ARTICLES

THE POLITICS OF RISK: PRE-LITIGATION SITE ASSESSMENT IN HOUSTON, TEXAS

BY
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This Article provides a case study of agency decision-making under uncertainty, specifically the administrative process used by a state agency to investigate potential site contamination. Analysis of the Railroad Commission of Texas' use of site and risk assessment in a neighborhood built over crude oil storage tanks known as Kennedy Heights demonstrates how purportedly scientific processes can fail to embody the kinds of rational analytical approaches on which regulatory agencies publicly claim they depend. Primary documents outlining the various efforts of the state agency, in coordination with a regulated entity, suggest that these processes were shaped in different ways, used divergent assumptions, and ultimately yielded findings that more closely resembled arguments than results.

The rich history left behind by the story of Kennedy Heights gives us a chance to see the tasks of site characterization and risk assessment for what they are: inherently political exercises, riddled with limitations, and bounded in terms of what they can tell the expert or the layman. Given the changing standards of admissibility for scientific evidence in mass torts cases influenced by the holding in

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Daubert v. Merrill Dow Pharmaceuticals, Inc.*, this understanding has implications for the regulatory and common law uses of data gathering and analysis that extend far beyond the boundaries of one subdivision in Houston, Texas. The nature of risk assessment in the context of contaminated sites, where negotiation supplants analysis, should give us pause before we accept the growing expectation of scientific validity in the federal courts. Approaches to the admissibility of negotiated evidence in a post-*Daubert *context, where district court judges apply heightened tests of validity to expert-driven documents and testimony, are considered.*

I. INTRODUCTION

The residents of Kennedy Heights in southeast Houston, Texas wrestle with a complex set of questions about their neighborhood. At base is their concern that something dangerous, potentially even poisonous, exists beneath the soil of their single family homes. To get answers, they called upon the appropriate state and federal regulatory agencies in the early 1990s, specifically the Railroad Commission of Texas and the U.S. Environmental Protection Agency (EPA), to investigate what earlier contractors hired by the city suspected was residual contamination from crude oil storage. The investigations took ten years and encompassed two of four elements of the

scientifically accepted practice of risk assessment: exposure assessment[1] and risk characterization.[2] Residents of the subdivision also sought redress in the courts, filing toxic tort claims against the former owners of the site.[3] The two processes, risk assessment by the state and EPA and toxic tort litigation, are driven to varying degrees by questions of causation, which are answered by the same type of people: "experts." Before residents can be told whether the air they breathe or the water they drink is causing them harm or threatening them, a series of "experts," mostly contractors hired by an agency or potentially liable party, will first look at the totality of the evidence and make a series of judgment calls.[4]

This Article will demonstrate how one final product of either process, whether called a "site assessment" or "risk assessment," is merely a stylized account of a negotiated process between regulated entities and agencies that lack the wherewithal to participate in the give-and-take that is involved. Simply put, the thesis is that the institutional setting in which risk assessments are undertaken can subordinate intellectual form while elevating negotiation and compromise. The results of this politicized investigation might be clearly stated in a government document, but the assumptions underlying the findings and the process that led to the collection of data points will be obscured or left out.

Why does this finding matter for toxic tort litigation? It is important because, despite the shortcomings inherent in a politicized process and problems with communicating risk once it has been quantified by hired experts, this approach to risk assessment[5] is accepted practice among regulatory agencies. More generally, it comports with the received view of science first sketched by Karl Popper. Popper noted that, far from universal knowledge derived from formal logic, science is an imperfect process involving intuition, conjecture, inference, professional judgment, and repeated testing.[6] This sort of "deductive falsification" guides most of the progress of science today.

However, a relatively recent development in the courts offers a competing view of science, one that is more closely aligned with the

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1 "Exposure assessment is the process of measuring or estimating the intensity, frequency, and duration of human exposures to an agent currently present in the environment . . . ." COMM. ON THE INSTITUTIONAL MEANS FOR ASSESSMENT OF RISKS TO PUB. HEALTH, NAT'L ACAD. OF SCI., RISK ASSESSMENT IN THE FEDERAL GOVERNMENT: MANAGING THE PROCESS 20 (1983), *available at* http://newton.nap.edu/books/0309033497/html/20.html.

2 "Risk characterization is the process of estimating the incidence of a health effect under the various conditions of human exposure described in exposure assessment. It is performed by combining the exposure and does-response assessments." *Id.*

3 Order Consolidating Actions at 1, Adams v. Chevron U.S.A., Inc., No. 96-1462 (S.D. Tex. Aug. 6, 1996).

4 *See* KRISTEN SHRADER-FRECHETTE, RISK AND RATIONALITY 53 (1991) (explaining the risk assessment process at Yucca Mountain, Nevada).

5 Proposed Guidelines for Carcinogen Risk Assessment, 61 Fed. Reg. 17,960, 17,981 (Apr. 23, 1996).

6 *See* David Goodstein, *How Science Works*, *in* REFERENCE MANUAL ON SCIENTIFIC EVIDENCE 67, 70–71 (Fed. Judicial Ctr. ed., 2d ed. 2000) (explaining Karl Popper's falsification theory).

logician's search for universal knowledge derived from formal logic.[7] The ascendancy of this new standard of scientific validity in the courts presents residents of contaminated communities and agency policymakers with a conundrum: the methods upon which they must rely to demonstrate that their properties pose a risk and should be cleaned up call for improvement and greater transparency, while at the same time a new judicial interpretation of scientific evidence threatens to discount the practice *as a whole*. This Article argues that, given the nature of risk assessment in the context of contaminated sites, where negotiation supplants analysis, the courts' growing expectation of scientific validity is unrealistic at best.

Following the Supreme Court's decision in *Daubert v. Merrill Dow Pharmaceuticals, Inc.*,[8] federal trial judges are charged with the task of determining the admissibility of scientific evidence, including the results of site and risk assessments that are used in toxic tort cases. Because causation claims in toxic tort cases rest on expert testimony, this "gatekeeper" role for district judges is critical: if experts are not allowed to speak to their findings, most toxic tort cases will be dismissed on summary judgment. How are district judges supposed to evaluate evidence that purports to be scientific? *Daubert* requires a trial court, under Rule 104(a) of the Federal Rules of Evidence (FRE),[9] to determine whether an expert is testifying from "scientific knowledge"[10] and whether their reasoning or the methodology underlying their findings is "scientifically valid."[11] In dictum, the Court added several criteria for whether information testified to by an expert witness could be considered valid, in addition to the test of "general acceptance" formerly used in *Frye v. United States*:[12] whether the methodology employed to generate the information can be proven wrong, whether the method has undergone publication or peer review, the existence and maintenance of standards controlling the technique's operation, and the method's known or potential rate of error.[13] Many courts have read these requirements (and others suggested in subsequent decisions[14]) to mean that the evidence presented by a scientific expert should be without flaws, logical leaps, or inferences that have not been proven fully. This high standard of validity is evidenced in the "corpuscular approach" used by most courts: a proponent of scientific evidence must establish the reliability and

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7 *See* STEVE J. HEIMS, JOHN VON NEUMANN & NORBERT WIENER: FROM MATHEMATICS TO THE TECHNOLOGIES OF LIFE AND DEATH 136 (1980) (outlining Von Neumann's efforts to explain the mysteries of life through formal mathematic structure).

8 509 U.S. 579 (1993).

9 FED. R. EVID. 104(a); *Daubert*, 509 U.S. at 589–93.

10 *Daubert*, 509 U.S. at 589–90.

11 *Id.* at 592–93.

12 293 F. 1013 (D.C. Cir. 1923).

13 *Daubert*, 509 U.S. at 593–94.

14 *See* Gen. Elec. Co. v. Joiner, 522 U.S. 136, 147 (1997) (holding that a court may conclude that there is simply too great an analytical gap between the data and the opinion proffered); Kumho Tire Co. v. Carmichael, 526 U.S. 137, 159 (1999) (holding that a district court can base its decision upon failure to satisfy either *Daubert*'s factors or any other set of reasonable reliability criteria).

relevance of *every individual study* from which he drew his findings (in addition to the same test for the expert's broader conclusions).[15] Absent this finding, the study (and testimony) will be excluded.[16]

Challenges to expert testimony were more successful following the *Daubert* decision. One report found that "the exclusion rate in the Third Circuit for evidence based on physical science in a product liability case jumped from 53% during the two years before *Daubert* to 70% between mid-1995 and mid-1996."[17] A fifty-case sample of civil actions spanning three months found that district judges excluded 90% of the challenged experts.[18] The post-*Daubert* environment, characterized by a conception of science that is more exacting than the scientific method itself, posed a challenge to the residents of Kennedy Heights, whose legal counsel decided to settle rather than face a *Daubert* hearing on their soil and water contamination evidence.[19] The changing judicial conception of the scientific process also raises questions regarding how one should make sense of site characterization and risk assessment, such as what took place at Kennedy Heights for more than ten years.[20] Do the results of site assessment in

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15 *See* Thomas O. McGarity, *On the Prospect of "Daubertizing" Judicial Review of Risk Assessment*, 66 LAW & CONTEMP. PROBS. 155, 172 (2003).

16 An example of the use of the corpuscular approach is *General Electric Co. v. Joiner*, the reasoning of which (along with *Daubert*) has been enshrined in a recent amendment of Rule 702 of the FRE. FED. R. EVID. 702. In *Joiner*, the plaintiffs' experts concluded—and offered to testify—that plaintiffs had developed lung cancer because of their exposure to polychlorinated biphenyls (PCBs). Gen. Elec. Co. v. Joiner, 522 U.S. at 140. The experts offered five studies to support this finding, one animal bioassay and four epidemiological studies. The Supreme Court ruled that the trial judge was entitled to find that each of the studies lacked the necessary validity for drawing a reliable scientific inference regarding PCBs and whether they caused cancer. *Id.* at 144–45. One of the studies lacked statistical significance (although the Court did not provide a gauge of the p values necessary for declaring a significant finding, leaving that determination for the authors of the study). *Id.* at 145. Another found a statistically significant relationship between PCB exposure and lung cancer death, but because the Japanese factory workers in that study had been exposed to other potentially carcinogenic substances (such as rice oil), the study was invalid (again, there is no discussion of whether statistical measures for accounting for confounding variables used in the study were adequate, or how one would evaluate such a procedure). *Id.* at 146. Plaintiffs' experts were not allowed to testify as to their findings. *Id.* at 146–47.

17 LLOYD DIXON & BRIAN GILL, CHANGES IN THE STANDARDS FOR ADMITTING EXPERT EVIDENCE IN FEDERAL CIVIL CASES SINCE THE *DAUBERT* DECISION, at xvi (2001).

18 *See* Jan Beyea & Daniel Berger, *Scientific Misconceptions Among Daubert Gatekeepers: The Need for Reform of Expert Review Procedures*, 64 LAW & CONTEMP. PROBS. 327, 358–59 (2001).

19 *See* GREGG P. MACEY & LAWRENCE SUSSKIND, USING DISPUTE RESOLUTION TECHNIQUES TO ADDRESS ENVIRONMENTAL JUSTICE CONCERNS: CASE STUDIES 36 (2003), *available at* http://www.epa.gov/compliance/resources/publications/ej/cbi-case-study-report.pdf (prepared for the U.S. EPA Office of Environmental Justice) (discussing plaintiffs' concern that the judge would make swift rulings on certain aspects of the case).

20 *See* Andrew Trask, Daubert *and the EPA: An Evidentiary Approach to Reviewing Agency Determinations of Risk*, 1997 U. CHI. LEGAL F. 569, 569 (advocating for "reducing [scientific] uncertainty by applying the *Daubert* standard for admissibility of expert testimony to judicial review of agency decisions"); E. Donald Elliott et al., *Science, Agencies, and the Courts: Is Three a Crowd?*, 31 ENVTL. L. REP. 10,125, 10,129 (2001) (discussing the attractiveness of applying a "'regulatory *Daubert*' as a principle for judicial review of agency decisionmaking in

Kennedy Heights, where "scientific" methods were applied in a form of negotiation between a regulated entity (Chevron) and a resource-strapped and arguably inept agency (the Railroad Commission), suggest that litigators should call for a more stringent application of the *Daubert* doctrine? Or does such an approach to admissibility render entire areas of inquiry, such as risk assessment, essentially off-limits to toxic tort plaintiffs? Is there another way to view the process of site or risk assessment that would be more useful to interested parties in a toxic tort litigation?

To explore these issues, this Article sets out the story of Kennedy Heights. Rather than focus on the case that was ultimately settled by a court-appointed special master, the Article delves into the *administrative* process of investigating potential site contamination. The process is recounted here following extensive document review, including internal and external Railroad Commission correspondence, field notes, and data; site and risk assessment documents prepared by all relevant parties; historical primary documents regarding the site's history; and interviews with a handful of "experts" charged with managing the process (from the Railroad Commission, Exploration Technologies, Inc., the Texas Natural Resources Conservation Commission, and Chevron attorneys, who spoke on behalf of the contractors who prepared the site's only comprehensive risk assessment report).

The resulting case study will help make sense of how site and risk assessment fail to embody the kinds of rational analytical approaches upon which regulatory agencies publicly claim they depend and that they hold up to their constituents as scientific. Second, given the standards of admission for scientific evidence in mass torts cases shaped by the holding in *Daubert*, the Kennedy Heights experience should give us pause before we accept the assumption, exhibited even by the final judge to preside over *Adams v. Chevron U.S.A., Inc.* (*Adams v. Chevron*),[21] that such evidence must be sufficiently established and constitute scientific proof of a certain proposition.[22] Primary documents outlining the various efforts toward site characterization and risk assessment suggest that these processes were shaped in different ways, used divergent assumptions, and ultimately yielded findings that more closely resembled arguments than results. The rich history left behind by the Kennedy Heights story gives us a chance to see the tasks of site characterization and risk assessment for what they are: inherently political exercises, riddled with limitations, and bounded in terms of what they can tell the expert or the layman. Such an understanding has implications for the regulatory and common law uses of data gathering and analysis that extend far beyond the boundaries of one subdivision in Houston, Texas.

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the scientific realm . . . as a reform to enhance agency decisionmaking, to refine judicial review, and to promote accountability").

[21] Adams v. Chevron U.S.A. Inc., No. 96-1462 (S.D. Tex. Feb. 19, 1998).

[22] Transcript of Hearing Before the Honorable David Hittner at 17, Adams v. Chevron U.S.A. Inc., No. 96-1462 (S.D. Tex. Feb. 19, 1998).

II. THE SITE: KENNEDY HEIGHTS, TEXAS

A. Preliminary Note

This Article describes the site characterization and risk assessment undertaken by administrative bodies in Kennedy Heights. There are three primary rationales for conducting a single case study: when the case meets all the conditions for and thus is a "*critical case*" for testing the propositions of a well-formulated theory, when it "represents an *extreme or unique case*," and when it is a "*revelatory case*."[23]

Occasionally, there will be a clearly specified theory with a set of propositions that can be tested by a single case because the case meets each of the conditions for testing the theory. Graham Allison's *Essence of Decision* fits this description.[24] The single case was the standoff between the Soviet Union and the United States over the siting of intermediate-range missiles in Cuba. Allison offered and compared three competing theories to generate the best explanation for the type of crisis embodied in the conflict.[25] Similarly, Gross et al. focused on a single school in their work *Implementing Organizational Innovations*.[26] The conventional wisdom was that innovations failed because of certain barriers to innovation, namely, organizational members' initial resistance to change.[27] Gross et al. demonstrated that, in one school, flawed implementation processes rather than barriers explained outcomes.[28] The work was considered a defining moment in innovation theory.[29]

Another occasion for presenting a single case is when it represents an extreme example.[30] This is true when a phenomenon is so rare that social scientists are unable to find common patterns, such as occurs in clinical psychology when a rare syndrome is identified.[31]

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[23] ROBERT K. YIN, CASE STUDY RESEARCH: DESIGN AND METHODS 38–41 (2d ed. 1994).

