

**Review of GAI Draft Report Devoted to Audit of Pottstown Landfill
Current Releases of Waste-Derived Chemicals to Water and
Recommendations for Evaluation of Closure Plan**

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The Pottstown Landfill Closure Committee (Committee) charged GAI with conducting an audit of current releases of waste-derived chemicals from the Pottstown Landfill. Drs. H. Cole and G. Fred Lee were requested to provide an independent review of the adequacy and reliability of the GAI audit. They were also requested to provide guidance to the Committee on Pottstown Landfill closure issues. Dr. Cole was primarily responsible for gas air quality issues and Dr. Lee, for groundwater, surface water quality issues and issues pertaining to the durability of cover, liner systems. Presented herein is a summary of Dr. Lee's findings and conclusions.

Approach

In conducting this assessment of releases of waste-derived chemicals from the Pottstown Landfill, Lee independently reviewed many of the same documents that GAI had reviewed, as well as others, on each aspect of water-related monitoring of the Pottstown Landfill, i.e., for releases to groundwater, surface water, etc. Dr. Lee's review included examination of not only the data and monitoring reports by Waste Management Inc. consultants, but also the expected reliability of the data and report conclusions.

It is concluded that GAI's conclusions regarding past and current releases of waste-derived chemicals from the Pottstown Landfill to water are generally appropriate.

At this time, and within the bounds discussed elsewhere herein, the landfill liner system that has been constructed since Waste Management assumed ownership of the landfill in 1984, appears to be functioning to prevent detectable releases of analyzed waste-derived chemicals to the underlying groundwater system.

Also, there have been no reported *detected* releases of analyzed waste chemicals or analyzed transformation products to surface waters in stormwater runoff from the landfill.

There is greater confidence in the conclusion regarding the lack of evidence of groundwater pollution by the post-1984 landfill because there are multiple lines of evidence, including composition of the groundwater as assessed by the groundwater monitoring wells and the volume of water (fluid) in the leak detection zone underlying

the composite liner for each of the landfill cells constructed since 1984. However, reliable groundwater monitoring at and near the Pottstown Landfill is difficult to accomplish because of the fractured rock aquifer system underlying the Landfill. The conclusion regarding lack of detected releases of waste-derived chemicals in stormwater runoff is more tenuous because of the less-comprehensive monitoring of stormwater runoff and its impacts. Releases of waste-derived chemicals could have occurred without being detected by the existing stormwater runoff monitoring system.

Adequacy of Groundwater Pollution Remediation from Old Landfill

The old, unlined and asphalt-lined Pottstown Landfill that was active prior to the 1980s has polluted groundwater to the south and southwest of the Landfill. This has resulted in the initiation of a remediation (pump and treat) effort to try to stop the spread of the pollution and to clean up the polluted groundwaters. It appears that the current remediation of the polluted groundwater from the old landfill and the former leachate storage lagoon is capturing the groundwater pollution plume and thereby halting the spread of the pollution. However, reliable groundwater monitoring at and near the Pottstown Landfill is difficult to accomplish because of the fractured rock aquifer system underlying the Landfill, making it difficult to rule out the possibility that not all the polluted groundwater is being captured.

It is unclear whether the old landfill is still releasing waste-derived chemicals that are polluting groundwaters. GAI did not provide sufficient detail on the design of the old landfill or its closure (presence or absence of liners and impermeable covers) to enable an understanding to be developed of the current situation with respect to the old landfill's continuing to pollute groundwaters. **However, it appears that the cover over the old landfill is not preventing entrance of moisture into the waste that leads to leachate generation and continued groundwater pollution.**

At the GAI presentation to the Committee on February 23, 2005, T. Kyper stated that the studies of the groundwater pollution by the old landfill showed that the pollution was "non hazardous," and as a result, the site was not placed on the list of Superfund (CERCLA) sites. The claim that the pollution of the groundwater is "non-hazardous" is not accurate. The groundwater pollution plume that developed to the south and southwest of the landfill contains chemicals that are known to be hazardous and a threat to human health when they are consumed in drinking water. Those familiar with how the US EPA places hazardous chemical sites on the NPL Superfund list know that this listing depends on a variety of factors other than the hazardous nature of the polluted groundwaters.

