Inferences and Assertions. An opinion must be derived by the scientific method and supported by appropriate validation. *Id.* In other words, the scope of a testifying expert's work must include gathering data and testing the assertions (i.e., the hypotheses).

2. **"Reliability"**

Evidentiary reliability must be based on scientific validity. Daubert, 509 U.S. at 590, fn. 9 (Reliability: does application of the principle produce consistent results?"). The testifying expert must develop a scope of work that will yield a reliable basis for the expert's opinions. The expert must have a combination of the appropriate qualifications, experience and evidence to be able to reach the opinions regarding the contentions in a case.

a. Credentials, training or experience. Potential experts should be able to cite their background and demonstrate that it is adequate for them to render opinions regarding the contentions of the case. If not, the testifying expert needs to have

consulted with and/or relied on the work of others in filling in the gaps of his or her training and experience.

b. Theory. Potential experts should view their initial findings as theories which must be tested. While the data may suggest a conclusion that the expert feels is more likely than not, can the data be used to refute valid questioning?

c. Test the Hypothesis. The scope of a testifying expert's work should include testing the expert's theory(ies) or opinion(s). Typically three lines of corroborating evidence are used to support a conclusion. The scope of the expert's work should include developing multiple lines of evidence. If the evidence is corroborating and the appropriate intellectual rigor has been applied, then the opinion is arguably valid and scientifically sound.

d. Test for Alternative Explanations. The scoping should include testing for alternative explanations. Do the data support reasonable alternatives that could also explain the "facts" of the case. Could there be other sources, other sources of exposure, other factors that could have affected property values, other factors that already limit property use? Are there data to eliminate these other reasonably plausible alternative explanations?

3. **The Four *Daubert* Criteria**

a. As indicated previously, *Daubert's* four non-exclusive factors may be applied when appropriate. *Id.* at 593. The testifying expert should be able to specifically address the following:

i. Whether the scientific theory or technique can be and has been tested.

ii. Whether the underlying scientific theory or technique has been subjected to peer review and publication.

iii. Whether the scientific theory or technique has a known or potential rate of error, and if standards exist to control the technique's operation and error.

iv. Whether the scientific theory or technique has attained general acceptance within the relevant scientific community.

III. Aids for the Testifying Expert

To aid testifying experts in assessing their ability to withstand *Daubert* challenges, the following concepts may help identify when expert opinions are likely to be rejected:

1. Poor Connective Reliability. Expert's extrapolations from the raw data behind the expert's opinions to his or her conclusions must be sound, and that any opinions

connected to existing data only by the *ipse dixit* of the expert (the "say-so" of the expert) are not to be admitted. *See General Electric Co. v. Joiner,* 522 U.S. 136, 146 (1997).

One cannot leap from an accepted scientific premise to an unsupported one. This is similar to the use of a surrogate with no real scientific basis (i.e., xylene causes disease, butane is similar to xylene, and therefore it causes disease – with no further analysis of butane). The use of a surrogate must be sound and grounded in an examination of the physical/chemical characteristics or factors that are relevant to the surrogate's use. See *Moore v. Ashland,* 151 F.3d 269, 279 (5th Cir. 1998); *Wheat v. Pfizer, Inc.*, 31 F.3d 340, 343 (5th Cir. 1994).

2. False and Misleading. Challenges to opinions that are considered misleading often follow an assessment of Rule 403 of the Federal Rules of Evidence where the probative value is substantially outweighed by the danger of confusion of the issues (unfair prejudice is the test). Even if admissible under Federal Rule of Evidence 702, opinions could be excluded under the balancing test of Rule 403. *See Healthpoint, Ltd. v. Stratus Pharmaceuticals, Inc.,* 273 F.Supp.2d 769 (W.D. Tex. 2001); *Camp v. Lockheed*, 1998 WL 966002 (S.D. Tex. 1998, Houston Div.); *Garcia v. Columbia Medical Center*, 996 F.Supp. 617 (E.D. Tex. 1997, Paris Div.); *Moore v. Ashland*, 126 F.3d. 679 (5th Cir. 1997); *United States v. Posado*, 57 F.3d 428, 435 (5th Cir. 1995).

3. Speculative Conjecture. Mere speculation or conjecture is not admissible as a basis for an opinion. *In re Air Crash Disaster at New Orleans, La.*, 795 F.2d 1230 (5th Cir. 1986); *Eastern Auto Distributors, Inc. v. Peugeot Motors of America*, 795 F.2d 329 (4th Cir. 1986) (unsupported and speculative assumptions).

4. Fails to Consider Other Variables. An expert's failure to consider or control for other explanatory variables can make an expert's conclusion essentially worthless and subject to exclusion. *Munoz v. Orr*, 200 F.3d 291, 301 (5th Cir. 2000). This would apply to an expert's failure to consider obvious alternative explanations.

