Comments on the Los Angeles County Addendum to the EIR for the Sunshine Canyon City/County Landfill

Comments Submitted by
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In October 2004, the County of Los Angeles Department of Regional Planning Impact Analysis Section issued "Sunshine Canyon City/County Landfill Addendum to Final Environmental Impact Report and Final Subsequent Environmental Impact Report" (Addendum) in connection with draft Conditional Use Permit 00-194-(5) that would make various modifications in the conditions governing operation of the Sunshine Canyon Landfill. I have been requested by the law firm of Altshuler, Berzon, Nussbaum, Rubin & Demain to provide comments on the Project authorized by the draft CUP, as well as general background information on landfills and, in particular, landfill containment systems.

I. Background and Experience in Reviewing Landfill Impacts

This section of the report sets forth my experience and qualifications in the review of the environmental impacts of landfills. As summarized in Appendix A, Dr. G. F. Lee obtained a bachelors degree in environmental health sciences from San Jose State College, San Jose, California, in 1955 and a Master of Science in Public Health degree from the University of North Carolina, Chapel Hill, in 1957. Both of these degree programs included education on the impact of solid wastes, including landfills. In 1960 he was awarded a PhD degree in Environmental Engineering from Harvard University. For 30 years he held university graduate-level teaching and research positions at several major US universities. Dr Lee became involved in the review of the impact of municipal solid waste landfills beginning in the 1960s while he held the position of Professor of Water Chemistry and Director of the Water Chemistry Program at the University of Wisconsin, Madison. During the 13 years that Dr. Lee held this position he was involved in investigating several situations of groundwater pollution by municipal solid waste (MSW) landfills.

In 1973 Dr. Lee was appointed to the position of Professor of Engineering and Director of the Institute of Environmental Sciences at the University of Texas at Dallas. While holding this position he conducted research on the ability of landfill liners to contain wastes for the US EPA National Groundwater Research Center located in Ada, Oklahoma. In the 1980s Dr. Lee was appointed to the position of Distinguished Professor of Environmental Engineering and Director of a multi-university hazardous waste research center Site Assessment and Remediation Division. During this time he continued research on landfill liner issues.

Throughout the 30 years that Dr Lee held university graduate-level teaching and research positions he conducted over $5 million in research and published over 500 papers and reports. He was also a part-time consultant to governmental agencies and industry on environmental protection issues,

including municipal and hazardous waste landfills. He has been involved in the review of over 80 landfills. Beginning in the 1980s Dr. Lee has been a consultant to several states on developing landfilling regulations, including California, Michigan, Texas, Colorado and New Jersey.

In 1989 Dr. Lee retired from university teaching and research and expanded his part-time consulting activity into a full-time activity. He was joined by Dr. Anne Jones-Lee in this activity. Over the past 15 years Drs. Lee and Jones-Lee have worked with water utilities, municipalities and public groups in evaluating the potential impacts of proposed and existing landfills. They have published extensively on their work; their papers and reports are on their website, www.gfredlee.com. Their papers and reports provide guidance on how to reliably evaluate the potential impacts of landfills and, most importantly, provide guidance on how to develop landfills that are protective for as long as the landfilled wastes are a threat to generate both leachate that can pollute groundwater and surface waters, and landfill gas (including odors), and how to address justified NIMBY (not in my back yard) issues.

One of the areas of particular relevance of Drs. G. F. Lee and Anne Jones-Lee's expertise is their work on evaluating the long-term impacts of US EPA Subtitle D dry tomb type landfills during the period that the wastes in the landfill will be a threat to generate leachate and landfill gas that can pollute the environment. Their publications provide guidance on the issues that must be addressed to properly evaluate the full range of impacts over the very long period of time that the wastes in the landfill will be a threat. They have determined that it is extremely important, as part of developing a landfill, that full consideration be given to properly addressing the postclosure activities that will have to be addressed when the landfill is closed. In 2004 the Pottstown Landfill Closure Committee representing Montgomery and Berks Counties in Pennsylvania, the city of Pottstown, Pennsylvania, and several other communities selected Dr. Lee to be an independent peer reviewer on the closure of the Pottstown Landfill. In this capacity Dr. Lee is advising the counties and communities on the issues that should be adequately addressed in developing a final closure plan for this municipal solid waste landfill to render it as protective as possible for as long as the wastes in the landfill will be a threat. This activity has already demonstrated the need to address as many of these issues as possible as part of initial landfill permitting to better prepare for the eventual closure of a landfill.

