Comments on Deficiencies in the Morrow County Board of Health's "Additional Terms and Conditions" for Issuing a License to Washington Environmental Ltd. for the Proposed Washington C&DD Landfill

Comments Prepared by
G. Fred Lee, PhD, PE, DEE
G. Fred Lee & Associates, El Macero, CA 95618
Ph: (530)753-9630 Em: gfredlee@aol.com
www.gfredlee.com

June, 2006

In the winter of 2006 a group citizens requested that I review the potential public health and environmental impacts of the proposed Washington and Harmony C&DD landfills that are to be developed in Morrow County, OH. This led to the development of a report,

> Lee, G. F., "Improving Public Health and Environmental Protection from the Proposed Morrow County C&DD Landfills," Report of G. Fred Lee & Associates, El Macero, CA, February 14 (2006). http://www. gfredlee.com/Landfills//CDD-LF-Improvement.pdf.

Initially the Morrow County Board of Health disapproved the applications for these landfills. Subsequently, the Morrow County Board of Health established "Additional Terms and Conditions" and issued a license to Washington Environmental Ltd. for development of the Washington C&DD landfill. Information on these issues is available on the County's website, http://www.morrowcountyhealth.org/page.aspx?ID=142647.

I have reviewed the Board of Health's "Additional Terms and Conditions" with respect to their adequacy for protection of public health, groundwater resources and the interests of those in the sphere of influence of the proposed landfill. Presented below are issues of concern regarding the Morrow County Board of Health's "Additional Terms and Conditions" for issuing a license to Washington Environmental Ltd. for the proposed Washington C&DD landfill.

A. Leachate Recirculation

The fundamental problem with the Morrow County Board of Health's proposed approach for allowing leachate recirculation is that the proposed landfill design, with a liner consisting only of two feet of compacted clay with a maximum permeability of 10^{-6} cm/sec, is not a type of landfill where leachate recirculation should be allowed, based on increased potential for groundwater pollution. This liner will allow rapid leakage of leachate through it that will lead to groundwater pollution. Increased leachate amounts on the liner will lead to increased rates of liner leakage and groundwater pollution. As discussed by Jones-Lee and Lee (2000) and Lee and Jones-Lee (2006), leachate recirculation should only be practiced in those landfills that have a double composite

liner consisting of HDPE and two feet of compacted clay for each liner, with a leak detection system between the two composite liners.

Another reason to restrict leachate recirculation at the proposed Washington C&DD landfill is the potential for the increased moisture in the landfill to lead to increased hydrogen sulfide production. The US EPA (2005), in their draft "Guidebook: Hydrogen Sulfide Prevention & Control at Construction and Demolition Debris Disposal Facilities," recommends against leachate recirculation because of increased H_2S production.

Leachate Collection System and Management. The Board of Health's A.2 requirement for preventing the blockage and clogging of leachate collection systems is not necessarily possible to achieve. Such leachate collection systems can become blocked in such a way as to not be able to become unblocked by actions of the landfill owner.

Item A.3 specifies analysis for sulfite. Does the Board mean sulfide? It is unlikely that sulfite will be present in landfill leachate.

Item A.5 states, *"The owner or operator shall manage, re-circulate and/or dispose of leachate in accordance with applicable regulations."* This requirement should have included the words "and be protective of public health, groundwater resources and the environment."

H_2S Odors. Item A.6, requiring the Licensee to *"at least daily … determine whether hydrogen sulfide gas odors can be detected at the limits of the disposal area,"* is not adequate to insure that the owner/operator will reliably attempt to detect hydrogen sulfide odors.

Under A.8, an additional item should be required in the log book that indicates whether H_2S odors were detected at the limits of the disposal area (as required by item A.6).

Item A.8 requires that leachate recirculation be suspended <u>after</u> hydrogen sulfide or other gases are detected and *"… poses a nuisance, causes an offensive odor, or poses a threat to the public health or safety or the environment …."* This reactive (<u>after</u> the adverse impact) approach can be strongly adverse to the health and interests of nearby property owners/users. This approach could allow for significant adverse health impacts on sensitive individuals <u>before</u> the Board of Health takes action to protect their health. The Board of Health should have established requirements for landfill siting (including adequate buffer lands) and gas emission control that would have required that Washington Environmental Ltd. develop a landfill that would not be adverse to nearby property owners/users through gaseous emission trespass onto their properties. This proactive, protective approach is in accord with the Board of Health's Mission:

> "*… to promote, protect and provide for the optimal personal and environmental health of the Morrow County General Health District."*

The final condition in A.8 that leachate recirculation can be resumed once *"… any offensive odor, nuisance or threat to the public health or safety or the environment is eliminated"* is another inappropriate approach, in that even though Washington Environmental Ltd. will have demonstrated that it cannot control hydrogen sulfide and other gaseous emissions, the Board of Health is proposing to allow them to resume leachate recirculation, which can lead to the same problems again. Since it is possible to manage leachate without recirculation – through collection (to the extent possible) and offsite treatment – this is the approach that should be used. This is the standard approach used at many other landfills.