[24] GRAHAM T. ALLISON, ESSENCE OF DECISION: EXPLAINING THE CUBAN MISSILE CRISIS (1971).

[25] *See id.* at 245 (explaining that three conceptual models were used to explore the Cuban Missile Crisis, whereby "[e]ach conceptual framework consists of a *cluster* of assumptions and categories that influence what the analyst finds puzzling, how he formulates his question, where he looks for evidence, and what he produces as an answer").

[26] NEAL GROSS, JOSEPH B. GIACQUINTA & MARILYN BERNSTEIN, IMPLEMENTING ORGANIZATIONAL INNOVATIONS: A SOCIOLOGICAL ANALYSIS OF PLANNED EDUCATIONAL CHANGE (1971).

[27] *Id.* at 1, 195–96.

[28] *See id.* at 200–01 (concluding that the school's failure to implement the innovation "was a consequence of the director's restricted view of the process of the implementation of organizational innovations and his lack of awareness of his role obligations to his subordinates when he initiated this process").

[29] *See, e.g.*, Michael S. Knapp, *Between Systemic Reforms and the Mathematics and Science Classroom: The Dynamics of Innovation, Implementation, and Professional Learning*, 28 (Nat'l Inst. for Science Educ., Research Monograph No. 1, 1997), *available at* http://www.wcer.wisc.edu/archive/NISE/Publications/Research_Monographs/KNAPP/KnappALL.pdf (citing IMPLEMENTING ORGANIZATIONAL INNOVATIONS as one of three major works since the early 1960s advancing innovation theory through case study research).

[30] YIN, *supra* note 23, at 39–40.

[31] *See id.* at 39 (providing as an example some patients' inability to recognize familiar faces if given only visual cues and the consequent difficulty for scientists of establishing common

A final rationale concerns the revelatory case as single case.[32] A revelatory case is recommended when "an investigator has an opportunity to observe and analyze a phenomenon previously inaccessible to scientific investigation."[33] Elliot Liebow's *Tally's Corner* was one of the first examples of a social scientist gaining access to a circle of individuals living in an impoverished neighborhood.[34] By doing so, he demonstrated, through thick descriptions of the problems of unemployment, how further research could be carried out.[35] The seminal example of a combination of the theory testing and revelatory case study is *The Challenger Launch Decision* by Diane Vaughan.[36] In 575 pages, Vaughan shows the inaccuracy of conventional theories for why the Challenger was allowed to launch in January 1986. Through meticulous historical reconstruction based on over 122,000 pages of documents collected by a presidential commission and copies of original National Aeronautics and Space Administration (NASA) documents stored at a warehouse at the Johnson Space Center,[37] Vaughan showed that production pressures and managerial wrongdoing were not to blame. Rather, NASA experienced an "incremental descent into poor judgment" where signs of potential danger were normalized in engineering risk assessments.[38] Vaughan noted: "The cause of disaster was a mistake embedded in the banality of organizational life . . . . As this book revises historically accepted interpretations, it embraces broader themes. It describes how deviance in organizations is transformed into acceptable behavior."[39] *The Challenger Launch Decision* has encouraged an entire subdiscipline in historical sociology of disaster studies.[40]

The following case study represents an attempt to capture the first two rationales for a single case study because it is both a critical and a unique case: By reconstructing a ten-year negotiated process that led to the results of site and risk assessment, the author seeks to offer a competing interpretation of these assessment methods. The following case study can be held up against standard accounts of risk assessment that portray a rational, scientific exercise. It can also provide avenues for future scholarship and broader case comparison on how resource-limited regulatory agencies carry out decision making in the presence of uncertainty.

At the same time, the Kennedy Heights story is revelatory on two levels. First, no one has told this particular story before, except when the EPA

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patterns in the syndrome due to its rarity).

32 *Id.* at 40.

33 *Id.*

34 ELLIOT LIEBOW, TALLY'S CORNER: A STUDY OF NEGRO STREETCORNER MEN (1967).

35 *Id.* at 3–10 (discussing the need to expand the focus of poverty research beyond poor women and children).

36 DIANE VAUGHAN, THE CHALLENGER LAUNCH DECISION: RISKY TECHNOLOGY, CULTURE, AND DEVIANCE AT NASA (1996).

37 *Id.* at 459–60.

38 *Id.* at xiii.

39 *Id.* at xiv.

40 *See, e.g.*, Kathleen J. Tierney, *Toward a Critical Sociology of Risk*, 14 SOC. F. 215, 224, 229 (1999) (discussing the impacts of Vaughan's research on the field of risk analysis).

asked the author to discuss the settlement process. Second, the phenomenon of an inept agency negotiating the findings of a contaminated site investigation has in large part proven inaccessible to legal scholars and social scientists. The author discovered the primary sources for this case study through a series of fortuitous events. While researching the settlement process that ended toxic tort litigation in this case, a prominent law firm in the case invited the author to travel to a nearby warehouse where the entirety of its discovery and trial preparation materials had been catalogued and stored. The author spent the better part of one week at the warehouse and generated copies of the pleadings, expert reports, correspondence, exhibits, depositions, and historical documents. These were supplemented with more recent public records requests to the Railroad Commission and EPA, which shared jurisdiction over the site. The length of the following case study is intended to offer sufficient evidence for the negotiated process that the author discovered, and also to enable other researchers to consider new and heretofore unarticulated explanations for why, after ten years and millions of dollars spent on everything but site cleanup, the residents of Kennedy Heights were asked to accept the status quo and move on with their lives. This Article offers only a detailed reconstruction of an agency-industry negotiation, for which the former was woefully unprepared. The reasons why the process proved asymmetric, or why the residents were and continue to feel short-changed, are too many and varied to be sifted through and settled in one case. Still, the story is one worth telling, and in some detail. In addition to its alternative interpretation of a scientific process and its foundation in materials that are not normally available to legal scholars, it represents an effort to bring what happened in Kennedy Heights to a broader audience of attorneys and legal scholars. The residents with whom the author spoke at the subdivision wanted to share their experiences with this audience, and extra efforts to preserve the chain of events as they occurred will be evident to the reader.

The narrative begins with a history of the site, including its transformation from crude oil storage pits to single family residential properties. The racial underpinnings of decisions to develop the property in certain ways suggest one explanation for why the residents of this subdivision, who are predominately black, approached this process with such mistrust. Whether the racial makeup of the neighborhood contributed to the lack of action by the City of Houston for twenty years after problems began to arise is a question that cannot be answered with the materials that the author encountered. The next sections describe the discovery of the presence of crude oil under the property and reconstruct the assessment process. The account of site investigations will show how resource constraints and the kinds of pragmatic considerations that they require can subsume objective analysis in the practice of site and risk assessment. The discussion section explores implications for assessment-as-negotiation, particularly as they relate to the climate for toxic tort litigation that arose following the *Daubert* decision.

B. History: The Racial Underpinnings of Site Redevelopment

The Pierce Junction oil well yielded a quarter of a million barrels of oil every two months during the 1920s.[41] Discovered in 1921, the well was connected by pipeline to a series of pits, including three unlined earthen storage tanks southeast of Houston, known as the Mykawa Tank Farm.[42] Each with the capacity to hold 300,000 barrels of crude oil, the pits were located to the south of Selinsky Road and to the east of what is now Cullen Boulevard (then Chocolate Bayou Road) in the Kennedy Heights subdivision.[43] The northeast and northwest pits were operational and covered with lumber roofing while the southeast pit was filled with brine.[44] The storage pits were partially destroyed by a hurricane that broke apart the wooden roofs covering the pits in 1927.[45] Because of the damage, as well as marginal production at the Pierce Junction field, owner Gulf Production Company (Gulf Oil) ceased operations at the tank farm.[46]

While actual use of the property after the pits were abandoned is uncertain, it is clear that the site accommodated other land uses over the course of the next four decades.[47] The pits remained visible in aerial photographs taken in 1935, 1945, 1955, and 1969.[48] During much of this time, Gulf Oil failed to "secure the site from the public and, as a consequence, municipal waste, junk, debris, rubbish and hazardous substances were deposited at the site."[49] In the mid-1960s, Gulf had the site appraised and

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41 *Pierce Junction Well Flows 250,000 Barrels in Two Months Period*, HOUS. CHRON., Sept. 2, 1921.

42 Deposition upon Written Questions of James F. Stephenson at 2–3, Simmons v. Chevron U.S.A., Inc., No. 95-14770 (S.D. Tex. Apr. 10, 1996).

43 *Id.*; Statement of Nov. 30, 1924, Received Dec. 15, 1924 by the Texas Railroad Commission (on file with author) (showing amount of tankage capacity location and quantity of crude petroleum owned by the pipe line, the amount held in storage for others, and unfilled storage at close of business).

44 Deposition upon Written Questions of James F. Stephenson at 3, Simmons. v. Chevron U.S.A., Inc., No. 95-14770 (S.D. Tex. Apr. 10, 1996).

45 *Id.*

46 *See* ECOLOGY & ENV'T, INC., EXPANDED SITE INSPECTION: FINAL REPORT 2-2 (2001) (prepared for U.S. EPA Region 6) (on file with author) (reporting that, "[a]ccording to aerial photographic analysis, the property was not used for oil and gas activities after 1930, the earliest date for which aerial photographs are available.")*.*

47 For example, some documents suggested that Gulf Oil leased the property to local dairy farmers and cattlemen. A review of aerial photographs from 1930 to the 1960s revealed evidence of cows in a field southeast of the northwest pit in 1955.

48 Memorandum from David Krentz, Envtl. Health, Health & Human Servs., City of Houston, to Anthony Crisci, Capital Projects, City of Houston (Oct. 30, 1991) (on file with author) (regarding Kennedy Heights water line replacement).

49 Plaintiffs' Second Amended Complaint at 4–5, Adams v. Chevron U.S.A., Inc., No. 96-1462 (S.D. Tex. Oct. 1, 1996). In a letter to a city official, the contractor who first encountered signs of crude oil contamination also noticed items that appeared to have been dumped in the area of the former pits ("(6/3/91) Hit foreign debris at 5002 Fairgreen"; "(8/05/91) Hit car rim 11326 Murrway, underground"; "(12/03/91) Murrway Station # 32+55 (car door)"; "(12/3/91) Murrway Station # 32+20 (tire)"). Letter from C.W. Paskey, Constr. Coordinator, Pas-Key Constr. Servs., Inc., to Richard Scott, Deputy Dir., Capital Projects Dep't, City of Houston (Aug. 27, 1992) (on file with author).

began to take steps to dispose of the property. The appraisal documents refer to the land near the tank farm, located near Chocolate Bayou, as a "typical Negro area."[50]

> Should this land be developed for low to medium priced housing with F. H. A. or V. A. financing, it would have to be a bi-racial development according to the present . . . regulations. It is felt that eventually this would be the highest and best use of this property because it would then serve as a buffer between the white residential area in Crestmont Park and the heavily colored developments to the north and west.[51]

> We feel by being surrounded by negro subdivisions this property is committed to a use, either for subdivision purposes or other, by this element. Eventual industrial use may be foreseeable; although, this seems unlikely with the nearest trackage available two miles away.[52]

References to the social demographics of the area are indeed striking. Yet they mask a more important distinction made in appraisal documents for the tank farm. Prior to sale of the property, developers calculated the appropriate cost of the land purchased with the storage tanks filled, *after* their contents ("sludge," or the remnants of stored crude oil[53]) were removed[54] and the property sold to white residents.[55]

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[50] Letter from Earl A. Wyatt, Earl A. Wyatt and Assocs., to M.L. Hanna, Gulf Oil (Aug. 15, 1966) (on file with author).

[51] *Id.*

[52] Letter from R.E. Clemons, The Clemons Co., to J.L. Irvin, Vice President, Gulf Refining Co. (Jan. 5, 1961) (on file with author).

[53] The bottoms of crude oil storage tanks contain a mixture of crude oil, water, and other substances that is commonly referred to as basic sediment and water, or BS&W.

[54] Earl A. Wyatt, Appraisal of 131.61 Acres of Land, John White Survey, A. 1011, Harris County, Texas, for M.L. Hanna, Gulf Oil (Feb. 10, 1964) (on file with author). The appraisal describes the value of the site as follows:

> The present worth of subject property is its market value less the cost of draining, filling and leveling the three large open tanks.
>
> Mr. R. Salmon, a dirt moving contractor, estimates it will take 3 months or longer to do this work, at a cost of $2500 per tank. Mr. Neville of Humble figures his cost at $1500 per acre of tank on some tanks in Humble that have as much as 6' of B.S. & W. These tanks are approximately 400 feet square, and it is felt that $5000 per tank is a safer estimate of cost, as it is not known how much experience Mr. Salmon has actually had in this type [of] work. Like Mr. Neville, Mr. Salmon would spread out the sludge on the land to dry.
>
> It is felt that land east of Chocolate Bayou Road will not sell as high as land adjoining a present residential development, especially where this land will have to be developed as a buffer zone between colored and white areas.
>
> For the above reason it is felt that the price being asked for the 29 acres fairly well represents the price at which a residential developer would buy subject property, if it were in its original condition and free and clear of tanks.

Id.

[55] In describing the "[h]ighest and [b]est [u]se" of the land, the appraisal prepared for Gulf Oil says, "The most profitable use for this land appears to be for medium priced houses for

For six years, Gulf Oil "unsuccessfully attempted to dispose of this acreage."[56] The company then negotiated with John Lester, the president of Log Development Company, who was interested in "acquiring the site for a Negro residential and commercial development."[57] In 1968, Gulf Oil conveyed the site to Log Development.[58] The transaction involved a tax-free exchange of the Pierce Junction Tank Farm (valued at $274,107) for the northwest corner of Richmond and Montrose Streets, in Houston.[59] Log Development did not remove any tank bottoms in the area of the earthen tanks utilized by Gulf Oil.[60] Lester simply had the berms along the sides of the pits pushed inward, filling the pits. The Kennedy Heights subdivision physically replaced the Mykawa Tank Farm in the late 1960s.

C. Residents Discover the Problem

The name of the subdivision, its location, the way it was marketed, and documents obtained from Log Development suggest that, in the end, the homes built over the tank farm were targeted at below-middle-income African-American buyers. The subdivision quickly filled with new homeowners. However, several aspects of the subdivision seemed "off" to the new residents. Sidewalks and backyards would buckle and sink. Residents noticed putrid smells and strange colorations in their tap and bathwater. Some even experienced diseases that were not in their family histories, including multiple forms of cancer and lupus. One resident had to cope with four different forms of cancer nearly simultaneously.

