Comments on the Potential Impacts of the Peoria Disposal Company Landfill Expansion on Public Health, Groundwater Quality and the Environment

Submitted By

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Summary of PDC Landfill Expansion Potential Impact Issues

Based on a review of the Peroia Disposal Company (PDC) proposed landfill expansion application and my expertise in reviewing the potential impacts of hazardous and nonhazardous waste landfills on public health, groundwater resources and the environment, I conclude the following:

Overall Assessment

- The PDC proposed landfill expansion application fails to provide reliable information on the potential impacts of the existing as well as the proposed expansion of the hazardous waste landfill.
- The PDC landfill represents a near-term and long-term threat to public health, groundwater resources and the environment associated with releases of hazardous and deleterious chemicals from the landfill.
- PDC has failed to inform Peoria County and the public about the long-term (effectively, forever) threat that the landfilled hazardous wastes represent to domestic water supplies that can be impacted by landfill releases of leachate (soluble components of the deposited hazardous wastes).
- The PDC proposed landfill expansion includes the continued acceptance of a wide variety of hazardous waste types that are a potential threat to public health, groundwater resources and the environment.
- In addition to known, regulated chemicals, hazardous wastes of the type that PDC has been accepting and proposes to continue to accept contain a wide variety of unregulated, unmonitored hazardous and deleterious chemicals that are a threat to groundwater quality and nearby air quality.
- Since a substantial part of the hazardous wastes that PDC has been accepting and proposes to continue to accept are from non-local (non-Peoria County) sources, the Peoria County public is being exposed to hazardous chemicals that more appropriately should be managed in the vicinity of their source.
- The medical doctors in the Peoria area have recommended that the PDC hazardous waste landfill not be allowed to expand. This recommendation is in accord with prudent public health protection from the hazardous chemicals that are being brought to and deposited in the PDC hazardous waste landfill.

Airborne Releases of Hazardous Chemicals

- PDC has failed to properly evaluate the airborne releases from the existing landfill, as well as those that could occur from the landfill expansion, which are a threat to public health and the environment in the vicinity of the landfill.
- PDC has failed, in developing this landfill, to provide adequate PDC-owned buffer lands between where hazardous wastes have been and are proposed to continue to be deposited, and adjacent properties.
- The inadequate buffer lands lead to a situation where airborne releases of regulated and currently unregulated hazardous chemicals, through off-gases and volatilization, have limited opportunity for dispersion on PDC property before trespass onto adjacent properties.

Potential Pollution of Groundwaters

- The base of the existing and proposed expansion of the PDC landfill is hydraulically connected to a complex aquifer system that is an important source of domestic water supply for the Peoria area.
- The PDC landfill liner system, consisting of plastic sheeting and clay layers, will, in time, deteriorate in its ability to prevent hazardous waste leachate from penetrating through it, which can lead to the pollution of groundwaters with hazardous and deleterious chemicals. This will cause the groundwaters to be a health threat to those who use them for domestic water supply, and will render the groundwaters unusable for domestic and many other purposes.
- PDC's current and proposed groundwater monitoring system, employing vertical monitoring wells spaced hundreds of feet apart, is inadequate to detect leachate-polluted groundwater when it first reaches the point of compliance for groundwater monitoring. This can lead to offsite (adjacent property) pollution of groundwaters, without this pollution having been detected by the monitoring wells.
- PDC's proposed approach for monitoring/maintenance of the landfill cover will not prevent, for as long as the wastes are a threat, water from penetrating through the cover and entering the wastes to generate leachate that will contain hazardous chemicals at concentrations that are a threat to pollute groundwaters.
- Overall, PDC's approach toward analyzing the potential threat that the hazardous waste landfill represents to pollute groundwaters is superficial and based on inadequate evaluation of the long-term characteristics of the landfill liner system and the flow paths by which leachate that penetrates through the liner system can pollute groundwaters of the area.

Funding for Postclosure Monitoring, Maintenance and Groundwater Remediation

- PDC only proposes to provide postclosure care (monitoring and maintenance) of the landfill for the minimum 30-year period. This approach does not conform to Peoria County's requirement of "perpetual care."
- PDC has established a postclosure funding approach in the form of a Trust Fund, which will provide for minimal postclosure monitoring and maintenance during a 30-year postclosure care period.
- Apparently, PDC's approach to postclosure funding will require that Peoria County provide postclosure funding beyond this minimum 30-year postclosure care period, for the effectively infinite period of time that the wastes in the landfill will be a threat. The required postclosure funding will represent a significant financial burden and liability to the County.

G. Fred Lee's Qualifications

Advisor to Peoria Families Against Toxic Waste (PFATW) and Heart of Illinois (Peoria) Sierra Club on the potential impacts of the Peoria Disposal Company Hazardous Waste Landfill on public health, groundwater quality, and the environment.

Education
BA degree Environmental Health Science – San Jose State College, California, 1955
Master of Science in Public Health – University of North Carolina, 1957
PhD Environmental Engineering – Harvard University, 1960

Professional Experience
30 years of graduate-level university teaching and research in environmental engineering/science
$5 million in university research on water quality
including US EPA-supported research on landfill liners
Published over 500 papers and reports on that research

Taught short courses on impacts of landfills for American Society of Civil Engineers, American Water Resources Association, National Ground Water Association, and University of California Extensions at Berkeley, Davis, Riverside and Santa Barbara. Presented numerous invited lectures to American Chemical Society local sections on the impacts of landfills.

Advisor to governmental agencies on landfilling regulations (including California, Michigan and Texas), landfill developers and companies (IBM and others) on managing hazardous wastes.

Director of the Site Assessment and Remediation Division of a multi-university hazardous waste research center.

Retired from university teaching/research in 1989 and expanded part-time consulting to full-time endeavor through G. Fred Lee & Associates. Published an additional 600 papers since 1989, including about 120 papers on landfill impacts – available on website, www.gfredlee.com.

Work on Landfill Impacts began in 1953. Investigated potential impacts of 85 landfills for water utilities, governmental agencies and public groups, including 12 hazardous waste landfills and eight Superfund site landfills.

G. F. Lee paper on landfill impacts awarded "Best Paper published in Journal AWWA in 1984," by American Water Works Association's Water Resources Division.

Published comprehensive reviews of potential impacts of landfills, including issues of

- ultimate failure of liners and covers,
- inadequacy of groundwater monitoring,
- need for postclosure funding for as long as the wastes in the landfill are a threat,
- characteristics and decomposition of buried wastes.

Professional Engineer in State of Texas
Diplomate in the American Academy of Environmental Engineers

Comments on the Potential Impacts of the Peoria Disposal Company Landfill Expansion on Public Health, Groundwater Quality and the Environment

The Peoria Disposal Company (PDC) has proposed to expand and extend the operation of their hazardous waste landfill for an additional 15 years. There is considerable concern on the part of the public in the Peoria, IL, area of the landfill about the impact of the existing PDC landfill as well as the proposed expansion of this landfill on public health, groundwater quality and the environment within the sphere of influence of the PDC hazardous waste landfill. The Peoria Families Against Toxic Waste (PFATW) and the Heart of Illinois (Peoria) Sierra Club have requested that I review the PDC landfill expansion application and other information pertinent to Peoria County's review of the expansion of the hazardous waste landfill. Presented herein is my review of the potential impacts of the PDC hazardous waste landfill.

Overall Conclusions

I find that both the existing PDC hazardous waste landfill and the proposed landfill expansion represent a significant threat to groundwater quality in the area of the landfill. Basically, PDC has failed to adequately present/discuss and address the long-term threat that the proposed PDC landfill expansion represents to public health, groundwater resources and the environment. There is also a threat to public health and the environment in the vicinity of the PDC landfill from airborne releases from the continued operation of the PDC landfill.

It is recommended that the County not approve the proposed expansion of the PDC landfill. Further, the County and the regulatory agencies should require that PDC fund a comprehensive investigation of the barrel trench for existing releases of waste chemicals and pollution of the aquifer system.

Background to these Comments

I have been involved in the review of landfills and management of solid wastes beginning in the mid-1950s as part of my undergraduate degree studies in public health at San Jose State College in San Jose, California. I obtained a BA degree from this institution in 1955. I obtained a Master of Science in Public Health (MSPH) from the University of North Carolina, Chapel Hill, School of Public Health in 1957. I obtained a PhD degree in Environmental Engineering from Harvard University in 1960. My areas of expertise include water supply water quality, water and wastewater treatment, water pollution control for surface waters and groundwaters, and solid and hazardous chemical/waste impact investigation and management.

After obtaining my PhD degree in 1960, for 30 years I held university professorial positions at several US universities, including for 13 years at the University of Wisconsin, Madison. During my university graduate-level teaching and research career I conducted about $5 million in research and published about 500 papers and reports on this research. One of the areas of my research was studies on the ability of compacted clay and plastic sheeting (HDPE) landfill liners to prevent landfill leachate from passing through them for as long as the wastes in a landfill are a threat to pollute groundwaters underlying a landfill.

In 1989 I retired from 30 years of university teaching and research and expanded my part-time private consulting activities to a full-time activity. Since then Dr. Anne Jones-Lee (my wife) and I have been the principals in our firm, G. Fred Lee & Associates. We work on advanced level water quality impact evaluation and management. One of the areas of our activity is evaluation of the potential public health, groundwater resource and environmental impacts of proposed landfills and landfill expansions. We have worked on about 85 landfills (see Appendix B, pages 19-20), including 12 hazardous waste landfills and eight landfills at Superfund sites. I have also served as an advisor to a hazardous waste landfill developer and to several companies, including IBM corporate headquarters on managing hazardous waste. Frequently our work on evaluating landfill impacts is conducted on behalf of water utilities, municipalities and other public or governmental entities that are concerned about the potential impacts of a new landfill or landfill expansion on groundwater resource water quality. Our work has also included advising governmental agencies on appropriate landfilling regulations. Attached to these comments as Appendix B is a summary of my academic and professional experience pertinent to my conducting this review of the proposed PDC landfill expansion.

As part of our consulting activities we have continued to be active in developing papers and reports on landfills as well as on other areas in which we are involved. Over the past 17 years we have developed an additional approximately 600 papers and reports, a substantial number of which are devoted to landfill issues. Our papers and reports are available on our website, www.gfredlee.com. In 2004 we developed a report on the "Flawed Technology of Subtitle D Landfilling." This report has been periodically updated, including the most recent update in March 2006:

> Lee, G. F. and Jones-Lee, A., "Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste," Report of G. Fred Lee & Associates, El Macero, CA, December (2004). Updated March (2006).
> http://www.members.aol.com/apple27298/SubtitleDFlawedTechnPap.pdf

It represents a synthesis and integration of our previous papers and reports and includes extensive references to the literature. While this report focuses on municipal solid waste landfills, much of the Flawed Technology review is applicable to hazardous waste landfills, including the proposed PDC landfill expansion. The current version of the Flawed Technology review is appended to these comments as Appendix A.

In the discussions presented below on the deficiencies in the PDC landfill expansion application in reliably informing the Peoria County Board and the public about the potential impacts of the proposed landfill expansion, reference is made to specific sections of the Flawed Technology review that provide additional discussion of the issues of concern relative to a particular section of the application.

Specific Comments on the Application for the PDC Landfill Expansion

Volume 1

Executive Summary. In the Executive Summary of the PDC landfill expansion application, beginning on page ES-1, it is stated that, "*Section 39.2 of the Act* [Illinois Environmental

Protection Act (415 ILCS 5/1 et seq.)] *provides nine criteria that the proposed facility must meet to the satisfaction of the unit of local government."* It is found that, of these nine criteria, criteria numbers 2, 3 and 5,

* * *

> *"2. The facility is so designed, located and proposed to be operated that the public health, safety and welfare will be protected,*
> *3. The facility is located so as to minimize incompatibility with the character of the surrounding area and to minimize the effect on the value of the surrounding property,*
>
> * * *
>
> *5. The plan of operations for the facility is designed to minimize the danger to the surrounding area from fire, spills or other operational accidents,"*

will not be met by the approach for the development of the PDC landfill expansion presented in the proposed landfill expansion application. As discussed herein, the proposed hazardous waste landfill expansion application fails to discuss the fact that many of the waste components that are proposed to be deposited in the landfill expansion will be a threat to public health, groundwater resource quality and the environment, **forever**. The proposed landfill containment system design (landfill liner and cover), monitoring and maintenance will not provide for reliable containment of all waste components for as long as they will be a threat to the environment. Without high degrees of certainty of public health, groundwater resource and environmental protection from these proposed landfilled wastes for as long as they represent a threat, the proposed expansion should not be approved by the Peoria County Board.

One of the problems with PDC's proposed approach for developing a landfill expansion is that the proposed expansion is located above a complex and interconnected water supply aquifer that provides domestic water supply to public and private entities. Since the proposed landfill liner containment system will eventually fail to prevent releases of waste-associated chemicals to the underlying aquifer system, the proposed landfill expansion is a significant threat to an important domestic water supply. This, in itself, is adequate justification to cause the Peoria County Board to reject the proposed expansion of the PDC landfill.

With respect to criteria numbers 2 and 3 cited above, an additional significant deficiency in the proposed landfill expansion is that, as shown in Figure 1-1 on page 1-2 of the application, PDC has failed to acquire adequate buffer lands between where wastes are proposed to be deposited and adjacent properties. Adjacent property owners/users should be entitled to use of their property without adverse impacts associated with trespass of waste-derived chemicals at their property line. Meeting this requirement means that PDC should site the proposed landfill expansion with at least several miles of buffer lands between where wastes are proposed to be deposited and adjacent property lines. Without adequate buffer lands, adjacent property owners/users' health, welfare and interests, including property values, will be adversely affected by the proposed landfill expansion.

