

**Comments on GeoSyntec Consultants' Draft Report
"Landfill Facility Compliance Study Task 8 Report—Summary of
Findings and Comprehensive Recommendations"
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GeoSyntec Consultants has submitted draft reports presenting the results of the Landfill Compliance study that this firm has conducted for the California Integrated Waste Management Board (CIWMB). Presented below are comments on the Landfill Facility Compliance Study Task 8 Report (GeoSyntec, 2004).

Overall

Overall, this draft report on California landfills' compliance with regulatory requirements is not a credible discussion of many of the issues that should be discussed to reliably inform the CIWMB and others of the significant long-term environmental problems that exist with achieving compliance with California Title 27 regulatory requirements of preventing groundwater pollution by landfill leachate for as long as the wastes in the landfill will be a threat. GeoSyntec did not discuss well-known deficiencies in minimum design Subtitle D landfills' ability to prevent groundwater pollution during the time that the wastes in such a landfill will be a threat.

GeoSyntec's discussion and recommendations for several key areas of inadequate regulations and regulatory implementation by the Regional Water Quality Control Boards (RWQCBs) is unreliable. These issues are discussed in the Specific Comments section presented below.

This report is another example of the unreliable information that GeoSyntec presents on landfills, where they fail to discuss the ultimate failure of the landfill cover system to keep the wastes dry and of the liner and leachate collection system to collect all leachate that will be generated in MSW landfills for as long as the wastes in the landfill will be a threat. This report also fails to discuss the unreliability of the groundwater monitoring systems permitted by the California Regional Water Quality Control Boards to detect groundwater pollution by landfill leachate when the polluted groundwater plume first reaches the point of compliance for groundwater monitoring, as required by Title 27 and Subtitle D regulations. Further, the report fails to discuss the significant deficiencies in the current assured postclosure funding to address all plausible worst-case scenario failures of the landfill containment system and groundwater monitoring system that can occur for as long as the wastes in a landfill will be a threat to cause groundwater pollution and/or to generate landfill gas.

In our ASCE Civil Engineering Forum article on Environmental Ethics as applied to the development of landfills, Dr. Jones-Lee and I (Lee and Jones-Lee, 1995) have discussed the problem of consulting firms that generate income from landfill development reliably reporting on the long-term problems that today's minimum Subtitle D landfills will experience. This GeoSyntec report is another example of this problem.

The CIWMB needs to issue a contract to develop a reliable report on the long-term problems that today's Subtitle D landfills will have in meeting current Title 27 regulatory requirements of protecting groundwaters from pollution by landfill leachate during the time that the wastes in the landfill will be a threat.

Specific Comments

The specific comments presented below do not represent all of the specific comments that could be made about the unreliable information presented in the GeoSyntec Task 8 Report. They are, however, representative of the significant problems of the GeoSyntec Report being a credible discussion of existing and future landfills' compliance with landfill regulations.

GeoSyntec states on page 3, paragraph 1, in the Executive Summary (ES) of its draft report,

“This report represents the culmination of the California Integrated Waste Management Board’s (CIWMB) contracted Landfill Facility Compliance Study. This study is the most comprehensive cross-media inventory ever undertaken of California landfills, involving multiple regulatory agencies in measuring the overall environmental effects of MSW disposal in California.”

Further the first paragraph of the ES states,

“Phase I of the study consists of a comprehensive, cross-media inventory and assessment of the environmental performance of MSW landfills for the time period from January 1998 through December 2001. Phase II consists of an assessment of the effectiveness of current regulatory requirements for control of environmental impacts over time and identification of possible ways to improve regulations to provide for greater environmental protection.”

However, as discussed by Lee (2003a, 2004a), the GeoSyntec approach for evaluating the near-term and long-term protection of groundwater from pollution by landfill leachate is fundamentally flawed because of the way in which this study was conducted as it relates to the assumptions that GeoSyntec used in evaluating environmental compliance. GeoSyntec has repeated these assumptions on page 16 of the Task 8 Report:

“The assumptions were:

- 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. This 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.”*

The statement on page 17,

“The experiences of Phase I demonstrate that this type of simplified approach can provide a relatively uniform and effective measure of environmental performance that allows for the rapid analysis of a wide range of site characteristics with respect to environmental performance”

is not accurate. Lee (2003a, 2004a) has provided detailed discussions of the unreliability of these assumptions. GeoSyntec’s assessment of current and future compliance of existing minimum Subtitle D landfills to the Title 27 groundwater protection performance standard of protecting groundwater from pollution by landfill leachate is unreliable. As discussed by Lee (2003a, 2004a), it is not reliable to rely on regulatory agencies’ reporting of groundwater pollution by the landfill as an assessment of compliance with California Title 27 requirements of protecting groundwater from impaired use for as long as the wastes in the landfill will be a threat. Lee has documented several instances where regulatory agency staff have not reliably assessed existing groundwater pollution, the reliability of the groundwater monitoring system to detect existing groundwater pollution, and the potential of a proposed landfill to comply with Title 27 requirements of protecting groundwater from pollution.

