

## **G. Fred Lee & Associates**

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October 30, 2003

### **Workshop on Landfill Postclosure and Financial Assurance**

Via email: [paparian@ciwmb.ca.gov](mailto:paparian@ciwmb.ca.gov)

Mike Paparian, Board Member  
CIWMB  
Sacramento, CA

Dear Mr. Paparian:

I note from your October 29 "Update from Mike Paparian, CIWMB – November 2003" that on November 3 you are holding a Landfill Post-Closure and Financial Assurances Workshop, where the questions are,

- Are post-closure maintenance (PCM) activities at solid waste landfills required for more than 30 years after the closure of the landfill?
- If so, then for what period of time are operators required to provide the financial assurance demonstration for these maintenance activities?
- At what point may an operator draw on the financial mechanism to cover already-incurred PCM expenses?

While I cannot attend the November 3 workshop because I am presenting a paper at the American Water Resources Association national meeting in San Diego, I wish to submit these comments into the record of this workshop to ensure that a proper representation of the inadequacies of the current 30-year postclosure care funding approach is in the record.

The issues of inadequate postclosure maintenance and the inevitable remediation funding at today's Subtitle D landfills are issues that have been of concern for many years to me and many others who are knowledgeable on the composition of municipal solid waste and industrial so-called "nonhazardous" waste, the processes that occur within Subtitle D "dry tomb" landfills, the properties of the liners that are allowed to be used, and the characteristics of the groundwater monitoring systems that are allowed at Subtitle D landfills. I have published extensively on the deficiencies in the RCRA-mandated minimum 30-year postclosure care period for Subtitles C and D landfills. A list of my papers and reports that are pertinent to these comments are appended. My papers and reports on this and other landfilling issues are available from my website, [www.gfredlee.com](http://www.gfredlee.com), in the Landfills - Groundwater section, Postclosure Care of Landfills subsection.

## **GAO and US EPA Inspector General's Findings**

An elementary examination of these issues leads to the conclusion that the 30-year postclosure assured funding period mandated in RCRA was a significant error on the part of the US Congress, which is recognized not only in the technical community, but also by various groups or individuals who have reviewed this issue. For example, the GAO (1990) in the Executive Summary of its report "Funding of Postclosure Liabilities Remains Uncertain," under a section labeled "Funding Mechanisms Questionable," concluded that,

*"Owners/operators are liable for any postclosure costs that may occur. However, few funding assurances exist for postclosure liabilities. EPA only requires funding assurances for maintenance and monitoring costs for 30 years after closure and corrective action costs once a problem is identified. No financial assurances exist for potential but unknown corrective actions, off-site damages, or other liabilities that may occur after the established postclosure period."*

Further, the US EPA Inspector General (US EPA, 2001) in a report, "RCRA Financial Assurance for Closure and Post-Closure," developed similar conclusions:

*"There is insufficient assurance that funds will be available in all cases to cover the full period of landfill post-closure monitoring and maintenance. Regulations require postclosure activities and financial assurance for 30 years after landfill closure, and a state agency may require additional years of care if needed. We were told by several state officials that many landfills may need more than 30 years of post-closure care. However, most of the state agencies in our sample had not developed a policy and process to determine whether post-closure care should be extended beyond 30 years, and there is no EPA guidance on determining the appropriate length of post-closure care. Some facilities have submitted cost estimates that were too low, and state officials have expressed concerns that the cost estimates are difficult to review."*

## **Length of Time Landfills will be a Threat**

US EPA contractors (Bonaparte, et al., 2002), with the approval of the Agency, are publishing statements about the hundreds of years that municipal solid wastes in a dry tomb landfill will be a threat to cause groundwater pollution. The report by Bonaparte, Daniel and Koerner claims that the municipal solid waste in a Subtitle D landfill will be a threat to cause groundwater pollution for about 200 years. However, this report should not be used to support the position that there would not be a threat for the waste in a dry tomb landfill to pollute groundwaters after 200 years. It should be obvious to anyone with an elementary understanding of the chemical processes that can take place in a dry tomb landfill that, as long as the wastes are kept dry, little or no decomposition or leaching occurs. Therefore, the wastes in a dry tomb landfill can be considered to be a threat effectively forever. As a result, the financial assurance for postclosure care should prepare for *ad infinitum* postclosure assured funding – i.e., for as long as the wastes in the landfill will be a threat.