> Well, what I remember though, when I was a kid, we used to . . . [catch] crawfish in the ditch behind the house, and I remember the soil had like four or five different levels. It was like orange, purple, blue, and I guess reddish, plus the dirt on top. But as a kid, I didn't know what it was . . . .
>
> . . . .

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white occupancy, with a 200' wide commercial strip fronting on Chocolate Bayou Road as a buffer strip against the all colored Cloverland Subdivision on the west side of Chocolate Bayou Road." *Id.*; *see also* Letter from Earl A. Wyatt, Earl A. Wyatt & Assocs., to M.L. Hanna, Gulf Oil (Feb. 17, 1964) (on file with author) (describing the area as "both colored and white, with Chocolate Bayou Road serving as the dividing line" and noting, "[b]ecause of colored settlements across the road to the west the highest and best use for this land appears for low cost homes for white occupancy." Regarding necessary costs, "[t]he three large open earthen pits on the land will have to be filled before subdivision work can proceed on all the land. This may cost from $2500 to as much as $5000 per tank.").

56 Memorandum from P.J. Maddison to R.B. Gillies (Nov. 14, 1967) (on file with author) (regarding the exchange of Pierce Junction Earthen Tank Farm, Chocolate Bayou Road, Houston, Texas).

57 *Id.*

58 State of Texas, County of Harris, Conveyance of Property from Gulf Oil Corporation to Log Development Company (Jan. 29, 1968) (on file with author).

59 Memorandum from P.J. Maddison, *supra* note 56.

60 Affidavit of John R. Lester, Adams v. Chevron U.S.A., Inc., No. 96-1462 (S.D. Tex. July 6, 1997).

> . . . [T]he water has always been bad. We tried putting water filters, everything on the water. And really I wish I would have kept the filters. Because the filters that we would take out, it [sic] was filled with oil and green gook and everything else. So finally it got so bad to where we were afraid to drink the water even with filters. We changed filters 2–3 times a month and it still was bad, so we had to start buying water to drink. And we've always had dogs in the backyard. And every dog we've had, anytime they would dig, they would die. At first we thought somebody was poisoning them. But after we looked at it, anytime they would dig deep in the yard, they would die. . . . So every dog we had in the back, that's what happened to them. And we had a pear tree in the back and it was like one side of it would bear pears and one side wouldn't. So the side that didn't bear pears, that's where the dogs would dig all of the time and evidently there was something there.[61]

> . . . [T]here's too many deaths for the amount of people. And that's what got somebody's attention. That too many people were getting sick and dying. And there were too many abnormalities and birth defects in people. I mean, you know, even whole households, everybody was sick. You know, not just one.[62]

> . . . [L]ike on my side, it was like every other house, somebody had died of cancer. You don't tell me that's normal. That's not normal. [The special master] was trying to tell us that that was normal in a neighborhood. It's not. This was just on one side, within a block. I'm not talking about the other side, or down the street. Just one side. You're talking about 12 houses and every other house, somebody has died with cancer.[63]

An additional concern focused on the water lines under subdivision properties that would often rupture. One resident, a school teacher, recorded the water main breaks on the inside cover of her husband's Bible.[64]

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[61] Interview with Kennedy Heights Residents, in Houston, Tex. (Apr. 20, 2002) (on file with author).

[62] Interview with Helen Hinson & Joanne Jones, Residents of Kennedy Heights, in Houston, Tex. (Apr. 15, 2002) (on file with author).

[63] Interview with Kennedy Heights Residents, *supra* note 61.

[64] Some of the entries included the following:

> Lord help us. We are your children. God[,] seems like the water is making Albert sick[.] Lord help him.
>
> September 12, 1971 The water has broken again. Lord[,] what can we do.
>
> October 4, 1971 Water break[.]
>
> October 22, 1971 Water break[.] The water smells real bad today. It['s] yellow looking. Lord[,] what are we going to do.
>
> April 26, 1972 The pipes are rusty[.] [T]he workers said let the water run a long time[.]
>
> July 1973 The water has broken again. Albert is sick[.] Lord[,] it[']s in your hands[.] Lord I have called the city[.] [T]hey won't fix the water.
>
> April 1975 Water breaks[.]
>
> June 1975 Water breaks[.]
>
> December 1975 Water break[.]

Residents registered complaints about the water main breaks for twenty years, yet Houston's Capital Projects Department did not begin major work on pipe excavation and replacement until the early 1990s.[65] The city sent a contractor, Pas-Key Construction Services, to excavate a site on Murr Way and replace some of the waterlines.[66] On September 18, 1991, the contractor shut down the site over concerns about soil contamination, having encountered "potentially contaminated toxic materials."[67] Other employees remarked that there was a creosote odor in the area and complained of eye irritation.[68] The workers left a sizable hole in the ground and "ceased all construction operations until further notice from the City of Houston Health Department."[69] Residents began to wonder why the work had ceased. Perhaps the pipe replacements were part of a broader effort to increase the number of units available within the subdivision, as word spread that a low-income housing development was in the planning stages for the area.[70]

May 1976 Water breaks.

November 12, 1976 Water breaks[.]

January 1, 1977 New Year[']s day the water breaks[.] I can't cook.

January 20, 1977 Water breaks again. Pipes are rusty[;] they look bad[.]

May 10, 1977 Water break[.]

May 8, 1978 City put in a blue plastic pipe[.] [H]ope it will hold[.]

This is May 3, 1981. The blue pipe busted[.] Oh God[,] the blue pipes are busting[.]

Feb. 4, 1982 Pipe burst[.]

June 19, 1983 Pipe burst[.] I can't cook[.] Lord what[']s next[.]

Valorie Lusk, Notes in Family Bible (on file with author).

65 Even after litigation began, City of Houston utility complaint notices from July 14, 1995, to September 29, 1996, reveal a total of 108 utility complaints made by Kennedy Heights residents. City of Houston, Utility Complaint Notices (on file with author). Residents continue to complain of water main breaks.

66 PAS-KEY CONSTRUCTION SERVICE, INC., REPORT ON WATER PROJECT NO. 10086 (1992) (on file with author).

67 *Id.*

68 Memorandum from John E. Arradondo, Dir., Health & Human Servs., City of Houston, to Howard N. Nicholas, Dir., Capital Projects Dep't, City of Houston (Oct. 15, 1991) (on file with author).

69 Letter from R.L. Paskey, President, Paskey Constr. Serv., Inc., to Howard Nicholas, Dir. of Capital Projects Dep't, Dep't of Pub. Works, City of Houston, and Anthony Crisci, Manager of Civil Constr. Section, Design & Constr. Div., Dep't of Pub. Works, City of Houston (Sept. 26, 1991) (on file with author). The Director of Health and Human Services for the City of Houston recommended that "excavations in the Kennedy Heights subdivision be temporarily halted." Memorandum from John E. Arradondo, *supra* note 68.

70 Construction on a new section of the Kennedy Heights subdivision began in 1994. *New Homes, Mortgage Assistance Offered*, HOUS. CHRON., Jan. 6, 1994, at A20. The developers engaged in one of the first environmental reviews of the area, which included soil and groundwater tests of the vacant property by Law Environmental, Inc. Law Environmental, Inc., Proposal for Phase I Additional Research and Limited Phase II—Field Sampling and Laboratory Testing Program, Kennedy Heights Subdivision, Houston, Texas, Law Environmental Proposal No. 71-4045, at 3–4 (Feb. 18, 1994) (on file with author).

III. AGENCY SITE AND RISK ASSESSMENT: TEN YEARS AND FEW ANSWERS

Unbeknownst to residents, the City of Houston hired a contractor to investigate petroleum contamination at Kennedy Heights.[71] Thus began a disjointed process convened by regulators and private industry, lasting more than ten years, to assess whether Kennedy Heights residents were exposed to dangerous levels of a variety of toxicants, including polycyclic aromatic hydrocarbons (PAHs), some of which are known carcinogens.[72] Some of the data gathered were used years later by residents' legal counsel to piece together a narrative for use in litigation against Chevron, which acquired the property from Gulf Oil prior to its conversion to residential property.[73] The residents' narrative proceeded as follows: Breaks in water pipes under Kennedy Heights, which were located in areas where the highest levels of contaminants were found, caused periods of depressurization that allowed the contaminants to enter the pipes.[74] During this time, Kennedy Heights experienced twenty to thirty water main breaks per mile per year.[75] The contaminants included several known animal carcinogens, including a number of aromatic hydrocarbon compounds.[76] One of the areas of the body affected by exposure to PAHs is the immune system.[77] Lupus, a disease in which the immune system loses its ability to tell the difference between

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71 LOCKWOOD, ANDREWS & NEWMAN, INC., POTENTIALLY PETROLEUM CONTAMINATED MATERIALS INVESTIGATION: KENNEDY HEIGHTS SUBDIVISION 2 (1991) (prepared for the City of Houston) (on file with author).

72 The Agency for Toxic Substances and Disease Registry explains that

> The Department of Health and Human Services has determined that some PAHs may reasonably be expected to be carcinogens. Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Agency for Toxic Substances and Disease Registry, ToxFAQs for Polycyclic Aromatic Hydrocarbons, http://www.atsdr.cdc.gov/tfacts69.html (last visited Jan. 27, 2007).

73 The resulting mass torts suit was filed against a series of named defendants, including Chevron and Gulf Oil companies and subsidiaries, developers, construction companies, investors, and investment trusts. Plaintiffs' Summary of the Case at 1, 20–21, Adams v. Chevron U.S.A., Inc., No. 96-1462 (S.D. Tex. Sept. 10, 1997).

74 *Id.* at 5.

75 Consultants for the plaintiffs found that "[c]rude oil constituents from tank bottoms entering the drinking water system are distributed to homes in a short period of time." JACK V. MATSON, EXPERT REPORT: ENVIRONMENTAL CONDITIONS AT KENNEDY HEIGHTS SUBDIVISION, HOUSTON, TEXAS 18 (1996) (prepared for O'Quinn, Kerensky, MacAninch & Laminack) (on file with author). The primary mechanism for the transport of hydrocarbons was "entry from suspension in water surrounding a main break." *Id.* Dr. Jack Matson found that methane had evolved from the conversion of tank bottom hydrocarbons and represented "an explosive threat to residents within the Pit Number One area [Northeast Pit]." *Id.* at 3.

76 Richard Clapp, with Boston University, reviewed a report by Meta Environmental, Inc. and the results of testing done in Kennedy Heights in September 1996, and found several substances that are animal carcinogens "and therefore may be expected to cause cancer and other toxic effects in exposed humans." RICHARD CLAPP, REPORT OF RICHARD W. CLAPP 2 (1996) (on file with author).

77 *Id.*

foreign substances and its own cells and tissues, was prevalent in Kennedy Heights at a rate several times the national prevalence rate.[78] Other diseases linked to some of the known or suspected carcinogens in the soil were also prevalent in the subdivision.[79]

Despite years of agency sampling and assessment and a trial that advanced through thirty-one days of testimony (ending in a special master-driven settlement), no work was carried out to replace the pipes under their subdivision or remove any remnants of the Mykawa Tank Farm. EPA offered the final official word on the subject of contamination at Kennedy Heights. In response to continued resident complaints, the agency performed an Expanded Site Inspection in August 1998 and concluded its work in 2001, finding the site did not meet criteria for listing on the National Priorities List.[80]

It is no surprise that the level of uncertainty over even the existence of contamination remained high throughout much of the ten year process, given the range of estimates derived from the various efforts of the parties. Yet these highly technical procedures, coordinated by state and federal agencies in cooperation with Chevron, consumed most of the resources devoted to investigating residents' claims.

A. The Early Focus on Murr Way

Site characterization began in September 1991 when the City of Houston hired a contractor (Lockwood, Andrews, and Newnam, Inc. [LAN]) to investigate petroleum contamination in the subdivision.[81] This occurred after city personnel sent to the site noted a "creosote like odor in the air" and found trihalomethanes (a volatile organic compound) and evidence of trichloroethylene.[82] Soil borings drawn along the water main replacement route at zero to ten feet found contamination at a depth of two to seven feet, including petroleum hydrocarbons "not normally indigenous to surface

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78 Clapp calculated prevalence rates for systemic lupus erythematosus (SLE) and compared his results with estimates of prevalence in whites and African-Americans in the United States. National prevalence rates ranged from about 10 to 50 cases per 100,000. His estimate of the combined population of both current and former residents of Kennedy Heights was 2,435, of which 10 cases of SLE were reported. The prevalence of SLE in the combined population was estimated at 411 per 100,000, or between 4.9 and 8.2 times the upper end of the range of prevalence of SLE in the United States population. Clapp concluded that since the lower end of the confidence interval for his estimate was still more than three times higher than the upper range for the United States population, the results were not likely to be due to chance fluctuation. *Id.* at 3–4.

79 *Judge Delays Water Project Until Safeguards Installed*, HOUS. CHRON., Apr. 12, 1995, at A21.

80 ECOLOGY & ENV'T, INC., *supra* note 46, at 5-2 (2001).

81 *See* LOCKWOOD, ANDREWS & NEWMAN, INC., *supra* note 71, at 2 (recounting the emergency request from the City of Houston to determine the extent of soil contamination in the Kennedy Heights subdivision).

82 CITY OF HOUSTON, REPORT OF LABORATORY INVESTIGATION OF SAMPLES COLLECTED FROM MURR WAY LOCATIONS 1 (1991) (on file with author).

soils."[83] While the city's analysis of samples taken from two water mains near Murr Way (where Pas-Key work had ceased) suggested "no contamination of the potable water supply system," LAN found concentrations of total petroleum hydrocarbons (TPH) above levels recommended by the Texas Water Commission (TWC) for soil contamination.[84] The city's Interim Director of Health and Human Services also argued water line replacement should continue, to allow for "higher water pressure" that would "decrease the probability of ground water infiltration."[85]

The full results of the city's testing efforts were not shared with residents or the contractor.[86] The TWC, Texas Railroad Commission (RRC), and regional office of the Environmental Protection Agency, on the other hand, were contacted. A TWC official arrived to conduct a site inspection, but because the excavated site was already filled in, he was not able to take samples (according to what are now Texas Natural Resource Conservation Commission (TNRCC) guidelines).[87] Residents, who began to meet as the Kennedy Heights Civic Association, formed a Contamination Committee and collected money to pay for their own environmental consultant.[88] Pas-Key also hired a consultant to investigate the site.[89] By January 1992, contractors hired by Pas-Key found "the contaminant is creosote mixed with crude oil which will cause skin rash, dermatitis and sometimes breathing difficulties."[90] The city's sampling activity affected four streets, although until this point contractors focused predominantly on the excavation area.[91] A contractor hired by the residents found even higher levels of polyaromated

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83 Memorandum from John E. Arradondo, *supra* note 68. City officials did not know "exactly what the man-made pits were used for" at this point, although they had obtained aerial photographs indicating the three large pits, each four acres in size. *Id.*

84 LOCKWOOD, ANDREWS & NEWMAN, INC., *supra* note 71, at 6. Concentrations of TPH that were above action levels for soil contamination set by TWC were found in soil samples from five of the twenty-one soil borings.

85 Memorandum from M. des Vignes-Kendrick, Interim Dir., Health & Human Servs., City of Houston, to Dir. of Capital Projects, City of Houston (Feb. 6, 1992) (on file with author).