PDC states as the first sentence in the first full paragraph on page ES-3, "*The purpose of this application is to demonstrate that the proposed facility meets the criteria provided in the Peoria County Siting Ordinance, and the nine pollution control facility siting criteria in the Act."* As documented below, this PDC statement is superficial and highly unreliable.

The last sentence in the following paragraph (still on page ES-3) states, *"The permit application will include substantial technical documentation that the expanded facility is designed and will be constructed and operated in accordance with all applicable state and federal solid waste landfill regulations."* Throughout the application PDC repeatedly states that the proposed development of the landfill expansion will meet existing regulatory requirements. What PDC fails to discuss is that it is well understood that existing federal and state regulatory requirements for landfilling of hazardous wastes are not adequate to protect public health, groundwater resource quality and the environment for as long as the wastes in the landfill will be a threat. These issues are discussed in various sections of our Flawed Technology review (Lee and Jones-Lee 2006), as well as summarized below.

Some of the important deficiencies in current regulatory requirements include that they allow the landfilling of wastes with only plastic sheeting and compacted clay liners, which will in time fail to prevent waste-derived chemicals from penetrating through them into the underlying groundwater aquifer system. Another significant deficiency is that there is no requirement for adequate assured postclosure funding of landfill monitoring and maintenance and eventual groundwater remediation for as long as the wastes in the landfill will be a threat. Without this assured funding in perpetuity, at some time in the future the groundwater resources associated with this landfill will be polluted by hazardous and deleterious chemicals, rendering them a threat to public health and unusable as a domestic water supply. These deficiencies will be discussed below in detail in the Landfill Closure and Post-Closure Care section.

One of the major issues with respect to landfilling of hazardous wastes is establishing adequate funding for postclosure monitoring and maintenance of the landfill for as long as the wastes in the landfill will be a threat. Peoria County should be complimented for including the "perpetual care" requirement in its Site Hearing section of the Peoria County Code. It wisely added the requirement of perpetual care to the siting application process. It is my understanding that this is above and beyond the requirements of Section 39.2 of the Illinois Environmental Protection Act, found at 415 ILCS 5/39.2. "Perpetual" is defined to mean "lasting for eternity." Peoria County has clearly adopted a "forever" standard of care, a standard that PDC fails to meet.

Another example of the deficiencies in current regulatory approaches is that landfills are allowed, under federal and state regulations, to be developed with inadequate buffer lands between waste deposition areas and adjacent properties. This means that the airborne releases from the landfill will have limited dilution/dispersion between the landfill and adjacent properties, and therefore expose those who use adjacent/nearby properties to significant health threats from hazardous chemicals released from the landfill.

Over the past 45-plus years that I have been involved in reviewing landfilling regulations, I have frequently observed how the regulations developed at the federal and state level represent significant compromises in providing the necessary public health and environmental protection from the landfilled wastes, in the name of reducing the costs of waste management. This situation leads to the conclusion that local regulatory agencies, such as county boards, must take the necessary steps to ensure that the development of a landfill within their jurisdiction is protective of the health, welfare and interests of their constituents. The Peoria County Board has

the opportunity and obligation to stop the further adverse impacts of the PDC landfill on those within the sphere of influence of this landfill.

PDC states beginning on page ES-6 and continuing on Page ES-7,

> *"Protection of groundwater quality is one of, if not the most important factor in the siting, design and permitting of any landfill. This is particularly true for hazardous waste landfills such as the PDC No. 1 Landfill. The primary risk to groundwater comes from landfill leachate. Leachate is water (primarily from precipitation infiltration) that seeps through the landfilled wastes. As it seeps through the wastes, various leachable constituents of the waste dissolve into the leachate. If significant quantities of leachate were allowed to infiltrate to groundwater, such as has happened at some poorly located unlined landfills, groundwater quality can be impaired. There are three primary factors that control the susceptibility of groundwater from a landfill: 1) the site geologic and hydrogeologic conditions, 2) the design, construction, and performance of the landfill's liner, leachate collection and final cover systems, and 3) the chemical characteristics of the leachate. As conclusively demonstrated in Section 2 of this siting application, groundwater protection at this site is assured by the natural geologic conditions, and is enhanced by the sophisticated landfill liner and leachate collection systems, and the stringent regulations that restrict the leachable concentrations of chemicals that can be landfilled at the PDC No. 1 Landfill Expansion."*

The above-quoted paragraph is more of the propaganda that PDC is foisting on the Peoria County Board and the public with respect to the ability of the proposed landfill design to protect groundwater from pollution by landfill leachate. With adequate design, construction and operation, a landfill liner system of the type that PDC proposes to use can initially collect the leachate in the leachate collection system and thereby reduce the magnitude of penetration of leachate and associated chemicals through the liner system into the underlying groundwater system. However, over time the integrity of the plastic sheeting liners will deteriorate to the point where they are no longer effective in preventing leachate from passing through them into the underlying groundwater system.

PDC wants the Peoria County Board to believe that the issues of long-term protection are restricted to just 30 years after closure of the landfill (i.e., the period over which PDC proposes to be responsible for postclosure care such as groundwater monitoring for landfill leachate pollution – see Executive Summary page ES-9, third full paragraph). However, the facts are that many of the waste components deposited in the PDC landfill will be a threat forever. There will be people in the Peoria area who will want to drink and otherwise use the groundwaters of the area for domestic and other purposes well after the liner system for the proposed landfill expansion will have failed to function as an effective barrier to prevent leachate from passing into the underlying groundwaters. The Peoria County Board has the responsibility of protecting not only current domestic water supplies, but also the water supplies for future generations who will want to live in this area. PDC in its application has failed to address this issue in a factual and reliable manner.

PDC in the last paragraph on page ES-7 states,

> "*The PDC No. 1 Landfill Expansion incorporates a double composite liner and highly efficient leachate collection system. The uppermost, or primary, liner consists of a thick (80 mil) high density polyethylene (HDPE) geomembrane liner. This geomembrane liner is 33 percent thicker than that required by State and Federal regulations."*

With respect to the 80-mil geomembrane (plastic sheeting) liner, the additional thickness of this liner compared to the minimum required design may slow down the rate of deterioration of this liner. It will not prevent it. The Flawed Technology review discusses what is known about the deterioration of plastic sheeting liners of this type. While it is not possible to reliably predict when this plastic sheeting will no longer function as an effective base for a leachate collection system, there is no question about the fact that ultimately it will deteriorate to the point where it is no longer an effective liner. At that time many of the waste components in this proposed landfill expansion will still be a threat to pollute groundwaters, rendering them a threat to the health of those who use them, for known, currently regulated pollutants, as well as the vast arena of currently unregulated and unmonitored hazardous chemicals that can be present in wastes of the type that PDC proposes to accept at this landfill.

PDC further states,

> *"The primary liner on the floor of Trenches C-2 through C-5 also includes a pure bentonite mat and another HDPE geomembrane directly beneath the uppermost geomembrane liner. Although costly and not required, this added protection has been incorporated to provide additional longterm assurances that the landfill will be protective of the environment."*

PDC did not discuss what is known in the literature about the problems with the ability of a bentonite mat of the type that is present in Trenches C-2 through C-5 to function as designed for as long as the wastes in the landfill will be a threat. As discussed in the Flawed Technology review, such bentonite mats are well known to experience failure to perform as designed, based on cation exchange reactions, where the sodium in the bentonite clay is replaced by calcium. This can lead to cracking of the bentonite mat, which allows for rapid transport of leachate through it.

Another issue that is not mentioned by PDC but is well known is that the HDPE liners are subject to permeation by certain organic solvents of the type that PDC proposes to accept as wastes in this landfill. This permeation (penetration) is a rapid process which occurs without there being holes in the plastic sheet. It can lead to highly hazardous chemicals passing through the liner system into the underlying groundwater system without the plastic sheeting experiencing its ultimate breakdown.

PDC further states,

> *"The primary liner is directly overlain by a highly permeable drainage material (sand on the floor, geonet/geotextile composite on the sidewalls). The liner and leachate collection system is sloped so that leachate that infiltrates to the bottom of the landfill is*

intercepted and efficiently drained to collection sumps. Leachate is routinely pumped from the sumps and is properly treated."

It is somewhat surprising that PDC has used sand in the leachate collection system. It has been known for many years that leachate collection systems are prone to plugging, especially when sand is used in such systems. While the Flawed Technology review discusses this problem from a municipal solid waste perspective, plugging can also be expected to occur in hazardous waste leachate collection systems. Coarser materials are typically recommended for leachate collection systems in order to minimize (but not necessarily eliminate) this plugging. As discussed in the Flawed Technology review, the plugging of a leachate collection system is of importance since it can increase the head (elevation) of the leachate on the liner, and thereby increase the rate of leachate penetration through holes in the liner.

PDC continues, *"The treated leachate is discharged to the sanitary sewer under an industrial use permit."* As discussed in the Flawed Technology review, there is increasing recognition that the current regulatory approach for monitoring and regulating chemicals in landfill leachate and domestic wastewaters is significantly deficient compared to the programs needed to reliably assess the presence of hazardous chemicals in leachate and treated domestic wastewaters. The US EPA is conducting a major program to begin to expand the typical 100-200 chemicals that are now regulated in wastewaters to include a much greater arena of the six million chemicals that are in use today.

As discussed in the Flawed Technology review, very few of the chemicals that are in use today and known to contaminate water are analyzed for or regulated, and many more chemicals are being discovered that are present in water and are a threat to the health of those who use the water for domestic purposes. Since many of these unregulated chemicals and their transformation products can be present in hazardous wastes and their leachate, there can readily be restrictions imposed in the future on the discharge of hazardous waste leachate to the sanitary sewer system in order to prevent leachate-derived chemicals from causing the wastewater treatment plant from violating its NPDES permit due to the presence of these "new" hazardous chemicals. These are not new chemicals, but are chemicals that have not been analyzed for under the current regulatory approach.

PDC continues on the bottom of page ES-7 and top of page ES-8,

"The primary liner and leachate collection system is designed and operated to ensure that no more than 12-inches of leachate will build up on the primary liner. Although the HDPE geomembrane liner is subjected to stringent manufacturing and construction quality assurance processes, a limited number of small imperfections could be present. As a result, a small quantity of leachate could possibly infiltrate through the primary liner. Additional liquids from condensation, consolidation water, and rain water that is trapped beneath the primary liner during the installation process can also exist. These liquids, however, would be intercepted by the secondary liner and leachate collection system. The secondary liner system consists of an 80 mil HDPE geomembrane liner (again, 33 percent thicker than that required by State and Federal regulations) over a minimum 3-feet thick engineered compacted clay liner. A secondary leachate collection

system is sandwiched between the primary and secondary liners. The secondary leachate collection system is sloped to drain leachate to dedicated sumps from where leachate is extracted and treated."

PDC's description of the functioning of the secondary liner system is correct as far as it goes. However, it fails to discuss the fact that the secondary plastic sheeting liner is also subject to failure, possibly at a greater rate than the primary plastic sheeting liner. The secondary liner system should not be relied on as a containment system, but as part of a leak detection system for the upper primary liner system. As discussed in the Flawed Technology review, when leachate is detected in the leak detection system between the primary and secondary liner systems, it is known that the primary liner system has failed and that it is only a matter of time until the secondary liner system will fail if it has not already done so.

The compacted clay liner underlying the secondary plastic sheeting liner forms a composite liner of plastic sheeting and a clay layer. If proper construction of the liners is achieved, a composite liner can be effective in collecting leachate that penetrates through the primary liner system. However, over time, the plastic sheeting liner in both the primary and secondary liner systems will decay. Even if high-quality construction is achieved, the clay layer of the liner will allow leachate to pass through it at a rate determined by the permeability of the clay layer. The compacted clay liner underlying the secondary plastic sheeting liner is subject to a number of potential problems. As discussed in the Flawed Technology review, there can be cracks in this liner due to desiccation. There can also be problems with the adequacy of construction, which can lead to preferential flow pathways through the liner system.

A key issue in leachate collection, either in the primary or secondary liner system, that PDC fails to discuss is that someone must operate and maintain the leachate collection system in perpetuity – i.e., for as long as the wastes in the landfill have the potential to generate leachate when contacted by water infiltrating through the cover. Leachate removal and leachate collection system maintenance, to the extent it can be practiced, will need to be conducted long after the 30-year postclosure period during which PDC proposes to practice postclosure care. Who will be responsible for the *ad infinitum* postclosure care that will be needed for this landfill? Will it be the County? Does the County fully understand the costs and responsibilities of this activity?

PDC states in the first full paragraph on page ES-8,

"PDC records the liquid volumes removed from each primary and secondary leachate collection sump. These data were used in computer simulations to calculate the amount of liquid head (or pressure) that acts on the secondary HDPE geomembrane liner. Because these simulations were calibrated to actual liquid drainage rates, they account for the real-life performance of the facility's liner and leachate collection system. Projecting forward, these computer simulations demonstrate that no more than 0.10 inch of liquid head will develop on the secondary liner (see Section 2.3 for details). This means that there will be essentially no hydrostatic pressure (less than 0.004 pounds per square inch) acting to drive liquids through the secondary HDPE geomembrane liner, 3 feet of compacted clay liner, and an average of 55 feet of low permeability natural clay.