Overall, the Morrow County Board of Health's "Additional Terms and Conditions" for managing the adverse effects of leachate recirculation is grossly deficient and contrary to protecting public health, welfare and the environment.

D. Protection of Public Health and the Environment

With respect to D.1, where the Board of Health requires that litter be collected only once a week, this is inadequate. Washington Environmental Ltd. should be required to police all nearby areas daily and collect all litter. Why should the owners/users of properties near the landfill have to experience litter for a week before it is removed?

D.2, with respect to mud removal, needs to define what the Board means by *"timely manner."*

D.3, which allows waste to be visible to offsite individuals for a week before being covered, is inadequate. The wastes should be covered each day.

F. Field Tiles

The requirement for removal of all drainage tiles raises an important issue about the potential for groundwater pollution at the site. An evaluation needs to be made as to whether a site which has drainage tiles in order to remove near-surface groundwaters is a suitable site for a proposed landfill.

G. Conformance to HB 397

It is possible that the Ohio EPA's rules for implementing HB 397 will specify <u>minimum</u> conditions, which at the proposed site for the Washington landfill, will not be protective. Under these conditions, it would be necessary to impose more restrictive conditions on the development of this proposed landfill than the minimum conditions adopted for implementation of HB 397.

Since the implementation rules for HB 397 will be applicable to the Washington C&DD landfill, and since it is likely that the Ohio EPA will significantly strengthen the design, operation, closure and postclosure care requirements for C&DD landfills over those that exist now, so that they more closely approximate conventional municipal solid waste landfills, it is appropriate to provide, as a primary reference for the application of HB 397 to the proposed Washington landfill, the Lee and Jones-Lee (2006 now 2007) "Flawed

Technology" review. This review provides a discussion of many of the issues that need to be considered in developing landfills of any type, including C&DD landfills.

K. One Hundred Foot Setback

One of the most significant errors made by the Morrow County Board of Health in developing the compromise "Additional Terms and Conditions" is allowing Washington Environmental Ltd. to deposit C&DD wastes up to within 100 feet of an adjacent residential property line. One hundred feet of property owned by the landfill owner is grossly deficient in providing adequate buffer lands for dissipation of waterborne and airborne releases of hazardous and deleterious chemicals and waste components from a landfill. Airborne and waterborne releases from landfills have been measured at over a mile from the landfill. Requiring only 100 feet of buffer land will clearly lead to trespass of pollutants released from the landfill onto adjacent properties.

Further, it is inappropriate for the Morrow County Board of Health to potentially allow Washington Environmental Ltd. to deposit wastes closer than 100 feet from adjacent property if the property is considered to be nonresidential. Owners/users of adjacent properties should be able to use these properties at their property line for whatever purpose is determined to be appropriate without experiencing adverse impacts of the landfill. What might now be considered to be nonresidential property could become residential in the future. Washington Environmental Ltd. should not be able to restrict the use of adjacent properties because of the existence of its landfill.

As discussed by Lee and Jones-Lee (2006, now 2007), inadequate buffer lands is one of the most important reasons for justified NIMBY ("not in my back yard") by those potentially impacted by a landfill. Morrow County Board of Health is allowing Washington Environmental Ltd to use adjacent properties to dissipate the impacts of hazardous and deleterious chemical and waste releases from their landfill, thereby exposing adjacent property owners/users to adverse impacts to their health, groundwater resources, air quality and interests. Morrow County Board of Health should have required that an independent study of the buffer lands required to dissipate the potential releases be conducted so that adjacent property owners/users' health, groundwater resources, air quality and interests would be fully protected from the proposed Washington landfill. The results of these studies would then be used to establish protective buffer lands (setback) between where wastes are deposited and adjacent property lines.

L. Acceptance of Mobile Homes

Since mobile homes may contain a wide variety of hazardous and deleterious chemicals, each mobile home accepted should be tested for hazardous and deleterious chemicals in each of its components, to ensure that the mobile homes do not contain chemicals that could be adverse to the environment through releases from the landfill.