Landfill Gas Releases

While the issues of landfill gas releases are being covered by Dr. Cole in his separate report to the Committee, there are some aspects that interface with water quality. It is apparent that there have been releases of landfill gas, apparently from the old landfill, that have caused groundwater pollution by vinyl chloride, which is a known human carcinogen. There is no evidence that the pollution of the groundwater by landfill gas migration has gone beyond the polluted groundwater plume that is being remediated; no

additional pollution of groundwaters due to landfill gas migration has been detected by the groundwater monitoring well array used. However, reliable groundwater monitoring at and near the Pottstown Landfill is difficult to accomplish because of the fractured rock aquifer system underlying the Landfill. Thus, the fact that additional pollution arising from landfill gas migration is not evidenced by the monitoring does not mean that it is not occurring.

The GAI report is significantly deficient in discussing the releases of hazardous or otherwise deleterious chemicals in gaseous releases from the landfill; the release is evidenced by apparently frequent, strong offsite odors. Offsite landfill odors are an indication that hazardous and otherwise deleterious waste-derived chemicals are being released from the landfill to offsite properties. Since there has been inadequate control of gaseous releases from the landfill, it is possible that the pollution of groundwaters by landfill gas has occurred at other locations that have not been detected by the existing groundwater monitoring well array. Of particular concern is the potential for landfill gas migration in fractures.

Implication for Future Releases

The conclusion that there is no monitoring evidence that the post-1984 Pottstown Landfill is detectably polluting groundwater with waste-derived chemicals, does not infer that leachate pollution of groundwater will not occur during the postclosure period for the landfill. While GAI stated that the Pottstown Landfill conforms to regulatory requirements and standard engineering practice, that conformance does not ensure that there will not be long-term groundwater pollution problems at this Landfill. The Landfill will be a threat to the health, environment and interests of the Pottstown area residents during the postclosure period.

Unreliable Information on Postclosure Care Period

Repeatedly, GAI mentioned in its draft report that the postclosure period for the Pottstown Landfill is **30 years**. That statement is highly misleading and represents one of the most significant deficiencies in the GAI report.

GAI should have carefully reviewed the state of Pennsylvania landfilling regulations available on the PA website, and then accurately reported on the requirements for a landfill owner to provide postclosure care. These regulations are presented on the PA Code website,

http://www.pacode.com/secure/data/025/chapter273/025_0273.pdf.

PA Code 25 Chapters 273 presents the primary regulatory requirements for developing, operating, closing and postclosure care for landfills. Chapter 271 Municipal Waste Management General Waste Management General Provisions Scope section § 271.2 states,

“This chapter specifies certain general procedures and rules for persons who operate municipal waste management facilities. This chapter, together with Chapters 273, 275, 277, 279, 281, 283, 284 and 285, specifies the Department’s requirements for municipal waste processing, disposal, transportation, collection and storage.”

PA landfilling regulations do not have a 30-year limitation on postclosure care.

Additional Considerations Regarding Expected Performance of Pottstown Landfill

How Long Is Postclosure?

As part of conducting the independent audit/review of the chemicals released from the Pottstown Landfill, G. F. Lee and Anne Jones-Lee prepared a preliminary draft report on the expected performance of the Pottstown Landfill containment and monitoring systems to function as intended for as long as the wastes in the Landfill will be a threat. Since the Pottstown Landfill is constructed and operated as a “dry tomb” type landfill, where the wastes in the landfill are to be isolated from moisture, the postclosure period is likely to be effectively, forever. This is because without contact with moisture (the goal of the landfill cover), the landfilled wastes become dormant and do not produce landfill gas and leachate. As discussed by Christensen and Kjeldsen (1989), ideally, and as occurs initially at some landfills, when the low-permeability cover is installed, the rate of generation of leachate and landfill gas becomes very low, approaching zero. The landfill wastes remain dormant as long as they remain dry, i.e., for as long as the integrity of the cover is maintained. The longer the integrity of the cover is maintained, the longer the wastes will remain dormant and a threat to produce landfill gas and leachate. Thus, the integrity of the cover must be maintained for as long as the wastes are buried, because once the integrity of the cover is breached and moisture enters the buried waste, landfill gas and leachate will be generated. However, as discussed by Lee and Jones-Lee (2005a) cover integrity is difficult to ensure *ad infinitum*, and it is difficult to detect failure of the cover integrity before substantial moisture has entered the wastes and has generated leachate and landfill gas. The failure of the cover to keep the wastes dry for as long as they have the potential to develop leachate and/or landfill gas makes this landfill a threat to cause public health problems through leachate and gas releases and a threat to surface and groundwater resources as well and to have airborne releases that are detrimental to the interests of those in the sphere of influence of the landfill.