5. Basis of Opinion is Clearly Unreliable. If the basis of an expert's opinion is clearly unreliable, the trial court may disregard that opinion in deciding whether a party has created a genuine issue of material fact. *See Berry v. Armstrong Rubber Co.*, 989 F.2d 822, 824 (5th Cir. 1993), *cert. denied sub nom, Cooper v. Armstrong Rubber Co.*, 510 U.S. 1117 (1994).

6. Miscalculations and Errors. Opinions based on inaccurate or erred information is not reliable. *See Munoz v. Orr*, 200 F.3d 291, 301 (5th Cir. 2000) (insufficiency of expert's opinion was evident when the facts forming his basis were miscalculations).

7. Lack of Objectivity and No Intellectual Rigor. Expert's opinion begins with an assumption, is biased, and lacks scientific methods used by other experts in his field. *See Munoz v. Orr,* 200 F.3d 291, 301 (5th Cir. 2000) (expert began his analysis with a biased assumption, which was an indicator that he lacked the necessary objectivity to make his analysis).

8. No Intellectual Rigor. Expert fails to employ the same intellectual rigor as he would in his regular professional work may have related opinions excluded as unreliable. *See Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 152 (1999).

9. No Verification = Skepticism. An expert who relies on "plaintiff's" compilations of data, without seeking to verify the information presented to him, gives rise to common sense skepticism, and therefore can make the opinion unreliable. *See Munoz v. Orr*, 200 F.3d 291, 301 (5th Cir. 2000); *Christophersen v. Allied-Signal Corp.*, 939 F.2d 1106, 1111 (5th Cir. 1991), *cert. denied*, 503 U.S. 912 (1992), *overruled on other grounds by Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 587 n.5 (1993); *see Sheats v. Bowen*, 318 F.Supp. 640, 644 (D.Del. 1970) (Expert fails to seek verification of facts relied upon).

10. Opinion Generated Solely for the Pending Litigation. Expert's opinion was not developed as a result of independent research (e.g. he relied on his client's attorneys for all info as basis). *See Metabolife Int'l, Inc. v. Wornick*, 264 F.3d 832, 841 (9th Cir. 2001); *Lust v. Merrell Dow Pharms., Inc*., 89 F.3d 594, 597 (9th Cir. 1996).

11. Bald Assurances are no Basis. An expert's bald assurances that his opinions are based on sound scientific techniques were insufficient; the expert must offer some objective, independent validation of his or her methodology. *See Daubert v. Merrell Dow Pharm.*, 43 F.3d 1311, 1316-17 (9th Cir. 1995) (*Daubert II*).

12. Common Sense is No Basis. Experts may not base their opinions on "common sense" where they fail to conduct any research commonly employed by experts in their field, or fail to rely on data that could be subject to testing and verification. This is considered insufficient data and unreliable methodology. *IQ Products Co. v. Pennzoil Products Co.*, 305 F.3d 368 (5th Cir. 2002).

13. Expert for Hire. "Expert closely fits the profile of an "expert for hire" whose opinions are more likely to be biased because his opinion was based solely on an incomplete review of existing literature, certain documents and small subset of reports produced in prior litigation. He had the wrong degree, and failed to perform any research to substantiate his opinion." *Newton v. Roche Laboratories*, 243 F.Supp.2d 672 (W.D. Tex. 2002).

14. No Verification by Scientific Method. Expert has not conducted any studies or analysis to substantiate his opinion. *Daubert*, 509 U.S. at 593; *Raynor v. Merrell Pharms., Inc.*, 104 F.3d 1371, 1375 (D.C. Cir. 1997).

15. Expert Not Qualified. An expert's knowledge, skill, experience, training or education must be separately examined in each area that an opinion is offered. *See Seatrax, Inc. v. Sonbeck Int'l, Inc.*, 200 F.3d 358 (5th Cir. 2000) (Expert's lack of formal training in the particular area, and his failure to conduct an independent analysis were insurmountable obstacles to qualifying him as an expert on that opinion).

IV. Human Bias and Natural Predispositions

Of particular note in many of the *Daubert*-related decisions is the perception developed by the courts that the testifying expert whose testimony was excluded was predisposed to support a particular view of the facts of the case. The tendency seems to be that experts are given the

opinions that they are asked to support by legal counsel and then they search for the facts that seem to support those contentions without testing their legitimacy. Especially in cases where a "victim" is perceived to have been harmed and a deep pocket exists that may have contributed to that harm, many plaintiff experts may be naturally inclined to want to support the claims of the plaintiffs. Similarly, the enthusiasm and/or ambition of smart scientists and engineers who are effective at debating a matter and want to please their defendant clients often lead some practitioners to be willing to take a defensive position that the plaintiffs have not proven their case without adequately assessing the facts of the situation or testing their own opinions. To use the words of an anonymous defense attorney: "They tend to believe their own bull---." Tort claims can take the form of a game of passing the "burden of proof" from the plaintiffs' experts to the defendants' experts and back to the plaintiffs' experts. Some matters we have witnessed appear to be more about winning than about ascertaining the truth and facilitating an objective assessment of the situation.