M. Testing of Production Wells on Adjacent and Nearby Properties

The Morrow County Board of Health's "Additional Terms and Conditions" requirement for testing of drinking water wells within 1,000 feet of the facility's property has several

significant deficiencies. These include restricting the testing to a limited number of drinking water wells within this distance. Agricultural and other wells should also be tested, in order to protect animals and crops. The 1,000-foot distance is inadequate to protect adjacent property owners/users from Washington landfill's pollution of their wells, since leachate-polluted groundwater from landfills has been found to occur at a mile or more from a landfill. In order to be protective under the conditions that exist for the Washington landfill, where there is inadequate characterization of the hydrogeology under and near the landfill, all existing and new offsite wells should be tested within several miles of the proposed landfill. Further, this testing should be continued until such time (likely, forever) as the wastes in the landfill are no longer capable of producing a leachate that can pollute groundwaters with any substance that can be hazardous or deleterious to groundwater quality. In addition, it should be acknowledged that the parameters that will be monitored, as currently set forth in Appendix A, should be significantly expanded as new or unrecognized water pollutants become known.

N. Illumination of Adjacent Properties

Washington Environmental Ltd. should not be allowed to illuminate adjacent properties. Adjacent property owners/users should be able to use their properties without being influenced by lights used as part of Washington Environmental Ltd.'s operation of the landfill. The Morrow County Board of Health's "Additional Terms and Conditions" provision N, which allows illumination of adjacent properties during normal operating hours of the landfill, constitutes trespass and a potential infringement of adjacent property owners/users rights. Illumination of adjacent properties by landfill owners/operators is one of the problems that Lee and Jones-Lee (2006 now 2007) and Hirshfeld et al. (1992) have cited as a potential basis for decreased property values near a landfill.

Another similar issue that the Morrow County Board of Health should have addressed is the control of excessive noise from the operation of the landfill. The Board of Health should have established a maximum noise level at the property line that Washington Environmental and the landfill operator would be allowed to cause without being permanently shut down.

O. Protection of Property Values

Morrow County Board of Health's proposed approach for protection of property values, limiting such protection to properties within 500 feet of the disposal area, is grossly inadequate. As discussed by Hirshfeld et al. (1992), the adverse impacts from a landfill on property values can extend for several miles from the landfill. Further, Washington Environmental Ltd. should not only pay the fair market value of the adjacent and nearby properties that exist prior to the development of the landfill, but also compensate the adjacent and nearby property owners/users for the time and expense of having to relocate from their property because of the presence of the landfill.

Other Issues

Screening of C&DD Wastes for Hazardous and Deleterious Chemicals. It has been well established by the US EPA C&D contractor (ICF 1995a,b) for evaluation of the characteristics of C&D wastes (known as C&DD wastes in Ohio) that C&D wastes

generate leachate with a wide variety of known hazardous and deleterious chemicals that can pollute groundwaters, rendering them unsuitable for domestic and many other purposes, as well as a very large number of unmeasured, unregulated chemicals. Morrow County Board of Health should require that Washington Environmental Ltd. conduct a comprehensive waste monitoring/evaluation program to screen the wastes for highly hazardous chemicals that can lead to enhanced potential for groundwater and air pollution. The recent finding that sealants/caulking compounds in older buildings and other structures, which can readily become part of C&D wastes, contain PCBs justifies requiring that all C&D wastes be screened for hazardous chemicals. This issue has been recently reviewed by Lee (2006) and by Lee and Jones-Lee (2006 now 2007).

The approach described by Lee and Jones-Lee (2006, now 2007) that has been adopted by the California Central Valley Regional Water Quality Control Board for screening of wastes for "inert wastes," which was developed by Marshack (1989), should be required by the Morrow County Board of Health for all C&DD landfills, and especially for the proposed Washington Environmental Ltd. landfill, since it is proposed to be located at a geologically unsuitable site for a landfill of this proposed design, operation, closure and postclosure monitoring/maintenance.

Requirement for Adequate Postclosure Funding. One of the areas that Morrow County Board of Health should have specifically addressed in establishing additional conditions for the proposed Washington C&DD landfill is the need to establish adequate funding for postclosure monitoring, maintenance and potential groundwater remediation that could be needed under plausible worst-case scenario situations over the period of time that the wastes in the proposed landfill could be a threat to release chemicals to the environment that could be adverse to public health, groundwater resources, air quality and the interests of those within Morrow County that could be impacted by the landfill. For planning purposes, the period of time that postclosure funding would be needed should be considered infinite. Washington Environmental Ltd. would be required to develop assured postclosure funding to meet all potential needs. This funding should be established in the form of a irrevocable dedicated trust established by Washington Environmental Ltd. Issues related to landfill postclosure funding are reviewed by Lee and Jones-Lee (2006, 2007).

