CDM

Technical Memorandum

To: *Andrew H. Quigley*

From: *Christopher M. Martel, P.E., BCEE, LEED AP*

Date: *February 27, 2007*

Subject: *Veolia Environmental Services Zion Landfill Gas and Odor Assessment*

Introduction

On behalf of the Solid Waste Agency of Lake County (SWALCO), Camp Dresser & McKee Inc. (CDM) has completed a landfill gas (LFG) assessment of the Veolia Environmental Services Zion Landfill (Veolia) located in Zion, Illinois. The objective of the assessment is to understand the nature and extent of the odor problems at the landfill and review the proposed improvements for adequacy. This work was completed in accordance with Task Order No. 16 of the Master Services Agreement between SWALCO and CDM.

To complete the assessment on the planned actions intended to control the odor problem at the landfill, CDM reviewed copies of the following documents provided by SWALCO and Veolia:

- *Quarterly Surface Emissions Monitoring Report* for 1st, 2nd, 3rd and 4th Quarters 2006 by Weaver Boos Consultants Inc. dated February 27, 2006, June 8, 2006, September 29, 2006, and December 15, 2006, respectively;
- Construction permit application to replace an enclosed flare submitted by Veolia to the Illinois Environmental Protection Agency (IEPA) Bureau of Air dated September 29, 2006;
- Draft construction permit to replace an enclosed flare submitted by Veolia to the IEPA Bureau of Air dated November 27, 2006;
- Second draft construction permit to replace an enclosed flare submitted by Veolia to the IEPA Bureau of Air dated December 5, 2006;
- *Construction Permit* for construction of a permanent enclosed flare and a temporary open flare granted by the IEPA Bureau of Air dated December 19, 2006;
- *LFG System Performance Proposal – Veolia ES Zion Landfill* by Environmental Information Logistics, LLC. dated November 2, 2006;

- Memorandum dated November 21, 2006 to Jim Taylor, SWALCO Director and Commissioner, City of Zion and Virginia Lopez, SWALCO Director and Trustee, Village of Winthrop Harbor from Andrew Quigley, Executive Director SWALCO summarizing the resolution status of the Veolia odor issue;
- Letter dated December 21, 2006 from James Lewis, Veolia Landfill Manager, to Mr. Michael Kuhn with the Lake County Health Department (LCHD) in response to a Violation Notice dated October 26, 2006;
- Memorandum dated January 5, 2007 to Jim Taylor, SWALCO Director and Commissioner, City of Zion and Virginia Lopez, SWALCO Director and Trustee, Village of Winthrop Harbor from Andrew Quigley, Executive Director SWALCO summarizing the Veolia planned flare construction schedule;
- Letter dated January 11, 2007 from James Lewis, Veolia Landfill Manager, to Emily Keane (CDM) that was accompanied by the documents listed above as well as gas generation rate calculations (from the United States Environmental Protection Agency [USEPA] LandGEM model) for the expansion area and pre-expansion areas, and three drawings depicting the Landfill Gas & Leachate System Plan, the Gas Extraction Wells and Laterals with Table, and the Proposed Landfill Gas Extraction Wells (LFG System Plan);
- E-mail dated January 19, 2007 from James Lewis, Veolia ES Landfill Manager, to Emily Keane (CDM) that was accompanied by gas flow results from a pipe flow model provided by Mike Niemann; and
- Drawing depicting the approximate area of wood chips used for daily landfill cover provided by James Lewis, Veolia ES Landfill Manager, to Emily Keane (CDM).

In addition, CDM reviewed the *2005/2006 Annual Audit Onyx Zion Landfill – Zion, Illinois*, dated September 11, 2006.