Limiting the head on the secondary (or bottom) liner system is key to limiting the leachate flux (i.e. infiltration rate) through the secondary liner system."

While not specifically mentioned in the Executive Summary, the computer simulations referred to in this paragraph that are used to predict leachate generation rates once the cover has been installed on the hazardous waste landfill are based on HELP model calculations (see page 2.3-12 of Volume 2). As discussed in the Flawed Technology review, while HELP model calculations/simulations can be reliable in predicting rates of water infiltration through the cover when the cover is new (if it is properly installed), they are not reliable for predicting water penetration rates through the cover and therefore leachate generation rates when the integrity of the cover begins to deteriorate. This begins to occur just after installation. Since PDC only proposes to maintain the superficial aspects of the cover for the minimum postclosure care period of 30 years, there will be need for someone to maintain the cover after that period, after PDC attempts to walk off and leave the responsibility for continuing monitoring, maintenance and eventual remediation for someone else to pick up. Will this become the responsibility of the County? If not, who will provide the funds to accomplish this?

The last full paragraph on page ES-8 is summarized in the final two sentences of the paragraph,

"Chloride was, by far, the constituent exhibiting the highest average concentration (21,634 ppm); the average sulfate concentration was 1,992 ppm. This data shows that, while somewhat salty, the leachate in the PDC No. 1 Landfill Expansion area does not contain high concentrations of toxic constituents."

PDC attempts to minimize the characteristics of the leachate with respect to its potential to cause groundwater pollution. Chloride at 21,634 ppm and sulfate at 1,992 ppm represent very high concentrations compared to those that would be allowed in a domestic water supply. Further, PDC states earlier in the paragraph that, "*The concentrations of only 4 regulated RCRA Hazardous Constituents (out of 175 analyzed) over a 10-year period averaged more than 1 part per million (ppm).*" As discussed above, the 175 chemicals that PDC analyzes for represent an infinitesimally small number of the many thousands of chemicals that are present in leachate and could represent a threat to public health and groundwaters of the area. Further, with respect to PDC's statement that the other measured chemicals have been found not to exceed concentrations of 1 ppm, many of the regulated chemicals are a significant threat to domestic water supply quality at concentrations well below 1 ppm.

On the bottom of page ES-8 and top of page ES-9, PDC states,

"PDC has continuously monitored groundwater quality at the facility for more than 16 years. The monitoring program was established in accordance with the State regulations and approved by the Illinois EPA."

PDC has failed to discuss the fact that regulatory agencies such as the Illinois EPA allow the development of groundwater monitoring systems based on vertical monitoring wells along the point of compliance for groundwater monitoring that have a low probability of detecting leachate-polluted groundwater when it first reaches the point of compliance for groundwater

monitoring. At best, this type of groundwater monitoring is largely cosmetic. As discussed in the Flawed Technology review, the initial leakage of a landfill liner system of the type proposed by PDC can generate finger-like plumes of leachate, which can readily pass by the monitoring wells without being detected by them. Failing to detect polluted groundwaters after 16 years of monitoring should not be interpreted to mean that at some time in the future significant groundwater pollution will not occur by landfill leachate in the vicinity of the PDC landfill and its expansion.

As mentioned below, section 2.2.5 on page 2.2-15 provides information on the geology underlying and near the proposed landfill expansion. The information provided shows that the geology, and therefore the hydrogeology of the area under the landfill is complex, with an Upper Till consisting predominantly of silty clay till with few isolated sand, gravel and silt lenses, and a Lower Sand, which is predominantly sand with some gravel and silty sand. This complexity makes monitoring of initial leakage through the landfill liner system difficult to conduct reliably. Further, the complexity also makes prediction of flow paths and flow rates of polluted groundwaters difficult.

PDC states at the end of the first full paragraph on page ES-9,

> *"Despite these very conservative assumptions, AEEI's modeling shows that there will be no numerically significant impacts to groundwater. Based on these results, AEEI concludes that the expansion to the PDC No. 1 Landfill will have no detectable impact on groundwater quality."*

The modeling that concludes "no impact" is basically computer game-playing, with little relevance to the real world that exists in the vicinity of the landfill. Computer modeling of the type described by PDC can readily be unreliable in predicting groundwater pollution from landfills, especially in situations such as those underlying the PDC landfill, of a complex geology. Computer models of this type require a number of assumptions to be made about model input parameters. These assumptions can have a significant impact on the results of the models. There is need for independent expert review of such modeling to evaluate its reliability. Further, the limited-scope hydrogeological investigation that has been conducted by PDC will need to be significantly expanded in order to develop reliable modeling input that will reflect the complexity of the hydrogeology underlying and connected to the PDC landfill site.

The statement is made on page ES-10 in the Executive Summary,

> *"Using this data, and data from other landfill developments, IRR concludes that the proposed landfill expansion will have no affect* [sic] *on the values of surrounding properties."*

I have repeatedly found in my review of proposed landfills and landfill expansions that landfill applicants can find one or more individuals/firms who will claim, as PDC claims, that the development of a landfill will have no impact on nearby property values. However, as discussed in the Flawed Technology review, a Duke University study has shown that property values are significantly impaired within about three miles of a landfill.

On page ES-13, the last paragraph of the Executive Summary states,

> *"In summary, this application demonstrates that there is a need for the expanded facility, and that the facility will include the safeguards necessary to ensure that the environment and the community's wellbeing are protected. By committing to this expansion, PDC wishes to continue contributing to the community for many years to come. Approval of this siting application is the first step in assuring this outcome."*

As summarized above and below with additional detail, the PDC application is fundamentally flawed in providing reliable information on the potential impacts of the proposed hazardous waste landfill expansion. PDC fails to address many of the key issues that must be addressed so that the Peoria County Board can fully understand the potential implications of allowing this hazardous waste landfill to expand/continue to operate. The Board should not only disapprove the expansion of this landfill, but also work with the regulatory agencies to more appropriately evaluate whether the existing PDC landfill is polluting groundwaters and to set up a more adequate monitoring program to determine when each of the sections of the existing landfill starts to pollute groundwaters so that remediation by PDC can be initiated in a timely manner.

Section 1. Starting on page 1-8, section 1.3 describes the types of hazardous wastes that PDC proposes to accept at the landfill expansion. A review of the chemicals that can be present in each of these waste types that will be accepted at the proposed landfill expansion shows that the anticipated waste stream can contain a wide variety of highly hazardous chemicals. While some of these waste streams will be treated to some extent and the treatment can reduce the magnitude of the hazard that the landfilled waste stream represents, it does not eliminate it. Moreover, the manufactured gas plant (MGP) remediation waste streams contain several organic compounds which are deposited "as is," without any treatment.

Section 2. Section 2, with the propaganda heading, "The Proposed Facility is Located, Designed, and Operated to Protect the Public Health, Safety, and Welfare," provides additional information on the characteristics of the proposed landfill expansion. As discussed above, the heading of this section is inappropriate, since the proposed landfill expansion does not provide for protection of public health, safety and welfare.

On page 2.1-2, the last paragraph under 2.1.2 Site Description states,

> *"The proposed facility is virtually surrounded by approximately 269 acres of additional property that are owned by PDC and/or affiliated companies. About 70 acres of the adjacent PDC-owned properties are occupied by closed landfill units and support facilities. The remaining 199 acres (approximately) of the surrounding PDC or affiliated company-owned properties are either farmed or undeveloped and wooded."*

With this paragraph, PDC attempts to confuse the reader into believing that there is a significant amount of buffer lands between where wastes have been or will be deposited in the landfill, and adjacent property. Normally in a landfill application, the landfill applicant delineates the distance between where wastes will be deposited and adjacent property lines. This information

is useful to enable the reviewer of the application to readily determine the buffer land distances that the applicant proposes to use. Some of the so-called surrounding property owned by PDC is occupied by former landfill areas. These areas are likely releasing hazardous chemicals to the atmosphere which are trespassing onto adjacent properties.

According to information on page 2.2-11 of the application, *"Water well records obtained from the ISWS and ISGS indicate that there are 70 wells located within one and one-half miles of the PDC No. 1 Landfill Expansion Facility Boundary (site). These include all known private, public and self-supplied water wells."* In addition, *"The ISWS and ISGS records list 11 wells within approximately 1,500 feet of the site."* This information indicates that there is significant use of groundwaters located near the existing and proposed landfill expansion that can potentially be polluted by landfill leachate.

Section 2.2.5 on page 2.2-15 provides information on the geology underlying and near the proposed landfill expansion. As discussed above, the information provided shows that the geology, and therefore the hydrogeology of the area under the landfill is complex, with an Upper Till consisting predominantly of silty clay till with few isolated sand, gravel and silt lenses, and a Lower Sand, which is predominantly sand with some gravel and silty sand. This complexity makes monitoring of initial leakage through the landfill liner system difficult to conduct reliably. Further, the complexity also makes prediction of flow paths and flow rates of polluted groundwaters difficult. A far more intensive hydrogeological investigation is needed to properly characterize the complexity of the hydrogeology underlying and near the landfill through which leachate-polluted groundwaters can pass on their way to the domestic water supply aquifer.

Beginning on page 2.2-18 a discussion of the hydrogeology of the area of concern is presented. From the information provided it appears that there is hydraulic connectivity between the strata located just under the landfill and the groundwater system of the area that is used for domestic and other water supplies. It is therefore likely that, when the ultimate failure of the liner system occurs, there will be pollution of groundwaters by hazardous waste leachate derived from the landfill.

PDC's conclusions are presented on page 2.2-23:

> *"**2.2.9 Conclusions***
> *The geologic and hydrogeologic conditions beneath the proposed expansion area have been identified based on a large number of soil borings and groundwater monitoring wells installed for the existing landfill. Based upon the geologic data acquired from these investigations, the site geology beneath the proposed expanded landfill is very favorable for landfill development. The in-situ Upper Till, which lies below the landfill invert (floor) and the top of the Lower Sand, is extensive in size, relatively impermeable, and provides a natural barrier for the protection of the Lower Sand. Therefore, the landfill liner coupled with the clay deposits provides protection for the underlying aquifer."*

Contrary to this statement, which is another PDC propaganda statement on the protective nature of the proposed landfill expansion, the conclusion is that the existing landfill and the proposed

expansion of it represent a significant threat to cause groundwater pollution by hazardous waste leachate in the vicinity of the landfill. Basically, PDC has not adequately characterized the underlying hydrogeology with respect to predicting when such pollution could be expected; however, there has been sufficient characterization to indicate that such pollution is inevitable once the liner systems for the landfill have failed.

Volume 2

Many of the landfill design issues presented in Volume 2 of the application were discussed in the comments on the Executive Summary sections on landfill design. The comments on deficiencies in landfill design presented in the discussion of the Executive Summary are applicable to this section as well.

Landfill Design and Construction. Page 2.3-6, section 2.3.3 Liner System provides a discussion of the liner system that is used. This description of the liner system is the same as was presented in the Executive Summary, with the exception of the statement for component 6, compacted clay liner, which is labeled as "Impervious fill." Compacted clay liners are not impervious. They have finite permeabilities, which can change over time. Labeling the compacted clay liner as "impervious fill" is propaganda.

Page 2.3-7, the last line mentions that, *"Impervious fill may be blended with bentonite as needed to achieve the required specified hydraulic conductivity."* The incorporation of bentonite in this liner can lead to problems with respect to the shrink-swell issues discussed in a previous section of these comments, where calcium can substitute for sodium in the bentonite clay, leading to shrinkage and cracking.

Page 2.3-8, the first paragraph under Geomembrane Liner states that R. Koerner of the Geosynthetic Research Institute at Drexel University demonstrated that HDPE geomembranes showed no degradation after at least 200 years of service. That statement is incorrect. Koerner's studies of a decade or so duration have been extrapolated to 200 years. As discussed in the Flawed Technology review, such extrapolations based on the Arrhenius equation are highly speculative. The facts are that there is a period of time after installation when the geomembrane layer (plastic sheeting) can be expected to function as designed, noting that there will be some holes in the liner at the time of construction. Over time, the liner will decompose and eventually fail to function as an effective barrier for transport of leachate through the liner. There is no reliable information that would demonstrate that HDPE plastic sheeting layers can be expected to function as designed for at least 200 years.

The statement in the last sentence of the first paragraph on page 2.3-8, *"The durability of HDPE GM could in this respect be classified as permanent,"* is unreliable. As discussed in the Flawed Technology review, there are a number of other investigators who have discussed a number of factors that can greatly shorten the time of durability. There is no question, however, that ultimately the HDPE plastic sheeting layer will degrade.

Page 2.3-9, in the section on the Geosynthetic Clay Liner, states beginning in the third sentence,

"As a natural mineral, the bentonite clay layer will not degrade with time. Furthermore, bentonite is well known for its very low permeability and swelling properties. In the event of a manufacturing or installation defect in the overlying geomembrane, the bentonite in the GCL will swell to effectively plug the defect."

This statement ignores the well known problems with GCL systems, of cation exchange, which leads to cracking of the clay. These issues are discussed in the Flawed Technology review.