The truth of the matter is that we are all biased to some degree. We tend to expect and believe what has been our experience in the past without adequately testing these expectations against "site-specific" conditions. We may be inclined to believe that any deviation from the standard guidance issued by regulatory agencies is inherently flawed. We may not understand the difference in the legal standards of reliability from those of a regulatory practice where we can assert our beliefs where it is up to the regulators to test them and agree or not to agree. As sharp practitioners, we tend to have large egos; we may naturally be inclined to not give up proving that we are right. Nonetheless, the role of a testifying expert - on a legal basis - is to assist the trier of the fact (judge or jury) in their efforts to determine the truth.

In today's world where we and our youth are bombarded each day by advertising claims that are not supported, when our news headlines reflect the errant actions of notable figures and businesses in "twisting" the facts for their own business or personal gains, and when the perception is that our elected leaders are no more honest than "car salesmen," is it not surprising that the ethics of our profession tend to support the business objectives of our employers and clients?

The challenge in being an effective expert that establishes credibility for a long, successful career lies in the ability to test our own biases and tendencies and to ask the question: Have we applied the intellectual rigor necessary to establish the legitimacy of our opinions honestly? Are they based on the application of the scientific method, specifically, and have we developed hypotheses for which we have not only identified supporting data, but have we tested these hypotheses against the remaining site-specific data?

V. The Role of Existing Standards in the Courtroom

There exists a perception by some experts regarding a growing practice of publishing and presenting (a few months before trial) information developed specifically for pending litigation. In a recent case, a plaintiff expert published data from a different expert and utilized a distorted presentation of the data in public support of a contention that was at issue in a pending case. Abbott (2005). In a similar circumstance, a different plaintiff expert prepared presentations of ground-water modeling results based on assumed parameters (including source terms) to contend that a plume underlies a large area of a city and presented the information in a public forum near the subject site a very short time before the expert's designation in a case and jury selection. In

another case, a plaintiff expert published data contending that a particular type of waste was undeniably the source of dioxins in the blood of nearby residents while ignoring various other publications regarding the multitude of sources of dioxins. The practice of publishing data developed for the purpose of litigation, and presenting the "findings" as being scientifically founded in public forums (in the venue of a tort claim about to be filed) is objectionable, and has become a classic example of the type of bias and questionable ethics of some experts. The inappropriateness of such actions, whether intentional or out of naïveté, is too obvious for us as professionals to condone and not take exception to the practice that is contrary to professional ethics. Violations in such professional ethics should be brought to the attention of appropriate professional societies for possible sanctions, or more.

VI. Pre-Publication of Information Developed for Litigation and Biasing the Public (Jury Pool)

Environmental research and geoscientific investigations performed by and for the EPA or for submittal to an environmental regulatory agency are often subject to *Daubert*-like tests. Such data, and/or theories expressed, as well as expert opinions, might better withstand scrutiny under *Daubert* because regulators in effect are peer reviewers of the work and because of the use of agency-specified guidance, which themselves may have been subject to EPA's quality and peer review programs. EPA and other environmental regulatory agencies have developed quality control systems to manage the quality aspects of environmental data collection, generation, and use. Individual processes in the EPA Quality System, in effect, satisfy specific aspects of the *Daubert* Rule.

During the past decade, a great number of cases have ruled that work following agency guidance satisfies the *Daubert* standards. As such, potential testifying geoscientists should consider certain environmental criteria and guidance in generating usable data and defensible opinions Brills, G.M., J.C. Worthington, A.D. Wait, 2000, "Quality Science in the Courtroom: U.S. EPA Data Quality and Peer Review Policies and Procedures Compared to the Daubert Factors," *Environmental Forensics*, Vol. 1, No.4, pp. 197-203. However, as noted in Part II of this series of papers, the rules on admissibility (aka, legal defensibility) used by the courts can be very different from those established by regulation. In particular, courts have found that agency risk criteria have been established to reduce the risk of harm and are inherently conservative. For example, regulatory criteria levels are not necessarily the levels at which harm will occur. Similarly, it is important to understand why courts have allowed the introduction of data whose "quality" have deviated from standard methods or which have not been developed by certified laboratories. Since we as experts may not have examined the same information and we may have somewhat different backgrounds and experiences, it is reasonable to expect that experts may disagree when the test is what is "more likely than not." In turn, judges and juries assess what "weight" to put to the evidence they have heard in rendering a decision. Understanding the usefulness of agency guidance as well as its fallibility is important to being an effective expert who appreciates the ethical basis for his or her opinions.

The ultimate ethical test, based on both legal precedent and good practice, is whether we have applied an appropriate level of intellectual rigor in testing the legitimacy of our opinions against site-specific circumstances consistent with that we would ordinarily use if we were to be publishing our own work. When we do test our hypotheses and ascertain that other plausible,

alternative explanations do not apply, it is perfectly appropriate to base our opinions, in part, on our experience and prior knowledge.