Background

The LFG collection and flare system at the Veolia Landfill was installed in 1997. Until approximately June 2006, Veolia reports to have had only a few odor complaints coming predominantly during the hottest period of the summer. During June and July 2006 Veolia began to receive numerous odor complaints from nearby residents. Excessive landfill gas odors were not observed during CDM's annual audit site visits in July 2006; however, Veolia responded to the complaints by assessing their gas collection system and subsequently acknowledged that the system was inadequate to handle the increased gas emissions from the landfill. Veolia believes the increased gas is predominantly caused by increased moisture entering the landfill. Veolia reports that leachate totals increased from 1.4 million gallons in 2005 to 3.7 million gallons in 2006 and believes the increase is mostly resulting from rain water infiltration through permeable cover/alternative daily cover. The water infiltration from rain events distributes evenly through the landfill which causes an increase in leachate and an increase in gas production.

Veolia has already taken some measures to control odors at the landfill including replacement of flame scanners to reduce flare shutdowns, installation of additional LFG extraction wells, installation of thousands of additional feet of LFG transfer piping to improve vacuum availability, replacement of inadequately sized valves and piping, installation of an additional sump for condensation, and turning down the wells in some areas of the well field to increase vacuum to areas generating the most LFG. According to Veolia Landfill Manager, James Lewis, these improvements tripled the amount of gas combusted from the expansion area since December 2005.

Veolia Landfill received a Violation Notice, L 2006 LK221, from the Lake County Health Department (LCHD) dated October 26, 2006. After receiving the notice, Veolia took additional steps to attempt to control odors at the facility. End-product compost biofilter material was placed over the area with the strongest odor. In addition, soil material was placed over other areas with lingering odors. According to James Lewis, these actions helped initially and the number of odor complaints decreased significantly for the first three (3) weeks; however, odors increased soon after. Veolia determined that covering with compost biofilter was not effectively reducing odor emanating from the landfill because gases just seemed to migrate to new areas, and as such Veolia subsequently stopped this covering practice. In addition, Veolia stopped leachate recirculation in the expansion area on January 23, 2007.

Planned Activities

Veolia plans to expand their current LFG collection and flare system with the installation of approximately twenty-five (25) new LFG extraction wells in 2007. The first fourteen (14) of these are scheduled to be installed by the end of February 2007. The goal of the LFG system expansion is to increase the amount of LFG that is collected and combusted to a level where uncontrolled emissions become insufficient to cause an odor problem. New header piping will be installed to connect the new wells to the existing LFG collection system.

Veolia also plans to increase the available vacuum in the system and increase the flare flow capacity. Veolia plans to install two (2) new 3,000 standard cubic feet per minute (scfm) blowers, each rated for 100 inches of water column vacuum. The flare system expansion is planned to include a new enclosed flare with a maximum design capacity of 6,000 cubic feet per minute (cfm). In addition, a temporary open flare (candlestick flare) is scheduled to be installed in February 2007 which will operate during construction of the new flare. The temporary flare will have a maximum design capacity of 3,000 cfm.

Veolia submitted a permit application to construct the new enclosed flare in September 2006. The permit was granted in December 2006 and the construction and installation of the new 6,000 cfm flare is scheduled to be completed in July 2007. In addition, landfill Cells 8A and 8B are scheduled to receive partial final cover later this year.

CDM Review

CDM completed a review of the documents listed above to understand the nature and extent of the odor problems at the landfill and assess of the adequacy of Veolia's planned improvements. The review was completed on Veolia's predicted LFG generation rates using the USEPA LandGEM model, gas transmission calculations using the Pipe Flow Expert™ model, gas system improvement design drawings, and gas surface scan results.

Gas Generation Modeling

Veolia provided the predicted LFG generation rates, using the LandGEM model, for two scenarios. The first scenario was for the pre-expansion areas of the landfill that operated over the years 1975 through 1995, prior to leachate recirculation. The second scenario was for the expansion area that began accepting waste in May 1998 and began leachate recirculation in November 2003. This second scenario for the expansion area assumes an operating period for the years 1998 through 2011 and was to take into account the increased gas production from leachate recirculation. CDM reviewed the modeling inputs and results to assess if the predicted gas generation rates were appropriate to size the LFG collection system expansion. The inputs used by Veolia for the LandGEM model included the following:

Scenario 1

- methane generation rate potential (k) of 0.024 $year^{-1}$
- potential methane generation capacity of 140 cubic meters per megagram (m^3/Mg)

Scenario 2

- methane generation rate potential (k) of 0.04 $year^{-1}$
- potential methane generation capacity of 140 m^3/Mg

The combined results of Scenario 1 and Scenario 2 were used to help size Veolia's planned LFG system expansion. The generation curve predicts a peak generation rate of 5,021 cfm in 2011. The generation rate for 2007 is 4,027 cfm.

