Developing Protective Landfills

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During my testimony and cross examination at the January 14, 2013 Alberta Canada Environmental Appeals Board hearing on the approval of the Thorhild landfill, I discussed reasons that the site proposed for the Thorhild landfill is not geologically suitable for a landfill of the type proposed. The site does not provide for natural protection of groundwater quality and public health for as long as the wastes in the landfill would be a threat; and the features of the proposed landfill do not compensate for the unsuitability of the site. Wastes in a landfill will be a threat to public health and groundwater quality for as long as for as the wastes in the landfill, when contacted by water, can generate leachate containing chemicals that are hazardous or otherwise deleterious to public health or groundwater quality. The presence of leachate in a groundwater renders that water unsuitable for use for domestic and other purposes.

A member of the Appeals Board requested additional information about the development of MSW landfills at geologically unsuitable sites, i.e., sites that do not provide natural protection of groundwater quality and public health for as long as the wastes in the landfill would be a threat. I indicated that under some circumstances it should be possible to develop an MSW landfill at certain geologically unsuitable sites and still provide protection of groundwater quality and public health for as long as the wastes in the landfill will be a threat. I summarized my writings on this issue for the Board, and below.

Since long before the US EPA Subtitle D landfill regulations were promulgated, advancing the lined and covered "dry-tomb" landfilling of municipal solid waste, I have been involved in research and assessment of various aspects of the management of solid wastes for the protection of public health and environmental quality. I have discussed in many applications, inadequacies in provisions and implementation of Subtitle D regulations, and standard dry-tomb landfilling practice for ensuring protection of public health, groundwater/surface water quality, and the interests of those in the sphere of influence of interest of a landfill for as long as the wastes represent a threat. I have also discussed issues that need to be properly addressed so that MSW landfills can be developed, maintained, and funded to provide long-term protection, and suggestions as to how those issues could be faced and handled. A summary of our writings in these areas is presented in our "Flawed Technology" review:

> Lee, G. F., and Jones-Lee, A., "Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste," Report of G. Fred Lee & Associates, El Macero, CA, December (2004). Last updated October (2012).
> http://www.gfredlee.com/Landfills/SubtitleDFlawedTechnPap.pdf

In response to the Board member's question about developing protective landfills, I made reference to three of our paper/reports. One was:

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/Landfills/LFoverviewMSW.pdf

That report discusses why the current minimum design, operation, closure and postclosure monitoring/maintenance, and groundwater remediation requirements for plastic-sheeting and compacted-clay-lined and covered ("dry tomb") landfills will not be protective of public health and the environment for as long as the wastes will be a threat. That report also discusses how MSW landfills developed under Subtitle D can be modified to improve the protection of public health and environmental quality.

The incorporation of a properly constructed double-composite liner with a leak detection layer between the two liners would provide more reliable early detection of liner breaches, before groundwater pollution occurs. When leachate is found in the leak detection layer, repairs would need to be made in the landfill cover to stop the penetration of water through the cover that can generate leachate. Rather than trying to rely on groundwater monitoring wells spaced a hundred or more feet apart at the point of compliance for groundwater monitoring to signal cover and liner breach (as is typically the case under minimum Subtitle D requirements), the failure of the upper composite liner would be detected by the presence of leachate in the leak detection layer, before groundwater is polluted. This approach, however, requires that adequate postclosure funding be available for landfill monitoring and maintenance for as long as the wastes in the landfill will be a threat, i.e., as long as they could generate leachate. To prevent crushed plastic bags in the waste from hiding wastes from moisture till the plastic bags decompose, the MSW would need to be shredded prior to landfilling. While such provisions could be readily implementable, their inclusion would increase the cost of MSW disposal several fold; those costs should be borne by those who generate the wastes that are disposed of in the landfill.