VII. Examples of Misleading Testimony

The following are examples based in part on case studies, and on examples of misleading testimony. Because many of these case studies do not have written records or published opinions, the authors are relying on their prior experiences in describing these matters. These examples are set out in this paper for illustrative purposes only, and do not necessarily recite exactly the opinions of the involved experts.

Example 1. Ground-Water Supplies and Threats to Such Supplies (circa 1984)

In a particular Superfund case, the government's expert referenced a regional water supply study to contend that the deep aquifer at the Superfund site was characterized by fresh water. In examining the deep well data, the government's expert noted that the samples collected reflected fresh water conditions, but failed to review the history of the wells' completion or examine the "raw" geophysical logs for the specific locale of the site (see Figure 1).

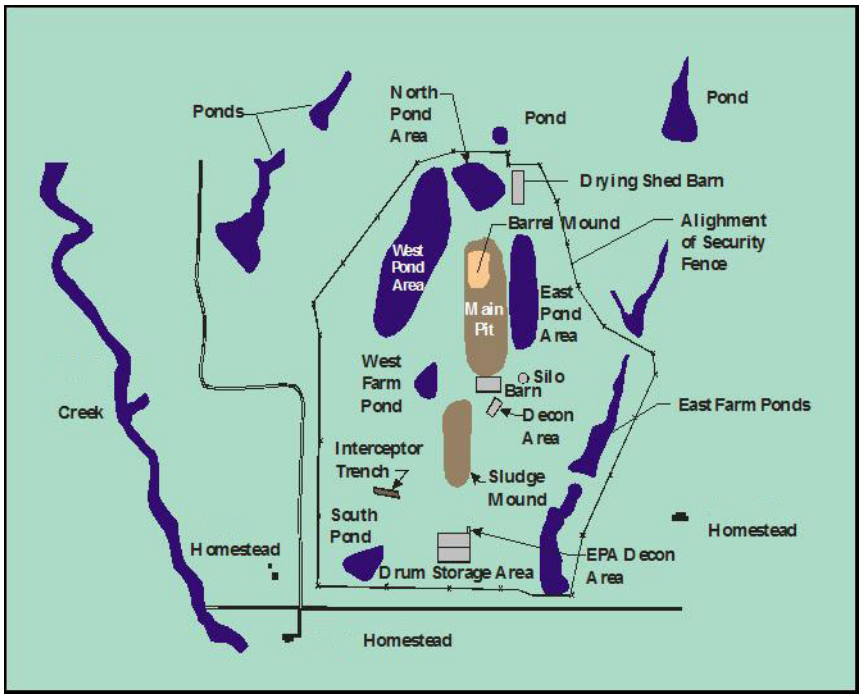

Figure 1 – Government Expert Failed to Follow Good QA/QC Practices

Site-specific studies by the defendants proved that the deep aquifer was saline, that the government's wells had not been properly constructed and reflected shallow water floating on top of deep water when sampled, and that the intervening aquitard had been stable for some 250,000 years (its salt content reflecting diffusion and not convective movement). The outcome was that a federal judge ruled in favor of the defendants and not the government and found that the government had been capricious in seeking data to support its contentions without examining the quality of the government's work against its own standards.

The error on the part of the government's expert was not to test the hypothesis against other data, but to use site-specific data without examining the quality of the data and in not developing multiple lines of evidence to corroborate the expert's opinion. The government's expert failed to follow good QA/QC practices in examining the field notes and field data while arriving at conclusions regarding the conditions at the Superfund site. In contrast, the defendants tested their hypotheses and developed corroborating information based on multiple lines of evidence.

Example 2. Site Investigation Methods and Procedures

In another case, plaintiffs claim that chemicals from a particular plant had migrated through the ground water into adjacent ditches and in turn were washed onto the plaintiffs' adjacent residential properties. A well-regarded expert collected "ground-water" samples from a few inches below the bottom of the ditches. The expert ignored the fact that the facility had historically discharged waste water and that urban activities were also a source of the chemicals measured. The expert did not measure potentiometric pressures within the ground-water system near and below the ditches and did not develop a hydrogeological cross section for the offsite area based on ground-water levels within the residential area. Instead, the expert extrapolated water level contours from the plant's onsite monitoring wells.

