Disposal of Contaminated Sediments/Soils in MSW Landfills: Need to Consider the True Cost[1]

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ABSTRACT
A disturbing trend among governmental agencies is the remediation of so-called "non-hazardous" contaminated sediments/soils by deposition in minimum-design Subtitle D municipal solid waste landfills or landfills with equivalent design. This is done despite the fact that in terms of protection of public health and environmental quality, the designation "non-hazardous" is misleading at best, and the fact that minimum-design Subtitle D landfills as being allowed, will not ensure protection of groundwater quality for as long as the buried wastes remain a threat. Although acknowledged in the regulatory documentation and exposed in the writings of a few in the scientific/engineering community, the environmental and public health issues that will inevitably be faced at minimum-design Subtitle D landfills are underplayed, and even misrepresented, to the public. Discussion of relevant issues, as well as remarkable omissions, characterized the October 2004 USACE/USEPA/SMWG conference, "Addressing Uncertainty and Managing Risk at Contaminated Sediment Sites." This paper addresses many of those neglected issues.

INTRODUCTION

Many Superfund and other hazardous chemical sites contain contaminated soils, and some, contaminated aquatic sediments, that are hazardous to public health and/or the environment. If those solids are deemed to be a "hazardous waste" based on US EPA testing procedures, they must be deposited in a US EPA Subtitle C hazardous waste landfill. However, frequently Superfund and other hazardous chemical sites contain soils, aquatic sediments, and/or mine tailings that are not classified as "hazardous wastes" based on US EPA testing procedures, but are, nonetheless, hazardous to public health and or the environment.

There is a disturbing trend among state governmental agencies and the US EPA of including landfilling at a minimum-design Subtitle D municipal solid waste (MSW) landfill in the remediation plans for such so-called "non-hazardous" contaminated sediment and soils. For

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example, in several instances, the US EPA and a state regulatory agency have teamed up to dispose of PCB-contaminated sediments in municipal Subtitle D landfills. This has been proposed for the remediation of PCB-contaminated sediments from the upper Fox River in Wisconsin, and potentially for sediments from the Hudson River in New York state. In pursuing this approach, a rural community is typically approached to become the host for contaminated sediment in an existing or to-be-developed "municipal" landfill or landfill of equivalent design. The host community is "assured" by the regulatory agencies that the pollutants in the contaminated sediment or soil will be contained in the landfill and will not lead to contamination of the area near the landfill. The prospective host may be further enticed by payment of a modest fee per ton of contaminated sediment landfilled to accept the "non-hazardous" waste in a landfill in their area.

This approach to "remediating" contaminated sediments/soils is problematic on several fronts. What is not revealed in the promotion of this approach is the whole truth about the nature of "non-hazardous" waste and municipal solid waste, and the ability of a minimum-design Subtitle D landfilling containment system to secure contaminants for as long as they remain a threat. It is this whole truth about the environmental and public health protection truly afforded by minimum-design Subtitle D landfilling systems as they are permitted for MSW and industrial solid wastes, that continues to be glossed over, distorted, ignored, and indeed misrepresented, although acknowledged in the regulatory documentation and in the writings of a few in the scientific/engineering community.

There is a mistaken belief that because municipal solid wastes only contain "non-hazardous" waste, MSW landfills pose no real threat to public health or environmental quality. However, has discussed by Lee and Jones-Lee (2004a), the way in which the US EPA classifies a solid waste as "hazardous waste" or "non-hazardous waste" allows substantial amounts of hazardous and otherwise deleterious chemicals to be legally placed in municipal solid waste landfills. The result is that MSW landfill leachate contains a variety of hazardous chemicals that are a threat to human health and the environment. It also contains large amounts of conventional pollutants that can themselves render a groundwater unusable for domestic and many other purposes. Thus, while sediments/soils slated for "remediation" in a Subtitle D MSW landfill may meet the technical description of "non-hazardous waste," they cannot be considered innocuous, lacking hazardous chemicals, or lacking the potential to cause significant adverse impacts on public health or environmental quality. The environmental and public health issues that inevitably will be faced at minimum-design Subtitle D landfills may be exacerbated by the incorporation of sediments/soils derived from Superfund/hazardous chemical sites that are classified as "non-hazardous."

USACE/USEPA/SMWG JOINT SEDIMENT CONFERENCE

In October 2004, the USACE/USEPA/SMWG Joint Sediment Conference devoted to "Addressing Uncertainty and Managing Risk at Contaminated Sediment Sites," was held in St.