Another approach for developing more protective landfills is to abandon the US EPA allowed dry-tomb landfilling approach in favor of treating the wastes in a landfill equipped with a double composite-liner system (two plastic-sheeting/clay liners) with a leak detection system between the liners. Treatment would be accomplished by shredding the wastes, exposing them thoroughly to water to accelerate and optimize fermentation of fermentable components of the waste and to leach the leachable components, and rinsing the residues thoroughly with clean water until the rinse water had removed all leachable components. This treatment would have to be accomplished during the period of time that the liner system can be expected to contain/collect all leachate. Once the wastes no longer had the potential to leach hazardous and otherwise deleterious chemicals, the treatment would be complete and the wastes would no longer pose a threat. This approach is discussed in the following paper, reference to which was also provided to the Board:

Lee, G. F. and Jones-Lee, A., "Landfills and Groundwater Pollution Issues: `Dry Tomb' vs F/L Wet-Cell Landfills," Proc. Sardinia '93 IV International Landfill Symposium, Sardinia, Italy, pp. 1787-1796, October (1993).
http://www.gfredlee.com/Landfills/Fermentation-Leaching-Sardinia.pdf

That paper also discusses why the currently allowed leachate recycle (bioreactor) landfilling approach in a minimum-design single-composite-lined landfill with monitoring wells spaced hundreds of feet apart does not afford reliable, long-term protection and can, in fact, lead to even greater groundwater pollution than a conventional Subtitle D landfill.

The third reference provided to the Board members was:

> Jones-Lee, A. and Lee, G. F., "Appropriate Use of MSW Leachate Recycling in Municipal Solid Waste Landfilling," Proc. Air & Waste Management Assoc. 93rd annual national meeting Salt Lake City UT paper 00-455 CD ROM Pittsburgh, PA, June (2000). http://www.gfredlee.com/Landfills/leachatepapsli.pdf

That paper discusses the addition of leachate back into the shredded wastes during the fermentation and leaching phase to enhance fermentation of the decomposable organic wastes to produce landfill gas. With the inclusion of such leachate recycle with the aforementioned wet-cell approach, it is crucial that the fermentation/leaching be followed with thorough rinsing of the residues with clean water without rinse water recycle.

A proper fermentation/wet-cell waste treatment approach in a proper landfill would create a stable MSW residue within a decade or so that would not be a threat to cause groundwater pollution or landfill gas pollution of the area of the landfill.

Also key to developing a protective landfill is the maintenance of adequate landfill-owner-owned buffer lands between waste processing/disposal areas and adjacent property lines. While Subtitle D and many other associated regulations require a few feet of buffer land, typically about 1to 2 miles of buffer land owned by the landfill owner is necessary for the dissipation of odorous releases to prevent trespass of waste-derived chemicals onto adjacent property. As discussed in our "Flawed Technology" review cited above, landfill odours not only are highly noxious but also pose a health threat. Typically landfill proponents try to minimize the amount of landfill-owner-owned buffer land. They also tend to inflate the appearance of land buffering capacity offered by the landfill by focusing attention on distance between the waste deposition areas and the nearest exiting home, rather than between the waste deposition areas and the nearest adjoining property line. Their approach uses adjacent property for the dissipation of odours and other releases from the landfill, and thus uses others' property to expand the landfill "buffer land." Such appropriation of others' land reduces the value of adjacent property and contributes to justified NIMBY sentiment. The owner of property adjacent to a landfill should be able to use his/her property up to the property line without impact by releases from the landfill. All buffer lands should be on property owned by the landfill owner, and enforcement of landfill odour controls should be implemented at the adjacent property line.

These and related issues are discussed in detail in the cited references. Lee, G. F., and Jones-Lee, A., "Flawed Technology of Subtitle D Landfilling of Municipal Solid Waste," Report of G. Fred Lee & Associates, El Macero, CA, December (2004). Last updated October (2012). http://www.gfredlee.com/Landfills/SubtitleDFlawedTechnPap.pdf. Questions on these landfilling approaches can be directed to Dr. G. Fred Lee at gfredlee33@gmail.com.