

**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.  
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Comments Submitted to CIWMB by  
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In November 2003 I provided comments (Lee 2003a) on the technically invalid approach that GeoSyntec, Inc., had proposed in the draft report for evaluating the environmental performance of California's municipal landfills. In December 2003 the California Integrated Waste Management Board accepted the final GeoSyntec report which contained the same technically invalid approach for evaluating the existing environmental performance of Subtitle D landfills.

In accordance with the request for public comments on the draft Phase I report by GeoSyntec Consultants, "Results of Screening Analyses of 224 California MSW Landfills," I provided the following comments on section 3.3, beginning on page 26 of the draft report. The December 2003 GeoSyntec final report contains the same wording.

Section 3.3 Indicators of Parameter Performance, 3.3.1 Approach and Assumptions, states in the second paragraph that a proper evaluation of the performance of a landfill's pollution of groundwaters, air, soils and surface waters would require site-specific evaluations of each landfill. GeoSyntec states that,

*"Additionally, the amount of data required to make such an assessment is well beyond the scope of this work. Recognizing that quantifying environmental performance is a complex and difficult for any given site, much less 224 sites at once, an alternative measure of environmental performance was required. For these analyses, the actions taken by the various regulators were used as an indicator of environmental performance. One duty that is entrusted to each regulator is to take action if certain environmental standards are not being met. Three principal assumptions must be made in order to use these types of regulatory actions as reliable indicators of environmental performance. The assumptions are as follows:*

- 1. The monitoring systems at each site (such as groundwater wells and gas probes) are located, monitored, and reported in such a way that the site regulators have an adequate picture of the actual environmental performance.*
- 2. The actions the regulators take are appropriate responses for actual environmental impacts. The assumption requires that when presented with the site-specific data, the regulator draws an appropriate conclusion and takes an appropriate action. For example, if there is strong groundwater monitoring evidence that a landfill is impacting*

*the underlying groundwater, then it is assumed that the RWQCB would issue a cleanup and abatement order or would require a corrective action program.*

*3. The actions that regulators take are relatively uniform across the state. For example, if leachate seeps are observed by one EA in northern California and a leachate control violation is issued, then an EA in southern California observing identical seeps would also issue an identical leachate control violation.*

*For this screening-level analysis, these three assumptions are reasonable.”*

I first became involved in California landfill matters and their compliance with regulations in 1954, when, as an undergraduate in environmental health sciences at San Jose State College, I took a course on landfilling of wastes. The course included visiting several landfills in the San Jose and San Francisco Bay areas. One of the striking features of the course was that a number of the landfills visited were not in compliance with such factors as providing daily cover of the wastes, controlling vermin and releases from the landfill, etc.

In the early 1980s, while I was a professor in the University of Texas system, I was asked to advise the California State Water Resources Control Board on the development of Chapter 15 governing the landfilling of wastes. I assisted the Board staff and a Board member in developing the regulations and gaining approval for them. In 1989, while I held a Distinguished Professorship in Civil and Environmental Engineering at the New Jersey Institute of Technology, I was asked by the Metropolitan Water District (MWD) of Southern California to review the potential for the BFI Azusa Landfill expansion in the San Gabriel Basin to lead to groundwater pollution.

The San Gabriel Basin Water Master had appealed the Los Angeles Regional Water Quality Control Board's permitting of the expansion of this landfill to the State Board. I was asked to testify on this matter at a State Board hearing in the fall of 1989. It was at this hearing that I learned from the State Board staff that there was a significant problem with the way in which the Regional Water Quality Control Boards were interpreting/implementing Chapter 15. They were assuming that one foot of compacted soil with a permeability no greater than  $10^{-6}$  cm/sec would comply with the Chapter 15 Performance Standard of preventing the pollution of groundwaters by landfill leachate for as long as the wastes in the landfill would be a threat. It should have been obvious to anyone with the most elementary knowledge of Darcy's Law that one foot of compacted soil with a permeability of  $10^{-6}$  cm/sec, under the one foot of leachate head that is allowed, would be penetrated by the leachate in a few months and, therefore, would violate the Performance Standard of Chapter 15 of protecting groundwaters from pollution by landfill leachate. This issue is being ignored by the Regional Board staff and Boards.