References

Hirschfeld, S.; Vesilind, P. A. and Pas, E. I., "Assessing the True Cost of Landfills," *Waste Management & Res*. 10:471-484 (1992).

ICF Inc., "Construction and Demolition Waste Landfills," Report prepared for US Environmental Protection Agency, Office of Solid Waste, by ICF Incorporated, Contract No. 68-W3-0008, February (1995a).

ICF Inc., "Damage Cases: Construction and Demolition Waste Landfills," Report prepared for US Environmental Protection Agency, Office of Solid Waste, by ICF Incorporated, Contract No. 68-W3-0008, January (1995b).

Jones-Lee, A. and Lee, G. F., "Appropriate Use of MSW Leachate Recycling in Municipal Solid Waste Landfilling, " Proceedings Air and Waste Management Association 93rd national annual meeting, CD rom paper 00-455, Pittsburgh, PA, June (2000). http://www.gfredlee.com/Landfills/leachatepapsli.pdf

Lee, G. F., "Structure Sealants as a Source of PCBs," *Stormwater Runoff Water Quality Newsletter* 9(4):1, March 31 (2006).
http://www.gfredlee.com/Newsletter/swnewsV9N4.pdf

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

Marshack, J., "The Designated Level Methodology for Waste Classification and Cleanup Level Determination," Staff Report of the California Regional Water Quality Control Board, Central Valley Region, Rancho Cordova, CA, October 1986, Updated June (1989)
http://www.waterboards.ca.gov/centralvalley/available_documents/guidance/dlm.pdf

US EPA, "Guidebook: Hydrogen Sulfide Prevention & Control at Construction and Demolition Debris Disposal Facilities," Draft Report of the USEPA Region 5, Waste, Pesticides, and Toxics Division, Chicago, IL, December (2005).

Additional Comments on the Proposed Washington C&DD Landfill

G. Fred Lee, PhD, PE, DEE

Based on a review of the Washington C&DD Landfill application, the literature and my professional experience in reviewing over 80 landfills I have developed the following additional comments on the Proposed Washington C&DD Landfill.

Inappropriate Location for a proposed Landfill

The proposed Washington C&DD Landfill is to be located at a geologically complex site where groundwaters that will be polluted by leachate generated in the landfill after passage through the proposed landfill liner can trespass onto adjacent properties, undetected by the proposed landfill groundwater monitoring system. The landfill application provides only enough information to demonstrate that there is a high degree of certainty that in time, hazardous and deleterious chemicals generated within the landfill will be released to the environment. The application, however, fails to provide sufficient detail on the types of pollutants that will be present in landfill leachate produced at this landfill, the rate of passage of leachate through the proposed landfill liner into the underlying groundwater system, the unreliability of the proposed groundwater monitoring wells to detect leachate-polluted groundwater when it first reaches the point of compliance for groundwater monitoring, and the rate at which offsite groundwater production wells on adjacent properties will be polluted by the proposed landfill's releases of leachate which contains hazardous and deleterious chemicals.

Meeting Minimum Regulatory Requirements is not Necessarily Protective

The landfill applicant (Washington Environmental Ltd.) and the Morrow County Board of Health assume that meeting the minimum Ohio requirements for siting, design, operation, closure and postclosure care for this landfill, as amended by the compromise settlement agreement between Washington Environmental Ltd. and Morrow County Board of Health "Additional Terms and Conditions," will be protective of public health and the environment for as long as the wastes in this landfill will be a threat. It is understood by those who are knowledgeable on the impacts of landfills that meeting minimum requirements for a landfill is not necessarily protective of public health and the environment from pollution by hazardous and deleterious chemicals that are proposed to be deposited in the landfill for as long as these wastes are a threat to release such chemicals to the environment. While it is possible that a proposed landfill that meets the minimum requirements set forth by Morrow County Board of Health and the state of Ohio for public health and environmental protection will be protective at some locations and situations, at an inadequately sited, designed and operated landfill (including closure and postclosure care), such as the proposed Washington C&DD Landfill, considerably more than the minimum requirements must be met if the overall Morrow County Board of Health and state of Ohio public health and environmental protection regulations/requirements are to be achieved.

Inadequate Buffer Lands
An important issue is that the Washington C&DD Landfill is proposed to be constructed with grossly inadequate buffer lands between areas where landfilling will occur and adjacent properties. This lack of adequate buffer lands for dilution/dispersion of airborne and waterborne releases from the landfill means that the releases of pollutants that will occur from this landfill will trespass onto adjacent and nearby properties and thereby be a threat to the health, groundwater resources, the environment and the interests of those within the sphere of influence of the landfill.