***Importance of Plastic-Bagged Garbage.*** One of the issues that is not adequately considered (but is discussed in my writings) is that much of today's municipal solid waste is disposed of in plastic (polyethylene) bags. These bags are not emptied or shredded, but simply crushed by the landfill compaction equipment. These crushed bags "hide" the waste from any moisture that enters the landfill that could lead to fermentation and leaching of the wastes, until such time as the plastic bag decomposes. While there is no information on how long polyethylene bags will persist in a landfill environment, there is a general consensus that it could readily be on the order of hundreds of years. This is another factor that can significantly extend the period of time of required assured postclosure funding.

In summary, the 30-year period is an infinitesimally small part of the total period that the wastes in a dry tomb landfill will be a threat. As discussed in my writings and references contained therein, the magnitude of the postclosure funding should be based on the realistic assumption that the period of time over which there will be need for funding is forever.

Some do not like the concept of planning "forever." As an alternative, one could say "1,000 years." Today's Subtitle D dry tomb landfills will be a threat beyond 1,000 years. The studies by Belevi and Baccini (1989) on Swiss landfills predict that there will be pollution of groundwaters well beyond 200 years by landfill leachate. As Freeze and Cherry (1979) pointed out, Roman era landfills of over 2,000 years ago are still generating leachate. Those landfills are in a wet climate, where there has been appreciable opportunity for leaching.

### **Importance of Landfill Design and Siting**

The magnitude of postclosure funding should be set based on landfill design and siting. With respect to siting, landfills that are sited where there is natural protection of groundwater from pollution by landfill leachate when the liner systems eventually fail should be required to have far less postclosure funding than the typical California Subtitle D landfill, which is sited over groundwaters that will be adversely impacted by the leachate when it passes through the vadose zone and pollutes the underlying groundwaters. As part of determining the magnitude of postclosure funding, a detailed analysis should be conducted of how a particular landfill, with its design and geological setting, could lead to groundwater pollution that would have to be treated as part of groundwater remediation in a pump-and-treat system. Postclosure funding should be adequate to address plausible worst-case failure scenarios for a particular landfill.

### **Reliability of Groundwater Monitoring**

In making a plausible worst-case failure scenario evaluation of the magnitude of postclosure care funding that could be needed for a particular landfill, consideration should be given to the reliability of the groundwater monitoring system that is used for the landfill. As discussed in my writings, Regional Water Quality Control Boards are permitting Subtitle D landfills with monitoring wells spaced hundreds of feet apart at the point of compliance for groundwater monitoring. As Cherry (1990) points out, the initial

leakage through a plastic-sheeting-lined landfill will be via finger plumes of leachate, which can be on the order of a few feet wide at the point of compliance. Since each monitoring well can detect leachate-polluted groundwater about a foot on each side, monitoring wells spaced hundreds of feet apart have an appreciable distance between them through which leachate plumes can pass and not be detected until significant offsite pollution has occurred.

This situation is of sufficient concern so that some states, such as Michigan, require double composite lined MSW landfills, with a leak detection system between the two composite liners. This is a far more reliable approach for detecting Subtitle D landfill liner failure than the current approach of monitoring wells at the point of compliance. An evaluation should be made of the ability of the monitoring well array that is allowed at a landfill to detect groundwater pollution, as part of determining the magnitude of the required postclosure funding, since early detection will reduce the cost of remediation.

Today's Subtitle D landfills will, at best, only postpone when groundwater pollution occurs. The highly inadequate groundwater monitoring systems that are allowed by the Regional Boards for Subtitle D landfills will lead to substantial offsite groundwater pollution, which has to be cleaned up, much like today's Superfund site cleanups, involving pump and treat.