The inputs used by Veolia do not appear appropriate for designing a LFG collection and control system expansion where there are existing LFG odor problems. In Scenario 1, Veolia used a (k) value of 0.024 $year^{-1}$. According to the USEPA LandGEM model, a (k) value of 0.02 $year^{-1}$ should be used for standard municipal landfills in arid conditions and a (k) value of 0.04 $year^{-1}$ is should be used for standard municipal landfills in conventional conditions. CDM believes that a (k) value of 0.04 $year^{-1}$ is the appropriate input for Scenario 1. In Scenario 2, Veolia used the USEPA standard municipal landfill conventional (k) value of 0.04 $year^{-1}$; however, the expansion area operates with leachate recirculation and as such, an appropriate input for methane generation rate potential would be greater. CDM believes

that a (k) value of 0.07 year^{-1} is the appropriate input for Scenario 2. CDM ran the LandGEM model with these more appropriate input values for methane generation rate potential and the results show a peak generation rate of 7,107 cfm in 2011 and a rate of 5,887 cfm in 2007.

Gas Transmission Modeling

The gas transmission calculations using the Pipe Flow Expert™ model, provided by Veolia, were reviewed for accuracy and to determine the adequacy of the existing and planned piping to handle the anticipated LFG flow. The modeling results appear to accurately evaluate and quantify the flow losses through the system. The pipe sizes for the planned gas system expansion appear adequate to handle the anticipated gas flows and are in line with pipe sizing for similar landfill gas extraction and conveyance systems.

System Design Drawings

The LFG system expansion design drawings provided by Veolia include Drawing No. 1, Drawing No. 2 and Drawing No. C-5. The review was limited to these drawings which do not include gas system component detail sheets with the exception of one gas well detail on Drawing No. 1. The review was completed to assess the system with regard to the LFG odor problem at the facility. All detail drawing sheets would be needed to complete a comprehensive review of the design. The results of the LFG system expansion and new flare design indicated that the design generally complies with the requirements of Title 40 Code of Federal Regulations Part 60 (40 CFR 60), commonly known as the New Source Performance Standards for Municipal Landfills (NSPS) with the exception of the radius of influence (ROI) for the planned gas extraction wells[1].

The ROI for the proposed gas wells as shown in Drawing No. 2 varies from 100 to 150 feet. NSPS states that a well ROI should be limited to no more than 30 meters (generally accepted as 100 feet) unless an alternate ROI has been calculated through the results of a landfill "pump test". No such data were presented to support ROIs greater than 100 feet. By attempting to extend the ROI to greater distances through the use of higher vacuum, the possibility of air intrusion is magnified, especially with a highly permeable intermediate cover system. According to the well data presented in a table on Drawing No.1, the depth from the landfill surface is approximately 15 feet. This distance is significantly less than the ROI and is sensitive to the effects of increased vacuum causing air intrusion. Thus, significant increase in ROI is difficult to obtain simply through the application of higher vacuum.

Another issue noted during the review of the gas system expansion drawings concerned the LFG Conveyance Headers. Note 6 on Drawing No. 2 states, "Minimum LFG pipe slope is approximately 2% inside limit of waste." A 2% slope is too flat when taking into account future differential settlement of the waste mass. A 6% slope is desirable, with 3% being the

[1] U.S. EPA, February, 1999, Municipal Solid Waste Landfills, Volume 1: Summary of Requirements for New Source Performance Standards and Emission Guidelines for Solid Waste, EPA-453R/96-004 (updated). Appendix E, p. E-8.

absolute minimum. Flatter slopes tend to result in condensate pooling in the pipe and blocking gas flow.