Impact on Property Values
Information is lacking on the potential impacts of leachate-polluted groundwaters on the health, environment, welfare and interests of adjacent and nearby property owners. Of particular concern is the potential impact of the proposed landfill on the property values of all properties that are within the sphere of influence of the proposed landfill. The application also fails to provide adequate information on the potential for airborne releases of pollutants associated with the wastes deposited in the proposed landfill on offsite public health and the environment.

HB 397 Requirements
HB 397 establishes that the development of a C&DD landfill shall be protective of public health and the environment. The proposed Washington landfill, at the proposed site, will not be protective, with the result that this landfill cannot be constructed at this site and comply with HB 397.

Mission of Morrow County Health Department

> *"The mission of the health department is to promote, protect and provide for the optimal personal and environmental health of the Morrow County General Health District."*

in that the approval of the proposed Washington landfill at the proposed site violates this Mission requirement.

Inadequate Site Characterization
The complex hydrogeology underlying and near the proposed Washington C&DD Landfill, consisting of variable composition and permeability (including fractured clay, sand and gravel strata), requires a much more comprehensive hydrogeological investigation than has been conducted by Washington Environmental Ltd. An adequate investigation of the hydrogeology of an area that is to underlie a proposed landfill requires that the applicant conduct a sufficiently detailed set of measurements underlying and near the proposed landfill to enable a reliable estimate of the potential flow paths for leachate-polluted groundwater that will be generated under the landfill during the time that the wastes in the landfill will be a threat to generate such leachate.

The current hydrogeologic characterization for the proposed landfill is grossly inadequate to provide the kinds of information needed to evaluate the potential reliability of

groundwater monitoring wells to intercept leachate-polluted groundwaters when such groundwaters first reach the point of compliance for groundwater monitoring—i.e., along the line of groundwater monitoring wells. Washington Environmental Ltd., in developing their proposed groundwater monitoring well array, has arbitrarily assumed that all portions of the proposed landfill will pollute the groundwaters evenly by leachate passage through the liner system. They have ignored the fact that the composition of leachate, its rates of generation and the rates of passage through the liner system will be different for various parts of the landfill. This will lead to plumes of leachate-polluted groundwater of limited dimensions that can pass the point of compliance for groundwater monitoring without being detected by the groundwater monitoring wells.

A far more comprehensive landfill characterization and hydrogeologic investigation must be conducted in order to predict with sufficient certainty the characteristics of the leachate-polluted groundwater plumes that will be generated under various parts of the landfill and the lateral transport of this leachate-polluted groundwater to the point of compliance for groundwater monitoring. As it stands now, the groundwater monitoring system proposed by Washington Environmental Ltd. is grossly inadequate in its potential ability to detect leachate-polluted groundwaters before such groundwaters trespass onto offsite properties.

Additional information needed to characterize the landfill and the underlying hydrogeological characteristics includes information on the potential for the landfill cover to allow water to penetrate through the cover in various parts of the landfill at different rates and thereby generate leachate within various parts of the landfill at different rates. Further, information is needed on the potential for the landfill liner system to allow passage of leachate through the liner at varying rates depending on the location in the liner. In addition, the potential for C&DD wastes of various types to be deposited in various parts of the landfill in different amounts, which can lead to leachate of variable composition depending on the location within the landfill, needs to be evaluated.

The potential dimensions and characteristics of leachate plumes generated under various parts of the landfill need to be estimated based on the above required information. Based on the potential range of characteristics, sizes and pollutant composition of the leachate plumes that will be generated under the various parts of the landfill, reliable estimates need to be made of the rate of longitudinal and lateral transport of pollutants in the leachate plumes at the point of compliance for groundwater monitoring. In order to provide this information, a much more detailed characterization is needed of the permeability of the underlying strata (including horizontal permeability), with particular reference to the heterogeneous characteristics of this strata that can affect leachate-polluted groundwater transport and the potential for transport of leachate through fractures in the underlying clay strata and other high-permeability areas to be a potentially significant transport pathway for leachate-polluted groundwater. This information then needs to be compared to the ability of the proposed groundwater monitoring well array to detect leachate-polluted groundwater when it first reaches the line of groundwater monitoring wells along any side of the proposed landfill, with at least a 95 percent detection probability.

