Justification for the State of Michigan's Ban on the Deposition of Recyclable MSW Components to Preserve Landfill Space and Reduce Landfill Public Health and Environmental Impacts

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The State of Michigan has adopted a ban on the deposition of beverage containers and whole tires in the State's landfills. This ban takes place in October 2004. This approach has been challenged by the Solid Waste Association of North America. I am familiar with the role of municipal solid waste recycling and reuse in conserving landfill space and protecting groundwater quality, public health and the environment from hazardous/deleterious chemicals in municipal solid wastes. I have published several papers on this topic including,

> Lee, G. F. and Jones-Lee, A., "Three Rs Managed Garbage Protects Groundwater Quality," Proceedings Air and Waste Management Association 93rd national annual meeting, CD ROM paper 00-454, Pittsburgh, PA, June (2000). http://www.gfredlee.com/3rpap_sli.pdf.

The current municipal solid waste stream contains a wide variety of known and yet-to-be-identified hazardous and otherwise deleterious chemicals that are a threat to public health and the quality of groundwater that is used for domestic and agricultural purposes. Common household items such as batteries, fluorescent bulbs, and cleaning fluids contain such hazardous chemicals. Among the waste components in municipal solid waste are a variety of heavy metals and organic compounds that are a threat to human health when ingested in drinking water. In addition, municipal solid waste contains inorganic salts and so-called "nonhazardous" organics, which, when present in landfill-leachate-polluted groundwaters, cause the groundwaters, among other impacts, to have tastes and odors that render them unusable for domestic and many other purposes.

Landfills pose substantial, unavoidable environmental impacts. Rainfall and snowmelt can enter a landfill through defects in the landfill cover. Once water enters the landfill, it interacts with waste components to produce leachate (dissolved waste components) containing hazardous and toxic substances. These substances escape the landfill through rips, tears and areas of deterioration in the liner system, and can contaminate groundwater beneath the landfill. The contaminated groundwater then moves to off-site properties, where it can pollute domestic and other water supply wells. In addition, in those situations where groundwaters are discharged to the surface through springs, surface water pollution can occur. The pollution of groundwaters and surface waters by landfill leachate is a significant threat to public health, aquatic life and wildlife. Drs. G. Fred Lee and Anne Jones-Lee's website (www.gfredlee.com) contains several papers discussing the potential impacts of groundwater pollution by municipal solid waste landfills.

While the state of Michigan's landfill liner and groundwater monitoring systems are designed to minimize groundwater pollution by landfill leachate, they cannot necessarily eliminate it for as long as the wastes in the landfill will be a threat. Some of the waste components in the landfill do not degrade; they are, accordingly, a threat to cause groundwater pollution forever. Improved liners may postpone contamination, but, as the U.S Environmental Protection Agency has recognized, any containment system will eventually develop defects that allow water to enter the landfill, and leachate to escape (see review by Lee and Jones-Lee 2004). While groundwater monitoring systems may detect when liner leakage occurs, there is a potential that the groundwater monitoring system will fail to reliably detect groundwater pollution at the point of groundwater pollution compliance.

In addition, landfills release air pollutants that can, in the near- and long-term, affect human health, as well as pollutants that contribute to global warming. Some of the organic waste components in municipal solid waste can be converted in a landfill into landfill gas. Methane is produced in landfills from the fermentation of some of the organics in the waste; methane is not only a potential explosive hazard to residents near landfills, but also a potent cause of global warming. Further, gaseous emissions from landfills are a threat to cause groundwater pollution. In addition, these gaseous emissions contain a variety of volatile hazardous chemicals that are a threat to cause cancer and other diseases in those living/using areas near a landfill. While landfills contain landfill gas collection systems, these systems are not fully effective in preventing landfill gas and other volatile waste components from escaping from the landfill through the landfill cover. Finally, landfills can have a variety of additional impacts, such as odors, fugitive trash, dust, vermin, birds, etc., which are deleterious to the interests of those in the sphere of influence of the landfill.