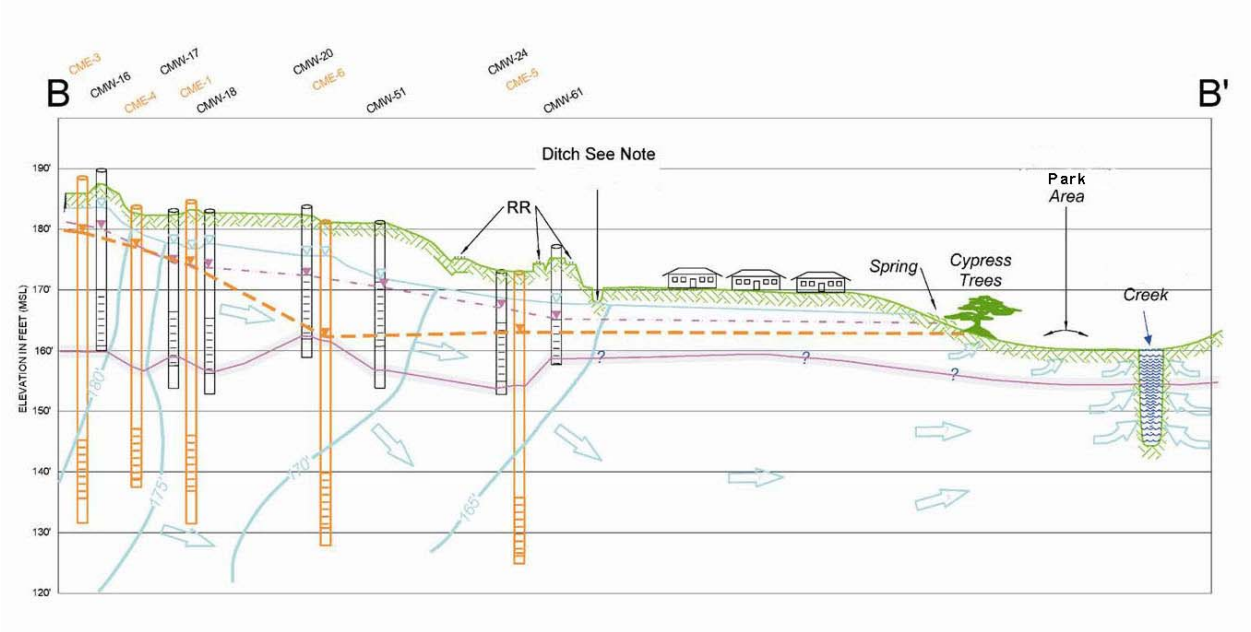

Figure 2 – Plaintiff's Expert Needed a Hydrogeologic Cross Section

The defendants completed "fingerprint" studies of the chemicals in the ditch culvert, obtained water-level data, and completed detailed testing of the chemical levels at different depths in the sediments to obtain corroborating lines of evidence that ground water was not affecting adjacent properties. The plaintiff expert erred in collecting sufficient data supportive of his opinions and then did not test them against additional site information nor did he test alternative explanations for the chemicals found in the ditch water.

Example 3. The Effectiveness and Limitations of Investigation Techniques

In a particular case in Texas, a defense expert based his opinions solely on hydropunch data for the plaintiffs' property and poorly developed wells on his client's property. The hydropunch

borings carried chemical constituents downward during sampling. Properly constructed borings with surface casing did not find the constituents below a given depth on the plaintiffs' property. The wells that were installed on the defendant's property were installed using rotary mud drilling techniques. They were developed using bailers removing three well casing volumes. The third time they were sampled, the results confirmed the contentions of the plaintiffs. The plaintiffs' expert reviewed historical fire department records, aerials, collected soil samples and water samples near potential sources on both the defendant's and the plaintiffs' properties, conducted chemical fingerprinting examination of the data, and consequently developed multiple lines of evidence supporting the defendant's activities as the source and eliminating alternative explanations for the affected ground water found on the plaintiffs' property.

Example 4. Allocation of Liability among the Sources of Contributing Parties

In another case, the lead potentially responsible party (PRP) at a Superfund site had alleged that other parties contributed significantly to the releases requiring remediation at the site, primarily on the basis that similar chemicals were found in the soil and ground water at their respective properties. Their experts did not test alternative explanations, despite the completion of remedial investigations generally in accordance with Superfund guidance, they had not examined historical aerials, subsurface boring data, historical maps including topographic maps, nor had they compared the chemical fingerprint of the chemicals found at different locations on the adjoining properties in order to test alternative explanations and assess historical pathways for migration (see Table 3).