The proposed monitoring well array, as set forth in the Washington Environmental Ltd. application, is presented in Appendix B "Monitoring Well Location Map." A review of the monitoring well array shows that there is a distance of approximately 1,800 feet between uppermost aquifer monitoring wells 1 and 2, and between shallow monitoring wells 6 and 7 along the northern and western sides of the proposed landfill. If Washington Environmental Ltd.'s assessment of the direction of groundwater flow is correct (to the north and northwest), there are vast distances along the northern and western part of the proposed landfill where leachate plumes generated within the landfill could pass the monitoring well array without being detected by the monitoring wells. It is appropriate to require that a groundwater monitoring well array for a proposed landfill contain a sufficient number of monitoring wells that monitor the underlying strata for leachate-polluted groundwater to be able to detect such groundwater when it first reaches the point of compliance for monitoring – i.e., the line of monitoring wells on the downgradient side of the landfill – with at least a 95 percent probability, for any leachate-polluted groundwaters developed under all parts of the landfill.

The proposed monitoring well array is not capable of detecting leachate-polluted groundwater before it reaches offsite properties, since leachate-polluted groundwater can pass by the groundwater monitoring point of compliance – i.e., the line of monitoring wells on the downgradient side of the landfill – without being detected by the monitoring wells. The monitoring wells proposed are spaced as much as 1,800 feet apart. Each monitoring well has the potential to sample water in the vicinity of the well within about a foot or two of the well. Therefore, leachate-polluted groundwater plumes that arise from leakage through the liner system along the northern and western part of the landfill can pass the point of compliance without being detected by the monitoring wells, since the leachate plumes can have lateral dimensions of a few feet, to tens of feet.

In order for the Board of Health to properly evaluate the ability of the monitoring well array to detect pollution of groundwater by landfill leachate, a much more comprehensive study of the heterogeneity of the underlying strata needs to be conducted to better define the heterogeneity. Based on this additional information, estimates need to be made of the characteristics of the leachate-polluted groundwater plumes that can arise from leakage of leachate through the clay liner from any location within the footprint of the landfill.

Inadequate Landfill Liner

The two foot thick clay liner is proposed for this landfill. The rate of passage of water, including leachate, through a clay liner is governed by Darcy's Law. Darcy's Law considers the permeability of the liner, its thickness and the depth of fluid (leachate) above the liner. Workman and Keeble (1989), as well as Daniel (1990) have provided information on the rate of migration of fluids, such as landfill leachate, through clay liners. This information is based on a Darcy's Law calculation. Mulder and Haven (1995) have reported on the California State Water Resources Control Board's Solid Waste Assessment Test (SWAT) program of determining the effectiveness of clay liners in preventing leachate from passing through them and polluting groundwaters underlying the landfill. As discussed by Lee and Jones-Lee (2006, now 2007), landfills with clay

liners similar to that proposed for the Washington C&DD landfill were found within a few years after installation to be polluting groundwaters with landfill leachate. This is what would be expected based on Darcy's Law calculations. It is now well understood in the landfill field that a clay liner is not an effective barrier to preventing leachate from passing through it which can cause groundwater pollution.

A two-foot thick clay liner with a permeability of 10^{-6} cm/sec is not an effective barrier to the passage of leachate through it for landfills sited at a geologically unsuitable site, such as the proposed Washington C&DD landfill, where pollution of groundwater by leachate that passes through the liner can lead to offsite groundwater pollution, which is a threat to the health, welfare and interests of adjacent and nearby property owners/users.

Daniel, D. E., "Critical Factors in Soils Design for Covers," Presentation at "Seminars – Design and Construction of RCRA/CERCLA Final Covers," Technology Transfer CERI 90-50, US Environmental Protection Agency, Washington, D.C. (1990).

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) updated March (2006). Last updated October (2012). http://www.gfredlee.com/Landfills/SubtitleDFlawedTechnPap.pdf

Mulder, J. H., and Haven, E. L., "Solid Waste Assessment Test (SWAT) Program," Report to the Integrated Waste Management Board 96-1CWP, by Division of Clean Water Programs, Water Resources Control Board, California Environmental Protection Agency, December (1995).

Workman, J. P. and Keeble, R. L., "Design and Construction of Liner Systems," In: T.H. Christensen, R. Cossu, and R. Stegmann (eds.), Sanitary Landfilling: Process, Technology and Environmental Impact, Academic Press, San Diego, CA (1989).

Offsite Odors

The proposed landfill will cause offensive odor and pose a threat to the public health or safety of the environment. Second, there is no issue that leachate generation will occur in the proposed Washington landfill. The proposed cover for this landfill will not prevent water from entering this landfill that can generate leachate. The wallboard, which is primarily composed of gypsum (calcium sulfate), in contact with water in a reducing environment (low oxygen), converts sulfate to sulfide (hydrogen sulfide). Hydrogen sulfide is a gas that is known to be released from various types of landfills, including C&DD landfills. Washington Environmental Ltd.'s final version of the application includes provision for leachate recycle. The Morrow County Board of Health, in their Additional Terms and Conditions, allows for leachate recirculation.