86 In a summary of Water Project 10086, Pas-Key states that "[b]ecause the City had not transmitted to Pas-Key the promised test results, on January 22, 1992 Pas-Key submitted various soil samples to Dr. Edwin B. Smith, a consultant retained and paid by Pas-Key." PAS-KEY CONSTRUCTION SERVICE, INC., *supra* note 66, at 2.

87 A TNRCC official familiar with the Kennedy Heights investigation stated:

> We received the complaint in 1991 and went out and took a look to figure out what was going on. Yeah, when the investigator actually got to the site, the excavation would have been for the placement of the water line and they had already filled that in when the investigator went out there. [If it had not been filled], [i]t's possible that there could have been a sample taken.

Telephone Interview with Tex. Natural Res. Conservation Comm'n Official (May 28, 2002) (on file with author).

88 Interview with Kennedy Heights Residents, *supra* note 61.

89 Letter from Edwin B. Smith, EFEH & Assocs., to Robert Paskey, Owner, Pas-Key Constr. Serv., Inc. (Jan. 29, 1992) (on file with author).

90 *Id.*

91 Letter from Philip D. Barnard, Assistant Dir., Capital Projects Dep't, City of Houston, to Robert Paskey, President, Pas-Key Constr. Servs., Inc. (Mar. 20, 1992) (on file with author).

hydrocarbons in the soil.[92] At around the same time, TWC changed its policy for analyzing hydrocarbons, eliminating one method for analyzing total petroleum hydrocarbon in water, land, and waste.[93]

The pace of activity picked up in 1994 and 1995, when American Home Dream Corporation requested an investigation of contamination at the site of a proposed additional fifty-three units within Kennedy Heights.[94] The contractor, RRC, and Chevron met to discuss the results, starting a trend where environmental scientists, regulators, and the regulated met regarding the site, at times without the input of the affected community.[95] Meanwhile, John Simmons, President of the Kennedy Heights Civic Association, started an investigation of his own, finding enormously high rates of cancer and lupus through an informal survey of the subdivision's 325 homes.[96]

B. Chevron-Railroad Commission Joint Efforts

RRC, holding jurisdiction over petroleum spills and deposits in Texas, investigated the Kennedy Heights neighborhood in 1994, reviewing results of the city health department's earlier tests for contamination and above-ground visual survey.[97] Based on the city's data, RRC concluded that there was no basis for the initiation of cleanup activities.[98]

To encourage regulatory action, residents began a letter writing campaign in August 1995, sending letters to TNRCC and RRC urging them to investigate the contamination under their homes.[99] An attorney representing

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[92] John Hanby, the consultant hired by the Civic Association, found "'extremely high' levels of petroleum-related chemicals" in the soil, with concentrations "several times higher than the city's highest reading." Bill Dawson & James Robinson, *Housing Project Site May Be Contaminated*, HOUS. CHRON., Feb. 15, 1994, at A1.

[93] Memorandum from Sheila Meyers & Anne Rhyne, Quality Assurance Specialists, Field Operations Div., Tex. Water Comm'n, to All Laboratory Personnel, Tex. Water Comm'n (Sept. 3, 1992) (on file with author).

> The purpose of this letter is to inform the laboratories that the TWC will only accept method 418.1 from "Methods for Chemical Analysis of Water and Wastes" . . . as an acceptable method for analysis of Total Petroleum Hydrocarbon (TPH) of water, soil and wastes . . . . [A] decision has been made to withdraw ASTM method 3328-78-B as an acceptable method . . . .

Id.

[94] Law Environmental, Inc., *supra* note 70, at 1.

[95] *Id.*

[96] Charles Zewe, *Houston Residents Sue Chevron over Health Problems*, CABLE NEWS NETWORK, May 26, 1997, http://www.cnn.com/US/9705/26/toxic.controversy/ (last visited Dec. 26, 2006) (citing a survey taken by Simmons that showed that there were 113 cases of cancer, brain tumors, lupus, and birth defects in the subdivision's 325 homes).

[97] George Flynn & Bill Dawson, *Relocation of Residents Proposed: Kennedy Heights Area Contaminated*, HOUS. CHRON., Aug. 8, 1995, at A1.

[98] *Id.*

[99] Over 200 letters were received by RRC, mostly in September 1995. Most of the letters followed a similar format. Some included entirely unique portions, such as a letter sent by Anita Smith, a resident of Kennedy Heights:

John Simmons and other families (approximately 2,000 individuals at the time) also presented a letter to the Chairman of RRC containing sixty-eight pages of signatures and citing findings of explosive levels of methane gas under certain homes.[100] RRC involvement began in earnest on August 23, 1995, when commission and Chevron representatives met to discuss the site.[101] As much of the residents' emphasis (which led to a motion for temporary injunction against the new contractor) focused on the threat of explosive levels of methane, Chevron proposed installing several gas monitoring wells in areas where high levels of subsurface methane had been identified.[102] According to Chevron, testing would "assist in identifying the source of the gas" and inform the applicability of surveying homes in the subdivision for gas concentrations.[103]

Chevron presented its Methane Investigation Proposal to RRC in September 1995. The proposal called for three gas monitoring wells using push tools in areas of "highest reported gas concentrations" (as found by residents' contractors[104]) to take samples at two-foot intervals (vertical).[105] The sample with the highest TPH reading for each well underwent additional testing for PAHs, metals, volatiles, semi-volatiles, and hazardous characteristics.[106] In addition, twelve to fifteen soil borings were taken to a depth of four feet to test for lower explosive limits of methane, CO_2, and O_2.[107] This was the first of several attempts by Chevron to measure the extent of contamination in Kennedy Heights. Local residents contested the series of assumptions on which the measurements were based. Table 1 provides the primary concerns raised by residents during testing at the subdivision.

> We the Resident[s] in the Kennedy Heights subdivision area . . . have relative's [sic] that have die[d]. And we still have family, neighbors who are still dieing [sic] and we have children who are having, liver, kenney [sic], tum[o]rs, and heart prombles [sic] and their [sic] are more than just that of prombles [sic] that a lot's [sic] of resident and their family are having. And we have some children who will not grow. . . . I also have 4 yr's [sic] old who is in liver fluer [sic]. Every [sic] sens [sic] he was bron [sic] he have had the liver promble[m] he bron [sic] with a pi[e]ce of his liver missing. Pleas[e] [w]e need your help bad[;] get us out of here. [T]he pepold's [sic] of Kennedy Heights need help now.

Letter from Anita Smith, Resident of Kennedy Heights, to Bill Hall, R.R. Comm'n of Tex. (received Sept. 14, 1995).

100 E-mail from Bill R. Hall to NIELSONJ, BIARDB, MITCHELL & DEESJ (Aug. 10, 1995, 10:19 CST) (on file with author) (regarding meeting on Kennedy Heights).

101 Memorandum from John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to Brenda Loudermilk, Special Counsel, R.R. Comm'n of Tex. (on file with author) (draft regarding status of Kennedy Heights investigation).

102 Memorandum from John J. Tintera, *supra* note 101.

103 *Id.*

104 The EPA's final report on the site indicated that "[m]ethane has been reported at concentrations ranging from 25,000 to 480,000 parts per million (ppm) in samples collected by the residents' contractors." ECOLOGY & ENV'T, INC., *supra* note 46, at 3-3.

105 R.R. Comm'n of Tex., Kennedy Heights Summary (Nov. 1995) (on file with author).

106 *Id.*

107 *Id.*

Table 1. Resident Concerns Regarding Chevron Sampling Proposals for Kennedy Heights

Chevron Proposal	Date	Resident Concerns
Methane Investigation Proposal (resubmitted as Installation of Gas Monitoring Wells for the Measurement of Methane Concentration and Flux Rates from Soil)	September 9, 1995 (revised October 11, 1995 and resubmitted December 7, 1995)	• Vapor phase hydrocarbons are from 2–11 feet with random, thin, and discontinuous distribution • Pockets of liquid and residual hydrocarbons are at 5–26 feet; sampling is too shallow at 4–10 feet • Three wells is inadequate • Need in situ and discrete samples with depth instead of 5 foot screens, to avoid dilution of samples • Samples will vent; will not be able to measure concentration, generation, or flux • Should test for a greater variety of PAHs • Vertical averaging will depress values • Fractures in clay can intersect methane pockets, allow gas to migrate to homes with cracked slabs • Methane will be generated until food source (hydrocarbons) is removed[108] Concerns post-investigation: • Systematic tight grid approach not used • Chevron "abandoned" sampling if no results, reported "no vapor" when should state "no sample" • Calculations for generation of methane based on inappropriate assumptions • Soil descriptions, video tapes do not support statement that grass roots caused elevated levels of methane • Comments that subsurface methane would render landscape barren are unsupported • Neglects methane accumulations beneath foundations[109]
Comprehensive Work Plan for Kennedy Heights Subdivision	October 18, 1996 (3d Draft)	• TNRCC regulations for residential exposure limits should be considered to determine acceptable levels of contamination • TNRCC should be involved due to the presence of chlorinated hydrocarbons • Chevron uses random rather than systematic sampling and too few samples within pits • There is no effort to locate the boundaries of the former pits • Monitor wells are too shallow at 5 feet • Chevron attempted to abandon a sampling effort in previous testing • Further testing should include tight grid of 50 feet for soil borings, borings where ETI sampled, borings and wells up to 14 feet, mapping of petroleum contaminated soils, testing for TPH using methods 418.1 and GC 8015B (before this only used 418.1)[110]

108 *Id.*

109 R.R. Comm'n of Tex., Summary of Residents Representatives Methane Comments (Mar. 20, 1996) (on file with author).

110 Letter from Kennedy Heights Residents Representatives, to R.R. Comm'n of Tex. (Apr. 3, 1996) (on file with author).

Residents' representatives and RRC staff were able to comment on several iterations of Chevron proposals, although this process was disjointed. RRC records indicate that certain meetings to discuss sampling efforts were held exclusively among Chevron and RRC representatives.[111] As sampling began, RRC and resident representatives were present to observe Chevron's efforts and to split samples for their own analysis when desired.[112] RRC adopted a statistical sampling frame for split samples, in addition to splitting samples with visible contamination.

On December 7, 1995, an RRC staff member learned that he had the authority to contract for equipment and materials needed to analyze the soil samples for methane gas and other contaminants that RRC planned to split with Chevron.[113] The official was also told, "[i]t is understood that the cost of this operation shall not exceed $2,500.00."[114] At the same time, an attorney for the plaintiffs requested that RRC observe certain sampling efforts on behalf of residents.[115] Some of RRC's final preparations included coordinating plans for responding to media interest. Interoffice correspondence regarding sampling activities would often include a characterization of media interest and any RRC response. Before testing started, an RRC official told Chevron's public affairs representative that his plan was to "respond to media inquiries about the RRC monitoring role in this but to refer questions about the testing, sampling, analysis, timetable, etc. to him."[116] By December 15, Chevron's methane investigation was ongoing with what had become four gas wells installed.[117]

Testing continued from mid-December 1995 to February 15, 1996. Preliminary data yielded 4,000 to 5,000 parts per million (ppm) methane

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111 For example, meetings held in May of 1996 and December of 1995 included only RRC, Chevron, and consulting firm representatives. R.R. Comm'n of Tex., Sign-in Sheet for RRC/Chevron Kennedy Heights Meeting (May 13, 1996) (on file with author); R.R. Comm'n of Tex., Sign-in Sheet for Kennedy Heights Chevron Technical Meeting (Dec. 6, 1995) (on file with author).

112 *See, e.g.,* E-mail from John J. Tintera, Assistant Dir., Site Remediation, R. R. Comm'n of Texas, to Kennedy Heights listserv (Dec. 21, 1995, 11:52 CST) (on file with author) ("It is anticipated that the plaintiffs[']representatives will also be on-site and will request to split gas samples with Chevron for seperate [sic] analysis. . . . Soil samples split with the RRC during last week[']s activities are being forwarded to Core Lab for independent analysis."). Some of the questions raised regarding split samples were whether Chevron would provide sample containers to RRC, whether they would be loaded under RRC observation, and whether Chevron would avoid RRC's personnel decontamination.

113 Letter from John James Tintera, Deputy Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to Guy Grossman, Dist. Dir., R.R. Comm'n of Tex. (Dec. 7, 1995) (on file with author).

114 *Id.*

115 Memorandum from Jeb Boyt, Staff Attorney, R.R. Comm'n of Tex., to Carole Keeton Rylander, Chairman, Barry Williamson, Comm'r & Charles R. Matthews, Comm'r, R.R. Comm'n of Tex. (Dec. 8, 1995) (on file with author).

116 E-mail from Brian Schaible to COMW.DEESJ, David Beshear & Scott B. White (Dec. 8, 1995, 12:08 CST) (on file with author) (regarding Kennedy Heights).

117 E–mail from John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Texas, to RED.KellyM, David Beshear, COMW.DEESJ & COM.HACHTMA (Dec. 15, 1995, 15:42 CST) (on file with author) (regarding Kennedy Heights update).

recovered from the monitor wells over the pits.[118] This was far below the level that RRC considered "explosive" (50,000 ppm) but it was believed "a greater concentration than Chevron anticipated measuring."[119] Data also showed two of twenty-five samples in excess of 1% TPH.[120] As Chevron periodically repeated its sampling procedures, a ritual ensued where RRC Site Remediation personnel unlocked the wells, monitored sampling activities along with plaintiffs' representatives, and requested split samples when visual contamination was noted. Occasionally, problems were reported. For example, instrument problems at the laboratory used by RRC meant that certain samples had to be shipped to a Corpus Christi lab for analysis.[121] These samples were shipped to Corpus Christi, then to Louisiana, and back to Corpus Christi.[122] RRC officials questioned the integrity of the samples and were told that there would be no charge for them.[123] On another occasion, Chevron told the other parties that a sample was insufficient and wanted to re-sample.[124] RRC representatives noticed visible contamination in the sample "and insisted and received split samples with residents."[125] Another problem concerned the effects of the wells on samples and methane readings. In mid-January 1996, field reports indicated that three of the four monitoring wells were partially filled with water. RRC officials indicated that they would ask Chevron about "what effect the water is having on the integrity of the testing."[126]

Methane testing ended with samples showing a maximum of 23,000 ppm methane at five feet, taken in an area where plaintiffs also encountered high levels.[127] RRC personnel reported that surrounding tests indicated that the comparatively high concentrations were localized.[128] Elevated TPH was found at levels up to 5,990 ppm[129] (recall that preliminary data in two samples showed 10,000 ppm, or 1% TPH).[130] By the close of the investigation,

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118 E-mail from John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to Kennedy Heights listserv (Jan. 10, 1996, 09:13 CST) (on file with author) (regarding Kennedy Heights status update).

119 *Id.*

120 E-mail from John J. Tintera, *supra* note 112 (regarding upcoming activities at Kennedy Heights).

121 E-mail from Art Correa, to MIERTSCHINW & John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex. (Jan. 17, 1996, 08:55 CST) (on file with author) (regarding Kennedy Heights core lab samples).

122 E-mail from Art Correa, to MIERTSCHINW & John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex. (Jan. 17, 1996, 09:28 CST) (on file with author).

123 *Id.*

124 Letter from Kennedy Height Residents' Representatives, *supra* note 110.

125 *Id.*

126 E-mail from Art Correa to MIERTSCHINW & John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex. (Jan. 24, 1996, 14:33 CST) (on file with author).