In all, the postclosure period issue of greatest concern, but the one least acknowledged in landfill planning, is the cessation of the dormant period, when the cover integrity is no longer adequately maintained and surveillance likely to be less than in the short-term. Lee and Jones-Lee (1991) described this situation in Figure 1. In 2004, the California Integrated Waste Management Board (CIWMB, 2004) presented the illustration shown in Figure 2. That rendering independently shows the same postclosure end-of-dormancy when landfill gas and leachate production resumes.

Waste Management has had, and continues to have, significant problems in installing and maintaining a low permeability cover over the closed parts of the Landfill as evidenced by continued leachate and landfill gas generation. The final draft of the Lee and Jones-Lee (2005b) report on the expected postclosure performance of the Landfill containment system (liner) and monitoring system (leak detection zones and groundwater monitoring

Figure 1. Comparison of Pattern of Landfill. Gas Generation over Time at Classical Sanitary Landfill and “Dry Tomb” Landfill
(from Lee and Jones, 1991)

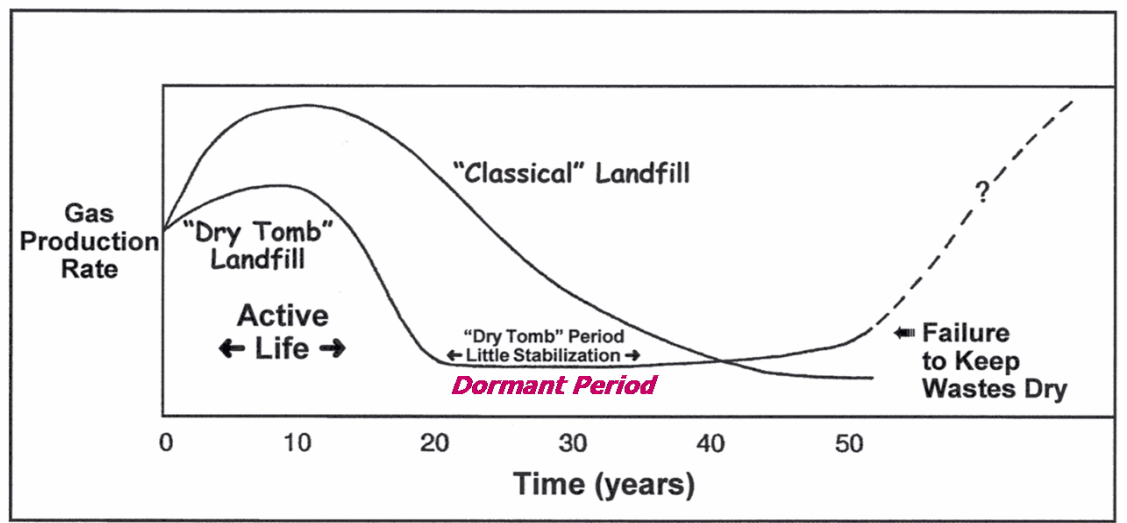
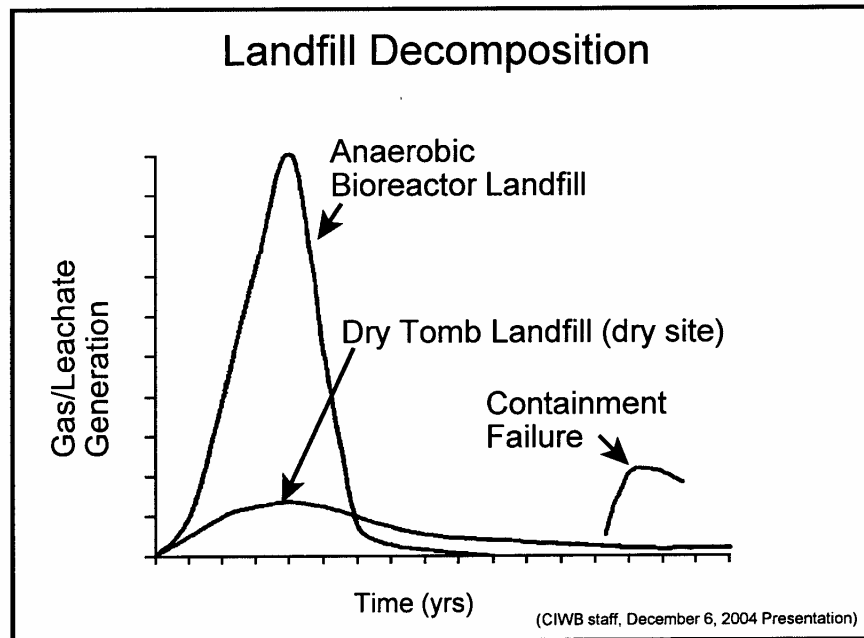