The US EPA (2005) draft "Guidebook: Hydrogen Sulfide Prevention & Control at Construction and Demolition Debris Disposal Facilities" provides information on the

development, release and potential impacts of hydrogen sulfide generated in C&DD landfills.

> US EPA, "Guidebook: Hydrogen Sulfide Prevention & Control at Construction and Demolition Debris Disposal Facilities," Draft Report of the USEPA Region 5, Waste, Pesticides, and Toxics Division, Chicago, IL, December (2005).

One of the fundamental errors that was made by the Morrow County Board of Health in approving a license for the proposed Washington C&DD landfill is that they have ignored the fact that C&DD landfills will have gaseous emissions that can readily trespass onto adjacent properties and be adverse to the health, welfare and interests of such properties' owners/users. Unless a highly efficient/reliable gas collection and treatment system is installed and operated, which is not proposed by Washington Environmental Ltd., gaseous emissions from landfills such as the proposed Washington C&DD landfill, where there are grossly inadequate buffer lands between where wastes are deposited and property lines of adjacent properties, will trespass onto these properties. Morrow County Board of Health's "Additional Terms and Conditions" regarding gaseous emissions monitoring and management, which allows the construction and operation of the Washington landfill without adequate buffer lands for dissipation of gaseous emissions on Washington Environmental Ltd.'s property, under conditions where an attempt will be made by the Board of Health to require after-the-fact monitoring and gas control, almost certainly means that there will be trespass of hazardous and deleterious gases from the proposed Washington landfill onto adjacent properties. The Board of Health's approach of trying to restrict such emissions after the landfill has been developed is strongly contrary to the Board of Health's Mission "… *to promote, protect and provide for the optimal personal and environmental health of the Morrow County General Health District."* Only those landfills that are proposed to be developed with adequate buffer lands for dissipation of gaseous releases from the landfill should be approved by the licensing agency.

The terms and conditions necessary for the Board of Health to prevent offsite adverse effects of gaseous emissions from the proposed landfill include providing adequate buffer lands of lands owned by Washington Environmental Ltd. to dissipate all gaseous emissions to insignificant levels before they reach adjacent properties. A site-specific evaluation of the magnitude of these buffer lands would need to be made to determine if it would still be possible to construct the proposed Washington C&DD landfill without trespass of gaseous emissions onto adjacent properties.

Inadequate Monitoring Well Number and Location

Information on the development of adequate monitoring wells to detect pollution of groundwaters before their trespass onto adjacent properties In lieu of an adequate number and location of monitoring wells, it is possible, with appropriate landfill siting and adequate buffer lands between where wastes will be deposited and adjacent properties, to dissipate the pollutants released from a C&DD landfill to non-significant levels in some geological strata prior to trespassing onto adjacent properties. Not only did the Board of Health fail to properly analyze the potential reliability of the proposed

groundwater monitoring well array, it also failed to evaluate the potential for dissipation of the pollutants that will be released from the landfill in the geological strata before trespass onto adjacent properties. If such an evaluation had been made, it is likely that it would have shown that there are pathways by which leachate-polluted groundwaters can be transported to adjacent properties with limited dissipation of pollutant concentrations.

With respect to siting/setback issues regarding evaluation of the potential for the proposed Washington C&DD landfill to pollute surface waters through the transport of leachate-polluted groundwaters to a surface waterbody at a distance of five miles, as well as to new or existing water supply wells located within a distance of four miles from the landfill, these distances were estimated based on the distance that could be needed to adequately dissipate the hazardous and deleterious constituents that could be present in C&DD landfill leachate in a hydrogeologic system such as in the vicinity of the proposed Washington landfill, in order to be protective of offsite surface and ground waters. It has been found at other locations that leachate-polluted groundwaters can travel for several miles in certain groundwater systems and still be present at concentrations which are adverse to public health and the environment. The fact that Washington Environmental Ltd. has proposed to construct, and the Morrow County Board of Health has proposed to allow the construction of the Washington landfill under conditions where the hydrogeology of the area has only been sufficiently characterized to indicate that it is complex and heterogeneous, justifies taking the conservative/protective approach of requiring four to five miles between where wastes will be deposited and nearby existing and potential future wells and surface waters. Such an approach is clearly within the Mission of the Morrow County Board of Health and the Ohio EPA of protecting public health and the environment from pollution by landfilled wastes. The conditions discussed above are within the siting requirements established in HB 397 of protecting public health and the environment.

