

## Developing Landfills that Protect People:

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# The True Costs

*It's time to review the role of permitting authorities in guaranteeing that use permits address many of the significant long-term challenges faced by owners of Subtitle D landfills.*

**G. Fred Lee Ph.D. and Anne Jones-Lee Ph.D.**

Typically, new or expanded MSW landfills are sited, designed, operated, closed, and receive post-closure care equivalent to the minimum required under current EPA Subtitle D regulations. Critical review of the characteristics of MSW and the properties of the landfill containment and monitoring systems in use, however, shows the process to be unsuitable where usable groundwaters are hydraulically connected to the base of the landfill. While these landfill sites typically are investigated to demonstrate that the natural geology of the area provides inadequate protection of the groundwater resources from pollution by landfill leachate, most sites are not adequately investigated to define how rapidly pollution of the underlying aquifer will occur once leachate penetrates the liner system. Usually it is only a matter of time once the liner system fails until offsite groundwater pollution occurs.

Under current federal and state regulations, a minimum Subtitle D landfill can be permitted at almost any location despite potential impacts of odors, dust, litter, LFG, and leachate on the surrounding area. In many parts of the US, elected officials must approve siting of such facilities as landfills, establishing conditions for their development and operation.

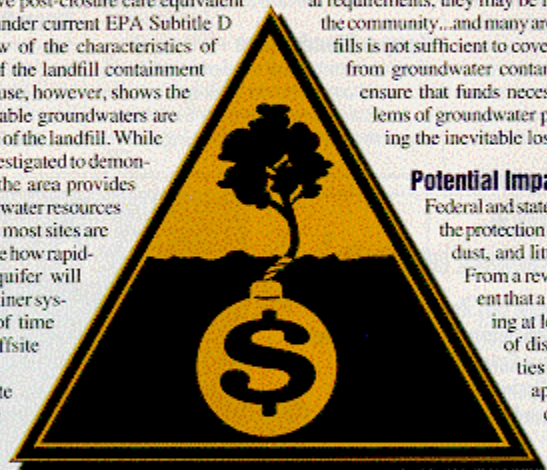
While these permits must comply with minimum state and federal requirements, they may be more protective of the interests of the community...and many are. However, income at many landfills is not sufficient to cover potential liability claims arising from groundwater contamination, and regulations do not ensure that funds necessary to address long-term problems of groundwater pollution will be available following the inevitable loss of containment integrity.

### Potential Impacts of MSW Landfills

Federal and state regulations do not always address the protection of adjacent property against odors, dust, and litter releases from MSW landfills. From a review of such problems, it's apparent that a buffer—at many landfills extending at least one mile—between the edge of disposal areas and adjacent properties is required. Thus, prospective applicants should allow for adequate buffer lands during their site selection process. The cost of the buffer lands should be factored into the cost of development.

operating the landfill. Use permits should stipulate that if odors, dust, litter, etc. reach adjacent property, landfill owners must develop operating approaches, including curtailment of operations at certain times. Permitting authorities should require compensation for property owners adversely impacted by the landfill at no less than the fair market value for the property in the absence of a landfill, plus compensation for expenses and hardships incurred.

**Pest Impacts.** While some people may call odorous, dusty, or littered conditions on adjacent properties an aesthetic problem, these conditions also can pose significant health hazards—particularly



### Potential Impacts of Subtitle D Landfills

- Groundwater and Surface Water Quality Impairment: public health, economics, aesthetics
- Migration of Methane and VOCs: public health, explosions, toxicity to plants and animals
- Illegal Roadside Dumping and Litter near Landfill: aesthetics, public health, economics
- Truck Traffic: highway safety
- Noise: nuisance, public health
- Odors: nuisance, public health
- Dust: nuisance, public health
- Windblown Litter: aesthetics, public health
- Vectors, Insects, Rodents, Birds: nuisance, public health
- Condemnation of Adjacent Properties for Many Future Uses
- Impaired View
- Decreased Property Values

