

## **MSW Landfilling in California in Under Subtitle D: Problems With Current Approaches and Suggested Alternatives**

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August 1997

In 1984, the State of California Water Resources Control Board (SWRCB) adopted Chapter 15 regulations which established an overall groundwater protection requirement that MSW landfill containment and groundwater monitoring systems **prevent groundwater use impairment for as long as the wastes in the landfill are a threat**. Chapter 15 also specified **minimum** liner and cover design requirements that **could** be used at **some** locations where the natural strata and/or groundwater characteristics are such that the minimum liner design requirements would achieve the regulations overall performance requirements of protecting groundwaters and surface waters from impaired use for as long as the wastes are a threat. While Chapter 15 is explicit in establishing a landfilling approach in California that requires groundwater quality protection, the implementation of these regulations by the regional water quality control boards has fallen far short of achieving this requirement. The regional boards' staff, without public review, adopted the position that Chapter 15 minimum liner design (one foot of compacted soil with a permeability of less than 10<sup>-6</sup> cm/s) would provide a liner system that would achieve Chapter 15's performance requirements of groundwater quality protection for as long as the wastes represent a threat at all locations where landfills could be sited. However, a simple Darcy's law calculation shows that the minimum design liner will allow leachate to be breached (pass through) in a few months. It should have been obvious in the mid 1980's to landfill design consulting firms and regulatory agency regional board staff that the minimum liner design could not protect groundwaters from impaired use by landfill leachate pollution for as long as the wastes in the landfill would be a threat for those landfills sited where there were groundwaters hydraulically connected to the landfill. In California there are few landfills that have been developed since the mid 1980's that do not have high quality groundwaters that are vulnerable to landfill leachate pollution. The SWRCB 1995 SWAT report found, as expected, that landfills developed with the minimum Chapter 15 liner were polluting groundwaters as did the unlined landfills.

In 1993, the SWRCB was required by the US EPA to change the minimum liner design to a Subtitle D, single composite liner. While it should have been obvious to landfill design consultants and regional board regulatory agency staff that a minimum Subtitle D, single composite liner could not enable a landfill sited where there were vulnerable groundwaters hydraulically connected to the landfill to achieve Chapter 15 and now the SWRCB's Landfilling Policy requirements of groundwater protection, the regional board staff and landfill applicant consultants have perpetuated the myth that a minimum design Subtitle D landfill sited at any location would protect groundwater quality from impaired use for as long as the wastes in the landfill will be a threat. The wastes in a Subtitle D, "dry tomb" type landfill will be a threat to groundwater quality forever. The plastic sheeting layer in a composite liner has a finite period of time during which it can serve as an effective means of collecting leachate that is generated within a landfill so that it can be removed in a leachate collection system. Minimum design Subtitle D landfills sited at locations where the natural strata will not protect the groundwaters in the

vicinity of the landfill will, at best, postpone, for a period of a few years to tens of years, when significant groundwater pollution occurs.

Further, the incorporation of the plastic sheeting layer in the liner system makes the monitoring of landfill liner leakage by vertical monitoring wells spaced hundreds or more feet apart at the point of compliance for groundwater monitoring highly unreliable. Today's groundwater monitoring system for detection of landfill liner leakage at minimum Subtitle D landfills was developed for unlined landfills where leachate transport out of the landfill occurred at all locations under the landfill. It has been known since 1990 that the finger plumes of leachate that are produced through the initial leakage through a composite liner can readily pass between groundwater monitoring wells without detection. These monitoring wells typically have zones of capture of about one foot on each side. Therefore, for monitoring wells spaced hundreds of feet apart there is little probability that the initial leakage through the liner would intersect a monitoring well at the point of compliance. Therefore, not only will minimum Subtitle D landfills eventually pollute groundwaters in the vicinity of the landfill, but also this pollution will not likely be detected until the groundwaters at an offsite production well are polluted by landfill leachate.

This paper summarizes the significant problems that exist today in the development and regulation of minimum Subtitle D landfills in complying with Chapter 15/Landfilling Policy requirements of protecting groundwaters from impaired use for as long as the wastes in the landfill will be a threat. Emphasis in this paper is given to demonstrating the need for landfill proponents, design consultants and regulatory agency staff and boards to use the well-established information from the literature that demonstrates that today's minimum Subtitle D landfills represent a fundamentally flawed technological approach for MSW management if the groundwaters associated with the landfill are to be protected from pollution by landfill leachate for as long as the wastes in the landfill will be a threat. This paper also discusses alternative approaches for landfilling utilizing the "dry tomb" approach or the fermentation/leaching approach that will protect groundwaters from MSW leachate pollution for as long as the wastes are a threat.

Since 1989 Dr. G. Fred Lee has been president of G. Fred Lee & Associates, a specialty consulting firm located in El Macero, California. Prior to that time, for 30 years, Dr. Lee held university graduate level teaching and research positions in environmental engineering, where he conducted over \$5 million in research, some of which was devoted to landfill liner systems. He has been involved in investigating MSW landfill leachate pollution of groundwaters since the 1960's. He is frequently an invited lecturer on this topic and has presented short-courses on landfills and water quality protection issues. He has been involved in conducting site specific investigations at over 50 MSW landfills located in the US and other countries. His current work focuses on developing MSW management approaches that will enable the landfilling of the non-recyclable residues without eventually causing groundwater pollution. Dr. Lee is a registered professional engineer in Texas and a Diplomate in the American Academy of Environmental Engineers. He has established a web site: <http://members.aol.com/gfredlee/gfl.htm> where many of his papers and reports on MSW and hazardous waste landfill issues are listed and available as downloadable files.

References as: "Lee, G. F., 'MSW Landfilling in California in Under Subtitle D: Problems With Current Approaches and Suggested Alternatives,' Offered for presentation at the SWANA 2nd Annual Landfill Symposium, Sacramento, CA, August (1997)."