Page 2.3-15 presents information on the proposed landfill cover. This cover will consist of a three-foot-thick vegetative soil layer, a subsurface drainage layer, a 60-mil HDPE geomembrane (plastic sheet), an 18-inch-thick "impervious fill" layer and a 12-inch-thick soil foundation layer. To someone not knowledgeable in the characteristics of these materials, this design might appear to be adequate to prevent moisture from entering the wastes through the cover for as long as the wastes in the landfill will be a threat. However, as discussed in the Flawed Technology review, there are several factors that influence the performance of the cover that cause it to decay in its design properties and ultimately allow large amounts of water to enter the wastes through it. This water forms leachate that, if not collected by the leachate collection and removal system, can lead to groundwater pollution.

Page 2.3-16 discusses the HELP-model-predicted expected performance of the cover. As discussed in the Flawed Technology review, the HELP model can be reliable for predicting the amount of infiltration for a new, properly constructed cover. However, over time the properties of the HDPE liner in the cover will deteriorate and eventually allow moisture that would normally be carried off on top of the HDPE liner in the cover, to penetrate into the wastes.

Page 2.3-17, the section Final Cover Stability fails to discuss the deterioration of the HDPE plastic sheeting layer in the cover. This deterioration will occur at a faster rate than the deterioration of the bottom liner system.

Page 2.3-18 discusses the use of gas vents to allow escape of volatile organic compounds from the wastes. This is a potential source of hazardous chemicals that can affect residents or users of properties near the landfill. Because of the inadequate buffer lands between the waste deposition areas and adjacent properties, this off-gas can represent a significant health threat.

While the proposed PDC landfill expansion liner and cover description provides for more than the minimum allowed design of a landfill containment system, this enhanced design is also subject to failure and will not prevent leachate from being generated in the landfill that can penetrate through the liner system into the underlying groundwater system during the time that the wastes in the landfill will be a threat.

Groundwater Impact Studies. Volume 2 contains section 2.5 Groundwater Impact Studies. This section on page 2.5-1, under Executive Summary, fourth paragraph states, "*Models of the engineered landfills were used to determine maximum upper limits on the diffusion of leachate through the sidewall liners and the floor liners."* This approach toward estimating groundwater impacts based on **diffusion** through the liner system is fundamentally flawed. This approach ignores that the ultimate deterioration of the HDPE liner system and the advective transport of

leachate and many of its associated chemicals through the compacted clay layer is the primary mechanism of leachate transport through the liner system that leads to groundwater pollution. Basically, this approach for estimating groundwater impacts assumes that the HDPE plastic sheeting and the clay will function perfectly, forever. No one who understands the properties of these materials would accept that assessment as reliable.

The statement is made in the last paragraph of the Executive Summary that,

> *"Therefore, Andrews Environmental Engineering, Inc. concludes the proposed expansion of the PDC No. 1 Landfill will have no adverse impact on groundwater quality and will satisfy the groundwater protection regulations of the Illinois Environmental Protection Agency."*

This statement is flawed with respect to the landfill expansion having no adverse impacts on groundwater quality. There will be adverse impacts on groundwater quality by leachate derived from the PDC landfill at some time in the future.

Table 2.5-4 lists leachate concentrations for a number of chemicals that have apparently been found at the existing landfill. They are listed as an upper 95-percent confidence limit. Several of these chemicals, such as vinyl chloride (which is a known human carcinogen), are a factor of 10 above the US EPA drinking water maximum contaminant levels (MCLs). To the extent that this table is representative of the leachate characteristics, it shows that there is potential for groundwater pollution by a variety of carcinogens that are present in the wastes.

Liss, Director of Environmental Services for Andrews Environmental Engineering, Inc. (a consultant to PDC), in his hearing presentation, as presented on the Peoria County website (http://www.co.peoria.il.us/download.php?section=county&newDir=PDC_Application/Meeting_Presentations&file=LissBarrowsPDCPresentation021706.pdf), on slide 6, under "2. Leachate Characteristics," states, *"Essentially, no leachate is generated once landfill is closed."* As discussed elsewhere in these comments, and as is well understood, failure to maintain the low-permeability plastic sheeting layer in the landfill cover for as long as the wastes in the PDC hazardous waste landfill will be a threat (forever), will mean that the initial low-permeability characteristics of the cover that can be achieved with high-quality construction, will deteriorate, allowing substantial amounts of water to infiltrate into the wastes through the cover, generating leachate that can lead to groundwater pollution.

On slide 7 of Liss' presentation, under "Organic Compounds," the last bulleted item states, "*Not significantly different and, in many cases, less toxic than municipal solid waste landfill leachate.*" Those familiar with the composition of municipal solid waste leachate know that it has a high potential to pollute groundwaters with known hazardous and deleterious chemicals, rendering the water a threat to the health of those who use it as a domestic water supply. Further, as discussed in the Flawed Technology review, such leachate contains a wide variety of unregulated hazardous chemicals that are a threat to public health and the environment.

In Liss' presentation he has included many of the same statements as in the landfill application with respect to the composition of the leachate. In slide 9 he states, "*Leachate inorganics*

content similar to seawater." What he does not indicate is that the PDC hazardous waste landfill leachate (similar to seawater) has a high potential to pollute domestic water supplies with inorganic salts, rendering them unusable as water supplies for domestic purposes.

In Liss' summary statement with regard to leachate characteristics on slide 11, he states, *"Very few organic compounds detected in leachate – all at mean concentrations less than 4 ppm."* Four parts per million (ppm) as a mean concentration, for a variety of organic pollutants derived from a hazardous waste landfill, represents a concentration that is a significant threat to cause groundwater pollution. Four parts per million is equivalent to 4,000 micrograms per liter. Micrograms per liter are more appropriate units for comparing leachate concentrations to drinking water maximum contaminant levels (MCLs) for many of the most significant pollutants associated with hazardous wastes. These are the units by which critical concentrations of a number of carcinogens are measured, with respect to assessing their impact on drinking water.

As discussed above in the comments on the Executive Summary of the PDC landfill expansion application, the groundwater impact study conducted by Andrews Environmental Engineering, Inc., does not present a reliable assessment of the potential for leachate-associated pollutants that penetrate through the landfill liner system to pollute groundwaters. Norris, in his testimony at the February 24, 2006, hearing on the Application for Local Siting Approval of a Pollution Control Facility, on pages 114-115 of the hearing transcript as presented on the Peoria County website (http://www.co.peoria.il.us/download.php?section=county&newDir=PDC_Application/Transcripts&file=PDC_2242006trans.pdf), states,

> *"There exists at this site a complex distribution of strongly differing soil types, soil materials across the site and with depth. The depth of weathering of these materials greatly varies from place to place across the site. Water drains readily and rapidly through the site. Contaminants that are not inside containment structures move with that water readily and rapidly down through the site. Such contaminants directly enter the aquifer system that is used ultimately by the public water supplies of the community, and the groundwater impact assessment modeling that was done is inadequate with respect to methodology and the results are inconsistent with site observations."*

On page 122 of this transcript, Norris states, *"As a result of this, any contaminants on the site that are moving with the groundwater as it moves vertically down the site are moving with that groundwater into the underlying aquifer."*

The modeling by Andrews Environmental Engineering, Inc., fails to adequately/reliably take into account the issues discussed by Norris in his assessment of groundwater flow patterns in the vicinity of the hazardous waste landfill site. While Andrews Environmental Engineering, Inc., concludes that there is no potential for the landfill to pollute groundwaters, Norris concludes the opposite – that there are flow paths from the area underneath the PDC hazardous waste landfill that can lead to groundwater pollution by landfill leachate.

Groundwater and Leachate Monitoring. It appears from Figure 2.6-1 that the monitoring wells along the downgradient side of the PDC Landfill are on the order of 200 to 400 feet apart. Since

each monitoring well will capture water at about one foot from the well, there are hundreds of feet between wells where leachate-polluted groundwaters can pass without being detected.

Landfill Closure and Post-Closure Care. Beginning on page 2.7-1 is a discussion of Landfill Closure and Post-Closure Care. As quoted in the PDC landfill expansion application on page 2.7-1, the Peoria County Pollution Control Facilities Siting Ordinance (Chapter 7.5, Article II of the Peoria County Code) states,

> *Section 7.5-38(e): "The applicant shall provide as part of the application detailed information regarding its proposed closing plan which may be required due to a voluntary or involuntary closing of the site. Such plan shall conform to the requirements of both the state and federal Environmental Protection Acts and any applicable rules or regulations adopted by the federal or state Environmental Protection Agencies, and shall provide financial planning information and technical information relevant not only to the actual closing of said site, but also for the perpetual care of said site after closing."*

PDC is choosing to ignore the perpetual care requirement of Peoria County and only proposes to provide for 30 years of postclosure care. Page 2.7-7 states that, *"This section describes the post-closure care activities that will be performed by PDC to ensure that the Area C Landfill is properly maintained throughout the 30-year post-closure care period."* As discussed elsewhere and as is well known, the 30-year postclosure care period is a minimum period and is an infinitesimally small part of the total time that intensive postclosure care will be needed as part of attempting to provide public health and environmental protection from the landfilled hazardous wastes. There will be need for adequate postclosure care, forever, if there is to be any hope of minimizing adverse impacts of the PDC hazardous waste landfill on water supply water quality, public health and the environment.

Page 2.7-8 indicates that between 11 and 30 years after closure of the landfill, the landfill will be inspected annually. That is a grossly inadequate inspection schedule to maintain the integrity of the landfill cover, etc., for those parts of the cover that are proposed to be maintained. This does not include the low-permeability HDPE layer of the cover, since its integrity cannot be assessed by visual inspection of the surface of the landfill.

Page 2.7-9 lists the components of the inspection. A key component that is not listed is the integrity of the HDPE plastic sheeting liner in the cover. As discussed in the Flawed Technology review, the integrity of this layer of the cover cannot be ascertained by visual inspection of the cover, because it is buried below the topsoil and drainage layer.

On page 2.7-15 is the section on Financial Assurance. According to this section, *"PDC has established a Trust Fund to provide for the required financial assurance,"* and submits updated reports to the Illinois EPA. As stated in the third paragraph on page 2.7-15,

> *"As shown in the October 2005 financial assurance report to the Illinois EPA, the required financial assurance to close the entire PDC No. 1 facility, including the Area C landfill, waste treatment plant, surface impoundments, containers, and leachate storage tanks, and to maintain the existing Landfill Sections 1, A and B, and PDC No. 1 Landfill*

Area C throughout the post-closure care period totals $4,414,483. The October 2005 report to the Illinois EPA also documents that the Trust Fund market value totals $5,506,975 as of July 31, 2005."

PDC introduced into the hearing record, near the close of the hearing, "Estimated Perpetual Care Costs." While the document is labeled "perpetual care," examination shows that it only covers 30 years of postclosure care. Perpetual care should be defined based on the period of time that the wastes are a threat to be released from the landfill to the environment, not some arbitrarily developed 30-year minimum postclosure care period, which was originally adopted as part of the Resource Conservation and Recovery Act (RCRA) by the US Congress. This PDC submission presents a breakdown of some of the estimated costs, such as for maintenance of the landfill cover. No funds have been established to repair/replace the plastic sheeting HDPE liner in the cover during the time that the wastes in the landfill will be a threat to public health and the environment.

A review of the Trust Fund covering this financial assurance, as presented in Appendix 2.7-2, shows that PDC has not provided for the Trust Fund to be applicable to PDC landfill postclosure activities beyond the 30-year postclosure care period that PDC proposes to provide for monitoring and maintenance of the PDC hazardous waste landfill. Who is going to provide for the postclosure activities from year 31 on, to hundreds to a thousand or more years that the wastes in the PDC hazardous waste landfill will be a threat? It is apparent that PDC proposes a "turn-key" transfer of the perpetual care obligations related to the site to the County of Peoria sometime after the postclosure release of the site by the Illinois EPA. The Flawed Technology review discusses the types of postclosure activities that will be needed, effectively, forever. For the PDC hazardous waste landfill these include

- Monitoring the groundwater monitoring wells,
- Removing leachate from the leachate collection sumps,
- Repairing the cover when there is erosion of it, and the plastic sheeting liner in the cover when it deteriorates and thereby fails to prevent moisture from entering the landfill that generates leachate,
- Cleaning out the leachate collection system associated with plugging of this system,
- Monitoring the composition and magnitude of releases of gas from the landfill gas vents,
- Performing groundwater remediation when the pollution of groundwater by landfill leachate is discovered in a monitoring well or more likely in an offsite production well,
- Replacing the domestic water supply sources for nearby property owners/users when the groundwaters that they are using for domestic water supply are polluted by landfill leachate, and
- Funding the liability for lawsuits that will result from developing and permitting a landfill that will obviously pollute groundwater during the time that the wastes in the landfill will be a threat.

In addition, in order to improve the reliability of detecting the failure of the liner for the PDC hazardous waste landfill and the pollution of groundwater while the polluted groundwaters are still on/under the PDC property, a much more comprehensive groundwater monitoring well array will be needed to detect the initial pollution of groundwaters by landfill leachate. The cost of installing, operating, monitoring and maintaining the existing and the additional monitoring

wells will have to be borne by those responsible for postclosure funding beyond the 30-year minimum period that PDC proposes to cover.

As discussed in the Flawed Technology review, an approach that could be effective in preventing groundwater pollution for double composite lined landfills, such as the PDC landfill, involves the construction and operation of a leak detectable cover on the landfill. This cover provides a means to determine when the plastic sheeting layer in the cover will no longer prevent moisture from penetrating through it and thereby generating leachate. The installation of the leak detectable cover should take place no later than when leachate is detected in the leak detection system between the upper composite liner and the lower composite liner. At that time, the installation of a leak detectable cover could stop leachate generation and thereby prevent groundwater pollution by the landfill when the lower composite liner fails to prevent leachate from penetrating through it.