### **Inadequate Funding for Cover Maintenance**

The current closure funding is not adequate to even replace the low-permeability layer of the landfill cover when problems occur. While landfill owners and operators claim that they will be able to repair leaks in the low-permeability layer, they will not know where the leaks are, since the low-permeability layer is buried below a topsoil and drainage layer and there is no leak detection system in the cover. At some time in the postclosure period, additional leachate will be generated as the landfill cover low-permeability layer deteriorates, and there is not sufficient postclosure funding to find and then properly repair the areas of the cover that are leaking.

### **Passing Costs on to Future Generations**

The approach that the Integrated Waste Management Board is now using with respect to requiring funding for closure and postclosure care is causing a significant part of the cost of solid waste management for those who are generating waste today to be passed on to future generations. The Integrated Waste Management Board should develop an approach that is based on having those who generate the waste pay the full cost for its disposal. The \$20 to \$30, or even \$50, per ton tipping fees for landfilling of wastes is grossly inadequate, compared to the true cost of landfilling of municipal solid wastes.

### **Recommended Approach**

The approach that should be used to develop the postclosure care funding should be additions to the tipping fee, to cover the development of a dedicated trust fund of sufficient magnitude to monitor, maintain and remediate groundwaters at any time during the period of time when the wastes are a threat – i.e., forever. The postclosure care funds must be held in a dedicated trust that is only to be used to address landfill monitoring,

maintenance and remediation. It cannot be made available to the private landfill developer, County Board of Supervisors or other entities for use for other purposes. Hickman, former head of the Solid Waste Association of North America, published several discussions of the deficiencies in the financial assurance instruments that are allowed today for funding of closure and postclosure care of landfills. Of particular note is the publication, "Financial Assurance – Will the Check Bounce?" (Hickman, 1992).

An issue that should be addressed by the Integrated Waste Management Board is whether the Board members are going to meet their obligation to develop and implement regulatory approaches that truly provide for groundwater quality protection for as long as the wastes are a threat – i.e., the requirements of Title 27. If they are, they are going to have to drastically change postclosure care funding magnitude and duration.

I wish to indicate that, if anyone claims that my assessment of these issues is technically incorrect, please require that they participate in an interactive, public peer review of the technical base for their claims. I am prepared to do this at any time and location. I am confident that such a peer review will show that my assessment of the situation is appropriate.

Additional information on these issues is provided in my writings, many of which are directly available from my website, [www.gfredlee.com](http://www.gfredlee.com), or through a request system on the website, through which a particular reference can be provided within a short time after it has been requested. I have attached a list of the papers that I have published over the years that are particularly pertinent to these comments.

### **Background to these Comments**

Information on my education, experience and expertise pertinent to these comments is appended.

### **References**

Belevi, H. and Baccini, P., "Long-Term Behavior of Municipal Solid Waste Landfills," *Waste Mgt. & Res.* 7:43-56 (1989).

Bonaparte, R.; Daniel, D. and Koerner, R., "Assessment and Recommendations for Improving the Performance of Waste Containment Systems" US Environmental Protection Agency Office of Research Development EPA/XXX/R-02/XXX Cincinnati, OH March (2002).

Cherry, J. A., "Groundwater Monitoring: Some Deficiencies and Opportunities," *Hazardous Waste Site Investigations: Towards Better Decisions, Proc. 10<sup>th</sup> Oak Ridge National Laboratories' Life Sciences Symposium*, Lewis Publishers, Gatlinburg, TN (1990).

Freeze, R. A. and Cherry, J. A., Groundwater, Prentice-Hall, Inc., Englewood Cliffs, NJ (1979).

GAO, "Funding of Postclosure Liabilities Remains Uncertain," GAO/RCED-90-64, US General Accounting Office Report to the Congress, Washington, D. C., June (1990).

Hickman, L., "Financial Assurance – Will the Check Bounce?" *Municipal Solid Waste News*, March (1992).

Lee, G. F. and Jones, R. A., "Is Hazardous Waste Disposal in Clay Vaults Safe?" *J. American Water Works Association* 76:66-73 (1984).

US EPA, "RCRA Financial Assurance for Closure and Post-Closure," Audit Report, 2001-P-007, US Environmental Protection Agency, Office of Inspector General, Washington, D. C., March 30 (2001).