GeoSyntec, in the Executive Summary of the Task 8 Report, presented two recommendations for improved regulation. One was the need for landfill gas migration studies during the active life of the landfill. The other was the need to conduct vadose zone monitoring for landfill gas migration that could lead to groundwater pollution. I support both of these recommendations. There is, however, need for regulatory guidance on properly evaluating the near-term and long-term performance of the landfill groundwater monitoring systems. Another important issue is the need to reliably evaluate the ability of the landfill liner and its associated leachate collection system and

landfill cover system to prevent groundwater pollution by landfill leachate for as long as the wastes in the landfill will be a threat.

A key issue that needs regulatory attention is the availability of postclosure funding for landfill monitoring and maintenance and for groundwater pollution remediation activities for as long as the wastes in the landfill will be a threat. At this time the RWQCBs and CIWMB are not reliably addressing these issues in the permitting of Subtitle D landfills in the State. Proper attention to these issues would show that the current approach for permitting landfills in California does not lead to protective landfills that will comply with Subtitle D and Title 27 requirements.

Page 19 states, in the section devoted to Water Quality Monitoring,

“Note that there are added complexities with respect to monitoring gas migration that would make monitoring gas more complex than it is for water. For example, molecular diffusion through even a composite liner will result, in time, in the presence of detectable concentrations of VOCs in soil-pore gas immediately exterior to the landfill liner. This is not a release, given that it is not being driven by a pressure gradient, yet such a “hit” could result in a regulatory response. A means for avoiding false-positive indications resulting from molecular diffusion would need to be developed prior to its implementation.”

It is inappropriate to consider molecular diffusion of landfill gas or leachate through a liner system as not a release of waste components or their degradation products, as stated by GeoSyntec. The issue that needs to be addressed is whether the molecular diffusion leads to groundwater pollution. Molecular diffusion of waste components and their transformation products through a liner is a function of the liner design and properties. It is possible to design liners and select materials that will significantly reduce molecular diffusion and its potential for associated groundwater pollution. While this issue has been understood for over 15 years, it is still not being adequately addressed in selecting liner materials and in liner design.

Page 20 states, in the section on Landfill Gas Monitoring and Control,

“Active landfills are more likely to have gas-related compliance issues than closed landfills.”

This statement is not necessarily true. Landfill gas migration problems will exist at today’s Subtitle D landfills for hundreds of years. As the crushed, but not shredded, plastic bags in which much of the garbage deposited in landfills today is placed decompose and thereby expose the waste to contact with infiltrating moisture, there will be additional landfill gas generation. It is highly likely, under the current regulatory approach, that there could be no or inadequate landfill gas collection and monitoring at the time that this occurs. This could lead to landfill gas public health and environmental problems. Lee and Jones-Lee (1999) have discussed the typical unreliability of landfill applicants’ and regulatory agencies’ predictions of the duration of landfill gas generation

in dry tomb type landfills where some of the waste components are allowed to be deposited in plastic bags that will not degrade for many decades.

Page 25 states, in the section on Base Liner System Regulations,

***“Double Liner Systems:** Recent studies [U.S. EPA, 2002] have found that Subtitle D compliant single composite liner systems can have a very high hydraulic efficiency and are capable of preventing adverse impacts on the environment.”*

US EPA’s assessment cited by GeoSyntec of the reliability of minimum Subtitle D landfills to protect groundwater from pollution by landfill leachate is based on an unreliable examination of the characteristics of municipal solid wastes (MSW) and the landfill liner systems typically used. There is no question that ultimately minimum Subtitle D landfills with a single composite liner will pollute groundwaters by landfill leachate if there are groundwaters hydraulically connected through a vadose zone to the base of the landfill. A critical review of the evolution of Subtitle D regulations and the US EPA’s current approach in support of these regulations shows that the Agency understood the deficiencies in the landfill liner systems being used. The US EPA (1988a), in its draft Subtitle D regulations stated,

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

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

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

As discussed in my writings, the US EPA was forced to issue Subtitle D regulations as a result of litigation by environmental groups. This led to the current Subtitle D regulations, where it was well understood that Subtitle D landfills would not be protective, and that groundwater pollution would occur. In recent years, however, the US EPA administrations have been trying to ignore the unreliability of the Subtitle D regulations in protecting groundwaters from pollution by landfill leachate. The Agency has gone as far as developing propaganda about the protective nature of landfills, which it posts on the Internet. Lee (2003b) has reviewed the unreliability of the Agency’s statements on the protective nature of Subtitle D landfills.