II. Environmental Impacts of the Project

A. Background to the Project

According to the Addendum to the EIR, the county of Los Angeles (Los Angeles County, 2004) prepared an Addendum to the EIR that addressed certain revisions to County Conditional Use Permit 86-312(5) issued in 1993 (the "1993 County CUP") for landfilling in the County portion of Sunshine Canyon (the "County Landfill") which was based on the *Final Environmental Impact Report for the Sunshine Canyon Landfill Extension* (State Clearinghouse No. 89071210), initially certified by the County of Los Angeles Board of Supervisors on February 19, 1991, and, after litigation, recertified with two Addenda and a document entitled *Additional Information and Analysis* (collectively, the "FEIR") on November 30, 1993. The FEIR was supplemented by the *Final Subsequent Environmental Impact Report, Sunshine Canyon Landfill* (SEIR), June 1998. This Addendum also addressed revisions to the Mitigation Monitoring and Reporting Summary (the "MMRS")

approved in 1993 for the County Landfill, which document is now referred to as the Mitigation Monitoring and Reporting Program (the "MMRP").

The Addendum to the EIR states that the draft CUP (1) complies with the directive of the Board of Supervisors to facilitate the development of a combined City/County landfill, as contained in Condition 10b of the 1993 CUP, and (2) ensures consistency of the CUP with the entitlements granted by the City in 1999 for the City/County Landfill Project described in the 1999 SEIR (the "Project").

The County has stated (Addendum to the EIR) that the changes in the currently proposed City/County Sunshine Canyon Landfill do not meet the standard for preparation of a supplemental or subsequent EIR because there is no substantial change to the Project described in the certified FEIR, as supplemented by the SEIR, and there has been no substantial change in circumstances or new information sufficient to warrant that level of review. However, as discussed herein, the proposed revised City/County Sunshine Canyon Landfill does have a number of significant changes that impact the environmental impact of the currently proposed City/County Landfill from that approved in the FEIR and SEIR. Some of these issues are discussed in this report.

According to the Addendum (p. 2-1), *"the irregularly shaped Project site, with jurisdictional boundaries of 494 acres in the City and 608 acres in the County, consists of portions of several parcels."* The County Landfill that was certified in the FEIR was to accommodate *"… disposal of an average of 6,000 tons of refuse per day (exclusive of inert/exempt materials), six days per week (with a 6,600-ton daily maximum), for a total of approximately 17 million tons of landfill capacity over the landfill's site life. The County Landfill footprint was approximately 215 acres. Disposal was permitted on multiple working face areas, which were limited to 2 to 3 acres each."* (Addendum p. 2-1.)

The Addendum (p. 2-1) states,

> *"While approving the 17-million-ton County Landfill project solely within the County, the Board of Supervisors also required that BFI pursue City approvals to accommodate an alternative design that would extend the landfill operation southeasterly from the County portion of Sunshine Canyon back across the City/County jurisdictional boundary into the City area abutting and including much of the inactive City Landfill. This design would increase the combined capacity of the City and County portions of Sunshine Canyon to approximately 100 million tons without appreciably expanding the total footprint of the separate operations in the City and County."*

According to the Addendum (p. 2-5 through 2-6),

> *"As described in the SEIR and approved by the City, the combined City/County Landfill will accommodate a total disposal capacity of approximately 90 million tons, consisting of 55 million tons in the City and 35 million tons in the County. Because of setback requirements and a change in the location of a sedimentation basin and related drainage issues, the design provides less capacity than the 100-million ton landfill envisioned in the County FEIR. The County portion of the Project included the 17-million-ton County Landfill currently in operation and the 18-million-ton increment in the 42-acre bridge*

area, both of which were authorized by the 1993 County CUP. The 42-acre bridge area also accommodates approximately 22 million tons of landfill capacity on the City side.

The Project allows for disposal in the combined City and County areas of an average of 11,000 tons per day, six days per week, of Class III solid waste (with a 12,100 ton daily maximum), and 6,600 tons per week of inert/exempt materials, which would result in approximately a 25-year operational site life. The landfill footprint would encompass approximately 451 acres: 194 acres in the City (including part of the inactive City Landfill) and 257 acres in the County (including the 215-acre footprint of the operational County Landfill and the 1993-authorized 42-acre bridge area). The Project also provides for a maximum 10-acre working face area (i.e., the area where waste is being deposited).