Louis, MO. A number of the presentations at that conference pertained to the issue of "remediating" contaminated sediments by placing them in MSW landfills. (PowerPoint slides of the presentations are available at http://el.erdc.usace.army.mil/training.cfm?Topic=Workshop&List=04oct-ccs) The last day of the conference was devoted to economic aspects of managing contaminated sediment. Logan and McShea (2004) presented a paper entitled, "The Role of Tradeoffs in Sediment Management." L. Evison, staff member in US EPA headquarters for the Superfund Program, presented a paper entitled, "Dollars and Sense in Risk Management Decision Making." While the speakers discussed some of the economic aspects of alternative approaches for management of contaminated sediment, they failed to discuss the potential long-term costs associated with landfilling of so-called "non-hazardous" contaminated sediments in municipal solid waste landfills. As discussed below, of particular concern are the postponed remediation costs associated with the ultimate failure of the landfill cover and single composite liner that the US EPA allows in current minimum-design MSW Subtitle D landfills, and the ultimate groundwater pollution created by those failures. While those costs were not considered, as discussed by Lee and Jones-Lee (2004a, b) they can be substantial. Several individuals at the conference, including representatives of the Corps of Engineers, were critical of the US EPA Superfund Program for its failing to include the long-term costs of managing contaminated sediments in landfills as part of the cost-evaluation of landfilling alternatives for contaminated sediments.

In their work, the authors have seen this disregard of the full costs of the landfilling that is incorporated into remediation plans. For example, the authors serve as the US EPA-supported Technical Assistance Grant advisors to the public on the adequacy of site investigation and remediation at the Lava Cap Mine site. That site is a National Priority List Superfund site with large amounts of mine tailings that contain high levels of arsenic and other heavy metals that are considered to be hazardous to public health and the environment. The soils and sediments derived from streams and a lake at that site must be remediated in order to protect public health and the environment; however, owing to the US EPA's approach for waste classification, they are classified as "non-hazardous waste." US EPA (2004) Region 9 has proposed the disposal of arsenic- and other heavy metal-contaminated sediments/soils from the Lava Cap mine tailings area at a minimum-design Subtitle D landfill In making that selection, the US EPA opted for the lowest cost remediation approach, without proper regard to the long-term costs of the ultimate failure of the landfill containment system. This option, while initially cheaper, will pass part of the true long-term costs of remediation of the site to the State of California and local political jurisdictions. A true long-term-cost evaluation could lead to selection of an alternative remediation approach as the most cost-effective. A review of the Lava Cap situation has been presented by Lee and Jones-Lee (2003). Additional information on the Lava Cap Mine Superfund site remediation is available at http://www.gfredlee.com/phazchem2.htm#lava.

In his paper at the Addressing Uncertainty and Managing Risk at Contaminated Sediment Sites conference, entitled, "The Need for Comparative Net Risk Evaluation (CNRE) - Steps Toward

Resolution," J. George of Alcoa specifically discussed the need to include long-term landfilling costs in evaluating the true costs of managing contaminated sediment by landfilling (George, 2004). There was considerable discussion by participants in the conference about the inadequacies in the approach being followed by the US EPA Superfund Program, US EPA Regions and state agencies in their evaluation of the costs of contaminated sediment management by landfilling; they consider only the short-term costs and ignore the long-term costs associated with inevitable failure of the landfill containment systems.

PROBLEMS WITH SUBTITLE D LANDFILLS

Dr. G. F. Lee has been involved in investigating groundwater pollution by municipal and industrial landfills since the mid-1960s. He has conducted university research on landfill liners composed of compacted soil/clay and plastic sheeting, and has reviewed numerous landfill-specific situations. He and Dr. Anne Jones-Lee have published extensively on deficiencies in the US EPA Subtitle D "dry tomb" landfill minimum design standards that preclude the ensured prevention of groundwater pollution by landfilled wastes for as long as the wastes in the landfill will be a threat. They have addressed these issues in a comprehensive review of the "Flawed Technology of Subtitle D Landfilling" (Lee and Jones-Lee, 2004a). That review includes a detailed discussion of the various mechanisms that are recognized to contribute to the failure of single-composite landfill liners. While focused primarily on landfilling of municipal solid waste, the Lee and Jones-Lee (2004a) discussion is also relevant to the issues of managing contaminated sediments/soils and mine tailings in minimum-design Subtitle D landfills.

