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Memo

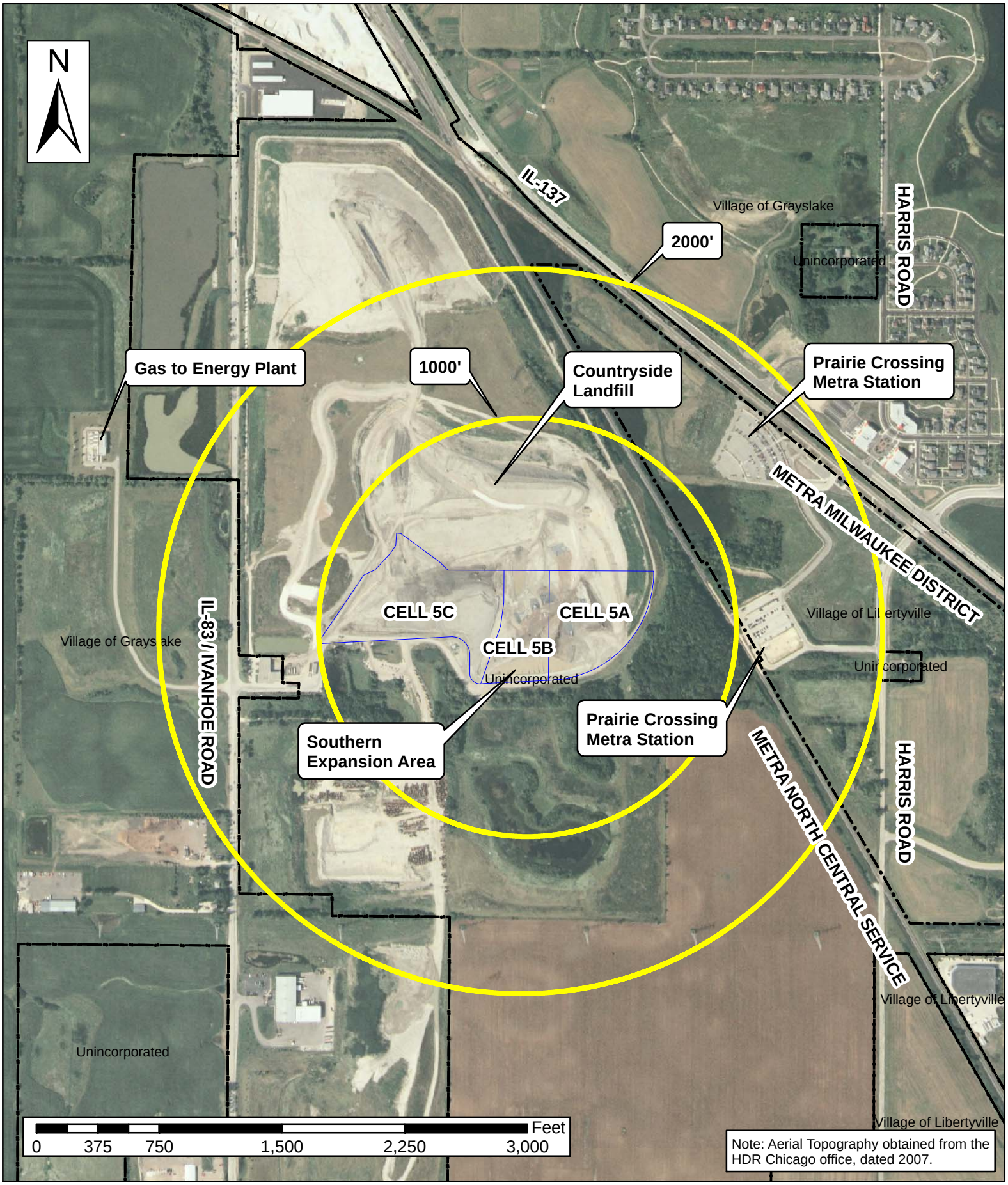
To:	Walter Willis, Solid Waste Agency of Lake County, IL Barry Burton, Lake County, IL Mike Ellis, Village of Grayslake, IL
From:	Bob Gorski, PE, Cliff Koenig, PE, Dave Traeger, HDR
Date:	March 5, 2009
Subject:	Waste Management Countryside Landfill Odor Investigation
Client:	Solid Waste Agency of Lake County, IL, Lake County, IL, Village of Grayslake
Project:	Task Order # 2 — Project No: 100385

The Solid Waste Agency of Lake County (SWALCO), Illinois (IL), Lake County, IL , and the Village of Grayslake, IL (collectively, the "Client") retained HDR Engineering, Inc. (HDR) to evaluate the circumstances surrounding the recent odor complaints related to the Countryside Landfill in Lake County and the remediation efforts implemented by Waste Management (WM). The Client also requested that HDR provide recommendations for further corrective actions. This memo provides an overview of the situation, observations from a site visit, and a summary of the review of the design and operational practices. This memo also reflects a review of the available information provided by the operator (WM) and discussions of the findings with SWALCO.