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Federal and state regulations do not always address the protection of adjacent property against odors, dust, and litter releases from MSW landfills. From a review of such problems, it is apparent that a buffer--at many landfills extending at least one mile--between the edge of disposal areas and adjacent properties is required. Thus, prospective applicants should allow for adequate buffer lands during their site selection process. The cost of the buffer lands should be factored into the cost of developing the landfill. Use permits should stipulate that if odors, dust, litter, etc. reach adjacent property, landfill owners must develop operating approaches, including curtailment of operations at certain times. Permitting authorities should require compensation for property owners adversely impacted by the landfill at no less than the fair market value for the property in the absence of a landfill, plus compensation for expenses and hardships incurred.

**Pest Impacts.** While some people may call odorous, dusty, or littered conditions on adjacent properties an aesthetic problem, these conditions also can pose significant health hazards--particularly where rodents, birds, and/or insects are attracted to the area. Similarly, offsite dust migration associated with the operation can be a source of PM<sub>10</sub> particles, which are known to present respiratory and other health hazards.

**Truck Traffic Impacts.** The use permit should require that the landfill owner control the garbage truck traffic to the landfill so that it does not interfere with normal traffic of the area. Further, the landfill owner should be required to upgrade and maintain those roads to handle the increased traffic.

**Surface Water Impacts.** Direct surface water impacts associated with stormwater runoff from the landfill can be a source of water pollutants. In addition to the potential for direct surface runoff from the landfill, there is a potential for airborne transport of waste to the waters. While there are USEPA stormwater runoff

monitoring requirements for landfills, it has been found that many regulatory agencies are not necessarily requiring verified, adequate monitoring.

The use permit should require that a more comprehensive surface water monitoring program be carried out during the active life and post-closure care period than is normally conducted at municipal landfills. This should include comprehensive monitoring of the potential for airborne transport of waste-derived constituents to nearby surface waters.

## **Post-Closure Care**

EPAs Subtitle D baseline landfill is a dry-tomb enclosure made of plastic sheeting and compacted soil that in theory will keep the wastes dry forever (or at least for as long as they are a threat to the environment). Regulations require owners to provide assured funding for post closure care for only 30 years with the added proviso that this period may be extended if necessary. Few, however, question the need to extend the post-closure care funding until all wastes have stabilized--an indeterminate period of time if containment is maintained. As it stands, liability for the site rests with the jurisdiction responsible for its development or permitting beginning in year 31 after closure, with little likelihood that adequate income remains to continue post-closure care funding. It is important that the permitting authorities recognize the situation and make provisions for the contingency in the body of the use permit.

**Landfill Gas Control.** While Subtitle D requires that LFG emissions be controlled through the development of a collection system, there is no assurance that such a system will be maintained for as long as the wastes can produce gas. In older landfills with permeable soil covering, LFG production takes place for 30 to 40 years in wet climates and for longer in arid climates.

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In dry-tomb landfills, LFG production is governed by the amount of moisture entering during operations. Following installation of the final cover, there will be a period of time in which gas production is limited by a lack of moisture. With the inevitable deterioration of the low-permeability cover, gas production will resume. Accordingly, permits should require owners to establish

dedicated funds derived from disposal fees that are sufficient to ensure operation and maintenance of gas collection, monitoring, and management systems for as long as its wastes can generate gas. As with leachate, there should be no limit to the time such funds are available.

Regulations covering LFG emissions--especially the hazardous components--are deficient compared to the regulation of these same components in other sources. Until more stringent rules are in place, however, local regulatory agencies are obligated to protect the public interest by requiring incorporation of state-of-the-art LFG monitoring and management systems. Regulations should require owners to monitor LFG flares and other combustion processes for hazardous components, and if excessive concentrations are found, require them to control releases below levels posing threats to public health and the environment.