Although the City approval contemplated that the City and County operations would be combined, it also recognized that the combination was not certain because it would require additional entitlements. Therefore, the City conditions anticipated the possibility that landfill operations in the two jurisdictions could remain separate and in two separate working face areas. Because of this contingency, the City approvals provided for a separate landfill operation within the City, allowing the disposal of up to 30,000 tons per week of refuse (an average of 5,000 tons per day, 6 days per week), with a daily maximum of 5,500 tons maximum, as well as up to 3,000 tons per week of inert/exempt materials, and a maximum total working face area not to exceed 5 acres."

The Addendum (p. 2-7) states that proposed revisions to the 1993 County CUP include the following:

"(1) Adjustments in Limitations on Daily and Weekly Intake Consistent with Combined Operation:

- *Increase maximum weekly intake of Class III waste from 36,000 tons to 66,000 tons; and limit the intake of inert/exempt materials to 6,600 tons per week.*
- *Increase maximum daily intake from 6,600 tons (currently permitted) to 12,100 tons.*
- *Eliminate exclusion for inert/exempt materials from intake limitations and define such materials."*

In summary, the City and County have each permitted separate landfill operations in their respective jurisdictions. The City has also approved, and the SEIR analyzed, a Combined Landfill, with mitigation measures, that would allow the net daily tonnage authorized in the previously permitted separate County Landfill to be disposed of on the City side of the Landfill. This daily tonnage would be in addition to the daily tonnage authorized for a separate City Landfill (Los Angeles City Ordinance No. 172933, Condition B-4).

The draft CUP now seeks approval from the County for a Combined Landfill that would allow the net daily tonnage authorized in the separate City Landfill to be disposed of on the County side of the Combined Landfill. This daily tonnage would be in addition to the daily tonnage authorized in the previously permitted, currently operating County Landfill (draft CUP, Condition 17).

B. Threats to Groundwater Pollution Caused by Landfills and the Inevitable Failure of Liner Systems

1. Waste in Dry Tomb Type Landfills Remains a Threat to Cause Groundwater Pollution Forever. A critical issue that must be considered is that some of the MSW waste components in any dry tomb landfill will be a threat to cause groundwater pollution effectively forever. As discussed by Lee and Jones-Lee (2005) in their report, "Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste," dry tomb type landfilling of the type being used by BFI in the existing County Landfill and the proposed City/County Landfill is designed to keep the wastes dry. A copy of this report is attached as Appendix B. This report provides updated information on the potential for composite lined landfills to ultimately cause groundwater pollution and other adverse impacts to public health and the environment. It contains summaries with appropriate references to other authorities' findings with respect to the inevitable failure of the landfill liner system to prevent groundwater pollution, as well as other issues that should be considered in evaluating the potential environmental impacts of the proposed Sunshine Canyon City/County Landfill.

Dry municipal solid wastes do not decompose or produce landfill gas. In closing the landfill, a plastic sheeting liner is to be placed over the wastes. On top of this plastic sheeting liner will be several feet of topsoil and a drainage layer. If the installation of this liner is reliably done to prevent moisture from entering the landfill, the landfill will stop producing landfill gas and leachate, and enter into a "dormant" period. So long as the landfill cover for the landfill is intact and prevents moisture from entering the landfill, the wastes will remain dry; however, failure to keep the landfill cover as an effective barrier to moisture entering the wastes during the postclosure period, which can extend over thousands of years (i.e., for as long as the wastes in the landfill are a threat to cause groundwater pollution), will result in landfill gas and leachate production. As a result, a key issue that needs to be addressed is whether BFI or some other entity will be available to monitor the integrity of the landfill cover and the production of leachate and landfill gas throughout the very long postclosure period.

2. Composite Liner Systems of the Type being Used at the Sunshine Canyon Landfill will Ultimately Fail to Collect Leachate in the Leachate Collection and Removal System and to Prevent Groundwater Pollution Under the Landfill. In evaluating the protective nature of landfill liner systems, a further critical issue of which decision-makers and the public should be aware is that the single composite liner used in the County part of the combined landfill will ultimately deteriorate to the point where it is no longer effective in serving as a reliable base for leachate collection in the leachate collection and removal system and in preventing leachate from passing through the plastic sheeting and compacted clay layer of the composite liner, causing groundwater pollution under the landfill. Lee and Jones-Lee (2005) have recently provided a comprehensive review, which includes new information that has been developed since the certification of the SEIR on the ultimate failure of a single composite liner of the type that BFI has installed in the County's part of the landfill. There is no doubt that ultimately the single composite liner underlying the County's part of the proposed City/County landfill will lead to groundwater pollution under the landfill. Lee and Jones-Lee (2005) have provided a detailed discussion with references to the recent literature on the mechanisms that lead to the plastic

sheeting layer and compacted clay layer ultimately becoming ineffective in preventing leachate generated within the landfill from passing through them into the underlying groundwater system.