I. Background

WM owns and operates the Countryside Landfill near Grayslake, IL as shown in Exhibit 1: Site Location Map. The facility is a municipal solid waste (MSW) landfill that opened in 1976. WM has a disposal agreement with SWALCO to accept and dispose of MSW generated in the County. The Countryside Landfill is permitted by the State of Illinois and currently has an active landfill gas collection system (LFGCS). This LFGCS system is required under the Clean Air Act (CAA) New Source Performance Standards and Emission Guidelines (NSPS/EG). The facility also has a current Title V Clean Air Act Program Permit, as required by the CAA and State of Illinois. This LFGCS includes 120 extraction wells and an enclosed flare for the combustion of the collected landfill gas. In addition, the facility has an agreement with a third party to combust landfill gas and convert a portion of the collected gas to electricity. This is accomplished in a landfill gas to energy (LFGTE) plant adjacent to the facility.

During the final six months of 2008 there were numerous complaints of odors emanating from the Countryside Landfill. Over this time period, nearby homeowners called in odor complaints to the Countryside Landfill, SWALCO, Illinois EPA Bureau of Land, Illinois EPA Bureau of Air, and the Lake County Health Department. The Lake County Health Department issued a violation notice to Countryside Landfill on December 4, 2008. The following are excerpts from the Health Department violation notice:



HDR

SITE LOCATION MAP

COUNTRYSIDE LANDFILL - GRAYSLAKE, ILLINOIS

Date
FEB 2009

Exhibit
1

1. Pursuant to Section 9(a) of the Illinois Environmental Protection Act 415 ILCS 5/1 et seq., no person shall cause, threaten or allow the discharge of any contaminant into the environment so as to cause or tend to cause air pollution in Illinois.

You are in apparent violation of the Section 9(a) of the Illinois Environmental Protection Act 415 ILCS 5/1 et seq., for the following reason: During the summer and fall of 2008, the Lake County Health Department received 38 complaints from residents regarding off site landfill gas odors. The Illinois EPA Bureau of Land received an additional 16 complaints which were referred to the Lake County Health Department.

2. Pursuant to Section 21(d)(2) of the Environmental Protection Act 415 ILCS 5/1 et seq., no person shall conduct any waste-storage, waste-treatment, or waste-disposal operation in violation of any regulation or standards adopted by the Board.

You are in apparent violation of 21(d)(2) of the Environmental Protection Act ILCS 5/1 et seq. due to the apparent violation of Section 9(a).

WM submitted a response to the December 4, 2008 violation notice dated January 21, 2009. WM's response included design plans, corrective actions to the odor problem, gas well data, and surface emission data. Additional boring logs and data have been provided by WM to HDR to assist in the review of the source of the odor emissions and remedial actions.

Based on conversations with WM, documentation provided by WM, and HDR's investigation, the odors leading to the complaints are originating from the Countryside Landfill and more specifically the southern portion of the landfill. Odors appear to be originating from portions of Cell 5A and Cell 5B. The specific areas of concern, identified by WM investigation, are shown as a dashed line in Figure 4, in Attachment A and located on Exhibit 1 in the vicinity of Cells 5A and 5B.

II. Odor

Odors are an inevitable part of MSW landfill operations. The waste that arrives in a garbage truck likely already contains decomposing garbage and garbage odors and depending upon the composition and temperature of the waste that odor may be more or less offensive. The intensity of the odors produced can vary significantly. Also, depending upon meteorological conditions the gaseous emissions produced in a landfill may travel a significant distance from the source. To effectively control landfill odor there are a number of actions that should be utilized; most of these exist to varying degrees in regulations and in what is considered good operating practices at landfills. These techniques are employed in the design, construction and operation of landfills.