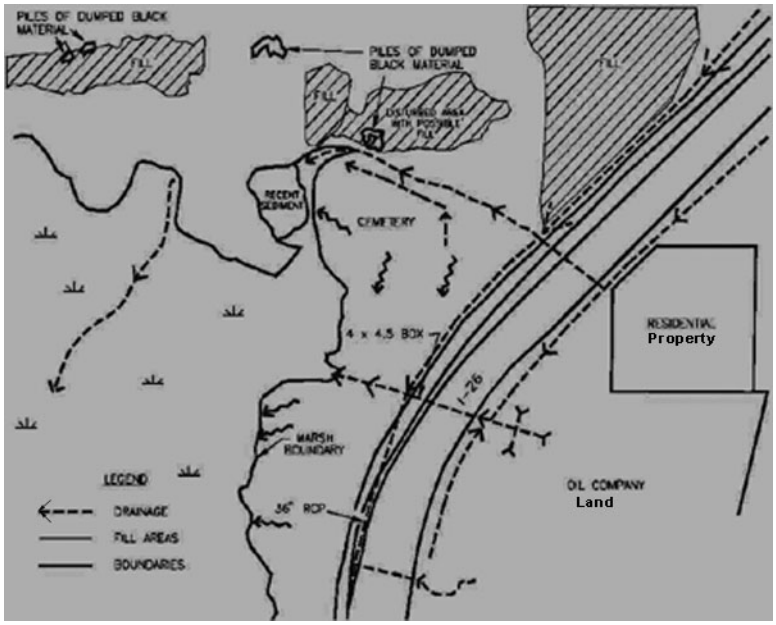

Figure 3 – Experts Failed to Examine Historical Data for the Site

The expert for the primary defending PRPs identified low-lying areas on the lead PRP's property, developed cross-sections with the chemical and DNAPL data noted on the cross-sections, chemical fingerprinting of the data from multiple locations and concluded based on multiple lines of evidence that the lead PRP had been the primary source of the releases on the properties of the Superfund site and that the samples reflecting the releases of the primary defending PRPs exhibited levels that did not require remediation. Both the trial court and

appellate court agreed with the defending PRP's expert. The error on the part of the lead PRP's experts was that they collected data supporting their hypothesis without testing that hypothesis against other site-specific data and alternative explanations for the site conditions. They were, therefore, ill-prepared at trial to support their contentions when confronted with contradictory site data.

Example 5. Natural Attenuation and Plume Stability

Another case involves an expert who contended, based solely on three years of data and the presence of degradation products, that a dry cleaner solvent plume was stable at a shopping center, despite the fact that the leading edge of the plume had not been defined. When additional wells were installed and pump tests were performed at the State's direction, it became evident that the plume was migrating with the flow of ground water and the well at the leading edge of the plume was reflecting concentration increases over time (see Figure 4).

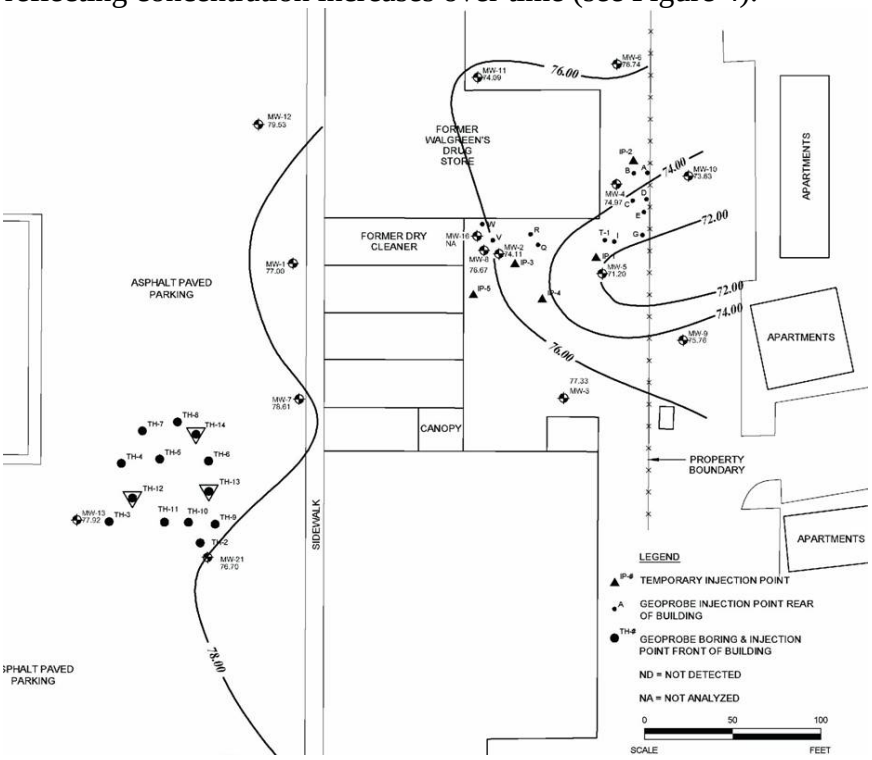

Figure 4 – Expert Did Not Use Multiple Lines of Evidence

More detailed analyses by another expert found that the degradation rates measured using multiple lines of evidence were significant but that the source flux was too great for the plume to become stable in the near term. After removing a large proportion of the mass by excavation and in situ chemical oxidation, the degradation rates were sufficient for the plume to stabilize and constituent levels to decrease over time.

Example 6. Historical Knowledge and Accepted Practices

In a particular case, a plaintiff expert referenced journals from the early 1900s and 1950s to contend that the technology existed to treat waste water discharges to current year 2000 discharge standards. The same expert contended that, based on a few publications in the 1960s and 1970s, it was known and "accepted practice" among knowledgeable practitioners that

storage of waste waters in earthen pits would result in releases to ground water. The plaintiff contended that the historical releases were the most significant since they had occurred over a longer period. The defense experts utilized EPA publications from the 1970s and 1980s to refute the contentions as well as various articles from trade journals and professional journals to contradict the contentions of the plaintiff expert. The defense experts also used chemical fingerprint data, NAPL fingerprint analyses and boring data to document the primary source requiring remediation today were actually related to recent operations (see Figure 5).