A Staff Report prepared by the Los Angeles Regional Water Quality Control Board (LARWQCB, 2003a) in connection with the City Landfill indicated that the use of an 80-mil thick plastic sheeting liner and a four-foot base clay liner would be "more reliable" than the minimum design of a 60-mil liner and a two-foot thick clay liner (Staff Report, Los Angeles Regional Water Quality Control Board, September 11, 2003, p. 7). However, a single composite liner, whether it has a 60-mil or 80-mil plastic sheeting layer or a two-foot or four-foot compacted clay layer, will not prevent the ultimate failure of the liner system that will result in leachate generated in the landfill passing through the liner into the underlying groundwater system. The difference between the two different thicknesses of the liner components represents a difference in time when pollution occurs – not whether pollution will occur. Since the wastes will be a threat forever to generate leachate, whether it takes 10 years or 20 years for leachate to pass through the clay layer is of no significance with respect to the ultimate pollution of groundwaters by the landfill.

As discussed in Finding 64 of LARWQCB (2003a) Order No. R4-2003-0155, recent studies have shown that 1,4-dioxane has been found in leachate from both the City Side Landfill and the County Extension Landfill. Further, dioxane has been found in three groundwater monitoring wells at the City Side Landfill. The new information that has been developed since the certification of the FEIR and the SEIR on the finding of dioxane in leachate from the currently operating County Landfill is of particular concern. Dioxane is only recently beginning to be recognized as a more common groundwater pollutant. It is part of the low molecular weight organic compounds that readily can pass through a plastic sheeting liner of the type that BFI has used in the County Landfill. As discussed by Lee and Jones-Lee (2005), low molecular weight organic solvents have been found to pass through HDPE plastic sheeting liner material that does not contain any holes, within a few days. The process governing this situation is called permeation. As discussed by Lee and Jones-Lee (2005), permeation is a mechanism by which landfills that generate leachate with low molecular weight organics can cause groundwater pollution without the plastic sheeting layer deteriorating. Ultimately, the composite lined landfill will lead to groundwater pollution by landfill leachate, as has occurred from the City's unlined landfill.

Following the discovery of dioxane, the LARWQCB issued Waste Discharge Requirements (WDRs) requiring the installation of a double composite liner (LARWQCB (2003b) Order No. R4-2003-0155, Finding No. 47, p. 8, and Section D-3 ("Requirement for Containment Structures"), p. 15.) This requirement applies only to the portion of the combined City/County Landfill within the territory of the City of Los Angeles. (Finding No. 6, p. 2; and Finding No. 15 on p. 3). The County Landfill is governed by separate WDRs (Finding No. 8 on p. 2), which call for a single composite liner.

3. Double Composite Liner Systems Provide More Protection by Enabling Detection of the Failure of the Upper Composite Liner and Thus Allowing Remedial Action to be Taken Before Groundwater Pollution Occurs. As discussed by Lee and Jones-Lee (2005) and as acknowledged in the LARWQCB (2003b) WDRs, a double composite lined landfill can be

considerably more protective in preventing groundwater pollution than a single composite lined landfill. This situation arises from the fact that in a double composite lined landfill there is a leak detection zone between the two composite liners. This leak detection zone can be used to indicate when the upper composite liner has failed. This situation enables the regulatory agencies to require that the landfill owner take the necessary actions (such as repairing the landfill cover to stop moisture from entering the wastes) to stop leachate generation in the landfill which is passing through the upper composite liner into the leak detection zone. As it stands now, the ultimate failure of the single composite liner system underlying the County part of the proposed City/County Landfill will have to be detected based on pollution of groundwater monitoring wells. However, as discussed below, developing reliable groundwater monitoring for pollution by landfill leachate in a fractured rock aquifer system of the type underlying the proposed City/County Landfill is virtually impossible to achieve reliably.