There are numerous constituents in landfill gas that can produce odors. The most common odors associated with landfills are from hydrogen sulfide (H_2S) and mercaptans (methyl and ethyl), as well as various other sulfur compounds (e.g. dimethyl disulfide, carbon disulfide, dimethyl sulfide, diethyl sulfide, carbonyl sulfide, etc.).

In addition, odor is relative from person to person, both in terms of detection levels and levels at which it is considered offensive. The H_2S odor can be particularly offensive at very low concentration (e.g. 1 part per million (ppm)) and can be detected by some people at concentrations in the range of 0.5 parts be billion (ppb).

At the time of this memo, no information was provided to HDR, which quantified the odor (intensity, chemical constituents, and concentrations). Odor measurements off-site would help document the concentration and better serve to define a violation. Odors can be quantified as specified in the Illinois Administrative Code, Title 35: Environmental Protection, Subchapter 1: Air Quality Standards and Episodes, Part 245: Odors. This regulation specifies that odors sampled with a Scentometer should be no more than 120 odor units/cubic foot as determined by Mills adaptation of ASTM D-1391-57. However, this regulation specifically addresses the inedible heat processing of animal or marine matter and currently does not appear to be applicable to landfills. There are also other techniques to monitor and measure for odor. These could be considered if corrective actions prove unsuccessful.

III. Source of Odors

Based on the site visit, review of furnished data, and discussions with WM, several potential causes and sources of the off-site odors were identified. These are discussed in greater detail in a subsequent section and include the following:

1. **Waste Types:** According to WM, in early 2008 they utilized approximately 2,000 tons of construction and demolition debris material from a C&D recycler to construct a temporary haul road within Cell 5A and 5B. This road was used to access the active landfill waste disposal area (working face). This construction and demolition debris was observed by WM personnel, at the time of delivery, to contain a significant quantity of drywall dust. Drywall dust is principally gypsum (calcium sulfate ($CaSO_4H_20$)), which when exposed to moisture and the carbon materials in the waste, can be broken down by anaerobic bacteria to form H_2S. As such, the acceptance of this gypsum dust and exposure to moisture may be one of the sources of odor. Because of the timing of construction the gas collections system, gas generated from this material likely was not captured by the active gas collection system on the site. WM has stated they have implemented revised waste acceptance procedures to prevent deliveries of large quantities of gypsum material in the future. These procedures were not provided for our review.

2. **Precipitation Infiltration:** WM reported significant rainfall had occurred during 2007 and 2008. WM has speculated that this rainfall could have accelerated the waste decomposition process, resulting in an increase in landfill gas production (principally methane and carbon dioxide) and thus increasing generation and the transmission potential for H_2S production and other malodorous gases.

   Cell 5A is located in the southeastern outer edge of the current permitted disposal area. Cell 5B is located just west of Cell 5A. Cell 5C is located west of Cell 5B. WM stated that the Cell 5A area was observed to be relatively dry during waste placement in 2005 and 2006. WM stated that during waste acceptance, in the end of 2006 through early 2007, more rainfall was observed compared with operation in early 2006. WM also stated that it started placing waste in Cell 5C in 2008. According to WM, the heavy rains in 2008 led to an accumulation of liquids in cell 5C. After the rainfall was pumped out, 6 feet of clay was installed to hold back leachate along the slope of adjacent cells 5B and 5C. WM has speculated that this retained liquid could have significantly increased the moisture content of the waste in Cell 5B and thus increased the level of anaerobic digestions and landfill gas generation in these areas.

Rainfall data obtained from the National Oceanic and Atmospheric Administration (NOAA) for the city of Chicago, IL is presented below.

Table 1: Chicago, IL Rainfall Data

Year	Precipitation (Inches)
2008	50.75
2007	35.65
2006	41.98
2005	23.02
2004	27.69
2003	31.84
2002	33.53
2001	45.99
2000	33.66
1999	38.33
1998	37.8

Average precipitation from the NOAA database for Chicago, IL from 1958 to 2008 is approximately 35.7 inches. Chicago, IL received an additional 15 inches of rain above the average annual rainfall, making it one of the wettest years on record. Assuming that Countryside Landfill received similar amounts of rainfall, this could have increased landfill gas generation for the landfill.

HDR was unable to review all site conditions which may have contributed to precipitation infiltration due to truck traffic at the working face and snow coverage. While it is not possible to prevent all moisture infiltration, observations suggest that drainage improvements can be made to reduce the amount of infiltration.