The deposition of beverage containers and whole tires in landfills unnecessarily consumes landfill space. Landfill capacity unnecessarily exhausted by discarded beverage containers and tires cannot be recovered. While State of Michigan landfills are among the most protective of landfills developed in the US, the State's landfills still represent long-term threats to public health and the environment from gaseous and liquid releases of hazardous and deleterious chemicals derived from wastes deposited in the landfills and from waste degradation products. Every new landfill exposes the public and the environment to additional hazardous/deleterious chemicals, often at new locations where landfills are not now located.

It is appropriate for the State of Michigan to adopt regulations that restrict the deposition of municipal solid wastes in the State's landfills that contain recyclable waste components such as beverage containers and other wastes such as whole vehicle tires that consume highly valuable landfill space. This approach is appropriate for prudent public health and environmental protection, and conservation of natural resources. It is highly appropriate to prevent the deposition of these types of wastes in a state's landfills from all sources.

Additional Information

Lee, G. F. and Jones-Lee, A., "Overview of Subtitle D Landfill Design, Operation, Closure and Postclosure Care Relative to Providing Public Health and Environmental Protection for as Long

as the Wastes in the Landfill will be a Threat," Report of G. Fred Lee & Associates, El Macero, CA (2004). http://www.gfredlee.com/LFoverviewMSW.pdf

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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). http://www.gfredlee.com/nwqmcl.html

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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, "Three Rs Managed Garbage Protects Groundwater Quality," Proceedings Air and Waste Management Association 93rd national annual meeting, CD rom paper 00-454, Pittsburgh, PA, June (2000). http://www.gfredlee.com/3rpap_sli.pdf

Jones-Lee, A. and Lee, G. F. "Appropriate Use of MSW Leachate Recycling in Municipal Solid Waste Landfilling, " Proceedings Air and Waste Management Association 93rd national annual meeting, CD rom paper 00-455, Pittsburgh, PA, June (2000).
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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 Sheehan, W., "Landfills Offer False Sense of Security," *Biocycle* 37(9):8 (1996).

Jones-Lee, A. and Lee, G. F., "Groundwater Pollution by Municipal Landfills: Leachate Composition, Detection and Water Quality Significance," Proc. Sardinia '93 IV International Landfill Symposium, Sardinia, Italy, pp. 1093-1103, October (1993).
http://www.gfredlee.com/lf-conta.htm

Background Information on Dr. G. Fred Lee's Qualifications in Support of Michigan's Ban on Beverage Containers and Whole Tires

G. Fred Lee is a principal and the president of G. Fred Lee & Associates, a specialty consulting firm focusing on problems associated with water quality, water and wastewater treatment, control of water pollution in fresh and marine waters and groundwaters, and solid and hazardous waste disposal investigation and management. He has a Ph.D. in Environmental Engineering & Environmental Science from Harvard University in Cambridge, Massachusetts, which he received in 1960. In 1957, he was awarded an M.S. Public Health degree in environmental science-environmental chemistry from the University of North Carolina (Chapel Hill) School of Public Health. He received a B.A. in environmental health science from San Jose State College in San Jose, California, in 1955. Prior to his current position with G. Fred Lee & Associates, he held numerous consulting and several university graduate-level teaching and research positions spanning over three decades. These include the position of Professor of Water Chemistry and Director of the Water Chemistry Program at the University of Wisconsin, Madison, for a period of 13 years. Subsequently, he helped organize and directed the Center for Environmental Studies at the University of Texas at Dallas, where he held the position of Professor of Environmental Engineering. He was a Professor of Civil and Environmental Engineering at Colorado State University and a Distinguished Professor of Civil and Environmental Engineering at the New Jersey Institute of Technology, where he also held the position of Director of the Site Assessment and Remediation Division at a multi-university hazardous waste research center. During his university teaching and research career, he conducted more than $5 million in research related to various aspects of water quality, including studies on behalf of the U.S. Environmental Protection Agency on the materials used as liners to contain wastes and pollutants at landfills. During that time he was also a part-time consultant to a number of governmental agencies, industry, and others in the U.S. and other countries.