## **G. Fred Lee's Papers and Reports Pertinent to Landfill Postclosure Care Funding**

Lee, G. F., "Deficiencies in the US EPA's Characterization of the Protection Provided by Subtitle D Landfilling of MSW," Report of G. Fred Lee & Associates, El Macero, CA, March (2003).

Lee, G. F., "Solid Waste Management: USA Lined Landfilling Reliability," An invited submission for publication in Natural Resources Forum, a United Nations Journal, New York, NY, December (2002).

Lee, G. F., "Criteria for Municipal Solid Waste Landfills (Section 610 Review)," Submitted to US EPA Docket Number F-1999-MLFN-FFFFF, Washington D.C., January (2000).

Lee, G. F. and Jones-Lee, A., "Unreliability of Predicting Landfill Gas Production Rates and Duration for Closed Subtitle D MSW Landfills," Report of G. Fred Lee & Associates, El Macero, CA, September (1999).

Lee, G. F. and Jones-Lee, A., "Assessing the Potential of Minimum Subtitle D Lined Landfills to Pollute: Alternative Landfilling Approaches," Proc. of Air and Waste Management Association 91st Annual Meeting, San Diego, CA, available on CD ROM as paper 98-WA71.04(A46), 40pp, June (1998).  
Also available at <http://www.gfredlee.com>.

Lee, G. F. and Jones-Lee, A., "Deficiencies in Subtitle D Landfill Liner Failure and Groundwater Pollution Monitoring," Presented at the NWQMC National Conference "Monitoring: Critical Foundations to Protect Our Waters," US Environmental Protection Agency, Washington, D.C., July (1998).

Lee, G. F. and Jones-Lee, A., "Developing Landfills that Protect People: The True Costs," MSW Management 7(6):18-23, Nov/Dec (1997).

Lee, G. F. and Jones-Lee, A., "Deficiencies in US EPA Subtitle D Landfills in Protecting Groundwater Quality for as Long as MSW is a Threat: Recommended Alternative Approaches," Report of G. Fred Lee & Associates, El Macero, CA (1997).

Lee, G. F. and Jones-Lee, A., "Development of a Potentially Protective Landfill: Issues Governing the True Cost of Landfilling," Report of G. Fred Lee & Associates, El Macero, CA, July (1997).

Lee, G. F. and Jones-Lee, A., "Overview of Landfill Post Closure Issues," Presented at American Society of Civil Engineers Convention session devoted to "Landfill Closures - Environmental Protection and Land Recovery," San Diego, CA, October (1995).

Lee, G. F. and Jones-Lee, A., "Recommended Design, Operation, Closure and Post-Closure Approaches for Municipal Solid Waste and Hazardous Waste Landfills," Report of G. Fred Lee & Associates, El Macero, CA, 14pp, August (1995).

Lee, G. F. and Jones-Lee, A., "Practical Environmental Ethics: Is There an Obligation to Tell the Whole Truth?" Published in condensed form "Environmental Ethics: The Whole Truth," Civil Engineering, Forum, 65:6 (1995).

Lee, G. F. and Jones-Lee, A., "Landfilling of Solid & Hazardous Waste: Facing Long-Term Liability," In: Proc. 1994 Federal Environmental Restoration III & Waste Minimization II Conference, Hazardous Materials Control Resources Institute, Rockville, MD, pp. 1610-1618, April (1994).

Lee, G. F. and Jones-Lee, A., "Landfill Post-Closure Care: Can Owners Guarantee the Money Will Be There?" Solid Waste and Power, 7(4):35-39 (1993).

Lee, G. F. and Jones, R. A., "Municipal Solid Waste Management in Lined, 'Dry Tomb' Landfills: A Technologically Flawed Approach for Protection of Groundwater Quality," Report of G. Fred Lee & Associates, El Macero, CA, 68pp, March (1992).

Lee, G. F. and Jones-Lee, A., "Municipal Landfill Post-Closure Care Funding: The 30-Year Post-Closure Care Myth," Report of G. Fred Lee & Associates, El Macero, CA, 19pp (1992).



## **Dr. G. Fred Lee, PE, DEE**

### **Expertise and Experience in Landfill Impact Assessment**

Dr. G. Fred Lee's work on municipal 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 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 groundwater 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 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 groundwater 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 lagoons.