Figure 2. Potential Course of Stabilization in a Dry Tomb Landfill
(from CIWMB, 2004)



systems) provides detailed information on these issues. It is expected that a reviewable draft of that report will be presented to the Committee for its review in March or April, in advance of the Committee meeting so that the Committee members have time to review it before the meeting.

It is important to understand that even if the cover system is reliably and adequately maintained during the postclosure period, the liner and leachate collection systems, buried beneath the waste, will be deteriorating. Buried beneath the waste, they will not be amenable to inspection, maintenance and repair to maintain integrity and function. Even with extended-term maintenance of the integrity of the landfill cover, deterioration of the liner and other sub-waste systems will continue during decades and centuries after the “closure” of the landfill. To compound this overall deterioration in the isolation system (“dry tomb”), the ability of the monitoring systems (groundwater monitoring wells and leak detection zones) to reliably detect failure of the liner and offsite groundwater pollution will be diminishing. Thus, once the cover no longer functions adequately to keep the wastes dry, decades or even centuries in the future, the liner and monitoring systems will no longer offer protection of public health and the environment from effects of landfill gas and leachate.

In December 2004 the California Integrated Waste Management Board (CIWMB, 2004) held a Postclosure Funding Workshop. There, Caldwell (2004) of Waste Management’s corporate headquarters in Houston, TX made a presentation entitled, “Performance-Based System for Post-Closure Care at MSW Landfills,” in which he claimed that the end of leachate and landfill gas generation in a closed landfill could be readily assessed based on leachate and landfill gas generation rate monitoring data. However, as discussed by Lee and Jones-Lee (2004), the Caldwell (2004) discussion of this issue was based on an unreliable assessment of the course of waste decomposition in a US EPA Subtitle D dry tomb-type landfill. GeoSyntec, a private geotechnical consulting firm that typically works for private landfill developers, had made a similarly misleading presentation, also entitled, “Performance-Based System for Post-Closure Care at MSW Landfills,” at an Association of State and Territorial Solid Waste Management Officials Meeting (GeoSyntec, 2003). There, GeoSyntec had also provided unreliable information regarding the expected period during which postclosure care funding would be needed for dry tomb landfills. Lee (2004) commented on the unreliability of that information as well. Such claims, notably made by landfill owners and their consultants, are little more than self-serving propaganda; they reflect a deliberate, self-serving attempt to convince regulatory agencies that there is a determinable and finite postclosure period for dry tomb-type landfills, after which monitoring/maintenance funding is no longer needed. If regulatory agencies can be convinced of that, landfill owners can limit their responsibility and the amount of funding they need to provide for postclosure.

Landfill Design Problem Areas

In their review of the expected performance of the Pottstown Landfill containment and monitoring systems, Lee and Jones-Lee (2005b) mentioned several landfill design as problem areas. These include,

- failure of the leak detection zone to properly function for as long as the wastes in the landfill will be a threat; and
- potential failure of the bentonite clay liner due to cation exchange shrinking and cracking;

While these design problems were recognized and discussed in the late 1980s by some experts in the landfill development field, landfill regulatory agencies have allowed the development of such liner systems that were suspect with respect to long-term performance compared to other liner designs. The use of such suspect approaches further shortens the period of time that the liner and leak detection zone will function as intended in the postclosure period. These issues do not change the ultimate failure of the system, but do possibly impact how soon the failure occurs. As discussed in Lee and Jones-Lee (2005) there are serious deterioration problems associated with the Landfill containment and monitoring systems.

In addition, there is concern about the

- inability to reliably monitor groundwater pollution in the fractured rock aquifer system underlying the landfill; and
- inadequate landfill cover construction/maintenance to prevent moisture from entering the closed parts of the landfill that lead to excess leachate generation in what are believed to be closed sections of the Landfill.