While such covers have been commercially available for a number of years, they have not been installed, since the regulatory agencies have been unwilling to require such installation because of the cost to the landfill owner and those who deposit wastes in the landfill. However, that situation could change at locations such as the PDC hazardous waste landfill, when it is clear that the upper composite liner has failed and that it is only a matter of time until the lower composite liner fails (if it has not already done so) and groundwater pollution will occur unless steps are taken to stop leachate generation.

Since it is not possible to repair the liner system underneath the landfill because of its being buried under the hazardous wastes, the leak detectable cover approach provides a means of preventing groundwater pollution. In order to implement this approach, however, postclosure funding would be needed to construct the leak detectable cover and, most importantly, to operate the leak detection system forever – i.e., for as long as the hazardous wastes in the landfill are a threat to generate leachate when contacted by water. Adoption of this approach would require large amounts of postclosure care funding that are not currently available for the existing PDC landfill and the proposed PDC landfill expansion.

All of these issues should be reviewed and defined by Peoria County, with respect to the potential long-term cost to the County, as part of its review of the PDC hazardous waste landfill expansion application. These same issues need to be defined with respect to the closure of the existing hazardous waste landfill, should the County determine that the expansion of this landfill should not be allowed because of the increased magnitude of the threat to public health, groundwater resources and the environment that already exists for the currently operating PDC hazardous waste landfill.

David E. Daniel Design Review. Presented in Section 2.8 of the application is a Design Review by David E. Daniel. Daniel states on page 2.8-2,

> *"The designs have evolved in the ensuing two decades but have not fundamentally changed, based on the excellent performance of the current generation of landfills. To the best of my knowledge, no modern hazardous waste disposal facility has caused contamination of groundwater."*

This statement should not be interpreted to mean that the wastes in modern hazardous waste landfills will not at some time in the future cause pollution of groundwater as the landfill containment system (liners and cover) deteriorates, thereby allowing the generation of leachate that will escape from the landfill into the underlying groundwater system.

With respect to Daniel's comment on conformance of the PDC hazardous waste landfill to regulatory requirements, it should be understood that the regulatory requirements that have been developed and are currently in place largely ignore the long-term situation of the wastes in a hazardous waste landfill being a threat to pollute groundwaters, effectively, forever, since many of the components in these wastes do not degrade. Further, the degree of hazardous waste treatment that is allowed by current regulatory requirements does not prevent the formation of leachate which contains highly hazardous chemicals that can eventually migrate through the liner system into the underlying groundwaters.

Daniel states on page 2.8-2 (bottom) and the top of 2.8-3,

> *"(1) HDPE Geomembrane Liners. High-Density Polyethylene (HDPE) is one of the most stable of all flexible lining materials. Its degradation is extremely slow. Laboratory studies have employed well-recognized techniques in material science for accelerated aging of materials for the purpose of estimating the probable performance life of such materials. An excellent summary is provided in a white paper published by the Geosynthetic Institute (http://www.geosynthetic-institute.org/papers/paper6.pdf)."*

I agree with this statement. In the 1980s, while I held a Distinguished Professorship in Civil and Environmental Engineering at the New Jersey Institute of Technology, and Director of the Site Assessment and Remediation Division of a multi-university hazardous waste research center, I held a contract with the then leading liner manufacturing company to conduct a review on the properties of various types of plastic sheeting landfill liner materials that were being used or proposed for use at that time. I concluded that HDPE-based plastic sheeting liners were the most stable and least likely to be affected by chemicals in municipal solid waste and hazardous waste. HDPE, however, at that time (and still today) has significant problems, the most important of which is that it cannot be expected to perform reliably as a liner that will prevent leachate passage through it for as long as the wastes in a hazardous waste (or municipal solid waste) landfill are a threat to cause groundwater pollution. While that assessment was developed by me in the 1980s, it still stands today. There is no question about the eventual degradation of HDPE plastic sheeting. While slow, it still does degrade.

In the next paragraph, Daniel discusses the work of the Drexel University Geosynthetic Research Institute, where he states,

> *"For buried HDPE geomembranes that are subjected to a temperature of 20° C, the predicted half-life, i.e., the time at which the geomembrane's physical properties have reduced 50 percent, is in the range of about 380 to 500 years."*

I have discussed this assessment in the Flawed Technology review based on chemistry, which is one of my areas of expertise. While a graduate student at Harvard University in the late 1960s I took coursework in polymer chemistry and became familiar with free radical degradation of polymers. This is recognized as one of the mechanisms by which HDPE plastic sheeting degrades. The limited-scope testing that was done at Drexel University, which has been extrapolated to 300 to 500 years, could easily be in significant error from several perspectives. First, the approach for extrapolation is based on what is called an Arrhenius equation, which relates the rate of decay of a chemical substance, to temperature. While Arrhenius equations are useful for many situations in interpolating between temperatures, great caution must be exercised in extrapolating from limited-term laboratory studies to hundreds to a thousand or more years of field conditions. What is known from these studies is that the HDPE plastic sheeting liners will degrade and that the wastes in the landfill will still be a threat when these liners are no longer functioning as effective barriers to prevent leachate transport through them.

Another issue of concern with respect to the existing PDC landfill is that the characteristics of the HDPE liners used in the various cells of this landfill have changed over the years. Based on my review of the characteristics of HDPE liners, the HDPE plastic sheeting used as liners in the 1980s was subject to more rapid failure to function effectively as a liner than the HDPE plastic sheeting that is used in landfills today. This means that the HDPE liners used in the earlier cells of the PDC landfill would be expected to fail more rapidly than the HDPE liners that are proposed for use in the landfill expansion. However, even today's HDPE plastic sheeting liners will ultimately degrade and fail to function as an effective liner in a landfill.

Daniel, on page 2.8-3, in his discussion of compacted soil liners, states,

> *"(2) Compacted Soil Liners. Clay soils are a geologic material that is produced from weathering of rock. The clay minerals themselves are geologically stable and are expected to last for millions of years."*

Daniel has not discussed the variety of factors that are well known to affect the ability of clay liners to perform at their design characteristics. As discussed in the Flawed Technology review, clay liners are subject to a variety of factors that can impair their ability to prevent leachate from passing through them at the design characteristics. These include problems in construction, desiccation cracking, cation exchange reactions (which affect shrink-swell properties), etc. While Daniel states that fine materials in the wastes will tend to cause clay liners to become less permeable, these other factors can readily make clay liners more permeable. The bottom-line issue with respect to clay liners is that they are not impermeable, and that, in time, leachate can pass through them, leading to the pollution of groundwaters underlying the landfill.

Daniel, on page 2.8-4, provides the following statement with respect to the final cover,

> *"(5) Final cover. Some final covers can be vulnerable to degradation over time due to temperature variations, potential penetration of plant roots into underlying materials, and other mechanisms. The proposed design is highly protective from a long-term performance perspective because there is a thick (3-ft-thick) layer of protective soil, and a composite geomembrane/compacted clay liner system that inherently has a high degree*

of redundancy and self-protection (for example, the geomembrane protects the underlying clay from desiccation, and the clay stops water percolation through any imperfections in the geomembrane).”

From Daniel’s statement one could gain the impression that the final cover for the proposed PDC hazardous waste landfill could prevent moisture from passing through the cover into the wastes, generating leachate. This is an inappropriate assessment of the actual expected performance. Daniel has not discussed the fact that the key element in preventing water from passing through the cover is the plastic sheeting layer in the cover. This plastic sheeting layer will degrade, likely at a faster rate than the bottom liner plastic sheeting, because of the greater exposure conditions that lead to free radical formation. Further, Daniel did not discuss the fact that compacted clay layers, such as the 3-ft-thick clay layer in the cover, will be subject to significant cracks.

In the late 1980s, Daniel was part of a group of individuals who assisted the US EPA in discussing the expected performance of landfill covers. In Daniel’s discussion of these issues (as discussed in the Flawed Technology review), he points out that studies in Wisconsin at Omega Hills showed significant cracking of the cover layer, which occurred within just a few years after installation. This same kind of cracking can be expected at the PDC hazardous waste landfill. Even with the proposed inspection and maintenance of the cover’s integrity, when the failure of the plastic sheeting layer in the cover occurs (i.e., it degrades and allows moisture to penetrate through the plastic sheeting into the wastes in the landfill), significant amounts of leachate will be generated that will be a significant threat to lead to groundwater pollution.

Since PDC only proposes to maintain the cover for 30 years after closing the landfill, and since it is not possible to inspect the plastic sheeting layer by visual observation of the surface of the landfill, and since the wastes in the landfill will be a threat forever, the inevitable leachate generation that will occur in postclosure year 31 and beyond will eventually lead to leachate transport of hazardous chemicals to the underlying groundwaters. As far as I can ascertain, there are no funds available, even within the 30-year postclosure period, to replace the plastic sheeting layer in the cover.

Daniel states on page 2.8-5, under Miscellaneous,

“To the best of my knowledge, no modern composite liner system of the type used for this facility and built within the last 25 years has resulted in groundwater contamination. The pervasive problems with dumps contaminating groundwater occurred prior to the modern era of landfill design, which began in the early 1980’s, when HDPE liners started to become widely used in conjunction with compacted clay and leachate collection systems. Today’s landfill technology has essentially solved the problem of groundwater contamination from landfills, with designs such as the one proposed for this facility.”

This type of statement is frequently made by those who are supporting the development of landfills on behalf of landfill applicants. It has been addressed in the Flawed Technology review with respect to providing an understanding of the appropriateness of this statement as it might relate to long-term performance. In the 20 or so years that this type of design of landfills has

been practiced, it would not be expected for groundwater pollution by landfill leachate to have been detected. This arises from several factors. First, the clay liners that are used, during this period of time, would be expected to prevent the migration of leachate through them, which would lead to groundwater pollution. While clay liners have finite permeabilities, the design permeability, if achieved at the time of construction, would preclude detecting leachate pollution of groundwaters in a 20-year period.

Another factor that needs to be considered in evaluating this statement of no known pollution by modern existing hazardous waste landfills is that the way that groundwater pollution from landfills is observed is through its detection in groundwater monitoring wells. As was discussed in Flawed Technology, based on the work of Cherry at the University of Waterloo, the placing of groundwater monitoring wells at hundreds of feet apart along the downgradient edge of a landfill could readily fail to detect the initial plumes of leachate-polluted groundwater passing the monitoring well line (the point of compliance for groundwater monitoring). The narrow plumes of leachate compared to the zones of capture of groundwater monitoring wells leads to a high probability that the initial pollution of groundwater will pass the monitoring wells without detection.

Basically, failing to see groundwater pollution by existing plastic sheeting and clay lined landfills is no indication that significant groundwater pollution will not occur at some time in the future.

On page 2.8-6, in the last paragraph, Daniel states, *"Assuming these issues are accounted for, it is my opinion that the PDC No. 1 Landfill Expansion will be protective of the environment for many centuries forward."* As discussed herein, that statement could readily be in error with respect to the duration of protection. Most importantly, it is an acknowledgement that, ultimately, when future generations in the Peoria area want groundwaters free of hazardous waste leachate for their domestic and other use, they will find that the existing PDC landfill will have polluted them with hazardous and deleterious chemicals. If the proposed expansion is allowed, the magnitude and extent of this pollution will be significantly increased.

Section 3 – The Facility is Compatible with the Character of the Surrounding Area and has No Effect on the Value of Surrounding Property. The conclusion is stated in the final paragraph of this section, on page 3.2-21,

> *"Based upon the above factors, together with the other studies and analyses undertaken by this firm, and with consideration of our substantial experience in the evaluation of landfill operations both in similar rural as well as more urban locations, we believe that the expansion is located so as to minimize the effect on the value of the surrounding properties."*

To the contrary, Hirschfeld et al. (1992) of Duke University found, for a number of landfills, that there were significant decreases in property values within several miles of a landfill. It is my experience that there are very few individuals who would want to live within a couple of miles of a hazardous waste landfill, especially one like the PDC landfill, which has very limited buffer

lands on the landfill owner's property to dissipate releases of hazardous and deleterious chemicals from the landfill before trespass occurs onto adjacent properties.

Section 5 – The Plan of Operations is Designed to Minimize Danger to Surrounding Areas. With such limited buffer lands between the landfilling operations and adjacent properties, any problems that develop with the PDC landfilling operations could more easily translate into adverse effects on adjacent property owners/users than if PDC had located their hazardous waste landfill with adequate buffer lands.

Section 9 – The Facility is Not Located Within a Regulated Recharge Area. In the text of the application, section 9, which can be found in Volume 2, beginning on page 9-1, it is stated,

> *"According to 35 IAC Part 617, only one regulated recharge area exists in Peoria County. This regulated recharge area, known as the Pleasant Valley Public Water District (PVPWD) Regulated Recharge Area, is located approximately 1.1 miles south of the proposed PDC No. 1 Landfill Expansion facility boundary."*

It is my experience that landfills can pollute groundwaters several miles from the waste deposition area. The fact that there is an important, protected public water supply recharge area within about a mile of the PDC hazardous waste landfill is of concern, since there is a potential for this landfill to pollute groundwaters underlying the protected recharge zone.

Areas of Concern to the Public

Based on my discussions with various members of the public, there are a number of aspects of the current PDC hazardous waste landfilling operations that need to be addressed to help the public understand the adequacy of the current regulation of the PDC landfill operations and any proposed expansion of it. A summary of these issues is presented below.