His work on the impacts of municipal solid waste landfills began in the 1960s where, 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 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 a Distinguished Professorship 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.

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 management issues. His work included evaluating the impacts of a number of municipal solid waste landfills.

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 65 different landfills 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 40 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 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. They make many of his publications available as downloadable files from his web site, [www.gfredlee.com](http://www.gfredlee.com).

In the early 1990s, he 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 panel to assess public health impacts of municipal landfills.

In addition to teaching and serving as a consultant in environmental engineering for over 40 years, he 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, 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 been and continues to be 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 US.

## 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 University 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

## **PUBLICATIONS AND AREAS OF ACTIVITY**

Published over 850 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 750 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.

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

<b>Arizona</b>	Verde Valley - Copper Tailings Pile Closure
<b>California</b> <i>(State Landfilling Reg.)</i>	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 Landfillsn(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
<b>Colorado</b> <i>(State Landfilling Reg.)</i>	Last Chance/Brush - Hazardous Waste Landfill Denver - Lowry Hazardous Waste Landfill Telluride/Idarado Mine Tailings
<b>Florida</b> <i>(State Landfilling Reg.)</i>	Alachua County Landfill
<b>Illinois</b> <i>(State Landfilling Reg.)</i>	Crystal Lake - McHenry County Landfill Wayne County Landfill
<b>Indiana</b> <i>(State Landfilling Reg.)</i>	Posey County Landfill New Haven-Adams Center Landfill (Hazardous Waste)
<b>Michigan</b> <i>(State Landfilling Reg.)</i>	Menominee Township - Landfill Ypsilanti- Waste Disposal Inc. (Hazardous Waste - PCB's)
<b>Minnesota</b>	Reserve Mining Co., Silver Bay - taconite tailings, Superior FCR Landfill, Wright County
<b>Missouri</b>	Jefferson County - Bob's Home Service Hazardous Waste Landfill
<b>New Jersey</b> <i>(State Landfilling Reg.)</i>	Meadowlands - Landfill Fort Dix Landfill Scotch Plains Leaf Dump

<b>New York</b>	Staten Island - Fresh Kills Landfill, Niagara Falls - Hazardous Waste Landfill, New York City - Ferry Point Landfill
<b>Ohio</b>	Clermont County - BFI/CECOS Hazardous Waste Landfill, Huber Heights - Taylorville Road Hardfill Landfill
<b>Rhode Island</b>	Richmond - Landfill
<b>South Carolina</b>	Spartanburg - Palmetto Landfill
<b>Texas</b> <i>(State Landfilling Regulations)</i>	Dallas/Sachse - Landfill Fort Worth - Acme Brick Hazardous Waste Landfill City of Dallas - Jim Miller Road Landfill
<b>Washington</b> <i>(State Landfilling Regulations)</i>	Tacoma - 304th and Meridian Landfill
<b>Wisconsin</b>	Madison and Wausau Landfills
<b>Belize</b>	Mile 27 Landfill
<b>Ontario, Canada</b> <i>(Prov. Landfilling Reg.)</i>	Greater Toronto Area - Landfill Siting Issues Kirkland Lake - Adams Mine Site Landfill Pembroke - Cott Solid Waste Disposal Areas
<b>Manitoba, Canada</b> <i>(Prov. Landfilling Reg.)</i>	Winnipeg Area - Rosser Landfill
<b>New Brunswick, Canada</b> <i>(Prov. Landfilling Reg.)</i>	St. John's - Crane Mountain Landfill
<b>England</b>	Mercyside Waste Disposal Bootle Landfill
<b>Hong Kong</b>	Three New MSW Landfills
<b>Ireland</b>	Bottlehill Landfill, County Cork Central Waste Management Facility, Ballyduff, County Clare
<b>Korea</b>	Yukong Gas Co. - Hazardous Waste Landfill
<b>Mexico</b> <i>(Haz. Waste Landfilling Regulations)</i>	San Luis Potosi - Hazardous Waste Landfill
<b>New Zealand</b>	North Waikato Regional Landfill
<b>Puerto Rico</b>	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

Mine Waste Management

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