## ***"First, even the best liner and leach ate collection system will ultimately fail due to natural deterioration"***

**Groundwater Pollution.** In promulgating Subtitle D regulations, EPA's Solid Waste Disposal Criteria (August 30, 1988) stated, "First, even the best liner and leachate collection system will ultimately fail due to natural deterioration, and recent improvements in landfill containment technologies suggest that releases may be delayed by many decades at some landfills." In its Criteria for Municipal Solid Waste Landfills (July 1988), EPA concludes, "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."

While in the late 1980s the landfilling field was just beginning to understand the deficiencies of a single composite liner system in protecting groundwaters from leachate, today these deficiencies are well understood. Still only eight states (or parts thereof) have recognized this problem and require double composite-lined systems. Moreover, while geocomposite clay liners are allowed by many regulatory agencies, the potential for liner failure because of minor structural stresses raises questions about their reliability. The purpose of the second composite liner under a leak detection system is to serve as the base for this leak detection system. The primary containment liner would still be the minimum Subtitle D liner. While addition of a geosynthetic clay system to the uppermost liner is to be encouraged, it should not be viewed as a replacement for minimum requirements. Several years ago the State of Michigan recognized the unreliability of traditional groundwater monitoring being used for Subtitle D landfills, and adopted the double composite-lined system for its landfills as part of improving the monitoring of liner leakage. This is the approach that should be used at a proposed landfill.

**Funding of Additional Protection.** Permitting authorities should require owners to dedicate trust funds of sufficient magnitude (based on anticipated revenues from disposal fees) to provide for all plausible worst-case scenario failures that could occur at the proposed sites, including the need for waste exhumation and proper waste residue management. For planning purposes, the period of the trust fund should be assumed to be infinite. These dedicated funds should be used in part to monitor for leakage through the uppermost composite liner. When such leakage is found, funds should be available to restore the dry-tomb character of the landfill.

Post-Closure Use of Buffer Lands. It would be practical to use the one-mile buffer lands for other purposes after the landfill is closed. Caution should be exercised, however, about the development of residences and nearby structures because of the LFG migration problem. Further, it would not be advisable to constrict wells within this buffer area. This could change the hydraulic gradient and accelerate the transport of leachate-polluted groundwaters should the above-described landfill containment and monitoring systems fail to function as expected.

## **Implementation**

Local agencies charged with use permit compliance oversight--often local health departments--typically are limited in their ability to address detailed Subtitle D landfill issues. Since local authorities cannot rely on state agencies to protect their interests, they should require applicants to provide adequate funds for acquisition of staff with the necessary expertise for proper oversight. Much of this work could be done under contract with private consulting firms that would not have a conflict of interest arising from working for landfill applicants. Part of the funds set aside in the dedicated trust could be allocated to this purpose.