The public and decision-makers should be aware that even though double composite liners provide more protection, they, like single composite liners, are also subject to failure, as shown by recent research. The LARWQCB (2003b) WDR requiring a double composite liner in the City portion of the Landfill, in Item 3 in section D "Requirements for Containment Structures," allows a geosynthetic clay liner (GCL) to substitute for two feet of compacted clay. While this approach is commonly allowed by regulatory agencies, there is recently developed information confirming that the GCL approach for developing a composite liner can readily be significantly inferior in achieving reliable composite liner properties. Lee and Jones-Lee (2005) have discussed the fact that GCL-type liners consist of sodium bentonite clay. Sodium bentonite, in its original form, is a swollen clay material that has very low permeability. However, in contact with leachate that has a high calcium-to-sodium ratio, the sodium in the sodium bentonite clay can be exchanged for the calcium in the leachate. Such an exchange causes the clay layer in the GCL to shrink and possibly crack.

Lee and Jones-Lee (2005) have discussed recent literature, where the investigators have found cracking of sodium bentonite clay layers. This literature includes recommendations that GCL should not be substituted for two feet of compacted clay in a composite liner because of the potential for it to develop cracks which could allow rapid passage of leachate that penetrates through holes, cracks and points of deterioration in the plastic sheeting component of the composite liner.

4. Monitoring Wells of the Type in Place at Sunshine Canyon can be Unreliable in Detecting Groundwater Pollution as a Result of Liner Failure. Page 3-23 of the Addendum to the EIR states in *Checklist Responses*, Item c,

> *"Incorporation of the mitigation measures … ensure that adequate groundwater protection and control systems are in place. With incorporation of these measures and requirements, any Project-related impacts to groundwater are detected and remedied; thus, the Project presents a less-than-significant impact to groundwater quality."*

This statement could lead decision-makers and the public to believe that the regulatory requirements established by the LARWQCB for the existing operational County Landfill and for the proposed City Landfill and the proposed "bridge" between the City and County Landfills will

have highly reliable groundwater monitoring systems that will detect, through monitoring wells, the ultimate failure of the single composite lined County Landfill and potentially the "bridge" between the City and County Landfills, and the proposed double composite lined City Landfill. However, as discussed by Lee and Jones-Lee (2005), groundwater monitoring wells of the type prescribed by the LARWQCB Order R4-2003-0155 are largely cosmetic with respect to being able to detect leachate-polluted groundwaters at plastic sheeting lined landfills when they first reach the point of compliance for groundwater monitoring.

Decision-makers and the public should be aware that the initial leakage through plastic sheeting lined landfills will occur through holes, rips, tears or points of deterioration in the plastic sheeting liner. This will lead to finger plumes of leachate of limited lateral dimension that could readily pass by the point of compliance for groundwater monitoring without being detected by the monitoring wells. In the case of the Sunshine Canyon Landfill, since there is fractured bedrock underlying the landfill, the initial leakage of leachate through the liner system can readily penetrate a fracture, which could rapidly transport the leachate-polluted groundwater beyond the point of compliance for groundwater monitoring, without being detected. The Addendum to the EIR is significantly deficient in its claims that a single composite liner for any expansion of the Landfill will be, because of the ability to "detect and remedy" any Project-related impacts to groundwater, sufficiently protective of groundwater quality. The facts are that the inevitable initial leakage through the liner system has a low probability of being detected by groundwater monitoring wells.

5. Groundwater Pollution Concerns in Sunshine Canyon. Decision-makers and the public should be aware of the following issues relating to the potential for groundwater pollution specifically in Sunshine Canyon.

First, while the County in its Addendum to the EIR attempts to portray the situation with respect to groundwater pollution that would result from the eventual failure of the landfill liner system as being of little or no significance with respect to causing groundwater pollution, the facts are that the groundwaters underlying the landfill are potentially useable as a domestic water supply and that they are hydraulically connected to an important groundwater basin just downgradient from the mouth of the canyon.