It was clear at that time that the Regional Board staff, without public review, had developed an approach for permitting of landfills, based on Chapter 15, which was technically invalid and did not protect groundwaters from pollution by landfill leachate from landfills developed under Chapter 15 regulations. The Regional Board staff assumed that the minimum liner design requirements of one foot of compacted soil with a permeability of less than  $10^{-6}$  cm/sec was the design requirement for all landfills that could be sited at any location in the State. This was never the intent of Chapter 15's liner design requirements. In fact, reading Chapter 15 makes it clear that the minimum design requirements are just that: minimum design. A site-

specific evaluation of the adequacy of design had to be made to be certain that the liner system (including monitoring, etc.) for a Chapter 15 approved landfill could comply with the groundwater protection Performance Standard set forth in Chapter 15 of preventing groundwater pollution by landfill leachate for as long as the wastes in the landfill would be a threat.

In connection with the review of the existing BFI Azusa Landfill, I reviewed the existing groundwater monitoring database that had been provided by BFI to the Los Angeles Regional Water Quality Control Board. I found that the quarterly monitoring data demonstrated that the existing landfill was already polluting groundwater. I testified to this effect at the State Board hearing on this landfill's proposed expansion. Also, the State Water Resources Control Board staff testified to this effect. However, the State Board, apparently for political reasons, chose to ignore our testimony and approve the expansion of the landfill. This caused MWD and the Water Master to appeal the State Board's decision to the courts. The courts eventually remanded the material back to the Los Angeles Regional Board, where, again, I testified that the existing landfill was polluting groundwater. The Los Angeles Regional Board had not acted on its data that it had been collecting for years on this landfill. The Board staff continued to deny that there was groundwater pollution by the landfill, even though I presented testimony on several occasions showing, from the groundwater monitoring data in their files, that the groundwater was polluted by the landfill.

A few years later, the US EPA, examining the same data set, concluded that the existing BFI Azusa Landfill was polluting groundwater with hazardous chemicals, and included it as one of the sources in the San Gabriel Valley Superfund site. This situation is just one example of many that have occurred, where the Regional Boards have not taken appropriate action in connection with their statutory regulatory requirement to act on groundwater pollution when it is first detected by the monitoring wells.

In the late 1980s, the State Water Resources Control Board, under the requirements of the State legislature for a solid waste assessment test (SWAT), conducted studies at many of the landfills in the State to determine whether they were polluting groundwaters. In the final report from the SWAT program, the State Board staff concluded that on the order of 90 percent of all the landfills in the State that had been evaluated were polluting groundwaters, and that, as expected based on Darcy's Law, the landfills that had been developed since 1984, when Chapter 15 was implemented, were polluting groundwaters, as were the unlined landfills that were developed prior to 1984. This clearly demonstrated that the approach that was used by the Regional Boards' staffs of assuming that one foot of compacted soil with a permeability of  $10^{-6}$  cm/sec would prevent groundwater pollution was technically flawed.

In connection with amending Chapter 15 to comply with Subtitle D, State Water Resources Control Board staff member H. Schueller, in his March 17, 1997, memo, indicated that it was the State Board's policy that the minimum Subtitle D liner requirements of a single composite liner would comply with the Chapter 15 (now Title 27) requirements of preventing groundwater pollution by landfill leachate for as long as the wastes in the landfill were a threat. When I asked the State Board, in a petition to the State Board in connection with the permitting of the University of California, Davis, landfill expansion, to review the appropriateness of this policy, the State Board did not act on the petition for a period of over four years. Finally, after

four years, I was notified that the time period for State Board review had passed, and the State Board had decided not to act on the petition. This is another example of how politics in the State controls regulation of landfills, with respect to compliance with Title 27 requirements. All of these issues are documented in my comments on my website, [www.gfredlee.com](http://www.gfredlee.com), in the Landfills - Groundwater section, or in reports that I can provide upon request.

During the past year, the Central Valley Regional Water Quality Control Board acknowledged that a single composite liner cannot protect groundwaters from pollution by landfill leachate for as long as the wastes in the landfill will be a threat, by requiring a leak detection system under part of the Subtitle D liner. However, there are still significant problems with the staff's interpretation of the regulations and technical issues associated with the expected performance of landfill containment systems.