Implications of Issuance of Certificate of Closure

One of the primary areas of concern with PA landfilling regulations is that DEP could issue a Certificate of Closure of the Landfill that would relieve Waste Management from further monitoring and maintenance of the landfill. Even if a Certificate of Closure is issued, PA landfill regulations enable to DEP to require that Waste Management be responsible for remediation of any groundwater pollution that occurs. However, if a Certificate of Closure is issued, it will be much more difficult to prevent the eventual failure of the landfill liner system to be detected before offsite groundwaters are polluted since there would be no groundwater monitoring. Detection of groundwater pollution would likely be detected by offsite production well pollution. It will be important that the Committee establish a review procedure with DEP that requires that a Certificate of Closure not be issued by DEP if the wastes in the Landfill can still generate leachate and/or landfill gas.

It needs to be openly recognized that Waste Management can, and should, be held responsible for Pottstown Landfill postclosure care and remediation of polluted groundwaters throughout the period during which the wastes in the Landfill are a threat to generate leachate/landfill gas. In order for the Committee to develop a program to address Pottstown Landfill releases that could occur during the postclosure period, it is suggested that the Committee consider the following actions.

- Have DEP make a presentation to the Committee on the details of the current PA landfill regulatory requirements for closing the Pottstown Landfill and for providing postclosure care for as long as the wastes in the Landfill are a threat to generate leachate and landfill gas.
- Have DEP discuss with the Committee the course of action that is anticipated to take place in developing and implementing a final closure plan for the Pottstown Landfill. The Committee should understand the points at which it can have input in developing the final closure plan and in the implementation of the postclosure

maintenance/monitoring (care) to adequately and reliably detect and control future releases of waste-derived chemicals that are hazardous or otherwise deleterious, so that the releases do not lead to significant offsite impacts to public health and the environment.

The Committee will need to carefully review the Landfill monitoring requirements that DEP establishes during the postclosure period to be certain that comprehensive landfill monitoring is maintained for ground water pollution prevention. While some reductions of some aspects of groundwater monitoring well monitoring may become justified, such as the frequency of monitoring of some parameters, the overall current monitoring program must be maintained and, as discussed below, expanded in some aspects.

Possible Changes in the Current Closure Plan

Based on a review of the currently adopted Pottstown Landfill Closure Plan, there are several aspects of the current water quality monitoring plan that need to be modified. One is that there is need to conduct chemical analysis of the water (fluid) that is collected in the leak detection zones for the landfill. At this time, the volume of the water that is collected in the leak detection zones is recorded, but no chemical analysis of this water (fluid) is conducted. The current approach will detect large-scale failure of the liner but may not detect initial failure of the liner. Analysis of the leak detection zone fluid for selected landfill leachate parameters could provide an indication of initial failure of the composite liner. The closure plan should be modified to require selected monitoring of each of the leak detection zones fluids.

Addressing Complacency

Because, as discussed above, there will likely be a dormant period early in the postclosure period when little or no leachate and or landfill gas is generated, DEP and the Committee could become complacent and lose vigilance for indications of landfill liner failure. The Committee may wish to try to modify the current closure plan to include the provision for funding continued third-party independent monitoring of the Pottstown Landfill containment system maintenance and monitoring data. The third-party monitoring would not replace the DEP responsibility for regulatory oversight of the Pottstown Landfill, but supplement it. The third-party monitoring should be paid for by Waste Management but report directly to the Committee with copies to DEP and Waste Management. The monitoring would be done by a contractor that is selected by the Committee with concurrence of DEP. This approach would give the Committee confidence that adequate attention is being given to Pottstown Landfill maintenance and monitoring.

March/April Committee Meeting

Lee's presentation at the March/April Committee meeting will focus on highlighting issues that the Committee may want to consider as part of reviewing the adequacy of the Landfill closure plan, previously approved by DEP, in addressing the long term threat that this Landfill represents to public health and the environment for as long as the wastes

in the Landfill are a threat to generate leachate and landfill gas. As part of developing a final closure plan for the Pottstown Landfill, there is need for the Committee to examine the full range of postclosure issues that can arise during the time that the wastes in the Landfill will be a threat. It is suggested that the Committee work with DEP to address these issues to ensure, to the maximum extent possible, that the necessary precautions/actions are in place to protect public health and the environment for as long as the wastes in the Landfill will be a threat.

References

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