Page 3-15 of the Addendum states in the third paragraph,

> *"Groundwater within the unweathered bedrock zone is primarily a Na-HCO_3-SO_4 type water with TDS ranging from 1,000 to 3,000 mg/L. Because of the high concentrations of salts and low yield, groundwater at the Project site cannot be used as a source of drinking water."*

In this statement, reference is given to the Los Angeles Regional Water Quality Control Board, *Corrective Action Program Waste Discharge Requirements, Order No. R4-2003-0155*, p. 5, Finding 29 (revised December 4, 2003). However, review of Finding 29 in the Los Angeles Regional Water Quality Control Board's Corrective Action Program WDRs shows that the Los Angeles County Addendum to the EIR provided unreliable information on the potential to use the groundwaters underlying the proposed City/County Landfill as a domestic water supply

source. The Regional Board's statement in Finding 29 is, *"Because of high concentrations of salts and low yield, groundwater at the site is currently not used as a drinking water source."* There is a significant difference between *"cannot be used"* and *"currently not used."* This is especially true when the state of California Water Resources Control Board has adopted a policy that waters with TDS less than 3,000 mg/L are considered potentially useable for domestic water supply.

Page 3-15 states in the last paragraph,

> *"Natural geologic and hydrogeologic features, such as faults and low permeability bedrock, greatly restrict groundwater movement between Sunshine Canyon and the San Fernando Valley Groundwater Basin and associated MWD and DWP facilities,"* with a reference to the FEIR, Section 3.2.3, p. 114 (1989).

However, in a subsequent sentence, the statement is made that the hydraulic conductivities in the bedrock beneath Sunshine Canyon range from 10^{-3} to 10^{-9} cm/sec. Hydraulic conductivity of 10^{-3} cm/sec is not low permeability. Further, The Los Angeles Regional Water Quality Control Board's Corrective Action Program WDRs of December 2003 states in Finding 28 that *"Groundwater flow within the canyon is generally to the southeast towards the mouth of the canyon and the velocity of groundwater flow within the alluvium is estimated to be from 0.04 to 4.4 ft/day."*

Page 3-16 of the Addendum states, *"After independently reviewing published hydrogeologic reports for the Sunshine Canyon area, the Watermaster for the Upper Los Angeles Basin Area concluded that, other than through the alluvium, there was no groundwater connection between Sunshine Canyon and the San Fernando Valley Groundwater Basin,"* with a reference to the SEIR, Section 4.3.2, p. 4-126 (1997). The Los Angeles Regional Water Quality Control Board's Corrective Action Program WDRs of December 2003 states in Finding 26, *"Pollutants released from the landfill can potentially be carried out the canyon and reach the groundwater basin and cause pollution."*

The facts as found by the LARWQCB in December 2003 therefore indicate that the groundwaters underlying the Landfill are in fact hydraulically connected to an important groundwater basin just downgradient from the mouth of the canyon.

Second, in 2003, the LARWQCB required BFI to implement a Corrective Action Program that includes construction of an impermeable subsurface barrier (cut-off wall) across the mouth of Sunshine Canyon, installation and operation of extraction wells to remove groundwater from behind the cut-off wall, and upgrading continuing operation of the existing groundwater extraction trench (LARWQCB 2003, Finding 65-66, p. 10). These recently instituted measures provide insufficient protection against further or future groundwater pollution. The Los Angeles Regional Water Quality Control Board WDRs provide information on the groundwater pollution that has occurred by the City's landfill. Contrary to statements made in the Addendum at page 3-16 that the groundwater extraction trench cut-off wall effectively prevents polluted groundwaters from polluting groundwaters downgradient of the cut-off wall, it is extremely difficult to develop an extraction trench and cut-off wall system that will prevent leachate-polluted groundwater

from passing through them for as long as the wastes in the landfill are a threat to generate leachate. This groundwater extraction cut-off wall system will have to be maintained effectively forever. It is inappropriate to assume that its performance based on its initial operation will continue to be effective for as long as the wastes in the landfill can generate leachate that pollutes groundwater that would have to be prevented from passing the cut-off wall. An issue of particular concern in the hydrogeological setting that exists in Sunshine Canyon down groundwater gradient of the landfill, where the cut-off wall is located, is that fractures in the bedrock exist which could allow leachate-polluted groundwater to pass under the cut-off wall and not be detected by the groundwater monitoring system. As discussed above and reviewed in detail by Lee and Jones-Lee (2005), monitoring fractured rock aquifer systems is highly unreliable.

Third, decision-makers and the public should be aware of the following additional information in evaluating the adequacy of the single composite liner system in place at the existing County Landfill.