Hirshfeld et al. (1992), of Duke University, in a paper, "Assessing the True Cost of Landfills," have summarized the potential impacts of landfills that should be addressed as part of landfill development. They point out that the environmental and social costs of landfills are usually ignored, which in turn inhibits the development of other waste management options, such as waste reduction, recycling and resource recovery. They divide the impacts of landfills into "physical" impacts and "social" impacts. The physical impacts are related to ground and surface water pollution by leachate migration, atmospheric releases of landfill gas, and fires. Landfill gas is known to cause explosions resulting in loss of life and property, and damage to vegetation. Hirshfeld et al. also point out that the non-methane organic compounds in landfill gas contain toxic chemicals that are a threat to cause cancer. Further, other components in landfill gas, such as hydrogen sulfide and organosulfur compounds can cause unpleasant odors associated with landfills.

The social impacts of landfills include increased traffic, visible air pollution, noise, aesthetic degradation and limited land utility. The social-impacts cost of landfills, according to Hirshfeld et al., is *"(1) the cumulative decrease of surrounding property*

values; (2) the cost associated with land utility effects, also known as an 'opportunity cost'; and (3) a 'hastening cost'."

Noise Pollution. Hirshfeld et al. (1992) discuss landfill noise as part of their discussion of "Social Impacts" of landfills:

> *"Noise at landfills can be noticeable in nearby residential areas. The USEPA (1975) notes that excessive noise can have many undesirable effects on those exposed to it. In most cases, however, the noise is simply regarded as an annoyance."*

Noise pollution of the areas near a proposed landfill is a justified issue of concern because of the often limited buffer land between where wastes will be deposited and adjacent properties. This means that adjacent property owners can potentially experience noise pollution on their properties by the proposed landfill.

Light Pollution. Another issue of concern to the public is that some landfills operate at night, where nearby property owners would experience pollution by lights at the landfill. Some landfill operators plan to operate heavy equipment at night, under lights, for compaction of the wastes that had been received that day. This can lead to significant disruption of the interests of the nearby property owners/users, which should be controlled/prohibited.

Stormwater Flooding Problems. Frequently, landfill applicants will state that a landfill facility will be designed, constructed and maintained with a run-on control system to prevent flow onto the active portion of the landfill during the peak discharge from a 25-year storm, and a run-off control system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm. Some members of the public are concerned about a proposed landfill causing increased flooding of their property through diversion of stormwater. While, the landfill developer plans to collect all stormwater that occurs on the landfill property in detention basins, this collection only applies to storms that result in a magnitude of less than the 25-yr, 24-hr discharge. Storms of greater magnitude than this will result in runoff from the landfill property onto adjacent properties.

Some landfills are constructed with a berm around the landfill property to divert waters around the property that now run onto this property. This berm could lead to increased flooding problems downstream of the proposed landfill. This would be of justifiable concern to the public, unless the landfill owner is required to manage the waters that now run onto the landfill property, which would be diverted around it by a berm, in such a way as to restore the current flow regime and amount downstream of the proposed landfill. Without requiring this approach, some downstream property owners could be adversely affected by the proposed stormwater management approach.

Decreased Values of Nearby Property. One of the major concerns of property owners with the establishment of a landfill in their area is the decrease in their property values.

Establishing a landfill with inadequate buffer lands between the waste deposition area and adjacent properties leads to decreased property values. This is a consequence of landfill owners/operators' failing to adequately control landfill releases to the air (odors, explosive gases, hazardous volatile chemicals, etc.) and groundwater (pollution), and landfill-associated activities such as truck traffic, noise, lights etc. While some landfill owners will claim that establishing a proposed landfill will not affect nearby property values, this is not in accord with the results of the studies conducted by Hirshfeld et al. (1992). They reported, based on studies at various locations, that decreased property values have been found as far as three miles from the landfill.

Individuals who own land immediately adjacent to a proposed landfill, as well as most others who own property within several miles of a landfill, can be expected to have their property values significantly decreased by the development of the landfill. This is of particular economic significance to some property owners, since their property could be developed with substantial residential and commercial activities if it were not for the presence of the landfill.

References

Hirschfeld, S.; Vesilind, P. A. and Pas, E. I., "Assessing the True Cost of Landfills," *Waste Management & Res*. 10:471-484 (1992).

US EPA, "Measuring External Effects of Solid Waste Management," R. Schmalensee, R. Ramanathan, W. Ramm and D. Smallwood (eds.), NTIS, PB-243407, U.S. Environmental Protection Agency, Washington, D.C. (1975).