Pollution of Groundwaters by the Barrel Trench Part of the Landfill. Based on testimony at the public hearing on the proposed expansion of the PDC landfill and the newspaper accounts of this testimony as presented in the *Journal Star* (Peoria) newspaper article by Elaine Hopkins, February 25, 2006, there is concern by the public about the pollution of groundwaters by an older section of the landfill referred to as the "barrel trench." There is need for the County to work with the public and the regulatory agencies to investigate this situation. This investigation will likely involve constructing additional monitoring wells and monitoring the groundwaters that are potentially impacted by the former landfill section, to determine if pollution is occurring from that part of the landfill. This investigation should be paid for by PDC and would include involvement of independent experts who could provide reliable information to the public on the development of the investigation, its implementation and its results. If there is an indication that this part of the landfill is polluting groundwaters, then PDC should be required to start a comprehensive groundwater investigation/remediation program to define the extent of the pollution, to control its further spread and to remediate the polluted groundwaters to the maximum extent possible. It is important to understand, however, that once an aquifer is polluted by hazardous or municipal solid waste leachate it is not possible to ever clean up the polluted part of the aquifer so that it can be used for domestic water supply. These issues are discussed in the Flawed Technology review.

Toxic Release Inventory. The public is aware, through toxic release inventory (TRI) data for the PDC hazardous waste landfill, that this landfill receives large amounts of highly toxic chemicals, and that part of the received chemicals are released to the atmosphere. This means that the PDC landfilling operations are exposing the public in the vicinity of the landfill to hazardous chemicals that would not otherwise occur in the area, at least to the same extent as are now occurring because of the landfill. The public is concerned that possibly the higher cancer incidence in the Peoria area may be related to the airborne releases of hazardous chemicals from the PDC hazardous waste landfill. For a discussion of the increased cancer incidence in the Peoria area, see Dr. Michael Vidas' February 27, 2006, hearing testimony, where he cites from the Illinois Cancer Facts and Figures of 2004 (http://www.co.peoria.il.us/download.php?section=county&newDir=PDC_Application/Transcripts&file=PDC_2272006trans.pdf).

An issue of particular concern is whether the off-gases from the closed as well as the operating parts of the existing landfill contain hazardous, volatile chemicals that are a threat to the health of those in the vicinity of the landfill. This is an area that needs independent, in-depth review to assess whether the public in that area is being exposed to greater concentrations of hazardous chemicals through airborne releases from the landfill than would occur if the landfill operations were terminated. The independent review should be based on comprehensive, in-depth, ongoing monitoring, to assess the types and amounts of hazardous chemicals emitted from the closed sections of the landfill (through off-gas releases), as well as the operating sections. This information then should be reviewed with respect to the hazards that these releases represent to the public and the environment in the vicinity of the landfill, considering not only the hazards of the known hazardous chemicals with respect to their potential individual impacts, but also the additive and synergistic impacts of combinations of hazardous and other chemicals that are an even greater threat to public health and the environment than the individual chemicals by themselves. Further, consideration should be given to the potential hazards of yet unrecognized, unregulated and unmonitored chemicals that can be present in hazardous waste landfill off-gases.

Physicians' Opposition to Continued Operation of the Landfill. There is considerable concern by members of the public that those living, working or using the lands near the PDC hazardous waste landfill are exposed to greater concentrations of hazardous chemicals than would occur if the landfill were not operating. The issue of the hazards of living or working near landfills has been addressed in the Flawed Technology review. The following section is from that review.

> *"An issue of concern is whether those who live near landfills show evidence of adverse health effects. It is known from a number of studies conducted by the Centers for Disease Control (Anderson, pers. comm., 1999) that some populations living near landfills have shown a greater incidence of some diseases. Elliott et al. (2001) have reported that children of people living near landfills in England tend to have a higher rate of birth defects than the general population. A review of the various studies that have been conducted, however, reveals that the epidemiological approach for discerning health effects associated with populations living near landfills is not sufficiently sensitive to reliably determine whether releases from the landfill are at least in part responsible for the health effects. A complicating factor is that those living near landfills frequently are*

economically disadvantaged and of a different ethnic mix than the general population. Further, data that have been developed on this issue have often been devoted to former (closed) landfill situations, where there is far greater limiting of landfill emissions than will occur, at least initially, with today's Subtitle C and D landfills."

Subtitle C landfills are hazardous waste landfills, and Subtitle D landfills are municipal solid waste landfills.

Dr. Vidas, a physician in the Peoria area, in his testimony on behalf of the Peoria Medical Society at the February 27, 2006, hearing on the Application for Local Siting Approval of a Pollution Control Facility, Volume VI, as presented on the Peoria County website (http://www.co.peoria.il.us/download.php?section=county&newDir=PDC_Application/Transcripts&file=PDC_2272006trans.pdf), stated,

"First of all, I want to thank you for allowing me to participate in the affairs of these hearings. I feel it's very important, and I as a physician feel that it's an important part at least for me to express my opinion, and I thank you very much for allowing me to do such for all of those here. As you know, I am an otolaryngologist, ear, nose, throat doctor, and essentially deal with the disease of the head and neck. I have been on the Peoria Mayor's Task Force of Medical Waste in 1990. I have written a paper on epidemiology of head and neck cancer in my residency, in my training.

You may ask why a doctor? The oath of the medical -- the World Medical Association, AMA, and other associations suggest that I, as a doctor, have a responsibility to you and our community. Excerpts from the oaths are as follow: I solemnly pledge myself to consecrate my life to the service of humanity; the health of my patient will be my first consideration; To dedicate all of my knowledge and strength to the preservation and improvement of the health of mankind and to the treatment and prevention of disease, and to work in good conscious wherever it is required by society.

I will remember that I remain a member of society with special obligations to all of my fellow human beings. A physician shall respect the law and also recognize a responsibility to seek changes in those requirements which are contrary to the best interests of the patient. A physician shall recognize a responsibility to participate in activities contributing to an improved community. In this vein, the following resolution proposed by my fellow physician and friend Dr. Don Crane, for the upcoming Illinois State Medical Society meeting in April will be introduced. Next Wednesday I will introduce this resolution for adoption by the Peoria Medical Society. And if you don't mind, I would like to read that resolution.

Whereas, hazardous waste deposited in toxic landfills contains heavy metals and many chemicals that once deposited will remain unchanged forever, and whereas, some toxic waste landfills are atop aquifers which municipalities obtain their drinking water, and whereas there is no liner available that would outlast the toxic waste. Whereas failure of the liner will eventually result in the leaching of toxic waste into the aquifer and water supply, therefore be it resolved that the ISMS, Illinois State Medical Society, and the

American Medical Association take a position of opposition to new or the expansion of toxic waste landfills over aquifers.

And further be it resolved that the ISMS and AMA adopt the position that toxic waste landfills currently in existence over aquifers be relocated to areas where no aquifers lie. This resolution is in keeping as to what our duty is as physicians to the community in which we reside."

PDC attempts to discredit Dr. Vidas' testimony in its rebuttal statement, which can be found in the public comment section of the Peoria County website (http://www.co.peoria.il.us/download.php?section=county&newDir=PDC_Application/Public_Comment&file=PDCCommentWE3172006.pdf), where the statement is made, "*In summary, there is no exposure occurring to the public as a result of air quality and no increased risk of cancer to the general public as a result of the facility."* Based on my formal public health education, and 40-plus years of work examining the potential impacts of chemicals on public health and the environment, such statements by PDC can readily be superficial and unreliable.

According to their rebuttal statement, *"… none of the TRI reported compounds were detected at the facility boundary."* The first question to ask is about the adequacy of the monitoring program upon which this statement is based. Was monitoring done with adequate detection limits during the time when the greatest potential for release was occurring? Also, those knowledgeable on the presence of hazardous chemicals in the environment know that TRI reported chemicals represent a small number of the potentially hazardous chemicals that could be present in releases from the PDC hazardous waste landfill. As discussed in the Flawed Technology review, the US EPA has reported that there are over six million chemicals in commerce today. Only a very small number (about 100 to 200 or so) are monitored for. There could readily be hazardous chemicals in the hazardous waste accepted by PDC that are not monitored for, yet represent a significant threat to public health and the environment on adjacent and nearby properties.

Letters similar to Dr. Vargas' in opposition to the proposed expansion of the PDC hazardous waste landfill were received by the County from Keith Steffen, Administrator and Dr. William Scott, Regional Medical Director of the OSF Center for Occupational Health; Dr. R. Parker McRae, Jr., President of the Medical Staff of Proctor Hospital; Dr. Gary Zwicky, President of the Medical Staff of OSF Saint Francis Medical Center; and Dr. Stephen M. Smith, President of the Active Medical and Dental Staff of Methodist Medical Center of Illinois. The physicians' position against the proposed expansion of the PDC landfill is in accord with prudent public health protection policy.

Peoria is the Dumping Ground for Hazardous Wastes in the Midwest. An issue of particular concern to many of the Peoria area public is that a substantial part of the wastes that are being deposited in the existing PDC hazardous waste landfill and presumably will be deposited in the landfill expansion will be from out of the Peoria area. As discussed in the PDC hazardous waste landfill expansion application on page 1-1,

> *"The facility currently receives hazardous waste and non-hazardous industrial waste from Peoria County and other communities throughout Illinois and from other states such as Alabama, Arkansas, Indiana, Iowa, Kansas, Kentucky, Minnesota, Missouri, Nebraska, Ohio, Tennessee, and Wisconsin."*

Thus, according to PDC, there are twelve other states contributing wastes that are deposited in the PDC landfill. Since there are many appropriate questions about the ability of the PDC hazardous waste landfill to protect public health, groundwater resources and the environment for as long as the landfilled wastes are a threat, the additional wastes from non-local sources contribute to the magnitude of the hazard that the Peoria area public can be expected to experience from problems with this landfill and its expansion. Members of the public are concerned that they are being exposed to the hazards associated with the landfilling of hazardous wastes from other areas of the Midwest that more appropriately should be managed in the areas where the hazardous wastes are generated.

Public Involvement in Review of PDC Landfilling Operations. The public potentially impacted by PDC's landfilling operations is concerned that PDC can change its operations, including waste streams received, etc., without the public being made aware of the changes. In order to help the public understand PDC's landfilling operations, the County should appoint a public advisory panel that would periodically meet to discuss current operations and proposed changes in operations of the PDC hazardous waste landfill. This panel should receive monitoring reports, updated TRI data on receipts and releases, reports of incidents at the landfill that could affect adjacent and nearby property owners/users, reports on the potential releases from the older parts of the landfill, as well as the monitoring that is being done at the landfill, etc. This public involvement in review of PDC landfilling operations should be implemented immediately to cover the remaining years of the currently permitted landfilling operation.

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Appendix A

Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste

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Updated March 2006

This appendix is available as,

Lee, G. F., and Jones-Lee, A., "Improving Public Health and Environmental Protection from Inadequately Developed Landfills," from: Lee, G. F., and Jones-Lee, A., "Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste," Report of G. Fred Lee & Associates, El Macero, CA, December 2004, updated March (2006).
http://www.members.aol.com/annejlee/ImprovProt-LF.pdf

Appendix B

Dr. G. Fred Lee, PE(TX), DEE
AAEE Board Certified Environmental Engineer

Expertise and Experience in Hazardous Chemical Site and Municipal/Industrial Landfill Impact Assessment/Management

Dr. G. Fred Lee's work on hazardous chemical site and municipal/industrial landfill impact assessment began in the mid-1950s while he was an undergraduate student in environmental health sciences at San Jose State College in San Jose, California. His course and field work involved review of municipal and industrial solid waste landfill impacts on public health and the environment.

He obtained a Master of Science in Public Health degree from the University of North Carolina, Chapel Hill, in 1957. The focus of his masters degree work was on water quality evaluation and management with respect to public health and environmental protection from chemical constituents and pathogenic organisms.

Dr. Lee obtained a PhD degree specializing in environmental engineering from Harvard University in 1960. As part of this degree work he obtained further formal education in the fate, effects and significance and the development of control programs for chemical constituents in surface and ground water systems. An area of specialization during his PhD work was aquatic chemistry, which focused on the transport, fate and transformations of chemical constituents in aquatic (surface and ground water) and terrestrial systems as well as in waste management facilities.

For a 30-year period, he held university graduate-level teaching and research positions in departments of civil and environmental engineering at several major United States universities, including the University of Wisconsin-Madison, University of Texas at Dallas, and Colorado State University. During this period he taught graduate-level environmental engineering courses in water and wastewater analysis, water and wastewater treatment plant design, surface and ground water quality evaluation and management, and solid and hazardous waste management. He has published over 1,100 professional papers and reports on his research results and professional experience. His research included, beginning in the 1970s, the first work done on the impacts of organics on clay liners for landfills and waste piles/lagoons.

His work on the impacts of hazardous chemical site and municipal/industrial solid waste landfills began in the 1960s when, while directing the Water Chemistry Program in the Department of Civil and Environmental Engineering at the University of Wisconsin-Madison, he became involved in the review of the impacts of municipal solid waste landfills on groundwater quality.

In the 1970s, while he was Director of the Center for Environmental Studies at the University of Texas at Dallas, he was involved in the review of a number of municipal solid and industrial (hazardous) waste landfill situations, focusing on the impacts of releases from the landfill on public health and the environment.