GeoSyntec staff have for years been claiming at landfill permitting hearings that a single composite liner will be “protective.” However, these claims are obviously technically flawed, since they do not adequately and reliably consider the characteristics of municipal solid waste in a dry tomb type landfill and the properties of landfill liner systems that are allowed today. These issues have been discussed in Lee and Jones-Lee

(1998a, 2004), and in other papers and reports on the Lee and Jones-Lee website, www.gfredlee.com.

GeoSyntec in its statement on the lack of need for double composite lined landfills has ignored the major benefit of a double composite liner system – i.e., improved reliability of detecting upper composite liner failure before widespread groundwater pollution has occurred. The state of Michigan has examined this situation and concluded that double composite lined landfills are needed because of the unreliability of groundwater monitoring associated with single composite lined landfills. This issue has been discussed by Lee and Jones-Lee (1998b) and in other papers on the Lee and Jones-Lee website.

Page 27 states, in the section on Site-specific post-closure period,

“It is recommended that the current regulatory 30-year minimum period may stay the same if prescriptive standards are added for leachate quality, landfill gas quality, water quality, and level of waste degradation, to evaluate the potential future environmental impact of a site.”

GeoSyntec has been claiming that it is possible to reliably predict/assess the period of time that a particular landfill will be a threat to generate landfill gas and leachate (see references cited in Lee, 2004b). However, as discussed by Lee (2004b), such claims ignore the processes that will take place in a Subtitle D landfill after it is closed. Chapter 15, now Title 27, regulations are explicit in requiring that a municipal solid waste landfill be protective of groundwater quality for as long as the wastes in the landfill are a threat. Since some of the municipal solid waste components that are potential pollutants will, in a dry tomb type landfill, be a threat to pollute groundwaters forever, the current 30-year postclosure funding requirement needs to be changed to require that a landfill owner have a dedicated trust fund established at the time of landfill closure to address all plausible worst-case landfill containment system failures for as long as the wastes in the landfill are a threat. These issues have been discussed in various Lee and Jones-Lee papers presented on their website, where references are provided to publications by governmental agencies and others on the deficiencies in current postclosure funding, such as by the US Congress General Accounting Office.

Skinner (2001), a former US EPA high-ranking official in the office of solid waste management and currently Executive Director and CEO of the Solid Waste Management Association of North America, has stated,

“The problem with the dry-tomb approach to landfill design is that it leaves the waste in an active state for a very long period of time. If in the future there is a breach in the cap or a break in the liner and liquids enter the landfill, degradation would start and leachate and gas would be generated. Therefore, dry-tomb landfills need to be monitored and maintained for very long periods of time (some say perpetually), and someone needs to be responsible for stepping in and taking corrective action when a problem is detected. The federal Subtitle D

rules require only 30 years of post-closure monitoring by the landfill operator, however, and do not require the operator to set aside funds for future corrective action. Given the many difficulties of ensuring and funding perpetual care by the landfill operator, the responsibility of responding to long-term problems at dry-tomb landfills will fall on future generations, and the funding requirements could quite likely fall on state and local governments.”

Further, Lee (2003c) has discussed the need for the California Integrated Waste Management Board to develop reliable postclosure funding mechanisms for today’s Subtitle D and other landfills.

Page 32 starts a discussion of Anaerobic Bioreactors. This section discusses the potential benefits of adding moisture to a landfill. It fails, however, to discuss the well-known problems with this approach, such as increased potential for groundwater pollution from minimum design Subtitle D landfills. Also of concern is that, unless the plastic bags of garbage are shredded so that moisture added to the landfill can readily interact with the wastes, the potential short-term benefits of bioreactor landfills will not be realized. Jones-Lee and Lee (2000) have discussed these issues.

Page 33, in the section on Alternative Base Containment Systems, states,

“Experience with the field performance of single composite liner systems (Bonaparte et al., 2002) indicates that liner leakage rates will be very small for MSW landfills with a single-composite liner system properly designed and constructed to minimum state and federal criteria with good CQA practices.”