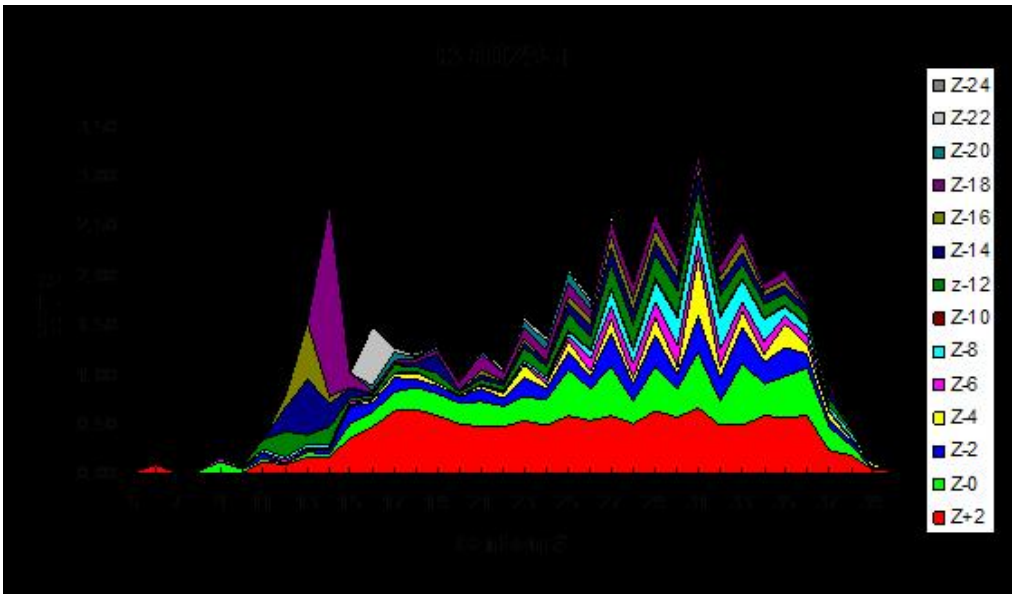

Figure 5 - NAPL Fingerprint Analyses

The plaintiff expert erred in wanting to find a basis to argue that the defendant should pay for a cleanup and identified supporting information without testing his hypotheses against other site-specific data and other historical references. The plaintiff expert was naïve and based his opinions on speculation that was not supported by multiple lines of evidence.

Example 7. Uses of and Limitations of Plume Modeling

Another case involving natural attenuation issues involved an expert who contended that a plume was not stable based on a proprietary model that had not been peer-reviewed. For the modeling, plaintiff's expert assumed input parameters that exaggerated the potential extent of migration. The plaintiff's expert did not perform the type of studies outlined in EPA guidance for assessing natural attenuation. On the other hand, defense experts did so and utilized multiple lines of evidence to calculate the degradation rates and to demonstrate that the onsite recovery system could not have prevented plume migration. They found instead that natural attenuation was preventing plume migration. Plume modeling using site-specific data instead of assumed parameters and calibrated against a portion of the historic data accurately predicted and matched subsequent data. Modeling is a tool and is only as good as the accuracy and quality of the input data (see Figure 6).