## **Independent Third-Party Monitoring**

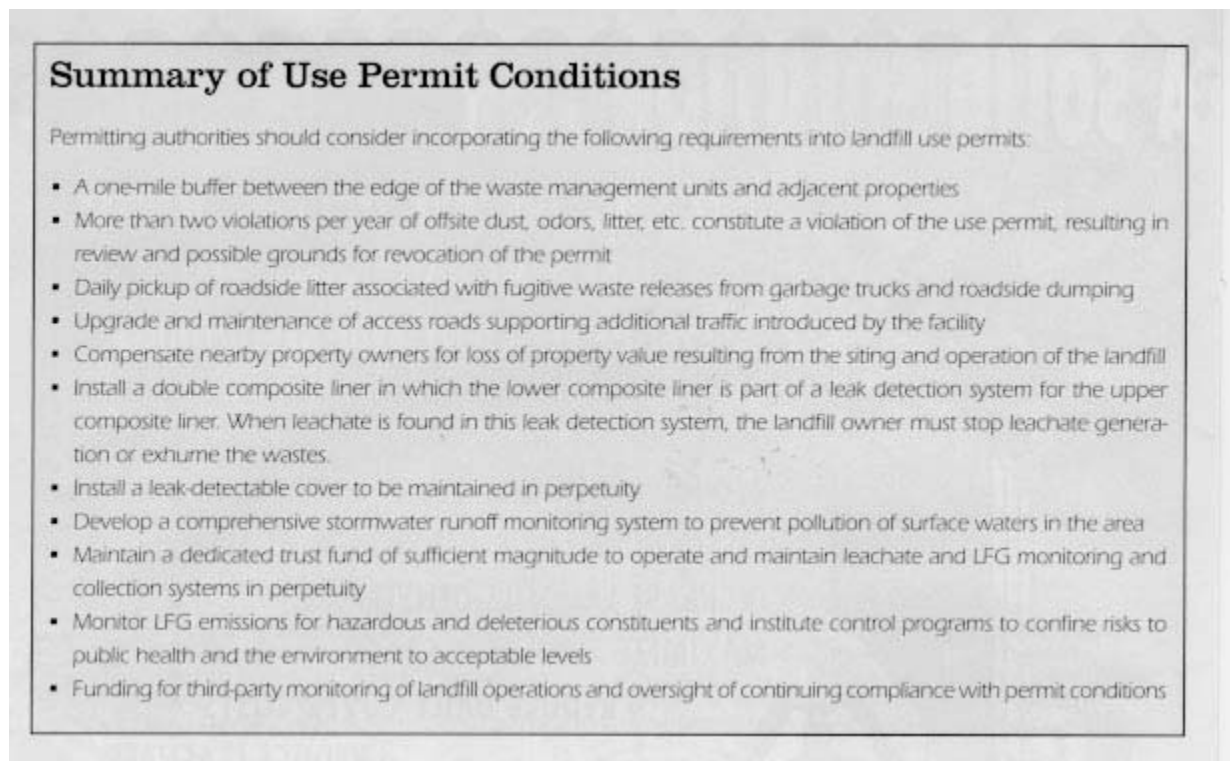
In order to protect the public interest, the permitting authority should require independent third-party monitoring to be supported by the landfill applicant. For a proposed landfill, the county board of supervisors should require that the landfill applicant develop a dedicated trust fund from disposal fees. Ideally this would generate sufficient income in perpetuity to ensure that there are adequate funds for those potentially impacted by the landfill to have a team of experts conduct independent monitoring of the landfill operations for as long as the wastes represent a threat. This would require several hundred thousand dollars per year income from the trust. This independent monitoring, while paid for by the landfill applicant, would be conducted by individuals who would report directly to a committee representing the

potentially impacted public and local regulatory agencies. This monitoring, however, would not eliminate the need for the landfill owner and the regulatory agencies to conduct the current, at least minimum, monitoring requirements set forth in Subtitle D and any other applicable regulations.

## Financial Considerations

Court decisions limiting the ability of waste authorities to practice waste flow control has increased competition among landfills. This, in conjunction with increased rail and long-haul activity has forced many local and small to mid-size regional landfills to lower tipping fees, exacerbating problems already associated with below-real-cost garbage disposal. Under such conditions, many landfills lack the ability to cover legally mandated closure and post-closure care costs, much less establish trust funds to ensure adequate long-term care. Since it appears unlikely that flow control will be reinstated in the near future, permitting authorities should carefully evaluate the availability of adequate funds to close an existing landfill in accordance with regulatory requirements. **MSW**

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**Summary of Use Permit Conditions**

Permitting authorities should consider incorporating the following requirements into landfill use permits:

- A one-mile buffer between the edge of the waste management units and adjacent properties
- More than two violations per year of offsite dust, odors, litter, etc. constitute a violation of the use permit, resulting in review and possible grounds for revocation of the permit
- Daily pickup of roadside litter associated with fugitive waste releases from garbage trucks and roadside dumping
- Upgrade and maintenance of access roads supporting additional traffic introduced by the facility
- Compensate nearby property owners for loss of property value resulting from the siting and operation of the landfill
- Install a double composite liner in which the lower composite liner is part of a leak detection system for the upper composite liner. When leachate is found in this leak detection system, the landfill owner must stop leachate generation or exhumate the wastes.
- Install a leak-detectable cover to be maintained in perpetuity
- Develop a comprehensive stormwater runoff monitoring system to prevent pollution of surface waters in the area
- Maintain a dedicated trust fund of sufficient magnitude to operate and maintain leachate and LFG monitoring and collection systems in perpetuity
- Monitor LFG emissions for hazardous and deleterious constituents and institute control programs to confine risks to public health and the environment to acceptable levels
- Funding for third-party monitoring of landfill operations and oversight of continuing compliance with permit conditions

Condensed from: Lee, G. F, and Jones-Lee, A., "*Development of a Potentially Protective Landfill: Issues Governing the True Cost of Landfilling*," Report of G. Fred Lee & Associates, El Macero, CA, July (1997).

For additional information, a copy of the original paper, and/or references to the backup literature, contact the authors' website:  
<http://www.gfredlee.com>

# EDITOR'S COMMENTS

John Trotti

## What Evils Lie Beneath the Surface

Finding an iceberg on the cover of a solid waste magazine might seem a little strange to some, but we could think of no better way to call attention to a situation we feel screams for attention...the true (and mostly hidden) costs of MSW landfills. Were not opposed to the bulk of Subtitle D requirements. However, there are several areas we feel need redress--including those having to do with monitoring, long-term care, and financial responsibility--all to which we will be paying close attention in this and subsequent issues. Particularly, I would like to call your attention to the article entitled "Developing Landfills that Protect People: The True costs" by Drs. C. Fred Lee and Anne Jones-Lee that, in essence, amounts to our firing a waning shot over the bow. In the future--to carry the analogy a step further--well unlimber the main batteries and fire for effect at notions such as that a dry tomb environment can be maintained forever, or that we should be passing on an open-ended liability to generation x.

There are those who feel that Subtitle D was drafted for the aid and comfort of a few, large, private-sector waste management companies. The argument is put forth that not only did design and construction requirements provide them with increased business opportunities by driving smaller landfills out of business, but that the 30-year limit to financial responsibility offered these owners the opportunity (with a bit of paper shuffling) to walk away clean, effectively sticking the public with an unfunded liability. While we do not subscribe to this cynical view, we agree with the conclusion that the public is at risk of becoming the "stuckee" when containment eventually breaks down. Whether this takes place 31 or 310 years after closure is beside the point, which is that those who get to pay for the cleanup--you and your kids--are not going to be as concerned over how they got into the mess as to where the moneys going to come from.

Already were hearing from managers who are getting nervous because their waste has gone into privately-owned (and now closed) landfills in which the 30-year clock is already running. It may comfort some to hope that courts in the future will decide that liability for the landfill and its contents extends beyond the mandatory postclosure care period, and that the ABC Waste company will be responsible forever, but prudence suggests otherwise. Even if you can find the current landfill owner after 30 years, what is there to suggest that funds will be available to cover the cost of remediation when the containment breaks down?

The solid waste manager of a mid-sized city shared with me his frustration at being at the mercy of just such a situation. "Were the deepest pocket in the area so I know were on the hook forever," he lamented. "Not only do I not have a clue as to what's gone into the site, but I'm totally out of the loop until the postclosure care period is up." Worse still, when he tried to explain to his city council the nature and magnitude of the present threat (in the hope they would see that the safest course for the future lay in taking control of the entire process from collection to disposal), they went ahead and re-signed with the same outfit as before at another of its landfills.

Thus the cover. We think that today's competitive tipping fees are scaled to that portion of an iceberg you can see. You may not want to think about what lurks beneath the surface, but your descendants will hold you in higher regard if you do.