In the early 1980s while holding a professorship in Civil and Environmental Engineering at Colorado State University, he served as an advisor to the town of Brush, Colorado, on the potential impacts of a proposed hazardous waste landfill on the groundwater resources of interest to the community. Based on this work, he published a paper in the Journal of the American Water Works Association discussing the ultimate failure of the liner systems proposed for that landfill in preventing groundwater pollution by landfill leachate. In 1984 this paper was judged by the Water Resources Division of the American Water Works Association as the best paper published in the journal for that year.

In the 1980s, he conducted a comprehensive review of the properties of HDPE liners of the type being used today for lining municipal solid waste and hazardous waste landfills with respect to their compatibility with landfill leachate and their expected performance in containing waste-derived constituents for as long as the waste will be a threat.

In the 1980s while he held the positions of Director of the Site Assessment and Remediation Division of a multi-university consortium hazardous waste research center and Distinguished Professor of Civil and Environmental Engineering at the New Jersey Institute of Technology, he was involved in numerous situations concerning the impact of landfilling of municipal solid waste on public health and the environment. He has served as an advisor to the states of California, Michigan, New Jersey and Texas on solid waste regulations and management. He was involved in evaluating the potential threat of uranium waste solids from radium watch dial painting on groundwater quality when disposed of by burial in a gravel pit. The public in the area of this state of New Jersey proposed disposal site objected to the State's proposed approach. Dr. Lee provided testimony in litigation, which caused the judge reviewing this matter to prohibit the State from proceeding with the disposal of uranium/radium waste at the proposed location.

Dr. Lee's expertise includes surface and ground water quality evaluation and management. This expertise is based on academic course work, research conducted by Dr. Lee and others and consulting activities. He has served as an advisor to numerous governmental agencies in the US and other countries on water quality issues. Further, he has served on several editorial boards for professional journals, including *Ground Water*, *Environmental Science and Technology*, *Environmental Toxicology and Chemistry*, etc. Throughout his over-45-year professional career, he has been a member of several professional organization committees, including chairing the American Water Works Association national Quality Control in Reservoirs Committee and the US Public Health Service PCBs in Drinking Water Committee.

Beginning in the 1960s, while a full-time university professor, Dr. Lee was a part-time private consultant to governmental agencies, industry and environmental groups on water quality and solid and hazardous waste and mining management issues. His work included evaluating the impacts of a number of municipal and industrial solid waste landfills. Much of this work was done on behalf of water utilities, governmental agencies and public interest groups who were concerned about the impacts of a proposed landfill on their groundwater resources, public health and the environment.

In 1989, he retired after 30 years of graduate-level university teaching and research and expanded the part-time consulting that he had been doing with governmental agencies, industry and community and environmental groups into a full-time activity. A principal area of his work since then has been assisting water utilities, municipalities, industry, community and environmental groups, agricultural interests and others in evaluating the potential public health and environmental impacts of proposed or existing hazardous, as well as municipal solid waste landfills. He has been involved in the review of approximately 85 different landfills and waste piles (tailings) in various parts of the United States and in other countries, including 12 hazardous waste landfills, eight Superfund site landfills and five construction and demolition waste landfills. He has also served as an advisor to a hazardous waste landfill developer and to IBM corporate headquarters and other companies on managing hazardous wastes.

Dr. Anne Jones-Lee (his wife) and he have published extensively on the issues that should be considered in developing new or expanded municipal solid waste and hazardous waste landfills in order to protect the health, groundwater resources, environment and interests of those within the sphere of influence of the landfill. Their over 120 professional papers and reports on landfilling issues provide guidance not only on the problems of today's minimum US EPA Subtitle D landfills, but also on how landfilling of non-recyclable wastes can and should take place to protect public health, groundwater resources, the environment, and the interests of those within the sphere of influence of a landfill/waste management unit. They make many of their publications available as downloadable files from their web site, www.gfredlee.com.

Their work on landfill issues has particular relevance to Superfund site remediation, since regulatory agencies often propose to perform site remediation by developing an onsite landfill or capping waste materials that are present at the Superfund site. The proposed approach frequently falls short of providing true long-term health and environmental protection from the landfilled/ capped waste.

In the early 1990s, Dr. Lee was appointed to a California Environmental Protection Agency's Comparative Risk Project Human Health Subcommittee that reviewed the public health hazards of chemicals in California's air and water. In connection with this activity, Dr. Jones-Lee and he developed a report, "Impact of Municipal and Industrial Non-Hazardous Waste Landfills on Public Health and the Environment: An Overview," that served as a basis for the human health advisory committee to assess public health impacts of municipal landfills.

In 2004 Dr Lee was selected as one of two independent peer reviewers by the Pottstown (PA) Landfill Closure Committee to review the adequacy of the proposed closure of the Pottstown Landfill to protect public health, groundwater resources and the environment for as long as the wastes in the closed landfill will be a threat.

In addition to teaching and serving as a consultant in environmental engineering for over 40 years, Dr. Lee is a registered professional engineer in the state of Texas and a Diplomate in the American Academy of Environmental Engineers (AAEE). The latter recognizes his leadership roles in the environmental engineering field. He has served as the chief examiner for the AAEE in north-central California and New Jersey, where he has been responsible for

administering examinations for professional engineers with extensive experience and expertise in various aspects of environmental engineering, including solid and hazardous waste management.

His work on landfill impacts has included developing and presenting several two-day short-courses devoted to landfills and groundwater quality protection issues. These courses have been presented through the American Society of Civil Engineers, the American Water Resources Association, and the National Ground Water Association in several United States cities, including New York, Atlanta, Seattle and Chicago, and the University of California Extension Programs at several of the UC campuses, as well as through other groups. He has also participated in a mine waste management short-course organized by the University of Wisconsin-Madison and the University of Nevada. He has been an American Chemical Society tour speaker, where he is invited to lecture on landfills and groundwater quality protection issues, as well as domestic water supply water quality issues throughout the United States.

Throughout Dr. Lee's 30-year university graduate-level teaching and research career and his subsequent 16-year private consulting career, he has been active in developing professional papers and reports that are designed to help regulatory agencies and the public gain technical information on environmental quality management issues. Drs. Lee and Jones-Lee have provided a number of reviews on issues pertinent to the appropriate landfilling of solid wastes. Their most comprehensive review of municipal solid waste landfilling issues is what they call the "Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste," which was originally developed in 1992, and redeveloped and updated in the fall of 2004. Between the two versions they have published numerous invited and contributed papers that provide information on various aspects of municipal solid waste landfilling, with emphasis on protecting public health and the environment from waste components for as long as they will be a threat. The "Flawed Technology" review has been periodically updated, including the most recent update in March 2006, which can be found on their website at
http://www.members.aol.com/apple27298/SubtitleDFlawedTechnPap.pdf.

This review provides a comprehensive, integrated discussion of the problems that can occur with minimum-design Subtitle D landfills and landfills developed in accord with state regulations that conform to minimum Subtitle D requirements. The "Flawed Technology" review contains a listing of the various reviews that Drs. Lee and Jones-Lee have developed, as well as peer-reviewed literature. Over 40 peer-reviewed papers are cited in "Flawed Technology" supporting issues discussed in this review.

SUMMARY BIOGRAPHICAL INFORMATION

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EDUCATION

Ph.D. Environmental Engineering & Environmental Science, Harvard University, Cambridge, Mass. 1960

M.S.P.H. Environmental Science-Environmental Chemistry, School of Public Health, University of North Carolina, Chapel Hill, NC 1957

B.A. Environmental Health Science, San Jose State College, San Jose, CA 1955

ACADEMIC AND PROFESSIONAL EXPERIENCE

Current Position:

Consultant, President, G. Fred Lee and Associates

Previous Positions:

Distinguished Professor, Civil and Environmental Engineering, New Jersey Institute of Technology, Newark, NJ, 1984-89

Senior Consulting Engineer, EBASCO-Envirosphere, Lyndhurst, NJ (part-time), 1988-89

Coordinator, Estuarine and Marine Water Quality Management Program, NJ Marine Sciences Consortium Sea Grant Program, 1986

Director, Site Assessment and Remedial Action Division, Industry, Cooperative Center for Research in Hazardous and Toxic Substances, New Jersey Institute of Technology et al., Newark, NJ, 1984-1987

Professor, Department of Civil and Environmental Engineering, Texas Tech University, 1982-1984

Professor, Environmental Engineering, Colorado State University, 1978-1982

Professor, Environmental Engineering & Sciences; Director, Center of Environmental Studies, University of Texas at Dallas, 1973-1978

Professor of Water Chemistry, Department of Civil & Environmental Engineering, University of Wisconsin-Madison, 1961-1973

Registered Professional Engineer, State of Texas, Registration No. 39906

Diplomate, American Academy of Environmental Engineers, Certificate No. 0701

PUBLICATIONS AND AREAS OF ACTIVITY

Published over 1,100 professional papers, chapters in books, professional reports, and similar materials. The topics covered include:

- Studies on sources, significance, fate and the development of control programs for chemicals in aquatic and terrestrial systems.
- Analytical methods for chemical contaminants in fresh and marine waters.
- Landfills and groundwater quality protection issues.
- Impact of landfills on public health and environment.
- Environmental impact and management of various types of wastewater discharges including municipal, mining, electric generating stations, domestic and industrial wastes, paper and steel mill, refinery wastewaters, etc.
  Stormwater runoff water quality evaluation and BMP development for urban areas and highways.
- Eutrophication causes and control, groundwater quality impact of land disposal of municipal and industrial wastes, environmental impact of dredging and dredged material disposal, water quality modeling, hazard assessment for new and existing chemicals, water quality and sediment criteria and standards, water supply water quality, assessment of actual environmental impact of chemical contaminants on water quality.

LECTURES

Presented over 760 lectures at professional society meetings, universities, and to professional and public groups.

GRANTS AND AWARDS

Principal investigator for over six million dollars of contract and grant research in the water quality and solid and hazardous waste management field.

GRADUATE WORK CONDUCTED UNDER SUPERVISION OF G. FRED LEE

Over 90 M.S. theses and Ph.D. dissertations have been completed under the supervision of Dr. Lee.

ADVISORY ACTIVITIES

Consultant to numerous international, national and regional governmental agencies, community and environmental groups and industries.

Municipal Solid Waste Landfills and
Groundwater Quality Protection Issues Publications

Drs. G. Fred Lee and Anne Jones-Lee have prepared several papers and reports on various aspects of municipal solid waste (MSW) management and hazardous waste management by landfilling, groundwater quality protection issues, as well as other issues of concern to those within a sphere of influence of a landfill. These materials provide an overview of the key problems associated with landfilling of MSW and hazardous waste utilizing lined "dry tomb" landfills and suggest alternative approaches for MSW management that will not lead to groundwater pollution by landfill leachate and protect the health and interests of those within the sphere of influence of a landfill. Copies of many of these papers and reports are available as downloadable files from Drs. G. Fred Lee's and Anne Jones-Lee's web page (http://www.gfredlee.com). Recent papers and reports on landfilling issues are listed below. Copies of the papers and reports listed below as well as a complete list of publications on this and related topics are available upon request.

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Landfills Evaluated by G. Fred Lee and Anne Jones-Lee

Arizona *(State Landfilling Regulations)*	Verde Valley - Copper Tailings Pile Closure Mobile – Southpoint Landfill
California *(State Landfilling Regulations)*	Colusa County - CERRS Landfill San Gabriel Valley - Azusa Landfill (Superfund Site) City of Industry - Puente Hills Landfill North San Diego County, 3 landfills San Diego County - Gregory Canyon Landfill El Dorado County Landfill Yolo County Landfill Half Moon Bay - Apanolio Landfill Pittsburg - Keller Canyon Landfill Chuckwalla Valley - Eagle Mountain Landfill Mountain View – Mountain View Landfill Barstow - Hidden Valley (Hazardous Waste) Mohave Desert - Broadwell Landfill (Hazardous Waste) Cadiz - Bolo Station-Rail Cycle Landfill University of California-Davis Landfills (4) (3 Superfund Site) San Marcos - San Marcos Landfill Placer County - Western Regional Sanitary Landfill Placer County – Turkey Carcass Disposal Pits Imperial County - Mesquite Landfill Los Angeles County - Calabasas Landfill and Palos Verdes Landfill Contra Costa County – Concord Naval Weapons Station Tidal LF (Superfund) Nevada County - Lava Cap Mine Area Landfill (Superfund Site) Sylmar - Sunshine Canyon Landfill Roseville - Roseville Landfill
Colorado (*State Landfilling Regulations)*	Last Chance/Brush – (Hazardous Waste Landfill) Denver - Lowry (Hazardous Waste Landfill) Telluride/Idarado Mine Tailings
Delaware	Various MSW landfills – Evaluate past disposal of industrial wastes
Florida	Alachua County Landfill
Georgia	Meriwether County – Turkey Run Landfill Hancock County – Culverton Plantation Landfill
Illinois (*State Landfilling Regulations*)	Crystal Lake - McHenry County Landfill Wayne County Landfill Kankakee County – Kankakee Landfill Peoria County – Peoria Waste Disposal (Hazardous Waste)
Indiana (*State Landfilling Regulations*)	Posey County Landfill New Haven-Adams Center Landfill (Hazardous Waste)
Louisiana	New Orleans vicinity - Gentilly Landfill
Michigan (*State Landfilling Regulations*)	Menominee Township - Landfill Ypsilanti- Waste Disposal Inc. (Hazardous Waste - PCB's)
Minnesota	Reserve Mining Co., Silver Bay - taconite tailings Wright County - Superior FCR Landfill
Missouri	Jefferson County - Bob's Home Service (Hazardous Waste)