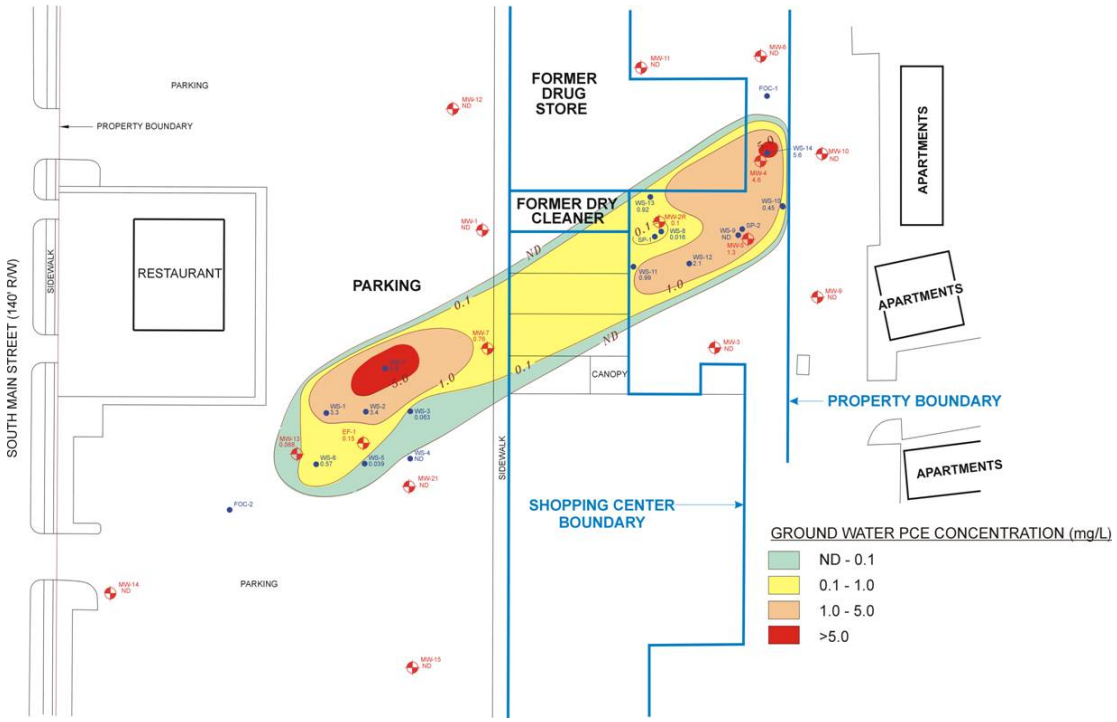

Figure 6 – Plaintiff's Expert Did Not Follow EPA Guidance on Assessing Natural Attenuation

For models to be admissible they need to have been appropriately tested to demonstrate their utility; in general, peer-reviewed models are admissible but only if the data used in modeling are defensible and the modeling methods consistent with accepted practice.

Example 8. Sources of Contamination

In a case involving the sudden death of young individuals exposed to the amoeba *Naegleria fowleri* while swimming in water from an unchlorinated, public water supply well, a plaintiff expert contended the *N. fowleri* were introduced during pump repairs, ignoring numerous other potential sources of the *N. fowleri* (see Figure 7).

Experts from other parties demonstrated that the plaintiff's opinion was speculative in nature and had not been tested and that the expert lacked the background and knowledge to testify in the matter. The case settled against some of the parties in part due to the ineffectiveness of the plaintiff expert's initial sampling and unfounded opinions.

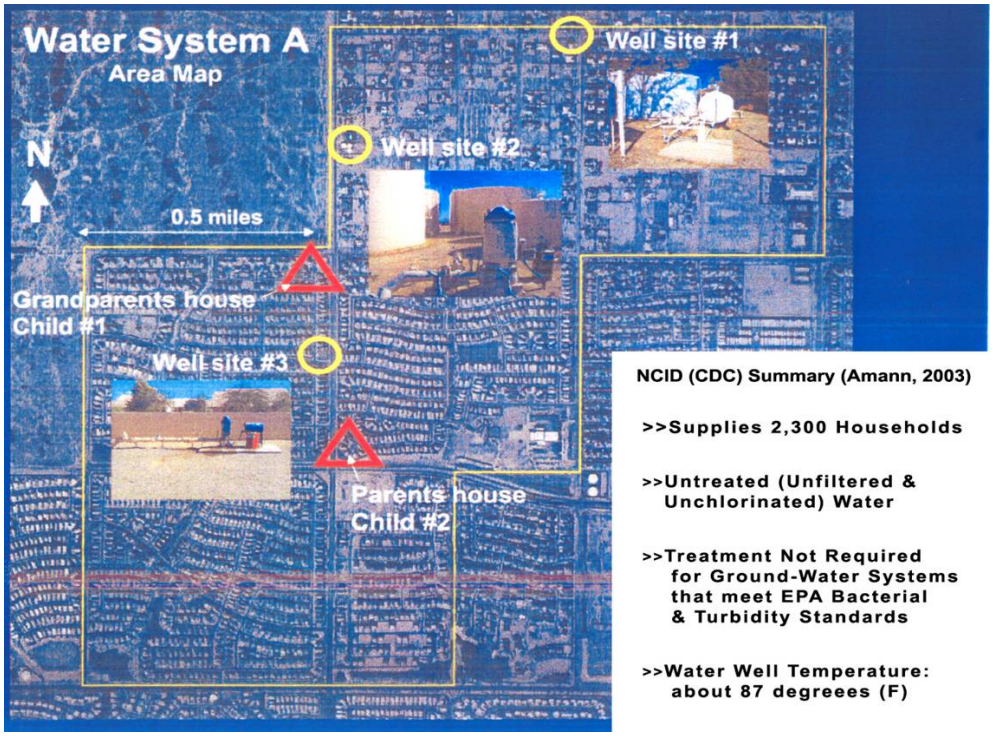

Figure 7 – Plaintiff Expert Did Not Evaluate Other Potential Sources

VIII. Conclusions

The recent *Daubert*-related cases provide guidance on certain legal standards for testifying experts. In general, these standards will improve the quality of geoscientific investigations, will require the work of experts to be better scoped and defined to include testing of hypotheses and the development of multiple lines of evidence based on the application of "intellectual rigor" using site-specific data. These standards and the misleading testimony that have been excluded by trial and appellate courts gives rise to an evident need to recognize the role that professional ethics plays in experts developing their opinions and testing their reliability. The authors hope that the papers in this series will help experienced as well potential experts and the professional geoscientific community in general to improve the quality of their work and the examples we as a group set for the other professionals that follow us.

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