127 E-mail from John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to Kennedy Heights listserv (Feb. 16, 1996, 08:35 CST) (on file with author) (regarding Kennedy Heights status update).

128 *Id.*

129 E-mail from John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to Kennedy Heights listserv (Feb. 21, 1996, 14:48 CST) (on file with author).

130 *Id.*

the highest concentrations of TPH found by Chevron and RRC were 29,000 ppm and 24,000 ppm, respectively.[131] Exploration Technologies, Inc., a consulting firm hired by the plaintiffs, found levels as high as 32,060 ppm, in addition to "liquid product" (crude oil) at several locations.[132] It is difficult to draw conclusions directly from these numbers, particularly since liquid product was never officially verified by RRC. We know that a 1993 RRC rule provided for cleanup of "non-sensitive" areas when TPH levels exceeded 10,000 ppm.[133] Kennedy Heights was a sensitive area, implying that a lower threshold should be applied, albeit with adherence to specific risk-based decision making rules and procedures.[134] A lower threshold was suggested by RRC District Manager Guy Grossman.[135] However, the rule (Statewide Rule 91) did not apply to spills that occurred before November 1, 1993.[136]

In March 1996, RRC met with Chevron to discuss the second phase of the investigation. Chevron's plan included an evaluation of all three pits with ten shallow groundwater monitoring wells, thirty-three hollow stem auger soil samples, and twenty-four cone penetration tests.[137] The overall goal of this phase was to "conduct a detailed toxicological risk assessment that will address the presence and distribution of contaminants, any exposure risk to

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131 R. R. Comm'n of Tex., Summaries of Analyses by Party (Dec. 1995 and Apr. 1996) (on file with author).

132 Exploration Technologies, Inc., Bore Hole Locations, Pit Number 1 (Aug. 15, 1995) (draft prepared for O'Quinn, Kerensky, McAninch & Laminak) (on file with author).

133 16 TEX. ADMIN. CODE § 3.91(b) (1993). Statewide Rule (SWR) 91 criteria are for crude oil spills in "non-sensitive" areas and include removal of all free oil immediately according to SWR 91 guidelines, horizontal and vertical delineation of all areas with more than 1% TPH (10,000 ppm), and proper reporting. *Id.* § 3.91(c), (e); R.R. Comm'n of Tex., Field Guide for the Assessment and Cleanup of Soil and Groundwater Contaminated with Condensate from a Spill Incident, *available at* http://www.rrc.state.tx.us/divisions/og/key-programs/spillcleanup.html.

134 *See* Flynn & Dawson, *supra* note 97 (quoting the district manager of the Railroad Commission of Texas as saying that Kennedy Heights would probably be considered a "sensitive area" and therefore qualify for cleanup of its contamination below 10,000 ppm).

135 *Id.*

136 For spills that did qualify for cleanup under the rule, RRC provided the following advice:

> Statewide Rule 91 distinguishes two categories of spills: (a) crude oil spills into non-sensitive areas; and (b) (i) hydrocarbon condensate spills and (ii) crude oil spills in sensitive areas. Rule 91 establishes clear goals for cleanup of crude oil spills in non-sensitive areas: immediate removal of all free oil, immediate vertical and horizontal delineation; specifying the "area of contamination" that must be delineated and disposed of or remediated, and specification of a final cleanup level of "1% by weight total petroleum hydrocarbon." Rule 91 is less clear about the second category of spills.
>
> It stands to reason that hydrocarbon condensate spills and crude oil spills in sensitive areas, which pose greater risks, should at least follow standards established for the equally important but less threatening spills.

R.R. Comm'n of Tex., *supra* note 133. Yet the same residential and industrial limits are given for TPH and BETX, a group of particularly toxic compounds associated with the processing of crude oil (benzene, ethylbenzene, toluene, and xylene). *Id.*

137 E-mail from John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to Kennedy Heights listserv (Mar. 19, 1996, 07:46 CST) (on file with author) (regarding Kennedy Heights status).

residents, and surface or subsurface water pollution."[138] Sixty days of fieldwork were planned to gather data to allow for a more comprehensive investigation of site contamination. RRC and Chevron worked out field operations so that representatives would be present for surveying, probing, and sampling. Again, RRC officials described budgetary constraints that "will limit us to five samples."[139] The parties started with the northwest pit for one week and then moved into the neighborhood.

C. Phase II of the RRC-Chevron Investigation Commences

In response to concerns about drinking water, Chevron's Comprehensive Work Plan included a proposal to collect samples from the outside hose bibs of thirteen selected homes "as soon as reasonably possible, but no later than 24 hours after a water line break has been repaired in the Kennedy Heights subdivision."[140] The company also offered free drinking water testing to residents whose homes were located in the general area of the northeast pit. Plaintiffs opposed the sampling program, claiming that it was "unlikely to detect contamination at any home not affected by a specific pipeline break."[141] More importantly, it would have "limited utility in determining how much contaminated water has entered homes in Kennedy Heights during the last twenty-five years."[142] Residents forwarded approximately eighty letters, originally mailed to TNRCC and to the Houston District Office of RRC, requesting cleanup of contamination at Kennedy Heights.[143] Fifty residents attended a technical meeting regarding Chevron's Work Plan, again questioning the risk assessment and its ability to appropriately characterize sporadic contamination entering residential lines after water main breaks.[144] At a pre-hearing conference in Houston, residents' attorneys claimed that the hearing process lacked ground rules,

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138 *Id.*

139 E-mail from Art Correa to MIERTSCHINW & John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex. (Mar. 22, 1996, 10:41 CST) (on file with author). In discussing bids for Kennedy Heights sampling, officials noted:

> As of 10:00 a.m. we have received three bids. The low bidder is a hub—Chemsolve from [A]ustin. Bid is for $ 481 for either fluid or soil samples. The amount we are authorized will limit us to 5 samples. Bids have been signed and amounts double checked for accuracy. Any suggestions on what criteria we can document to award it as lowest and best bidder. Bidding is officially closed at 10:10 a.m. after checking fax machine and with SR & SRT personnel from any other bids.

Id.

140 Fluor Daniel GTI, Comprehensive Work Plan for Kennedy Heights Subdivision, Third Draft (Oct. 18, 1996) (prepared for Chevron U.S.A. Production Company) (on file with author).

141 Letter from Allen Eli Bell, Attorney, Bernsen, Jamail & Goodson, L.L.P., to Terri Eaton, Assistant Dir., Envtl. Section, Office of Gen. Counsel, R.R. Comm'n of Tex. (June 4, 1996) (on file with author).

142 *Id.*

143 E-mail from John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to COMW.OG_GREENSHEET (May 9, 1996, 14:47 CST) (on file with author).

144 E-mail from John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to COMW.OG_GREENSHEET (May 23, 1996, 14:41 CST) (on file with author).

standards, or a clear burden of proof.[145] Residents withdrew from the hearing, but implored RRC to continue its efforts, stating "[t]here is plenty of data right now to move forward."[146]

D. Comparison of Results by Party

Upon conclusion of sampling over each pit by the various consultants, RRC prepared summaries of the contamination. Tables 2 through 4 provide an overview of the highest concentration of several compounds of interest, summarized by RRC.

Table 2. Highest Concentration Found As Proportion of TNRCC Regulatory Limit, Northeast Pit (ppm)

	Chevron	RRC	ETI	City	PSI
TPH at Surface	1,453	800	7,797	590	-
TPH	29,000*	24,000*	9,720	-	-
VOC	43.49*/10.7 (Methylene Chloride)	-	.212*/1.33 (Benzene) 25/1.0 (Toluene)	-	-
S-VOC	39.18/45.7 (Bis 2-ethylhexyl phthalate)	-	33*/.00608 (Bis 2-ethylhexyl)	-	2.649*/ .00608 (Bis 2-ethylhexyl)
Total Metal	11.7*/.366 (Arsenic)	-	2.5*/.366 (Arsenic)	-	.450*/.366 (Arsenic)
SPLP VOC	2.99*/.005 (Methylene Chloride)	.009*/.005 (1,2 dichloroethane) .037/.005 (Methyl Chloride)	-	-	-
SPLP S-VOC	.021*/.006 (Bis 2-ethylhexyl phthalate)	-	-	-	-
SPLP Metal	.24/2.0 (Barium)	.004*/.002 (Mercury) 1.7/2.0 (Barium) 2351*/300 (Sulfates)	-	-	-
DW VOC, S-VOC, Metal	-	-	-	-	.016/.1 (Chloroform), .012*/. 00608 (Bis 2-ethylhexyl), .001/.05 (Arsenic)

145 E-mail from John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to Terri Eaton, Assistant Dir., Envtl. Section, Office of Gen. Counsel, R.R. Comm'n of Tex., LG.JohnsonB, LG.FowlerL, SchieckD & Wrotenb (Nov. 17, 1996, 12:45 CST) (on file with author) (regarding Kennedy Heights pre-hearing conference).

146 *Id.*

Table 3. Highest Concentration Found as Proportion of TNRCC Regulatory Limit, NW Pit (ppm)

	Chevron	RRC	ETI
TPH at Surface	3,674	1,100	636
TPH	23,450*	18,000*	32,060*
VOC	36.63*/10.7 (Methylene Chloride)	-	-
S-VOC	19.39/45.7 (Bis 2-ethylhexyl phthalate)	-	33*/.00608 (Bis 2-ethylhexyl)
Total Metal	11.4*/.366 (Arsenic)	-	2.5*/.366 (Arsenic)
SPLP VOC	4.07*/.005 (Methylene Chloride)	-	-
SPLP S-VOC	.0068*/.006 (Bis 2-ethylhexyl phthalate)	-	-
TCLP Metal	-	1.2/2 (Barium) 303*/300 (Sulfates)	

Table 4. Highest Concentration Found as Proportion of TNRCC Regulatory Limit, SE Pit (ppm)

	Chevron	RRC	ETI
TPH at Surface	24	200	31
TPH value	31	200	8
VOC	5.99/10.7 (Methylene Chloride)	-	-
S-VOC	6.99/45.7 (Bis 2-ethylhexyl phthalate)	-	-
Total Metal	12.1*/.366 (arsenic)	-	-
SPLP VOC	4.14*/.005 (Methylene Chloride)	-	-
SPLP S-VOC	.01198*/.006 (Bis 2-ethylhexyl phthalate)	-	-
TCLP Metal	-	2678*/300 (Sulfates) 305*/300 (Chlorides)	-

TPH	Total Petroleum Hydrocarbons	VOC	Volatile Organic Compound
S-VOC	Total Volatile Organic Compounds	DW	Drinking Water
SPLP	Synthetic Precipitate Leaching Procedure, an analytic method to determine the mobility of compounds in soil	TCLP	Toxicity Characteristic Leaching Procedure, an analytic method to determine metal mobility
DW	Drinking Water	-	no hits or test for this compound

* above TNRCC regulatory limits (number below / represents limit); numbers for TPH with a * are above RRC guidelines for non-sensitive areas; at the time, sensitive areas were assessed on a case-by-case basis

While some compounds had levels exceeding regulatory standards for both declared and suspected human carcinogens (as indicated by an asterisk in Tables 2 through 4), RRC determined, through analysis of a risk assessment performed by Chevron, that the levels of contamination did not pose a sufficient threat to human health to warrant remedial action.[147] Prior to completion of Chevron's Work Plan, RRC responded to the concerns of State Senator Rodney Ellis regarding the anticipated risk assessment. The Assistant Director of the Environmental Section of RRC described risk assessment as follows:

> No single risk assessment model will account for site-specific variables in all cases, including those at Kennedy Heights. However, risk assessment techniques are designed to be adjusted to accommodate site-specific variables. Commission staff has experience evaluating site-specific risk assessments, including assessments of risk to nearby residents from surface and subsurface contaminants. If a thorough risk assessment of the residual contamination at Kennedy Heights indicates that the residents are or may be exposed to constituents of concern at unacceptable levels, appropriate remedial measures will be required.[148]

RRC's evaluation of Chevron's risk assessment led them to conclude that residents were not exposed to unacceptable levels of hydrocarbons, a finding echoed years later in EPA's risk assessment.[149] Residents were left to seek relief through the courts.

IV. THE LIMITS OF SITE CHARACTERIZATION AND RISK ASSESSMENT IN KENNEDY HEIGHTS

The above account of site investigations conducted by multiple agencies, jurisdictions, and consulting firms represents only one side of the Kennedy Heights story.[150] The value in piecing together this particular

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147 COMPLIANCE SOLUTIONS, INC., ADDENDUM TO BASE LINE RISK ASSESSMENT FOR THE KENNEDY HEIGHTS SUBDIVISION I (1997) (on file with author) (prepared for Chevron USA Production company). "CSI concluded that while weathered crude oil is present in some portions of the Subdivision, it does not present a significant risk to the health of the residents." *Id.*; Letter from Denisé Guervia for William B. Allison, Partner, Allison & Shoemaker, L.L.P. to Terri K Eaton, Assistant Dir., Office of Gen. Counsel, R. R. Comm'n of Tex. (Oct. 2, 1997) (on file with author) (regarding Addendum to Base Line Risk Assessment for the Kennnedy Heights Subdivision (Final Draft)).

148 Letter from Terri K. Eaton, Assistant Dir., Envtl. Section, Office of Gen. Counsel, R.R. Comm'n of Tex., to William-Paul Thomas, Chief of Staff, Office of Senator Rodney Ellis (June 7, 1996) (on file with author).

149 ECOLOGY & ENV'T, INC., *supra* note 46, at 5-2.

150 For example, on March 23, 1999, roughly 2,400 plaintiffs met at the Hofheinz Pavillion basketball court at the University of Houston and were asked to accept a settlement. Chambers' Plaintiffs' Response to Motion to Withdraw of John O'Quinn from their Representation as their Counsel at 6, Adams v. Chevron U.S.A., Inc., No. 96-1462 (S.D. Tex. Feb. 9, 2000). An attorney asked the group to pause and recite the Prayer for Serenity ("Lord, grant me the serenity to accept the things I cannot change, courage to change the things I can, and wisdom to know the difference."). Most residents were too broken to protest the choice they would have to make:

sequence of events lies in its demonstration of how pragmatic considerations as well as factual uncertainty can overshadow objective analysis as parties move to investigate a contaminated site. The primary dynamics at work as the site assessment process unfolded in Kennedy Heights included a growing disconnect between residents' concerns and the sampling frame choices made by contractors, RRC-Chevron interaction, and interpreting findings from the first two phases of the investigation through risk assessment methodologies developed by consulting firms for Chevron.