3. **Exposed Leachate:** Prior to 2008, there was an odor complaint that was attributed to exposed leachate and rain water, which drained to an old pond in the southern portion of the landfill. Odors from leachate are generated when leachate off-gases odorous compounds to the air. Odors can be minimized by limiting the amount of leachate stored in open pits or by treatment techniques such as aeration.

4. **Landfill Gas Collection System:** WM currently has an active landfill gas collection system in place at the Countryside Landfill. The attached Figures 2, 3 and 4 illustrate the gas collection system reviewed for the odor investigation. The active gas collection system pulls gas from the landfill and directs to either a flare for combustion or to a LFGTE facility adjacent to the site. If properly designed, built and operated, this active gas collection system should serve as the primary system for gas emission and odor control. As illustrated in Figure 2, prior to the time of the odor complaints (summer of 2008) only three wells (123, 124 and 125) were installed and operating in the area Cell 5A, 5B, suspected to be the primary source of odor emissions. WM has subsequently installed an additional 17 wells in the vicinity of Cells 5A and 5B as shown on Figures 3 (September 2008 gas system expansion) and Figure 4 (December 2008 gas system

expansion). WM actions, via gas system expansions, are described in further detail later under Section V, Review of Gas System.

5. **LFGTE Facility Outages:** WM stated that the LFGTE plant personnel occasionally do not provide advance warning to WM that the plant is to be or has been shutdown. As currently designed and configured, if the LFGTE system is shut-down without notice to WM of the shutdown, the active gas collection system experiences a drop in vacuum pressure in the wellfield (e.g., less vacuum than during normal LFGTE operations). As currently configured, the blower serving the flare station does not automatically increase vacuum to the wellfield, if the LFGTE plant shuts down. Because of the lower vacuum pressure in the active landfill gas collected system there could be an increased potential for landfill gas releases. WM indicated that once shutdowns are recognized they immediately increased vacuum pressure in the gas system wellfield. WM noted that they have stressed to the LFGTE personnel that WM should be notified of any shutdowns immediately. Increased automation of the system as well as better communications with the LFGTE facility could prevent such drops in vacuum pressure in the active collection system.

6. **Gas Extraction System:** Construction details for wells 202 through 210, 212 and 213 suggests that the bentonite seal installed could be improved to allow a more effective application of sufficient vacuum pressure to these wells. This vacuum pressure is necessary to collect the landfill gas within the projected radius of influence of these wells. Insufficient vacuum may lead to increased emissions. Site personnel have stated that some of the new wells have shown increased oxygen concentrations when a vacuum has been applied to the well, suggesting that there may be problems with some of the seals. The seals on these new wells should be further evaluated (and if necessary upgraded) if sufficient vacuum cannot be applied to the well to capture gas from within the projected radius of influence.

IV. Site Visit and Evaluation

HDR personnel met with Mr. Walter Willis (SWALCO) and Mr. Mike Hey (WM) at the Countryside Landfill on December 22, 2008. The purpose of the meeting was to review the history surrounding the off-site odor detections and the mitigation efforts constructed to address the problems.

During the site visit HDR observed the active disposal area (the working face located primarily in Cell 5C), and southeastern and southwestern areas of the landfill (the odor source areas identified by WM). During the site visit, HDR detected strong landfill gas odor on-site near extraction well 125, which is within the WM identified source area. HDR also observed the areas where WM had recently constructed additional gas collection wells and related system components. WM indicated that these wells were installed in the areas they had identified as the probable source areas. Additionally, HDR detected significant odors during the site visit in the southwestern area of the landfill in proximity of well 211.

During the site visit several areas of the Countryside Landfill were covered with snow from a recent and ongoing storm event. This made it impossible to thoroughly evaluate all areas of the site and to evaluate in detail the intermediate cover soil and gas collection system within the area identified by WM as the primary emission source areas (e.g., wells 124, 157 and 158). It was noted that the working face was relatively close to the odor source (as close as 200 feet).

Because of the limited access and nature of the site visit it was not possible to physically review all areas of the site and no instrumentation was used by HDR to measure or quantify gas emissions. As such, HDR accepted WM's statements and data that the areas labeled as the "affected area" (shown by a dashed line on Figure 4), and the area near well 211 were in fact the primary source areas leading to off-site reports of odor.