As discussed by Lee and Jones-Lee (2004a), Subtitle D sets forth a "dry tomb" approach to landfilling and establishes minimum design standards for it. These minimum design standards specify a plastic sheeting and compacted clay composite liner and a cover, which are intended to entomb the wastes to keep them dry and separate from groundwater and other aspects of the environment. Also established is a groundwater monitoring requirement intended to detect groundwater pollution by the landfilled wastes before widespread pollution has occurred. However, as currently developed and allowed, minimum-design Subtitle D "dry tomb" landfills will be a threat to groundwaters forever. At some time in the future the cover will deteriorate sufficiently to allow moisture to enter the landfill; that will led to the development of leachate in the landfill. Through imperfections present from the outset, liner deterioration over time, and chemical permeation, the liner system will eventually allow the leachate to pass through it. Where there is groundwater hydraulically connected to the base of the landfill, the leachate will pass through the vadose zone to the groundwater.

The initial leakage from a plastic sheeting lined landfill will produce finger-like plumes of leachate, rather than as a broad front. The groundwater monitoring systems and well arrays typically approved by federal and state landfill regulatory agencies incorporate vertical monitoring wells spaced hundreds to a thousand feet apart at the point of compliance for groundwater monitoring. Such systems are inadequate for detecting incipient finger-plumes of

groundwater pollution from a lined landfill; widespread groundwater pollution is likely to have occurred before it is detected in the monitoring system. Once an aquifer is polluted by landfill leachate, the polluted area cannot be reliably remediated and is lost for many beneficial uses.

The designation of waste as "non-hazardous waste" and the inoffensive label of "municipal solid waste" can be very misleading with regard to the potential threat posed by such materials to public health and environmental quality. In reality, such wastes can contain substantial amounts of hazardous and otherwise deleterious chemicals that pose significant threats to groundwater quality. Many of the hazardous and deleterious components of MSW and other "non-hazardous waste" do not disappear or become innocuous over time. Thus, the longer the wastes in a "dry tomb" landfill are kept dry, which is the goal of "dry tomb" landfills, the longer the inevitable failure and groundwater pollution is postponed. While claims are made that "dry tomb" landfills will be cared for to maintain their integrity, maintenance is required and planned for only for 30 years after closure. This is an infinitesimal portion of the time that the buried materials will be a threat. Further, the significant problems inherent in identifying weakness or failure of landfill covers or liners buried beneath hundreds of feet of waste are discussed by Lee and Jones-Lee (2004a).

In addition to the discussion of Subtitle D landfilling issues in Lee and Jones-Lee (2004a), the authors have also published discussions of issues and potential problems specifically associated with remediation of Superfund and hazardous chemical sites by landfilling (Lee, 2003; Lee and Jones-Lee 2000, 2003, 2004b). As discussed in those writings, minimum-design Subtitle D landfills will eventually become "Superfund" sites; large amounts of money will be required to clean up groundwaters polluted by them. Those who place contaminated sediments in minimum-design Subtitle D MSW landfills or landfills of equivalent design could ultimately be held responsible for paying millions to tens of millions of dollars for groundwater remediation. Those costs are part of the true cost of remediation of contaminated sediments/soils and tailings disposed in Subtitle D landfills.

MAKING LANDFILLS BETTER

Lee and Jones-Lee (2004a) discussed ways in which landfilling can be practiced to provide greater protection of groundwater quality. Generally, this cannot be done with the minimum design allowed under Subtitle D. Lee and Jones-Lee (2004a) recommend that MSW landfills be constructed with double composite liners with a leak detection layer between the two composite liners. In this way, it should be possible to detect the failure of the upper composite liner before leachate leaves the landfill. The landfill failure can be addressed while the groundwater has the protection of the lower liner. This approach can greatly reduce the long-term liability for funding of remediation of polluted groundwaters. The additional cost of landfilling in a double composite lined landfill is a few tens of dollars per ton of landfilled wastes. That cost, as well as the costs associated with rehandling the wastes and remediation of the landfill leakage, must be

considered as part of the true costs of landfilling of wastes and protecting public health and environmental quality.

At this time several states (e.g., New York, New Jersey, Pennsylvania) will not allow a single composite-lined landfill to be developed for MSW because of the inevitable failure of composite liners. The state of Michigan, for example, adopted the requirement for double composite lined municipal solid waste landfills because of the unreliability of conventional groundwater monitoring.

Additional information on Subtitle D landfilling issues that should be considered for disposal of "non-hazardous" contaminated sediments/soils and tailings in MSW landfills is provided at www.gfredlee.com in the Landfill Groundwater section.

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