A. The Importance of Sampling Frame Choice

Much of the variance in results gathered by parties operating in Kennedy Heights can be attributed to the choice of sampling frame by each consulting firm.[151] This was anticipated in the difference of opinion between RRC, residents, and Chevron as the parties set up the Methane Investigation Proposal. RRC expressed doubt over the time frame, volumes collected per tube, approximate location of the soil borings (which Chevron did not specify), Chevron's rationale for limiting its samples to four feet (when initial findings were in the two to seven foot range), its decision to sample at one to two month intervals, and the absence of any plan to determine the origin of the gas. Residents shared these concerns, particularly because their consultants found vapor phase hydrocarbons at two to eleven feet "with random, thin, and discontinuous distribution" and pockets of liquid hydrocarbons at five to twenty-six feet.[152] There was clear concern over possible sample dilution, which led residents to propose an in situ as opposed to a five foot screen approach and to predict that the wells would vent, fill with rainwater, and necessitate vertical averaging that would further depress values.[153] Sure enough, Chevron only set up four gas wells for use over thirteen months, three of which filled with water.[154] RRC's only recorded response was to note that they would ask Chevron about rainwater's effects on sample integrity.[155]

Residents reiterated their concerns post-sampling as well.[156] First, Chevron did not use a grid approach commonly applied by the industry.[157]

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either accept their settlement, or become pro se (representing themselves, should the court grant motions by O'Quinn and associates to withdraw as counsel) in a case that, should it proceed, would begin by considering challenges to the admissibility of evidence. Letter from John M. O'Quinn, Partner, O'Quinn & Laminack, to Deirdre M. Jones, Client (July 28, 2000) (on file with author).

151 Sampling frames concern how, for example, soil samples will be taken from a geographic area. Questions of timing, tools used, and horizontal and vertical spacing are considered in order to increase the likelihood that a contaminant, if present in the soil, will be detected and its location pinpointed.

152 *See supra* Table 1 (listing residents' concerns about Chevron sampling proposals).

153 *Id.*

154 *Id.*

155 *See supra* notes 124–126 and accompanying text.

156 *See supra* Table 1 (listing residents' post-investigation concerns about Chevron sampling proposals).

157 *Id.*

Consultants for the residents employed this approach, described by a scientist at Exploration Technologies, Inc.

> We began with a, it might have been a fifty-foot sampling grid, and what we did was map the various components, the methane, ethane, propane, butanes, and what we call C5+, the pentanes through xylene plus hydrocarbons, and of course the methane turned out to be the best indicator, again, the anaerobic degradation product of the crude oil, and what it indicated to us, and the purpose of doing the soil gas survey was to determine or delineate the aerial extent of the contamination in the subsurface . . . we do this first because we do not want to go out and install borings and/or install monitoring wells at random.[158]

There were also problems with sampling decisions made *during* the thirteen month period. Residents protested the fact that Chevron recorded abandoned sampling efforts as "no vapor" instead of "no sample" and based their sampling frame on methane generation assumptions not shared by residents or RRC.[159] Perhaps most troubling to residents was Chevron's neglect of methane accumulations under housing foundations.[160] Questions such as where to locate soil borings, what depths they should reach, and how often they should be collected are closely tied to the narrative of contamination that one is trying to construct. A community representative articulated the narrative for soil gas location as follows:

> We did a fifty-foot grid, but those little insets indicate that the contamination was so, I don't want to use the term random, but unpredictable, because what happened was they had these pits dug, and what they dug out they put as a berm around the pits. They filled the pits to well beyond the pit itself so that actually the crude oil was up into the berms. When they were ready to close those pits, they just bulldozed everything back into the pits. So if you can imagine, the best analogy I can give you is a vanilla and chocolate marble cake. So when they bulldozed all the berms back into the pit, now what you have is your chocolate is your product, or your crude oil saturated soils, that are now mixed in with your vanilla, which is less contaminated or possibly uncontaminated soils, so it's very difficult to predict where these pockets of product exist . . . we did some drilling, bore hole drilling after we finished our soil gas survey, and we did it based upon our soil gas anomalies, and I personally was present and collected samples on three particular bore holes which were drilled four feet apart. One on the, off the sidewalk but on someone's lawn, then moved over four feet to the west, and both were contaminated, the cores were dripping crude oil, moved over four feet again, and got nothing. That's how quickly you could go from contaminated soil to relatively clean soil.[161]

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158 Telephone Interview with Consultant, Exploration Technologies, Inc. (May 10, 2002) (on file with author).

159 *See supra* Table 1 (listing residents' post-investigation concerns about Chevron sampling proposals).

160 *Id.*

161 Telephone Interview with Consultant, *supra* note 158.

The possibility that soil gas locations could be randomly dispersed across the subdivision led scientists hired by residents to express concern over the likelihood of methane pockets.[162] Methane pockets, when reaching a level indicative of explosive potential, would be extremely dangerous if located under single family homes. Yet the Chevron Methane Investigation Proposal and Comprehensive Work Plan did not outline a plan to test housing foundations.[163] Nor did they account for exposure to vapors from degrading crude oil (in the form of ambient air sampling inside the homes located over the pits), hydrocarbon transport from soil to drinking water through water main breaks (by providing random drinking water testing throughout portions of the subdivision following a line break), or the discontinuous location of hydrocarbons and other soil gases (that could only be characterized through grid sampling).[164] Collectively, these early choices by Chevron, questioned by RRC but ultimately accepted, meant that resident understandings of their subdivision and fears regarding possible exposure pathways (drinking water and showers following pipe ruptures, inhalation from sub-foundation soil entering homes) and dangers (explosive levels of methane in housing foundations) were effectively excluded from consideration. This narrowing of potential findings occurred before the remainder of RRC's decisions, made almost exclusively with Chevron representatives, further limited the ability of RRC to characterize sporadic contamination entering resident lines after water main breaks.

By the time sampling efforts commenced, it was too late for residents to introduce protocols to investigate the validity of the above narratives. For example, residents' consultants produced a map of their fifty-foot grid, with bore hole locations over the NE pit (bisected by Murr Way and Lockgate Lane, the site of the bulk of the lupus cases).[165] The map indicates that "liquid product," or crude oil, was found at 11302 Murr Way (at eight to ten feet), 11303 Murr Way (twenty-four feet), 11315 Murr Way (ten and twenty-six feet), 11323 Murr Way (six to nine feet), 11322 Murr Way (five to eight feet), and 11323 Lockgate Lane (eight to ten feet).[166]

During joint testing by RRC and Chevron, ETI workers asked a RRC official for permission to demonstrate where the liquid product was located and were told that they lacked a work plan and had not submitted the requisite number of hours preceding their sampling activities.[167] On December 13, 1995, RRC notes discuss this encounter: "[Residents] want to spl[it] (core soils) [within] and adj[acent] to Chevron [monitoring well] @ 11323 MW. We have mtg.—Chevron say core rig disturb their well—I say we are implement[ing] Chevron plan and want to maintain interpret[ation] of Chevron data—but [in] the next round of assessment we may address

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162 *See supra* Table 1 (listing residents' concerns about Chevron sampling proposals).

163 Fluor Daniel GTI, *supra* note 140.

164 *Id.*

165 Exploration Technologies, Inc., *supra* note 132.

166 *Id.*

167 Telephone Interview with Consultant, *supra* note 158.

this."[168] Such an effort was not made, although later the EPA agreed that "visible hydrocarbons" were present in some of the samples.[169]

B. Site Characterization and Risk Assessment As a Negotiated Process Between RRC and Chevron

The Assistant Director of Site Remediation for RRC described a typical day of sampling at the subdivision as follows:

> Early in the morning, various parties, RRC, Chevron, Chevron's contractors, residents' representatives, and the residents' contractors would meet for a safety meeting and go over the daily activities that would go on there. RRC would have at least one, sometimes 2 or 3 representatives on site to witness the activities and keep records and then the sampling plans would proceed . . . our role was primarily monitoring. Of course, there's media attention and things like that. Occasionally we would have to answer questions like that.[170]

This image of parity in sampling and coordination across parties is not present in fifteen months of RRC correspondence documents, which focus primarily on media attention, RRC questions regarding cost and method, and, most importantly, the ongoing negotiation between Chevron and RRC over sampling protocol.

1. Media Attention

Field notes taken on-site and later represented in electronic correspondence often included the indication "no media attention" or "no media on-site."[171] Occasionally, media interest is noted, such as in a December 12, 1995, entry: "Chevron has staked locations for about two thirds of the locations for soil samples and monitoring wells. . . . High media interest—so far the questions have been directed at Chevron and plaintiffs, not our folks."[172] In addition, there are entries that describe situations that could potentially spark media interest:

> As of 8:00 a.m. this morning, everything is running smooth at KH. Yesterday Patty reported that the picket signs that were used last week have now been placed on the curbs of the residential area. . . . Between yesterday and this morning all monitor wells on the Northwest Pit have been evacuated.[173]

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168 R.R. Comm'n of Tex., Handwritten Field Notes (Dec. 13, 1995) (on file with author).

169 ECOLOGY & ENV'T, INC., *supra* note 46, at 5-1.

170 Telephone Interview with Site Remediation Official, R.R. Comm'n of Tex. (May 3, 2002).

171 *See, e.g.*, E-mail from John J. Tintera, *supra* note 127. ("There was no media attention yesterday, and only FOX TV was at the neighborhood this week for a short interview with Chevron personnel.").

172 E-mail from Brian Schaible, to COMW.DEESJ, David Beshear & Scott White (Dec. 12, 1995, 14:50 CST) (on file with author) (regarding Kennedy Heights).

173 E-mail from Art Correa to MIERTSCHINW & John J Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex. (Apr. 4, 1996) (on file with author).

The event most likely to encourage media involvement would be a finding of "explosive levels" of methane at Kennedy Heights. Entries in RRC field notes sometimes contained a notation that "no explosive levels" were found to date.[174] RRC internal correspondence also outlines meetings with Chevron representatives and other discussions regarding what RRC planned to say to certain parties (including the media) should they be asked about the process.

> [December 8, 1995:] [T]alked with Mickey Driver, Chevron public affairs rep in Houston this morning. They are putting out a media advisory today outlining what's going to happen next week. . . . I told Driver my plan was to respond to media inquiries about the RRC monitoring roles in this but to refer questions about the testing, sampling, analysis, timetable, etc. to him. He said that was fine. . . . Driver is highlighting the methane aspect and sticking to the Chevron party lines that there's no evidence anything else is there that poses a health risk.[175]

> [December 6, 1995:] Kennedy Heights Technical Meeting notes. Noon on Monday[.] Any violence leave[.] Safety #1[.] . . . Any questions about Chevron's plan will be referred to Chevron. What to say: We are on top of the situation[.] Monitoring the situation[.] Long as it takes[.] Chevron foot the bill not the tax payers[.] . . . Pick worst looking samples for analysis. Sample splitting priority: 1. Chevron 2. Plaintiff 3. RRC . . . . Soil gas permeability we will not be involved in.[176]

> [August 25, 1995:] [C]ontacted by John Cambell, an adjacent landowner, at KH, requesting information on the meeting with Chevron. . . . I'll provide the following information: "Commission staff met with Chevron representatives this Wednesday. The outcome of the meeting is that the Commission expects Chevron to submit a plan shortly (within weeks or days) which will include additional assessment activities as well as address safety concerns." If pressed for additional info I'll take the stance that it would be premature to speculate until the proposed plan is received, if pressed further I will refer the caller to Office of Information Services.[177]

2. RRC Questions

As RRC sought to manage perception of its involvement and determine what information it would share with various parties, it also tried to make sense of its role vis-à-vis Chevron and its contractors. No entry in the RRC correspondence files concerns a request for information made by Chevron to RRC staff. On the other hand, RRC readily inquired into the feasibility or

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174 *See, e.g.*, E-mail from John J. Tintera, *supra* note 129 ("Preliminary raw field data indicate that no explosive levels of methane gas were encountered").

175 E-mail from Brian Schaible, *supra* note 116.

176 R.R. Comm'n of Tex., Meeting with Chevron, Handwritten Notes (Dec. 6, 1995) (on file with author).

177 E-mail from John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to Scott White, COMW.DEESJ & David Beshear (Aug. 25, 1995, 11:33 CST) (on file with author) (regarding Kennedy Heights inquiry).

relative merits of methods and approaches throughout the site characterization process. RRC also struggled with severe resource constraints and sampling and analysis problems that arose with some frequency:

> [November 20, 1995:] I finished reviewing the Chevron proposal on Sample Testing. The problem is I won't know anything about our lab capability's [sic] till [sic] Carl N[elson] gets back.[178]

> [November 29, 1995:] [S]poke with Carl Nelson and he said he was not equipped to handle any of the sample testing that Chevron is proposing to do. I am waiting on two companys [sic] to fax me their cost estimates. Core Lab is the only one to fax their cost est[imate] and their cost for just one sample for each of the individual tests is $1260.00.[179]

> [December 7, 1995:] Authority to contract for equipment and materials necessary to analyze soil samples for methane gas and other possible contaminants from an unknown source associated with former crude oil storage pits. . . . It is understood that the cost of this operation shall not exceed $2,500.[180]

> [December 28, 1995:] RRC soil samples, obtained two weeks ago when samples were split between Chevron, the plaintiffs, and the RRC, are being independently analyzed by Core Lab. Results will be available within one to two weeks. Core Lab has reported that there is insufficient sample to run all tests on 3 of the 4 samples.[181]

> [January 17, 1996:] Core Lab is experiencing instrument problems and will ship the extract to the lab in Corpus. Samples that are affected are . . . Sample #13 - RRC tag# 20946 . . . 2' to 4' soil core sample . . . Sample #14 - RRC tag# 20947 . . . 4' to 6' soil core sample. Analysis needed to complete work are TPH-Diesel and SPLP-Semi-volatiles for the above Samples.[182]

> [January 17, 1996:] The following questions will be addressed on the Letter we will receive from Core Lab this morning: 1. The validity of the sample analysis. 2. Integrity of the sample being shipped back to CC [Corpus Christi]. 3. Why were samples shipped to CC, then to LA [Louisiana], and now back to CC.[183]

> [January 24, 1996:] Ray will speak with Lloyd Deuel [at Chevron] and get his response on what effect the water is having on the integrity of the testing. Patty

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178 E-mail from Art A. Correa to MIERTSCHINW & John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex. (Nov. 20, 1995, 16:11 CST) (on file with author).

179 E-mail from Art A. Correa to MIERTSCHINW & John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex. (Nov. 29, 1995, 11:57 CST) (on file with author).

180 Letter from John Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to Guy Grossman, District Dir., R.R. Comm'n of Tex. (Dec. 7, 1995) (on file with author).

181 E-mail from John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to Kennedy Heights listserv (Dec. 28, 1995, 8:16 CST) (on file with author) (regarding Kennedy Heights update).

182 E-mail from Art A. Correa, *supra* note 121.

183 *Id.*

> left the site at 1:30 after speaking with Chevron to make sure that the sample procedure that was changed (instead of pulling 6-5cc of volume with the syringe sample they are pulling 6-4cc of volume) is documented.[184]

> [February 20, 1996:] I'd like to go over these KH test results [Chevron's methane investigation report]. . . . I need to see the hotspots on the test results and . . . understand exactly what the report means.[185]

> [March 21, 1996:] What is our next step at KH? Do we approve [Chevron's] plan, wait on [residents'] comments? Their recent letter still leaves open ended when RRC will receive additional info. Let's request a status update report in 60 days.[186]

> [March 22, 1996:] As of 10:00 a.m. we have received three bids. The low bidder is a hub—Chemsolve from [A]ustin. Bid is for $481 for either fluid or soil samples. The amount we are authorized will limit us to 5 samples. Bids have been signed and amounts double checked for accuracy. Any suggestions on what criteria we can document to award it as lowest and best bidder.[187]

> [April 5, 1996:] A review of the analyses from various test samples in the Kennedy Heights Subdivision indicates concentrations of organic compounds that may be due to laboratory contamination or the addition of the compound as internal standards [1,2 Dichloroethane and Methylene chloride]. . . . Therefore, it is suggested that samples be taken from the same locations by equipment that has not been cleaned with solvents . . . .[188]

> [May 9, 1996:] Do you have a copy of the KH samples we sent out with the wrong address sever[a]l months ago? I can't find mine. Also, please check with Carl Nelson on status of when current samples will be completed. I'm getting media and Commissioner requests for info.[189]

3. Lack of Balance in the RRC/Chevron Relationship

Resource and knowledge constraints left the RRC at a disadvantage as it tried to negotiate the scope of Chevron's investigation. Chevron's Comprehensive Work Plan contained several glaring omissions, according to RRC staff.[190] Further meetings (exclusively with Chevron) led to an

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184 E-mail from Art A. Correa, *supra* note 126.