In 1989, Dr. G. F. Lee retired after 30 years of university graduate-level teaching and research and expanded his part-time consulting activities into a full-time business. Over the years, he have published over 950 professional papers, chapters in books, professional reports, and similar materials, including over 80 papers and reports on the impacts of municipal and industrial waste landfills and the development of landfills that will be protective of public health, groundwater resources and the environment. Many of these papers and reports are available on Dr. Anne Jones-Lee (his wife) and his website, www.gfredlee.com. A summary of his professional activities that are pertinent to solid waste management and the evaluation of the impacts of landfills on public health and the environment is attached.

Dr. Lee has direct experience investigating the impacts of municipal solid waste landfills in Michigan. In 1984, he was selected by the State of Michigan Toxic Substances Control Commission to review the State's solid waste landfilling regulations. He submitted a report titled, "Michigan Solid and Hazardous Waste Landfill Design Components, Investigation and Recommendation." Further, in the 1990s, he reviewed and submitted comments to the Department of Environmental Quality on the changes proposed for the solid waste landfilling regulations in Michigan.

Expertise and Experience in 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 groundwater) 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 65 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 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.

SUMMARY BIOGRAPHICAL INFORMATION

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July 27, 1933	530/753-9630	530/753/9956
Delano, California, USA	(home/office)	(home/office)

E-MAIL: gfredlee@aol.com WEBPAGE: http://www.gfredlee.com

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

PUBLICATIONS AND AREAS OF ACTIVITY

Published over 950 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.

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.

Overall Problems with "Dry Tomb" Landfills

Lee, G. F. and Jones-Lee, A., "Overview of Subtitle D Landfill Design, Operation, Closure and Postclosure Care Relative to Providing Public Health and Environmental Protection for as Long as the Wastes in the Landfill will be a Threat," Report of G. Fred Lee & Associates, El Macero, CA (2004). http://www.gfredlee.com/LFoverviewMSW.pdf

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). http://www.gfredlee.com/UNpaper-landfills.pdf

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). http://www.gfredlee.com/USEPApropaganda.pdf

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). http://www.gfredlee.com/nwqmcl.html

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., "'Dry Tomb' Landfills," *MSW Management* 6:82-89 (1996).

Lee, G. F. and Jones-Lee, A., "Municipal and Industrial Non-Hazardous Waste Landfills Impact on Public Health and the Environment: An Overview," Report to State of California Environmental Protection Agency Comparative Risk Project, Berkeley, CA (1994).

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., "Developing Landfills that Protect People: The True Costs," *MSW Management* 7(6):18-23, Nov/Dec (1997).

Liner Failure Issues

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, 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 (1992).

Lee, G. F. and Jones, R. A., "Geosynthetic Liner Systems for Municipal Solid Waste Landfills: An Inadequate Technology for Protection of Groundwater Quality?" *Waste Management & Research* 11:354-360 (1993).

Lee, G. F., "Comments on Tisinger and Giroud 'The Durability of HDPE Geomembranes,'" Letter to the Editor, Geotechnical Fabrics Report, Minneapolis, MN Submitted by G. Fred Lee & Associates, El Macero, CA, 4pp (1994).

Groundwater Pollution by Leachate

Jones-Lee, A. and Lee, G. F., "Groundwater Pollution by Municipal Landfills: Leachate Composition, Detection and Water Quality Significance," Proceedings of Sardinia '93 IV International Landfill Symposium, Sardinia, Italy, pp. 1093-1103 (1993).

Lee, G. F. and Jones-Lee, A., "Landfill Leachate Management: Overview of Issues," *MSW Management* 6:18-23 (1996).

Groundwater Monitoring

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., "A Groundwater Protection Strategy for Lined Landfills," *Environmental Science & Technology* 28:584-5 (1994).

Lee, G. F. and Jones-Lee, A., "Detection of the Failure of Landfill Liner Systems," Report of G. Fred Lee & Associates, El Macero, CA, 13pp (1996).