As an example, during the past year I commented on the technical deficiencies of another proposed expansion of the University of California, Davis, landfill. The staff assumed, without a critical review or public input, that a single composite liner underlain by an FML under the base of the landfill would be protective, in accordance with Title 27 requirements. The leak detection layer under the base of the landfill was not extended up the side slopes of the landfill. It was assumed that there will be no clogging of the leachate collection system over the thousand or more years that the landfill leachate collection system will have to function properly. A detailed discussion of these issues is presented in Lee (2003b).

It is clear that the GeoSyntec approach of assuming that the regulatory agencies will support the regulations that exist is fundamentally flawed as a basis for judging whether landfills in California, permitted under Subtitle D, are complying with the regulations for groundwater quality protection.

I have been involved in a number of landfill reviews on behalf of water utilities and others who are concerned about protecting groundwaters from a proposed landfill expansion or a new landfill. I have repeatedly observed that landfill applicants and their consultants make unreliable claims about the protective nature of Subtitle D landfills. As discussed in my writings, in 1989 the US EPA concluded that the single composite liner systems would eventually fail, leading to releases of leachate to groundwaters. There is growing recognition that this will occur. However, statements are made by landfill applicants and their consultants that the landfill cover will prevent moisture from entering the landfill and generating leachate for as long as the wastes in the landfill will be a threat. This is obviously not true. In the same application landfill applicants and their consultants will assert that there is only 30 years of postclosure monitoring and maintenance required, even though the wastes in a "dry tomb" landfill will be a threat forever.

There is no issue about the fact that the wastes in a Subtitle D "dry tomb" landfill will be a threat to pollute groundwaters, effectively, forever. Nothing happens to these wastes under dry conditions. They simply remain in this plastic sheeting and soil-lined landfill until the containment system fails to prevent moisture from entering the landfill, and fails to collect the leachate that is generated from this moisture in a leachate collection and removal system. While landfill applicants will claim that they are able to maintain the cover, this is a superficial

statement, in that they are only talking about visually inspecting the topsoil layer of the cover for areas of erosion, cracks, etc., and then filling in the cracks or erosion areas with some additional topsoil. There is no provision, nor is there funding, to inspect and repair the low-permeability plastic sheeting layer in a Subtitle D landfill cover. This cover will, in time, fail to prevent moisture from entering the landfill, which will generate leachate and landfill gas, leading to groundwater pollution and gas emissions from the landfill.

In order for the GeoSyntec Landfill Compliance Evaluation to be a credible review of these issues, it must discuss these topics in a factual manner. If it fails to do so, it will be more of the unreliable information generated by landfill consultants whose primary source of income is supporting landfill applicants.

This problem of unreliable reporting on landfill containment system effectiveness is well known in the field. Several years ago I was asked by the American Society of Civil Engineers (ASCE) and the American Water Resources Association (AWRA), as well as several University of California extensions, to present short courses on landfilling issues. A short course that I presented in New York City was attended by a member of the ASCE Ethics Committee. After the presentation I was informed by this member that it was her experience that my assessment of the unreliable information that is typically provided by consultants on landfills' ability to protect groundwaters from pollution by landfill leachate for as long as the wastes are a threat was appropriate. I was asked to prepare a write-up on this for ASCE. I did this, and a summary of this write-up was published in ASCE *Civil Engineering Forum* (Lee and Jones-Lee, 1995), which discusses the problems with permitting landfills today. These problems include getting the regulatory agencies and the consultants to provide a technically valid assessment of the properties of landfilled wastes and the ability of landfill liner systems to prevent groundwater pollution for as long as the wastes are a threat.

With respect to GeoSyntec's assuming that the monitoring programs for Subtitle D landfills are adequate to comply with regulatory requirements, this is totally inappropriate for a minimum Subtitle D landfill. Those who understand these issues and reliably report on them know that Subtitle D groundwater monitoring is at best cosmetic. As discussed in the various papers and reports that Dr. Jones-Lee and I have developed on this matter, Subtitle D landfills will initially leak through small holes, rips, tears or points of deterioration in the HDPE liner. As Cherry (1990) pointed out, this situation will produce fingerlike plumes of leachate of a meter to a few meters in width at the point of compliance for groundwater monitoring. The Subtitle D regulations require that the groundwater monitoring program detect a variety of potential pollutants and other constituents derived from municipal solid waste leachate that are present in groundwater when they first reach the point of compliance. The point of compliance can be no more than 150 meters from the edge of the waste management unit and must be on the landfill owner's property.