185 E-mail from David Beshear to John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex. (Feb. 20, 1996, 17:27 CST) (on file with author).

186 E-mail from John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to Terri Eaton, Assistant Dir., Envtl. Section, Office of Gen. Counsel, R.R. Comm'n of Tex. (Mar. 21, 1996, 08:31 CST) (on file with author).

187 E-mail from Art Correa, *supra* note 139.

188 E-mail from Bill Renfro to John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex. (Apr. 5, 1996, 16:40 CST) (on file with author) (regarding Kennedy Heights analysis).

189 E-mail from John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to Art Correa (May 9, 1996, 16:03 CST) (on file with author) (regarding Kennedy Heights samples).

190 One e-mail contained the following questions of the Comprehensive Work Plan:

> Why no evaluation of migratory pathways to residents and/or surface and subsurface waters? No toxicologic or risk assessment review of data. Need to evaluate presence and

understanding that some of the gaps in the site assessment process would simply be addressed at a later date: "This is viewed as preliminary to help [Chevron] plan for a more detailed assessment activity which will culminate in a final report that will include a detailed risk assessment."[191] But not all concerns were addressed, as evidenced by RRC's questions following completion of the methane investigation:

> [April 8, 1996:] Chevron still needs to explain several parts of the methane investigation, including:
>
> - origin of methane
> - why no methane maps submitted
> - if soils have low perm to gas, how does it diffuse through soils
> - why so many "no vapor" test and are they representative or a sampling technique problem
> - would a different sampling technique allow for higher concentrations
> - further evaluation of high levels of gas where Chevron reported them . . .
> - further explanation of soil moisture affecting perm[eability] and gas, is their [sic] a seasonal variation, does that tie-in with no vapor reports
>
> . . . Chevron claimed in one of our early meetings that since the [residents] had already sampled extensively, Chevron wouldn't re-create those tests but would hit the high concentrations. However, [residents] are reporting additional sampling events with ever-higher concentrations in areas Chevron hasn't tested. Methane concentration distribution appears highly variable. Because of the variability, I think we need to be able to say all residences were evaluated. The only way to do this is a sample grid with a focus adjacent to homes.[192]

Sample grids were never employed at the Kennedy Heights site. This did not keep RRC from claiming that findings of elevated PAH levels were "localized," despite the comparatively sporadic placement of soil borings by Chevron.

Most of the other questions raised by RRC were shared only with Chevron at frequent technical meetings. Residents and their representatives only commented on a handful of occasions, usually immediately after the submission of a draft sampling plan. There is no evidence in the record of the kind of extensive interaction that RRC and Chevron shared in 1995 and 1996, when most of the physical sampling took place. Thus, not only were resident narratives regarding possible exposure pathways excluded from consideration

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> level of contaminants and risk to residents/environment. Work plan does not address high TPH soils, free crude oil in subsurface, crude oil contaminated groundwater, BTEX [benzene, toluene, ethylene, and xylene], PAH's, or other contaminants as required by RRC letter of November 13, 1995. Report calls for only one water sampling event in monitor wells, what about seasonal fluctuations and time? No permeability or hydraulic conductivity testing of samples, cores, pit bottoms. Why are Hollow Stem Auger pit samples shallow and only 8–10 feet, with no deep tests?

E-mail from John J. Tintera, Assistant Dir., Site Remediation, R.R. Comm'n of Tex., to Terri Eaton, Assistant Dir., Envtl. Section, Office of Gen. Counsel, R.R. Comm'n of Tex. (Apr. 8, 1996, 16:57 CST) (on file with author) (regarding Kennedy Heights response).

191 *Id.*

192 *Id.*

by the broader sampling plans, but the minutiae of daily site-based decision-making proceeded parallel but apart from resident involvement (with the exception of resident presence at the actual sampling locations). Far from serving as the lead stakeholder in a site investigation concerning matters within its jurisdiction, RRC focused on taking a limited number of its own samples, managing media relations, and asking questions of Chevron contractors. Judging from RRC concerns that remained following the close of the methane investigation, some of these questions, such as whether to account for seasonal variations or the scattered location of soil gas pockets, were not even raised until near the close of the exercise. More importantly, residents were not made aware of the ad hoc choices made by RRC staff, such as equipment for use in sampling and their relative merits, where to send samples, what analytical methods to use, how to split samples (visually, randomly, or by some other means), how Chevron would avoid violating sample integrity, what the parties should do with diluted or questionable samples, and how RRC could serve its chosen role as monitor most effectively on a budget of $2,500.

C. Risk Assessment: The Final Stage in a Negotiated Process

A final narrowing of resident options occurred through analysis of the disparate findings noted in Tables 2 through 4. By 1997, the only analytic work to make use of the sampling data was done by Compliance Solutions, Inc. (CSI) and transferred to RRC through attorneys for Chevron.[193] The risk assessment concluded that "while weathered crude oil is present in some portions of the Subdivision, it does not present a significant risk to the health of the residents."[194] The risk assessment process did not consider the primary health outcome of concern to Kennedy Heights residents.

> Risk assessment incorporates the best technical judgment of EPA scientists as to what toxic effect (cancer or non-cancer) occurs at the lowest dose for each chemical, since protecting against this most sensitive effect will afford protection against those toxic effects that are seen only at higher levels of exposure. In this regard, [RRC] asked whether lupus erythematosus is considered as part of the Risk Assessment Report. Compliance Solutions has reviewed the published literature which indicates that lupus is not etiologically related to any of the chemicals of relevance to Kennedy Heights.[195]

Nor did CSI analyze samples of groundwater collected from soil borings as part of its formal risk assessment "because of the lack of appropriate background and regulatory criteria."[196]

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193 COMPLIANCE SOLUTIONS, INC., *supra* note 147.
194 *Id.* at 1.
195 *Id.* at 2.
196 *Id.* at 12.

In addition, CSI made a number of assumptions in its risk calculations. First, "the quality of the analytical and field information was often unverified or the required information was not provided to us for this risk analysis,"[197] leading CSI to take reports from elsewhere and use them to generate estimates of such variables as Method Detection Limits (MDLs), the lowest levels above which a laboratory can detect the presence of a substance in a soil or water sample.[198] For this calculation, CSI assumed that the ratio of MDLs to quantitation limits (the lowest level at which a substance can be reliably measured by a given method performed by a laboratory) was constant for each toxicant, obtaining the latter from a quality control study from Arthur D. Little and applying the numbers to Chevron data only (Phase 3 analytical results for select volatile organic compounds).[199] CSI also assumed that all reported data were valid, "unless it was clear from available records that the technical problems associated with a specific sample made its inclusion impossible."[200] It assumed that the subdivision represented an urban rather than non-disturbed background, based on data collected by Fluor-Daniel-GTI for Chevron, and developed estimates of background for various chemicals accordingly.[201] CSI then estimated 95% Upper Tolerance Limits (UTLs) for each chemical observed in background samples, but noted that "variations in the calculated 95% UTLs were noted, and are believed attributable to small sample numbers and the relatively few locations sampled at depth."[202] Chevron's statistician "considered 16 to be the minimum number [of] samples necessary to develop background statistics," but in order to achieve this number, CSI had to use Chevron's "no vapor" samples (which residents noted were abandoned samples rather than true "non-detects") to calculate its 95% UTLs.[203]

CSI next determined how the data were distributed using the Kruskal-Wallis statistical test.[204] The test compares the medians of samples from two or more groups, and answers whether all samples were taken from the same population.[205] While the test does not require a normal distribution in order to test its hypothesis, it does assume that measurements come from a continuous distribution.[206] We have seen that by all accounts, the distribution of soil vapors and certainly the sampling protocol at Kennedy Heights were discontinuous. In addition, the test, being nonparametric, does not allow for calculating confidence intervals, nor can it indicate to

197 *Id.* at 3.
198 *Id.*
199 *Id.* at 4.
200 *Id.*
201 *Id.* at 5.
202 *Id.*
203 *Id.*
204 *Id.* at 6.
205 The MathWorks, Statistics Toolbox, Kruskal-Wallis, http://www.mathworks.com/access/helpdesk/help/toolbox/stats/kruskalwallis.html (last visited Jan. 28, 2007).
206 *Id.*

what degree various measurements differ.[207] CSI dealt with the finding that background concentrations "showed marked skewness to the right" by taking the natural logarithm of each reported concentration, and generating the mean and standard deviation of the transformed data to calculate UTLs for the site.[208]

CSI's primary task was to compare data from samples collected to their 95% UTLs to "identify Potential Chemicals of Concern" (COCs).[209] As part of this comparison, CSI only labeled a chemical a COC if its geographic distribution was consistent with a potential source of contamination.[210] On the basis of one or both of these criteria—numerical comparison and distribution—CSI did not identify any COCs among the volatile organic compounds or semi-volatile organic compounds found at Kennedy Heights.[211] This process can be compared with the TNRCC's draft Ecological Risk Assessment guidance document, issued in November 1996:

> To evaluate the need for undertaking a response action, measured COC concentrations are compared to the lower of the human health [Protective Concentration Level] or ecological PCL for each COC (the lower of the two is called the critical PCL). If measured COC concentrations exceed the critical PCL for any COC, the person may either refine the PCLs by going to the next tier in the risk analysis (assuming the person is at Tier 1 or 2 for human health or Tier 2 for ecological) or implement a remedy pursuant to the [Texas Risk Reduction Program] requirements. . . .
>
> . . . Response actions must conform to one of two options for performance standards, termed Remedy Standard A or Remedy Standard B. Under Remedy Standard A, affected media must be removed or decontaminated to permanently reduce COC concentrations below critical PCLs. Under Remedy Standard B, removal, decontamination, or control measures may be applied to prevent exposure media exceeding critical PCLs.[212]

The Texas Administrative Code states that PCLs must be established for each COC in an environmental medium at a potential cleanup site unless a number of criteria are met.[213] None of the listed criteria applies to the Kennedy Heights property, however, meaning that under the regulations available in draft form in 1996, the lowest of three values—relating to three different kinds of PCLs—for each chemical should have been selected and compared with background levels to determine whether to proceed with a

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207 Gerard E. Dallal, Nonparametric Statistics, http://www.tufts.edu/~gdallal/npar.htm (last visited Jan. 28, 2007).

208 COMPLIANCE SOLUTIONS, INC., *supra* note 147, at 6.

209 *Id.*

210 *Id.*

211 *Id.*

212 TOXICOLOGY AND RISK ASSESSMENT SECTION, TEX. NATURAL RES. CONSERVATION COMM'N, GUIDANCE FOR CONDUCTING ECOLOGICAL RISK ASSESSMENTS AT REMEDIATION SITES IN TEXAS 4 (2001) (citations omitted).

213 30 TEX. ADMIN. CODE § 350.71(k) (2006).

soil assessment.[214] Present regulations deviate from the kind of site-specific determination of background that Chevron conducted and instead call for risk-based standards that are not based on the attainment of background unless background is greater than the risk-based PCL or the chemical is listed as a Texas-specific soil background concentration.[215] In any event, CSI did not compare its statistically-generated background levels to PCLs for each chemical, but rather to *soil sample data* offered by the parties, primarily from Chevron.[216]

Following completion of the Baseline Risk Assessment, the only other analytic application of the sampling data was carried out by EPA. Their report noted that "there were Quality Assurance/Quality Control issues with previously collected data and therefore the EPA would collect its own data to be used in [its] investigation."[217] This included mostly soil samples (sixty-two), as well as a few soil gas (thirteen) and groundwater (nine) samples, the latter utilizing Chevron's former monitoring wells.[218] All samples were taken at zero to two and four to six feet below the surface.[219] The inspection did not include drinking water samples because, as the report noted, "[a] review of City and State records indicate[d] that the drinking water supply in the Kennedy Heights neighborhood me[t] all drinking water standards."[220] Traces of volatile organic compounds were found in soil samples, as were traces in groundwater samples.[221] In addition, "a thin oily layer of non-aqueous phase liquid (NAPL) was encountered while taking water level measurements at groundwater monitoring well NE-30."[222] EPA contractors documented hydrocarbon odors at several sampling locations when opening soil core barrels.[223] Visible hydrocarbons were present in a monitoring well and in one of the soil samples.[224] Still, EPA engaged in risk calculations only for soil as a possible exposure pathway.

> The fact that almost all the TPH occurs in soils at depths greater than 2 feet [below ground] indicates that direct exposure to soil at depth is not a complete pathway and the risk is reduced. The EPA also assumed a "worst case scenario" in which the highest concentration of TPH detected under

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214 REMEDIATION DIV., TEX. COMM'N ON ENVTL. QUALITY, REGULATORY GUIDANCE: AFFECTED PROPERTY ASSESSMENT REQUIREMENTS 8 (2004).

215 30 TEX. ADMIN. CODE §§ 350.4(a)(6), 350.51(m) (2006).

216 COMPLIANCE SOLUTIONS, INC., *supra* note 147, at 5.

217 ECOLOGY & ENV'T INC., *supra* note 46, at 4-2.

218 *Id.* at 4-4.

219 *Id.*

220 *Id.* at 2-3 ("However[,] the EPA has met with both City officials and the residents several times, and the resident[s'] concerns about their drinking water supply remain unresolved.").

221 *Id.* at 4-6 to 4-7.

222 *Id.* at 4-7 ("An attempt was made to capture enough of the NAPL to send for laboratory analysis, but there was not a sufficient quantity available for sample collection. A decision was made to go ahead and sample the well, which went dry during purge activities. The well was allowed to recover and a sample was collected for analysis.").

223 *Id.* at 5-1.

224 *Id.*

> Texas Methods 1005/1006 (1580mg.kg), was excavated and spread on the ground surface. A child playing in the dirt and coming in direct contact with the soil containing the TPH through the oral, dermal, and inhalation routes of exposure would yield a hazard quotient less than one.[225]

The EPA concluded that "the soils do not present a risk to the residents from exposure to TPH by direct contact with *soil*."[226]

V. DISCUSSION

The foregoing description of the Baseline Risk Assessment and Expanded Site Inspection only begins to delve into the assumptions driving the analysis, which effectively ended at the comparison of background to sample values. Still, it provides substantial documentation of the decisions made by Chevron and EPA contractors, relying to a considerable degree on best guesses and the use of proxy data. The process was sufficiently removed from those affected by its results that residents chose to seek relief in the courts. Residents' data gathering and analysis, designed to directly test their narratives of contamination, were challenged by Chevron attorneys under *Daubert* principles. For example, doubt was cast on plaintiffs' computer model of how toxicants moved from waterlines to residents' sinks and bathtubs.[227] Chevron questioned many of the assumptions underlying the model itself and plaintiffs' choice of model inputs,[228] claiming the model was not "scientifically valid."[229]

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225 *Id.* at 5-1 to 5-2.