As discussed by Lee (2002), the Bonaparte et al. assessment of the protective nature of single composite liners is based on a flawed characterization of the properties and reactions of municipal solid waste components in a dry tomb type landfill. It is claimed in the Bonaparte et al. report that all of the waste components that are potential pollutants in a municipal solid waste dry tomb landfill will only be a threat to cause groundwater pollution for a finite period of time. However, an elementary understanding of these issues shows that such a claim has no technical validity.

Further, the Bonaparte et al. report acknowledges that the plastic sheeting layers used in a Subtitle D landfill will eventually fail to prevent moisture from entering the landfill and to prevent leachate from leaving the landfill and polluting groundwater. However, this report claims that, since all of the waste components in a municipal solid waste dry tomb landfill will somehow decompose, disappear or otherwise no longer be a threat to pollute groundwaters, and since the projected period of time that the plastic sheeting layers in a minimum design dry tomb type landfill will maintain their integrity is longer than all the components in a MSW landfill will be a threat, today’s minimum design Subtitle D landfills will be protective of groundwater resources from pollution by landfill leachate.

The fundamental flaw with this assessment is that the approach used to project the period of time that the landfill liner system will prevent moisture from entering the landfill and

leachate generated in the landfill from passing through the liner and polluting groundwaters involves the use of the Arrhenius equation to extrapolate from a few years of laboratory-based studies conducted under conditions that are different from those that occur in a landfill, to 1,000 years in the landfill liner environment. Those who understand physical chemistry and free radical degradation of HDPE know that such extrapolations have little technical validity. The facts are that the wastes in today's municipal solid waste landfills will be a threat to cause groundwater pollution forever, and that the liner systems used in Subtitle D landfills have a finite period of time when they can function reliably to create a dry tomb that will be protective of groundwater quality. Therefore, groundwater pollution by Subtitle D landfills is inevitable for all landfills sited where there are groundwaters hydraulically connected through a vadose zone to the base of the landfill.

Page 36, in the section devoted to Leachate Recirculation, suffers from the same unreliable reporting as discussed above for bioreactor landfills, since it fails to discuss the potential problems with this approach.

Page 38 presents the GeoSyntec Task 8 Comprehensive Recommendations. As discussed above in the comments on the Executive Summary, these recommendations are appropriate with respect to additional landfill gas monitoring; however, these recommendations are seriously deficient in discussing several of the major problem areas with today's minimum Subtitle D landfills in providing a high degree of assurance of complying with the Title 27 requirement of preventing pollution of groundwater by landfill leachate for as long as the wastes in the landfill will be a threat. Specific recommendations should have been made in the following areas:

- **Liner Reliability.** There is need to provide regulatory guidance that requires that a landfill applicant and RWQCB reliably evaluate the ability of the landfill liner and its associated leachate collection system and landfill cover system to prevent groundwater pollution by landfill leachate for as long as the wastes in the landfill will be a threat.
- **Groundwater Monitoring.** There is need for regulatory guidance on properly evaluating the near-term and long-term performance of landfill groundwater monitoring systems. As part of permitting and closing Subtitle D landfills, the landfill applicant should be required to reliably evaluate the probability that a proposed groundwater monitoring system will detect leachate-polluted groundwater that arises from leakage from any location in the landfill liner system, when the polluted groundwater first reaches the point of compliance for groundwater monitoring. The RWQCBs should be required to evaluate the reliability of these predictions.
- **Landfill Cover Integrity.** Landfill owners and the RWQCBs should be required to reliably evaluate the approach that will be used to detect when the low-permeability layer of a landfill cover fails to prevent moisture from passing through this layer into the wastes, for as long as the wastes in the landfill are a

threat. Further, landfill owners should be required to specify what will be done to repair the low-permeability layer of the landfill cover when the cover no longer maintains its original design specifications for preventing moisture from entering the landfill.

- **Long-term Landfill Gas Generation Problems.** Landfill owners and RWQCBs should be required to evaluate the long-term threat that crushed plastic bags of garbage represent to be a source of landfill gas when the plastic bags eventually degrade. Of particular concern is how the landfill gas collection system will be maintained and operated for the long period of time that landfill gas generation can occur.
- **Postclosure Funding.** A key issue that needs regulatory attention is the availability of assured postclosure funding for landfill monitoring and maintenance and for groundwater pollution remediation activities for as long as the wastes in the landfill will be a threat. The amount of funding that will be needed should be based on a reliable evaluation of plausible worst-case landfill containment and monitoring system failures for as long as the wastes in the landfill will be a threat. For planning purposes, this should be considered to be forever.

Page 42 presents the References that GeoSyntec relied on to develop this report. A review of these references shows that they do not include important refereed literature on the issues discussed in the report, which shows that some of GeoSyntec's statements are technically invalid and inadequate.

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