Flare and Blower System

The planned flare and blower system described in the *Application for a Permit to Construct an Air Emissions Source (Replacement Enclosed Flare)*, dated September 2006, was reviewed for adequacy to handle the increased LFG.

Veolia plans to install a temporary 3,000 scfm candle-stick flare in February 2007 to replace the existing 2,600 scfm enclosed flare during the one year duration of their construction permit. The objective of the temporary candle-stick flare is to handle the increased gas flow until the planned enclosed flare, with a maximum design capacity of 6,000 scfm, is installed in approximately July 2007. To increase vacuum strength, Veolia will install two new 3,000 scfm blowers, each rated for 100 inches water column vacuum.

The planned new flares and blowers may be sized to handle the increased gas production; however, the LFG generation rates based on LandGEM modeling with CDM's more appropriate input values for methane generation potential predict maximum gas generation will peak at 7,107 cfm in 2011. With an assumed 75 percent collection efficiency the average flow rate would be 5,330 cfm. Veolia's planned system enhancement with a maximum design capacity of 6,000 scfm is only over-designed by approximately 11%.

Surface Scans

CDM reviewed Veolia's surface scan results for each quarter of 2006, which were performed in accordance with Special Condition 7.1.7(a)(iv) of the Title V Clean Air Act Permit Program (CAAPP) Permit #97030064 . There were no exceedances of methane gas greater than 500 parts per million (ppm) above background at the surface of the landfill. The background methane concentration for the 2006 3rd quarter surface scan, measured on September 27, 2006, was significantly higher than the other three quarters. The high methane concentration during the 3rd quarter corresponds to the time period of the odor complaints and the LCHD Violation Notice. Background methane values were determined to be as follows:

- 1st quarter 2006 surface monitoring, conducted on February 21, 2006, determined a background value of 2.35 ppm;
- 2nd quarter 2006 surface monitoring, conducted on May 28, 2006, determined a background value of 9.29 ppm;
- 3rd quarter 2006 surface monitoring, conducted on September 27, 2006, determined a background value of 21.26 ppm; and

- 4th quarter 2006 surface monitoring, conducted on September 27, 2006, determined a background value of 11.94 ppm.

Conclusions

CDM generally agrees with the approach taken by Veolia to correct the odor problems they have been experiencing. It is clear that the increased odors at the landfill are a result of increases in LFG production and inadequacies of the existing LFG collection and flare system to control the additional LFG. The increase in LFG production can be directly attributed to the practice of leachate recirculation and the use of a permeable intermediate cover material that allows significant stormwater infiltration. While this increased moisture generated from running a leachate recirculation landfill is good for stabilization of the waste, the resulting increase in LFG generation has overwhelmed Veolia's LFG system.

The planned expansion of the LFG collection and control system includes adding gas wells and increasing the capacity of the blower and flare system. While these corrective actions are necessary, simply placing new wells and adding equipment will not completely solve the odor problem if the system is inadequately designed. The practice of leachate recirculation with a permeable intermediate cover material requires a strong commitment to installing and maintaining an effective LFG collection and control system. The use of this type of material readily allows gas to emit from the landfill and could compromise the effectiveness of the gas collection system, since a lower vacuum must be employed to prevent significant air intrusion.

The expansion of the gas collection system is an important step towards addressing the existing odor problem; however, the proposed expansion may not be capable of reducing odors to an acceptable level without additional measures being taken. CDM recommends the following:

- Prior to restarting leachate recirculation in the expansion area, which was stopped on January 23, 2007, Veolia should demonstrate that an adequate LFG collection and flare system is in place and that odors are under control.

- Increase the slope of the LFG conveyance header pipe to greater than 3% to prevent condensate pooling in the pipe and blocking gas flow.

- There may be deficiencies in Veolia's proposed LFG collection system expansion with regard to well spacing, and as such; Veolia should install the system with the understanding that additional wells may be needed.

- Monitor odors and LFG extraction system effectiveness daily and be quick to respond to any observed deficiencies (i.e., install additional wells, place impermeable cover, increase flare and blower capacity, etc.).