The approach that is typically allowed by Regional Boards in permitting of Subtitle D landfills is to allow the landfill proponent to install vertical monitoring wells at the point of compliance at 100 to sometimes several hundred feet apart. Each monitoring well, under standard sampling approaches, collects water from about one foot on each side (the "zone of capture"). This means that there are large spaces between monitoring wells at the point of

compliance where leachate-polluted groundwater can pass and not be detected by the monitoring well system. To assume, as GeoSyntec proposes, that the current monitoring well approach for Subtitle D landfills will comply with monitoring requirements is totally inappropriate and reflects either a lack of understanding of this situation or a distortion of the information available. The situation that should be discussed in a credible discussion of Subtitle D landfill compliance is that there will certainly be offsite groundwater pollution by landfill leachate, for those landfills where the downgradient edge of the waste placement is near the property line, before the pollution of groundwaters is detected by the typical vertical monitoring well array that is allowed by the Regional Boards. This situation alone makes the GeoSyntec approach toward characterizing the performance of existing Subtitle D landfills technically invalid. .

Another aspect of the situation is that, with respect to Subtitle D landfills in California, if the two feet of clay that underlies the HDPE plastic sheeting liner is installed properly and desiccation cracking has not occurred to a great extent, then it would take about 25 years for leachate that penetrates the HDPE liner through holes, points of deterioration, rips or tears, to exit the clay layer. This is a simple Darcy's Law calculation based on one foot of head on the hole in the HDPE liner. Therefore, it is going to be a number of years (depending on the hydrogeology of the site) before the failure of the HDPE liner and the underlying clay layer in the composite liner will possibly be detected by vertical monitoring wells. The GeoSyntec report will be flawed if it does not reliably discuss this situation.

The only reliable conclusion from the GeoSyntec report is that minimum-design Subtitle D landfills developed in California will eventually pollute groundwaters and this pollution will likely spread well beyond the point of compliance before it is detected.

## **Overall**

Overall, the GeoSyntec approach for evaluating the performance of Subtitle D landfills is fundamentally flawed with respect to assessing the current and future groundwater pollution. It is obvious that it is not possible to rely on Regional Board reporting of groundwater pollution at Subtitle D landfills as a reliable indicator of existing pollution as well as the potential for future pollution.

It will be important that the California Integrated Waste Management Board not allow GeoSyntec, Inc., to produce a report that uses its proposed approach quoted above to evaluate the existing and especially the future performance of the landfill liner and cover, gas collection system, and groundwater monitoring system in protecting groundwaters from pollution by landfill leachate for as long as the wastes in the California Subtitle D landfills will be a threat. Failure of the CIWMB to require that GeoSyntec reliably report on the long-term (for as long as the wastes will be a threat) problems that minimum Subtitle D landfills have in protecting public health, groundwater resources and the environment will be a clear indication that this Board cannot properly investigate and report on the problems of today's MSW landfills.

If there are questions about these comments, please contact me. I urge that the CIWMB carefully review this situation so that it does not support the generation of a report by GeoSyntec that will be a waste of time and money on assessing the potential for groundwater pollution by Subtitle D landfills.

## References

Cherry, J. A., "Groundwater Monitoring: Some Deficiencies and Opportunities," Hazardous Waste Site Investigations; Towards Better Decisions, Lewis Publishers, Proc. 10th ORNL Life Sciences Symposium, Gatlinburg, TN (1990).

Lee, G. F., "Comments on the California Integrated Waste Management Board Landfill Facility Compliance Study (GeoSyntec draft report)," Submitted to California Integrated Waste Management Board, Sacramento, CA, November (2003a).

Lee, G. F., "Comments on University of California, Davis, Proposed Landfill Expansion," Comments Submitted to Tom Pinkos, Executive Officer, California Regional Water Quality Control Board, Central Valley Region, Sacramento, CA, by G. Fred Lee & Associates, El Macero, CA, March 24 and April 2 (2003b).

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 Forum*, 65:6 (1995).