Post-Closure Care

Lee, G. F., "Comments on GeoSyntec's 'Performance-Based System for Post-Closure Care at MSW Landfills,' Presented at ASTSWMO Meeting, Salt Lake City, Utah, 22-24 July 2003," Report of G. Fred Lee & Associates, El Macero, CA, January (2004).

Lee, G. F., "Comments on the California Integrated Waste Management Board Landfill Facility Compliance Study," Comments Submitted to CIWMB by G. Fred Lee & Associates, El Macero, CA, November 2003.
http://www.gfredlee.com/CIWMBcomments11-20-03.pdf

Lee, G. F., "Comments on the California Integrated Waste Management Board Landfill Facility Compliance Study Phase I Report - Results of Screening of 224 California MSW Landfills, Developed by GeoSyntec Consultants, Inc., December 2003," Comments Submitted to CIWMB by G. Fred Lee & Associates, El Macero, CA, January (2004). http://www.gfredlee.com/CIWMBCompliance Study comments.pdf

Lee, G. F. and Jones-Lee, A., "Landfill Post-Closure Care: Can Owners Guarantee the Money Will Be There?" *Solid Waste & Power* 7:35-38 (1993).

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).

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 (1995).

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

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., "Closed Landfill Cover Space Reuse: Park, Golf Course or a Tomb?" Report of G. Fred Lee & Associates, El Macero, CA (1994).

Permitting of Landfills

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, R. A., “Review of Proposed Landfills: Questions that Should Be Answered," Report of G. Fred Lee & Associates, El Macero, CA, 22pp (1991).

Lee, G. F. and Jones-Lee, A., “Questions that Regulatory Agencies Staff, Boards and Landfill Applicants and their Consultants Should Answer About a Proposed Subtitle D Landfill or Landfill Expansion,” Report of G. Fred Lee & Associates, El Macero, CA, April (1997).

Lee, G. F. and Jones-Lee, A., “Evaluation of the Potential for a Proposed or Existing Landfill to Pollute Groundwater,” Report of G. Fred Lee & Associates, El Macero, CA, 18pp, July (1996).

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., “Potential Impacts of the Proposed Minimum Subtitle D Landfills on Agricultural and Greater Area Municipal Resident Interests,” Report of G. Fred Lee & Associates, El Macero, CA, August (1997).

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 (1995).

Lee, G. F. and Jones-Lee, A., “Permitting of New Hazardous Waste Landfills and Landfill Expansions: A Summary of Public Health, Groundwater Resource and Environmental Issues,” Report of G. Fred Lee & Associates, El Macero, CA, 82pp, October (1996).

Lee, G. F. and Jones-Lee, A., “Evaluation of the Potential for a Proposed or Existing Landfill to Pollute Groundwater,” Report of G. Fred Lee & Associates, El Macero, CA, 18pp, July (1996).

Lee, G. F. and Jones-Lee, A., “The Cost of Groundwater Quality Protection in Landfilling,” Report of G. Fred Lee & Associates, El Macero, CA, 8pp (1993).

Lee, G. F., and Jones-Lee, A., “Practical Environmental Ethics: Is There an Obligation to Tell the Whole Truth?,” Published in condensed form as “Environmental Ethics: The Whole Truth” *Civil Engineering* 65:6, American Society of Civil Engineers (1995).

Lee, G. F. and Jones-Lee, A., “Revisions of State MSW Landfill Regulations: Issues in Protecting Groundwater Quality,” *Environmental Management Review* 29:32-54, Government Institutes Inc., Rockville, MD, August (1993).

Fermentation/Leaching “Wet Cell” Landfills

Jones-Lee, A. and Lee, G. F. “Appropriate Use of MSW Leachate Recycling in Municipal Solid Waste Landfilling, ” Proceedings Air and Waste Management Association 93rd national annual meeting, CD rom paper 00-455, Pittsburgh, PA, June (2000).

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Hazardous Waste Landfills

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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, AZ
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 Lanc
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	Pottstown Landfill Closure Committee – Pottstown, PA
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