New Jersey	Fort Dix Landfill (Superfund Site) Cherry Hill – GEMS (Superfund Site) Lyndhurst - Meadowlands Landfill Scotch Plains – Leaf Dump
New York	Staten Island - Fresh Kills Landfill, Niagara Falls Landfill – (Hazardous Waste), New York City – Ferry Point Landfill
North Dakota	Turtle River Township - Grand Forks Balefill Facility Landfill
Ohio	Clermont County - BFI/CECOS Landfill (Hazardous Waste) Huber Heights - Taylorville Road Hardfill Landfill (C&DD) Morrow County – Washington and Harmony Townships C&DD Landfills
Pennsylvania	Pottstown – Pottstown Landfill
Rhode Island	Richmond – Landfill (C&D)
South Carolina	Spartanburg - Palmetto Landfill
Texas	Dallas/Sachse – Landfill Fort Worth - Acme Brick Landfill (Hazardous Waste) City of Dallas - Jim Miller Road Landfill Pasadena – Mobil Mining and Minerals industrial waste pile
Vermont	Coventry, Vermont - Coventry Landfill
Washington	Tacoma - 304th and Meridian Landfill
Wisconsin	Madison and Wausau Landfills
INTERNATIONAL LANDFILLS	
Belize	Mile 27 Landfill
Ontario, Canada (*Prov. Landfilling Regulations*)	Greater Toronto Area - Landfill Siting Issues Kirkland Lake - Adams Mine Site Landfill Pembroke - Cott Solid Waste Disposal Areas
Manitoba, Canada	Winnipeg Area - Rosser Landfill
New Brunswick, Canada	St. John's - Crane Mountain Landfill
England	Mercyside Waste Disposal Bootle Landfill
Hong Kong	Three New MSW Landfills
Ireland	County Cork - Bottlehill Landfill County Clare - Central Waste Management Facility, Ballyduff
Korea	Yukong Gas Co. - Hazardous Waste Landfill
Mexico (*Haz. Waste Landfilling Reg.*)	San Luis Pontosi Landfill- (Hazardous Waste)
New Zealand	North Waikato Regional Landfill
Puerto Rico	Salinas - Campo Sur Landfill

Surface and Groundwater Quality Evaluation and Management
and
Municipal Solid & Industrial Hazardous Waste Landfills

http://www.gfredlee.com

Dr. G. Fred Lee and Dr. Anne Jones-Lee have prepared professional papers and reports on the various areas in which they are active in research and consulting including domestic water supply water quality, water and wastewater treatment, water pollution control, and the evaluation and management of the impacts of solid and hazardous wastes. Publications are available in the following areas:

Landfills and Groundwater Quality Protection
Water Quality Evaluation and Management for Wastewater Discharges
    Stormwater Runoff, Ambient Waters and Pesticide Water Quality Management Issues, TMDL Development, Water Quality Criteria/Standards Development and Implementation
Impact of Hazardous Chemicals -- Superfund
    LEHR Superfund Site Reports to DSCSOC
    Lava Cap Mine Superfund Site reports to SYRCL
    Smith Canal
Contaminated Sediment -- Aquafund, BPTCP, Sediment Quality Criteria
Domestic Water Supply Water Quality
Excessive Fertilization/Eutrophication, Nutrient Criteria
Reuse of Reclaimed Wastewaters
Watershed Based Water Quality Management Programs:
    Sacramento River Watershed Program
    Delta -- CALFED Program
    Upper Newport Bay Watershed Program
    San Joaquin River Watershed DO and OP Pesticide TMDL Programs

Stormwater Runoff Water Quality Science/Engineering Newsletter

G. Fred Lee Advisory Services

G. Fred Lee & Associates was organized in the late 1960s to cover the part-time consulting activities that Dr. Lee undertook while a full-time university professor. In 1989, when Dr. Lee retired from 30 years of graduate-level teaching and research, he and Dr. Anne Jones-Lee, who was also a university professor, expanded G. Fred Lee & Associates into a full-time business activity. Examples of governmental agencies, consulting firms, citizens groups, industries and others for whom G. Fred Lee has served as an advisor include the following:

U.S. Environmental Protection Agency - Various Locations
Vison, Elkins, Searls, Connally & Smith, Attorneys - Houston, TX
International Joint Commission for the Great Lakes
U.S. Public Health Service - Washington, DC
Attorney General, State of Texas - Austin, TX
Madison Metropolitan Sewerage District - Madison, WI
Great Lakes Basin Commission - Windsor, Ontario
U.S. Army Environmental Hygiene Agency - Edgewood Arsenal, MD
City of Madison - Madison, WI
Council on Environmental Quality - Washington, DC
National Academies of Sciences and Engineering - Washington, DC
Water Quality Board State of Texas - Austin, TX
U.S. General Accounting Office - Washington, DC
U.S. Army Corps of Engineers - Vicksburg, MS
Tennessee Valley Authority - Various locations in Tennessee Valley
National Oceanic & Atmospheric Administration - Various locations
Organization for Economic Cooperation & Development - Paris
Attorney General, State of Illinois - Chicago, IL
State of Texas Hazardous Waste Legislative Committee - Austin
State of New Mexico Environmental Improvement Agency - Santa Fe
New York District Corps of Engineers - New York, NY
San Francisco District Corps of Engineers - San Francisco, CA
Wisconsin Electric Power Company - Milwaukee, WI
WAPORA - Washington, DC
Reserve Mining Company - Silver Bay, MN
United Engineers - Philadelphia, PA
Automated Environmental Systems - Long Island, NY
Procter & Gamble Company - Cincinnati, OH
Inland Steel Development Company - Chicago, IL
Kennecott Copper Corporation - Salt Lake City, UT
U.S. Steel Corporation - Pittsburgh, PA
Nekoosa Edwards, Inc. - WI
Zimpro, Inc. - Rothschild, WI
FMC Corporation - Philadelphia, PA
Acme Brick Company - Forth Worth, TX
Monsanto Chemical Company - St. Louis, MO
Gould, Inc. - Cleveland, OH
Illinois Petroleum Council - Chicago, IL
Inland Steel Corporation - Chicago, IL

Industrial Biotest Laboratories - Northbrook, IL
Wisconsin Pulp & Paper Industries - Upper Fox Valley, WI
Thilmany Pulp & Paper Company - Green Bay, WI
Chicago Park District - Chicago, IL
Nalco Chemical Company - Chicago, IL
Boise Cascade Development Company - Chicago, IL
Foley & Lardner, Attorneys - Milwaukee, WI
Timken & Lonsdorf, Attorneys - Wausau, WI
Strasburger, Price, Kelton, Martin & Unis, Attorneys - Dallas, TX
Rooks, Pitts, Fullagar & Poust, Attorneys - Chicago, IL
Jones, Day, Cockley & Reaves, Attorneys - Cleveland, OH
Sullivan, Hanft, Hastings, Fride & O'Brien, Attorneys - Duluth, MN
Hinshaw, Culbertson, Molemann, Hoban & Fuller, Attnys - Chicago, IL
Colorado Springs - Colorado Springs, CO
Mayer, Brown & Platt, Attorneys - Chicago, IL
Pueblo Area Council of Governments - Pueblo, CO
Platte River Power Authority - Fort Collins, CO
Linquist & Vennum, Attorneys - Minneapolis, MN
Norfolk District Corps of Engineers - Norfolk, VA
Spanish Ministry of Public Works - Madrid, Spain
The Netherlands - Rijkswaterstaat - Amsterdam, The Netherlands
U.S. Department of Energy - Various locations in US
King Industries - Norwalk, CT
Attorney General, State of Florida - Tallahassee, FL
State of Colorado Governor's Office - Denver, CO
Cities of Fort Collins, Longmont, and Loveland - CO
E.I. DuPont - Wilmington, DE
Allied Chemical Company - Morristown, NJ
Outboard Marine - Waukegan, IL
Amoco Oil Company - Denver, CO
Appalachian Timber Services - Charleston, WV
Mission Viejo Development - Denver, CO
Fisher, Brown, Huddleston & Gun, Attorneys - Fort Collins, CO
Tom Florczak, Attorney - Colorado Springs, CO
Wastewater Authority - Burlington, VT
Tad Foster, Attorney - Pueblo, CO
Holmes, Roberts & Owen, Attorneys - Denver, CO
Center for Energy and Environment Research - Puerto Rico
City of Brush - Brush, CO
Rock Island District Corps of Engineers - Rock Island, IL
Santo Domingo Water Authority - Dominican Republic
Ministry of Public Works and Environment - Buenos Aires, Argentina
Neville Chemical - Pittsburgh, PA
Fike Chemical Company - Huntington, WV
Stauffer Chemical Company - Richmond, CA
Adolph Coors Company - Golden, CO

Water Research Commission - South Africa
Grinnell Fire Protection Systems - Lubbock, TX
City of Lubbock Parks Department - Lubbock, TX
National Planning Council - Amman, Jordan
City of Olathe - Olathe, KS
City of Lubbock - Lubbock, TX
US AID - Amman, Jordan
Buffalo Springs Lake Improvement Association - Buffalo Springs, TX
Union Carbide Company - Charleston, WV
Canadian River Municipal Water Authority - Lake Meredith, TX
Mobil Chemical Company - Pasadena, TX
Unilever Ltd. - Rotterdam, The Netherlands
Brazos River Authority - Waco, TX
U.S. Army Construction Engineering Research Laboratory - Champaign, IL
James Yoho, Attorney - Danville, IL
Zukowsky, Rogers & Flood, Attorneys - Crystal Lake, IL
State of California Water Resources Control Board - Sacramento
Public Service Electric & Gas - Newark, NJ
Health Officer - Boonton Township, NJ
Scotland & Robeson Counties - Lumberton, NC
International Business Machines Corporation - White Plains, NY
Newark Watershed Conservation & Development Authority - NJ
State of Vermont Planning Agency - Montpelier, VT
CDM, Inc. - Edison, NJ
Attorney General, State of North Carolina - Raleigh, NC
City of Vernon - Vernon, NJ
Ebasco Services - Lyndhurst, NJ
Kraft, Inc. - Northbrook IL, with work in Canada, FL and MN
USSR Academy of Sciences - Moscow, USSR
Tillinghast, Collins & Graham, Attorneys - Providence, RI
City of Richmond, RI
Idarado Mining Company - Telluride, CO
Levy, Angstreich, Attorneys - Cherry Hill, NJ
Newport City Development - Jersey City, NJ
Orbe, Nugent & Collins, Attorneys - Ridgewood, NJ
Schmeltzer, Aptaker & Shepard, Attorneys - Washington, DC
CP Chemical - Sewaren, NJ
Dan Walsh, Attorney - Carson City, NJ
William Cody Kelly - Lake Tahoe, NV
NJ Department of Environmental Protection - Trenton, NJ
Hufstedler, Miller, Kaus & Beardsley, Attorneys - Los Angeles, CA
Main San Gabriel Basin Watermaster - CA
Metropolitan Water District of Southern California - Los Angeles, CA
San Diego Unified Port District - San Diego, CA
Delta Wetlands - CA
Simpson Paper Company - Humboldt County, CA

City of Sacramento - CA
Northern California Legal Services - Sacramento, CA
Rocketdyne - Canoga Park, CA
RR&C Development Co. - City of Industry, CA
American Dental Association - Chicago, IL
Emerald Environmental - Phoenix, AZ
Clayton Chemical Company - Sauget, IL
Stanford Ranch - Rocklin, CA
Public Liaison Committee - Kirkland Lake, Ontario
Miller Brewing Company, Los Angeles, CA
ASARCO Inc., Tacoma, WA
CALAMCO, Stockton, CA
Yunkong Gas Company, South Korea
Sutherlands, Pembroke, Ontario
Silverado Constructors, Irvine, CA
Agricultural Interests in Puerto Rico
City of Winnipeg, Manitoba
Strain Orchards, Colusa, CA
Davis South Campus Superfund Oversight Committee, Davis, CA
Monterrey County, California Housing Authority, Salinas, CA
CROWD, Tacoma, WA
Newport Beach, CA
SOLVE, Phoenix, AZ
Sports Fishing Alliance, San Francisco, CA
Caltrans (California Department of Transportation)
Citizens Group near St. John's, New Brunswick
Colonna Shipyards, Norfolk, VA
Clermont County, OH
Wright County, MN
Waikato River Protection Society, New Zealand
Drobac & Drobac, Attorneys, Santa Cruz, CA
Phelps Dunbar, L.L.P., Houston, TX
Walters Williams & Co, New Zealand
Environmental Protection Department, Hong Kong
NYPRIG New York City, NY
DeltaKeeper, Stockton
City of Stockton, CA
Central Valley Regional Water Quality Board, Sacramento, CA
Carson Harbor Village, Carson, CA
Sanitary District of Hammond, IN
South Bay CARES, Los Angeles, CA
Memphremagog Regional Council, Quebec, CANADA
Mobile, AZ
Pottstown Landfill Closure Committee, Pottstown, PA
Grand Forks County Citizens Coalition, Grand Forks, ND
Sunshine Canyon Landfill, Sylmar, CA
Meriwether County, GA
Hancock County, GA

Louisiana Environmental and Action Network, Baton Rouge, LA
OUTRAGE and POWER, Kankakee, IL
John Cobey et al., Morrow County, OH