Page 3-20 of the Addendum states, *"Note that the onsite detection of VOCs and 1,4-dioxane does not demonstrate that the composite liner at the operational County landfill is not functioning properly."* This should not be interpreted to mean that the composite liner in the County part of the Landfill appears to be functioning with respect to collecting the leachate generated within the Landfill and thereby preventing groundwater pollution, or that this level of performance could be expected to continue for as long as the wastes in the landfill will be a threat. As discussed herein and as is well known in the literature (Lee and Jones-Lee, 2005), ultimately the single composite liner in the operational County Landfill, as well as in those parts of the City/County landfill that will be lined with a single composite liner, will fail to collect all leachate generated in the Landfill.

The Addendum, page 3-20, states in the last paragraph with reference to the source of the dioxane that is polluting groundwaters at the Sunshine Canyon site, *"To the contrary, the composite liner is protecting groundwater, as demonstrated by the following: (i) the single composite liner conforms with the uniform liner design requirements of the Federal subtitle D regulations (40 CFR Part 258), which are the USEPA regulations for MSW landfills, and the liner requirements of Title 27 of the California Code of Regulations (CCR),…."* Even the US EPA has recognized, however, that the liner system would ultimately fail to prevent groundwater pollution. The US EPA (August 30, 1988a) Solid Waste Disposal Criteria state,

> *"First, even the best liner and leachate collection system will ultimately fail due to natural deterioration, and recent improvements in MSWLF (municipal solid waste landfill) containment technologies suggest that releases may be delayed by many decades at some landfills."*

The US EPA (July 1988b) Criteria for Municipal Solid Waste Landfills state,

> *"Once the unit is closed, the bottom layer of the landfill will deteriorate over time and, consequently, will not prevent leachate transport out of the unit."*

It is inappropriate to assume, therefore, that the recently discovered dioxane pollution could not be coming from the County Landfill simply because the Landfill complies with minimum Federal Subtitle D liner system requirements, where the regulating federal agency itself has recognized that such a liner system would ultimately fail.

Decision-makers and the public should be aware that the regulatory requirements discussed by the US EPA of a single composite liner are the minimum design that can be allowed under the original State Water Resources Control Board Chapter 15 (now Title 27). These State Water Resources Control Board regulations also have a Performance Standard, which specifies that the liner system used for a particular landfill must be able to achieve the protection of groundwater quality from impaired use by landfill leachate for as long as the wastes in the landfill will be a threat (Title 27, California Code of Regulations sections 20330 and 20950). Clearly, a single composite liner with either two feet or four feet of compacted clay and a 60-mil or 80-mil thick plastic liner in the Sunshine Canyon setting cannot achieve this level of performance for as long as the wastes in the landfill will be a threat.

Any expansion of the footprint and/or capacity of any landfill will result in environmental impacts, including an increased threat to groundwater pollution. Because of the inevitable failure of single composite liner systems, the unreliability of monitoring wells to detect groundwater pollution resulting from liner system failure, the hydraulic connection of the groundwaters underlying the landfill to an important groundwater basin just downgradient from the mouth of the canyon, and the recent discovery that dioxane pollution has already occurred in Sunshine Canyon, installation of a double composite liner in any expansion of the landfill in Sunshine Canyon would be an important, though only partial, means of mitigating the threat to groundwater pollution.

In addition, where the footprint of the landfill is expanded, even if the net daily tonnage disposed of in the landfill is not increased, and even if the expanded landfill has a double composite liner, such an expansion will still have environmental impacts, such as an increased threat to groundwater pollution. This is because double composite liners, like single composite liners, are ultimately subject to failure.

C. Other Impacts of the Landfill: Additional Differences between the City and County Landfill CUPs

Both the City (Los Angeles City Ordinance No. 172933) and the draft County CUP require BFI to follow certain protocols if material known or suspected to be unacceptable waste is discovered at the landfill, including but not limited to notifying appropriate City, State and County agencies, and storing the materials until they can be disposed of appropriately (draft CUP Condition 24; City Ordinance Condition B-5). The City, but not the County, also requires BFI to maintain a "Manifest of Unacceptable Waste," and to include in that Manifest a description, nature and quantity of waste; name and address of known source; amount of waste; specific handling procedures used; certification of accuracy of information in manifest (City Ordinance Condition B-5). The City Ordinance requirements are significantly more protective in preventing unacceptable wastes from being deposited in the Landfill.