226 *Id.* at 5-2 (emphasis added).

227 For much of this work, plaintiffs retained Charles Howard & Associates. Howard was a consultant to water, sewerage, and power utilities, as well as local, state, and federal governments across North America, in the development and use of computer techniques for water management. Letter from Charles D. Howard, Charles Howard & Assocs. Ltd., to Carl D. Shaw, Associate, O'Quinn, Kerensky, McAninch & Laminack (Sept. 30, 1996) (on file with author). After taking field measurements of water pressure at various points across the distribution system in Kennedy Heights, Howard used EPANET, a computerized water distribution system simulation developed by EPA, to model the fate and transport of contaminants to plaintiffs' homes. Based on the introduction of 1 gram per square meter of a contaminant to a hypothetical pipe break along the network, EPANET provided concentration estimates at certain locations, in maximum levels within each hour in milligrams per liter (mg/L) over a 24-hour period. Assuming contaminants entered the system during water main repairs, Howard modeled concentrations at various points along water pipes and at certain bellwether homes after a hypothetical repair at 11322 Murr Way or 11322 Lockgate Lane. His findings suggested that between .027 and 5.082 mg/L of contaminant would travel in pipe 4243, which delivered water to seven of the plaintiffs' homes, over the course of a 24-hour period following introduction of the contaminant to a pipe at 11322 Murr Way. *Id.* Plaintiffs also took water samples and samples of "liquid crude oil floating on the water in the excavation directly adjacent to the water main" after a pipe break at 11326 Lockgate Lane in September 1996. They found PAH concentrations of 2.4 ppm in the water and 7,826 ppm in the oil. Plaintiffs' Summary of the Case at 1, 7, Adams v. Chevron U.S.A., Inc., No. 96-1462 (S.D. Tex. Sept. 10, 1997); Transcript of Record Volume III at 161, Adams v. Chevron U.S.A., Inc., No. 96-1462 (S.D. Tex. Sept. 10, 1997) (testimony of Dr. Patrick Agostino).

228 Summary of the Case Submitted by Defendants, Adams v. Chevron U.S.A., Inc., No. 96-1462 (S.D. Tex. Sept. 10, 1997).

229 Chevron claimed that plaintiffs' model: a) was not initially designed to model oil

Defendants argued that much of the evidence regarding drinking water contamination was inadmissible under the doctrine set forth in *Daubert*.[230] Before the federal district judge could rule on the admissibility of drinking water and other evidence, the case settled out of court, in part because plaintiffs wanted to avoid the possibility of a ruling on summary judgment.[231]

One response to the kinds of dynamics at work between RRC and Chevron would be to ask whether more rigorous sampling and analysis protocols could have been employed. Indeed, this is the argument, albeit in a tangential venue, of those who would propose to apply the *Daubert* standard of admissibility to the judicial review of agency decisions. Kenneth Davis and Richard Pierce note in their administrative law treatise that "[t]o the extent that the FRE announce any policy relevant to the rules of evidence [governing administrative law] . . . that policy is contained in Rule 703."[232] The proposal to apply *Daubert*'s principles to agency-gathered scientific evidence views such a process as a check on agency discretion that would ask "agencies to explicitly indicate whether they have relied on science or policy to justify a decision. Agency policy requires deference. Agency science can and should be checked."[233] One can envision, for example, judicial review of an agency-commissioned risk assessment of Kennedy Heights, during which the known or potential rates of error of the sampling methods (sampling technology, sampling frame, location, timing, and other factors) and analysis tools (such as the development of background figures and the use of statistical tests) are used to determine the admissibility of risk assessment findings in support of the agency's decision not to pursue site cleanup.

It is true that some of the methods used by RRC and Chevron may be less accepted by the scientific community (e.g., random as opposed to grid sampling, screen as opposed to in situ soil sampling) or even existing and subsequent state regulations (e.g., comparing sampling results to statistically-generated background figures as opposed to protective concentration levels) than alternative approaches. But the post-*Daubert* climate suggests that heightened scrutiny is not the answer. Indeed, it is unlikely that the techniques employed at Kennedy Heights would ever meet the standards of relevance and reliability developed in *Daubert*, *Joiner*, and other cases. Should RRC and EPA have settled on the most universally accepted techniques for soil sampling and data analysis, the Supreme Court's interpretation of scientific knowledge as

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contamination but was created for modeling soluble substances such as chlorine, b) was not calibrated in response to field measurements, c) eliminated portions of the water distribution system to increase amounts of the contamination to certain homes, d) was run twice and then totaled, and e) resulted in more PAHs at certain homes than had been entered under the assumed water line break. *Id.*

230 *Id.*

231 MACEY & SUSSKIND, *supra* note 19.

232 2 KENNETH CULP DAVIS & RICHARD J. PIERCE, JR., ADMINISTRATIVE LAW TREATISE § 10.2, at 120 (3d ed. 1994).

233 Andrew Trask, Daubert *and the EPA: An Evidentiary Approach to Reviewing Agency Determinations of Risk*, 1997 U. CHI. LEGAL F. 569, 587 (1997). *But see* McGarity, *supra* note 15, at 155 (arguing for stringent review of scientific conclusions underlying risk assessments undertaken by regulatory agencies through a *Daubert*-inspired "corpuscular" approach).

"derived by the scientific method" and more recent courts' attempts to determine "fit" between data in former studies with the cases in front of them suggest that the effort would still fall short.

First, an agency investigating a site in which the contamination present is unknown will not be able to say with complete certainty whether its sampling methods can or cannot be proven wrong. Nor will it be able to derive a rate of error. Throughout the process, resource, timing, and knowledge constraints will force the monitoring agency to engage in bricolage, making do with whatever equipment and expertise are available. It is doubtful that the realities of agency oversight could, absent an infusion of substantial appropriations and personnel, lead to the use of nothing other than peer-reviewed and published methodologies.

But even more opposed to the *Daubert* standard is the practice of risk assessment itself, where findings are extrapolated from what limited data are known. Data inferences, such as those used in the Baseline Risk Assessment or in the hazard and dose-response assessments that take place long before an agency sets foot in a place like Kennedy Heights, cannot be "derived;" rather, they involve a series of judgment calls. Should an agency's more stringent approach to site and risk assessment withstand the scrutiny of an administrative law judge, the application of the *Daubert* corpuscular approach to dose-response studies linking PAHs to carcinogenicity, or epidemiological studies of its possible links to lupus, would in all likelihood end the inquiry. There are far too many links in the chain of causation from hazard assessment (whether one or more substances can cause certain disease outcomes) to dose-response assessment (what levels of a given contaminant contribute to an unacceptable risk of those diseases) to ecological assessment (finding the location and defining the fate and transport of chemicals of concern) to risk assessment (quantifying risk and comparing it with dose-response analyses to determine acceptable levels of a contaminant in soil or water) for even the most diligent agency to shore up its findings against the strict standards of validity that are commonly employed today.

An alternative response to the Kennedy Heights story would be to argue that, far from a search for *the* proper amalgam of methodologies, the process should be made more transparent in order to encourage the use of an *acceptable* approach to site characterization. As the sense of disconnect between resident narratives and RRC-Chevron site assessments illustrates, citizen and professional modes of producing knowledge differ immensely. Differences have been found between residents and "experts" in their definitions of data quality, methods of analysis, and accepted levels of measurement and statistical significance.[234] The contrast can be appreciated through a comparison of popular and scientific epidemiology.[235] Scientific

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[234] *See generally* Phil Brown, *Popular Epidemiology and Toxic Waste Contamination: Lay and Professional Ways of Knowing*, 33 J. OF HEALTH & SOC. BEHAV. 267, 268 (1992) (discussing the different perspectives community members and scientists have in investigating and interpreting environmental health data).

[235] *See* L. David Brown & Rajesh Tandon, *Ideology and Political Economy in Inquiry: Action*

epidemiology makes use of a variety of study designs (e.g., case control, prospective and retrospective cohort) to investigate the statistical relation between exposure to various elements and disease.[236] In contrast, citizens concerned about a possible source of disease engage in the following steps: a) groups of people in a contaminated neighborhood separately notice health effects and pollutants, b) they hypothesize a connection between the two, and c) a more cohesive group of residents learn about the particulars of the two, through symptom surveys, greater interaction among residents, gathering sources of information, and talking to officials.[237]

Failed attempts by residents of communities such as Kennedy Heights, Woburn, Massachusetts, and Love Canal to obtain answers to their "non-scientific" hunches result in distrust of agency officials. Participatory research offers an alternative to research of root causes of health concerns, which proceeds with an air of indeterminacy of means and ends.[238] The parties involved agree that achieving complete objectivity is impossible in these latter situations, and seek to uphold the value of useful knowledge regardless of whether it conforms to scientific notions of significance or proper units of analysis.[239] While it may seem difficult to dispute the validity of a technically-derived substantive claim with resident stories or contextual data, "truth" in participatory research is left indeterminate—only through planning, acting on plans, and observing and reflecting on results is truth confirmed. A popular example of the use of participatory research for site assessment is the local identification and prioritization of key issues through risk mapping.[240] Advances in geographic information systems technology allow residents to work with regulators to represent sources of environmental harm. Joint fact-finding efforts, used to assist in the mediation of public disputes, can govern the proper use of this and other methods, through group efforts to determine issues of concern, processes for gathering information, what questions should be asked, methods of analysis and their underlying assumptions, limitations to these methods, and how to proceed once new information is known.[241]

Research and Participatory Research, 19 J. OF APPLIED BEHAV. SCI. 277, 291–92 (1983) (comparing action research and participatory research approaches).

[236] *See* CHARLES H. HENNEKENS & JULIE E. BURING, EPIDEMIOLOGY IN MEDICINE 16–28 (Sherry L. Mayrent ed., 1987) (explaining design strategies used in epidemiologic research).

[237] Brown, *supra* note 234, at 269.

[238] Bunyan Bryant, *Pollution Prevention and Participatory Research As a Methodology for Environmental Justice*, 14 VA. ENVTL. L.J. 589, 599 (1995).

[239] *See* Brown, *supra* note 234, at 278 (noting that some communities may have exaggerated fears about the risks of hazards or the health effects of substances but such information can still be useful to public health officials).

[240] Kevin Smith, Christopher B. Barrett & Paul W. Box, *Participatory Risk Mapping for Targeting Research and Assistance: With an Example from East African Pastoralists*, 28 WORLD DEV. 1945, 1947 (2000).

[241] John R. Ehrmann & Barbara L. Stinson, *Joint Fact-Finding and the Use of Technical Experts*, *in* THE CONSENSUS BUILDING HANDBOOK 375, 377 (Lawrence Susskind et al. eds., 1999); *see* Heli Saarikoski, *Environmental Impact Assessment As Collaborative Learning Process*, 20 ENVTL. IMPACT ASSESSMENT REV. 681, 691 (2000) (noting that joint fact finding in the environmental impact assessment process led to a shared understanding of potential impacts to

Kennedy Heights presents a clear example of agency inability to gather data absent flaws, leaps of logic, and unproven inferences. Other examples exist, such as during facility siting processes governed by the National Environmental Policy Act,[242] where agencies were unable to gather quality environmental baseline data, limiting the validity of objective comparisons between project alternatives. Residents' daily interactions with a given locale give them a degree of familiarity with environmental conditions unavailable to federal agencies, such as when the Yavapai defeated construction of a dam at the intersection of the Salt and Verde rivers in Arizona[243] or the Northern Cheyenne resisted the "value neutrality" of the Bureau of Land Management's assessment of increased coal sales in Montana.[244] Stories of residents countering existing "scientific" findings are few, however, because of the lack of standing granted citizen groups *before* the "knowledge" presented in an Environmental Impact Statement or risk assessment is constituted by technical personnel. But would efforts at reforming site assessments, altering the sequencing of knowledge production or offering joint fact-finding or other partnerships in monitoring environmental impacts be feasible in a post-*Daubert* environment?

A starting point, surprisingly enough, would be to reconsider *Daubert* itself. In addition to eschewing the *Frye* general acceptance test, the Court addressed the difference between legal and scientific inquiry:

> Petitioners and, to a greater extent, their *amici* exhibit a different concern. They suggest that recognition of a screening role for the judge that allows for the exclusion of "invalid" evidence will sanction a stifling and repressive scientific orthodoxy and will be inimical to the search for truth. See, *e.g.,* Brief for Ronald Bayer et al. as *Amici Curiae*. It is true that open debate is an essential part of both legal and scientific analyses. Yet there are important differences between the quest for truth in the courtroom and the quest for truth in the laboratory. Scientific conclusions are subject to perpetual revision. Law, on the other hand, must resolve disputes finally and quickly. The scientific project is advanced by broad and wide-ranging consideration of a multitude of hypotheses, for those that are incorrect will eventually be shown to be so, and that in itself is an advance. Conjectures that are probably wrong are of little use, however, in the project of reaching a quick, final, and binding legal judgment—often of great consequence—about a particular set of events in the past.[245]

The search for an interpretation of *Daubert* that lies somewhere between the strict standards used by many district judges and the more flexible approach

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waste management alternatives).

242 National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321–4370e (2000).

243 Wendy Espeland, *Legally Mediated Identity: The National Environmental Policy Act and the Bureaucratic Construction of Interests*, 28 LAW & SOC'Y REV. 1149, 1150–51, 1169 (1994).

244 *See* James P. Boggs, *The Use of Anthropological Knowledge Under NEPA*, 49 HUM. ORG. 217, 221 (1990) (discussing the Northern Cheyenne's move to sue the U.S. Bureau of Reclamation because the social impact analysis in the environmental impact statement for additional coal sales in Montana ignored the Tribe).

245 Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 596–97 (1993).

hinted at in the above dicta continues. Some courts of appeals have erred on the side of a more liberal approach, finding that their task is not to establish a per se exclusion of a method not generally accepted or noting that they should consider a variety of factors when ruling on questions of reliability.[246] The debate over *Daubert*, its consequences for toxic tort claims, and the appropriate standard of admissibility for site and risk assessment data would be aided by considering the limits to scientific knowledge generally, agency means of carrying out "scientific" methods and processes, and their application to communities such as Kennedy Heights specifically. We should accept the nature of inquiries such as site and risk assessment as negotiated, ad hoc processes, requiring more participatory involvement of interested parties to assure their legitimacy. Then we can begin to consider a mid-range view of scientific evidence, located between scientific orthodoxy and overly-permissive admissibility, which will provide a space for agencies, residents, and potentially responsible parties to recognize their limitations and seek more common ground.

[246] *See, e.g.*, United States v. Posado, 57 F.3d 428, 434, 436 (5th Cir. 1995) (removing the per se rule against admissibility of polygraph examinations and remanding to the district court to apply the principles in the Federal Rules of Evidence and *Daubert*.); *In re* Paoli Railroad Yard PCB Litigation, 35 F.3d 717, 742 (3d Cir. 1994) (asserting that the district court should employ the factors in *Daubert* and any other relevant factors to determine the reliability of scientific evidence).