Throughout the site visit HDR and WM personnel discussed the issue of odors and efforts being undertaken by WM to mitigate the odor. The discussions were principally focused on the construction of additional gas collection wells and system components to increase gas collection in targeted source areas as shown in Figures 3 and 4. Although WM apparently did respond quickly in installing additional wells and collection system, these discussions suggested that there was not a proactive response plan in place to identify and respond quickly to odor complaints.

During the site visit, WM stated that the LFGTE facility was shutdown (at the time of the visit) and all the collected landfill gas was being combusted by the flare station.

V. Review of Gas System

a. Design

A cursory review of the LFGCS at the Countryside Landfill indicates it is designed to meet regulatory requirements for a gas collection and control associated with an MSW landfill. It is important to note that the regulatory compliant basis of design is based on controlling emissions of certain gases, and not on controlling odors. NSPS/EG regulations require landfills to collect landfill gas from active waste filling areas in which waste has been in place for 5 years. WM appears to be installing gas extraction wells prior to the 5 year waste in place requirement. Based on technical descriptions provided by WM, it appears that the piping and flare station are correctly sized to combust the anticipated volumes of landfill gas. The spacing (average radius of influence) of the extraction wells appear to comply with generally accepted design practices within the landfill gas industry. Figure 2 shows the gas collection system layout existing in the June, July and August 2008 timeframe (time prior to system expansion).

HDR conducted a cursory review of the design drawings, which illustrated the location of the most recently installed extraction wells in the southeastern area of the landfill. Wells installed in late 2008 include the following:

- September 2008 - wells 104, 105, 155, 156, 157, 158 and 159, as shown in Figure 3
- December 2008 - wells 201 through 208 and wells 212, 213 and one replacement well 111R, as shown in Figure 4

As noted above, 3 wells (123, 124 and 125) were installed in the southeastern portion of the landfill in the summer of 2008. WM installed 7 wells in the apparent odor generation area in September 2008 with a spacing of 150-300 feet between wells. In response to further odor complaints, WM installed an additional 10 gas extraction wells in the apparent odor generation area in December 2008, resulting in a spacing of 100-200 feet between wells. Wells installed in September 2008 and most wells in December 2008 appear to be functioning; their level of effectiveness in odor control could not be assessed due to winter conditions.

These new wells are in addition to those required by the Gas Collection and Control System (GCCS) Design Plan approved by the Illinois EPA in May 2000 and amended in September 2005. Installation of the additional active gas collection wells should help increase gas collection and thus reduction emissions from this area, provided they are properly constructed, operated and maintained. As discussed below, it appears that may not be constructed in a manner that allows them to fully optimize collection of landfill gas.

Surface emission monitoring (SEM) performed in October 2008 showed no exceedance of the regulatory threshold of 500 ppm by volume of methane. No other SEM data was provided to HDR. SEM is required by NSPS/EG to help ensure a LFGCS is functioning properly. By regulation certain areas may be excluded for the SEM path, including the active disposal area, areas with steep slopes and high traffic areas.

b. Well Construction

HDR reviewed the construction details for all landfill gas collection wells installed since mid-2008. From this review HDR identified concerns with the construction of wells 202 through 210, 212 and 213. These wells ranged in overall depth from 90-115 feet below the surface of the landfill. These wells have the gravel pack terminated approximately 15 feet below the surface of the landfill and a seal installed to help reduce the potential for pulling air into the gas extraction well and into the waste mass. A review of the well construction logs for these new wells suggests that the bentonite seal installed (two 1-foot thick layers) may result in difficulties in effectively applying sufficient vacuum pressure to these wells. There are a variety of measures that might be utilized to increase the effectiveness of the seal. These might include installation of additional low permeability soil or an impermeable barrier such as a synthetic liner around wells 202 through 210, 212 and 213 to improve well seals and thus increase the ability to draw a vacuum and better capture the landfill gas within the projected radius of influence of these extraction well. Ultimately the goal is to effectively capture the landfill gas in these areas and prevent emissions; this can also be accomplished with additional wells and will ultimately be achieved when an impermeable cap is installed on the closed landfill area.

c. Gas Collection System Operation

Operation of the gas collection system, including the operation of extraction wells in the areas of targeted concern, appears to be compliant with federal NSPS/EG requirements and the current Title V permit. Again, it is important to note that the regulatory compliant basis of operation is based on controlling emissions of certain gases, and not on controlling odors. These standards require the gas collection wells to have a negative pressure (vacuum), which pulls gas from the landfill, yet with not so much vacuum that oxygen concentration equals or exceeds 5% or temperature exceed 131^{o} F. Attachment B is a summary of the gas pressure, oxygen, and temperature data provided by WM. HDR was not provided data on extraction wells 205 and 207 because construction activities were not completed at the time of HDR's request for information.