A record-keeping requirement, such as the City's required Manifest of Unacceptable Waste, can be an important deterrent to unlawful disposal of unacceptable waste. Unacceptable waste unlawfully disposed in municipal landfills presents an additional significant environmental concern. More hazardous groundwater and other contamination can result from the disposal of such waste in municipal landfills. To the extent tonnage that would have been disposed of in a landfill with a manifest requirement is shifted instead to a landfill that lacks a manifest requirement, one might expect disposal of increased unacceptable waste in that landfill and, as a result, increased adverse environmental effects.

The City requires establishment of a Technical Advisory Committee (TAC) to ensure compliance with the conditions of approval (City Ordinance Condition C-12). The City requires the installation of video monitoring equipment at the site to ensure compliance with the conditions of operation, with the TAC having access to such tapes for one year following their recording (City Ordinance Condition C-14). The draft County CUP contains no similar provision for a monitoring committee, or for video monitoring to ensure compliance with County conditions. There can readily be significant differences in the environmental protection associated with landfilling, where landfilling on the City side of the City/County Landfill would take place under close supervision of a TAC, where the TAC would have video monitoring to examine, but landfilling on the County side of the City/County Landfill would occur without this type of supervision/inspection. Based on my extensive experience in evaluating landfills, I have found that violations of conditions of operation and environmental mitigation measures are routine. To the extent mitigation requirements are ignored, adverse environmental impacts increase. Aggressive monitoring measures are an important deterrent to violation. One can expect that landfills with aggressive monitoring measures are likely to have fewer violations. To the extent that tonnage that would otherwise have been disposed of in a landfill with aggressive monitoring requirements is shifted to a landfill without such requirements, one might expect more violations and thus greater environmental impacts.

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Appendix A

Dr. G. Fred Lee, PE, DEE

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 850 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.

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 75 different landfills and waste piles (tailings) in various parts of the United States and in other countries.

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 50 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 Pottstown 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.

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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 1,025 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 Southpoint Landfill, Mobile
California *(State Landfilling Regulations)*	Colusa County - CERRS Landfill San Gabriel Valley - Azusa Landfill 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 Barstow - Hidden Valley Broadwell Hazardous Waste Landfills Cadiz - Bolo Station-Rail Cycle Landfill University of California-Davis Landfills (4) 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 Los Angeles County – Palos Verdes Landfill Contra Costa County – Concord Naval Weapons Station Tidal Area Landfill Nevada County, CA Lava Cap Mine Area Landfill
Colorado (*State Landfilling Regulations)*	Last Chance/Brush - Hazardous Waste Landfill Denver - Lowry Hazardous Waste Landfill Telluride/Idarado Mine Tailings
Florida (*State Landfilling Regulations*)	Alachua County Landfill
Illinois (*State Landfilling Regulations*)	Crystal Lake - McHenry County Landfill Wayne County Landfill
Indiana (*State Landfilling Regulations*)	Posey County Landfill New Haven-Adams Center Landfill (Hazardous Waste)
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 Landfill
New Jersey (*State Landfilling Regulations*)	Meadowlands – Landfill Fort Dix Landfill Scotch Plains Leaf Dump
New York	Staten Island - Fresh Kills Landfill, Niagara Falls - Hazardous Waste Landfill, New York City – Ferry Point Landfill
Ohio	Clermont County - BFI/CECOS Hazardous Waste Landfill, Huber Heights - Taylorville Road Hardfill Landfill

Pennsylvania (*State Landfilling Regulations*)	Pottstown, PA - Pottstown Landfill Closure Committee
Rhode Island	Richmond Landfill
South Carolina	Spartanburg - Palmetto Landfill
Texas (*State Landfilling Regulations*)	Dallas/Sachse – Landfill Fort Worth - Acme Brick Hazardous Waste Landfill City of Dallas - Jim Miller Road Landfill
Vermont	Coventry, Vermont – Coventry Landfill
Washington (*State Landfilling Regulations*)	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 (*Prov. Landfilling Regulations*)	Winnipeg Area - Rosser Landfill
New Brunswick, Canada (*Prov. Landfilling Regulations*)	St. John's - Crane Mountain Landfill
England	Mercyside Waste Disposal Bootle Landfill
Hong Kong	Three New MSW Landfills
Ireland	Bottlehill Landfill, County Cork Central Waste Management Facility, Ballyduff, County Clare
Korea	Yukong Gas Co. - Hazardous Waste Landfill
Mexico (*Haz. Waste Landfilling Regulations*	San Luis Pontosi - Hazardous Waste Landfill
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 & 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

Appendix B

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