Review of the gas collection data shows a wide fluctuation of vacuum pressure levels on several of the new wells, in the area of concern. This may be due insufficient seals on these wells. Without sufficient vacuum on the gas extraction wells, the radius of influence of the well will be reduced and less landfill gas may be collected. However, if the landfill can increase the quantities of gas collected it, especially in areas of higher gas generation, it should help reduce the odor associated with these areas.

As part of the overall operations review it was noted that liquid levels in several extraction wells were higher than might otherwise be anticipated. While WM has pumps installed in several wells to lower moisture levels, it is likely that these liquid build-ups are preventing optimum gas collection because they reduce the radius of influence of the wells. WM should ensure that they are monitoring liquid levels in extraction wells, removing liquid, and monitoring performance of installed pumps in wells with high liquid level to increase the radius of influence of the landfill gas collection wells and as such increase gas collection.

d. System Optimization

Based on the September 2005 Gas Collection and Control System (GCCS) Design Plan, the landfill was projected to generate approximately 3,900 cubic feet per minute (cfm) of landfill gas in the year 2008. During the site visit, WM stated that the landfill is collecting approximately 2,400 cfm of landfill gas. Because the 3,900 cfm is an estimate based on a general model that includes the waste in the active fill area where gas collection is difficult to achieve, there is no way of stating with certainty how much additional gas might be captured with a more aggressive collection system. Flare flow rate data and LFGTE flow rate data was not provided to confirm the amount of gas collected and combusted. The total flow of landfill gas collected should currently be higher with the additional landfill gas extraction wells in operation. This documentation should be provided to demonstrate that the installation of the gas extraction wells in September and December 2008 has increased total landfill gas collection.

It is suggested that WM review the potential gas generation, as estimated in their design, and evaluate if increased gas collection can be achieved with a more aggressive gas collection operation. As a secondary consideration, if more landfill can be capture from a more aggressive capture system, another engine may be needed at the LFGTE plant.

VI. Landfill Operation

In addition to a review of the gas collection system, HDR observed overall landfill operation and is providing the following observations as they might otherwise relate to landfill gas generation and odor releases.

a. Active Face

WM utilizes a disposable plastic tarp system as an alternative to soils for daily cover of the active face. This is done to maximize the useable air space. At the end of each day, landfill personnel place an approximately 40-foot by 100-foot tarp over the waste within the active face. This tarp system is intended to help reduce the potential for stormwater intrusion and to help reduce odor emissions during non-operating hours. This plastic tarp is not removed; instead waste is placed directly on top at the beginning of the work day. If significant garbage odors are detected at the active face, further evaluation of solid waste cover material may be necessary.

b. Cover Maintenance

During the site visit it was observed that some of the silt and clay used as intermediate cover material exists in large pieces and chunks. This material may be frozen and may not have been well compacted. If this condition exists in warm weather or is not corrected prior to significant snow melt it could contribute to storm water infiltration. This coarse surface condition could provide a

pathway for moisture to be trapped and thus enter the landfill; these infiltration pathways can also end up as pathways for landfill gas to be emitted from the landfill.

The final cover design for the site includes a geo-membrane that provides additional protection against moisture intrusion and the escape of landfill gas/odors. It is recommended that areas with rough surface grades be re-graded vegetated when weather permits. Stressed vegetation can be used as an indication that landfill gas is present. If stressed vegetation is seen, further investigation should be conducted to determine if landfill gas is present.

VII. Odor Response Action Plan

Landfills with odor problems often need to develop a response action plan to address odor complaints. Identification and review of factor leading to odor sources and documentation of the corrective actions should be performed when an odor complaint is received.

When WM receives an odor complaint, personnel should document the date and time of the complaint and initiate a structured procedure to identify the source of the odor. This documentation will allow WM to track odor sources and evaluate if current practices (design, construction and operations) can be improved to reduce odor emissions.

VIII. Summary of Recommendations

HDR has reviewed the information it has been furnished on the recent odor issues at Countryside Landfill. A key finding was that WM has, in response to the odor concerns, installed several gas extraction wells in the southeastern portion of the landfill, at the WM identified odor source of area. This gas extraction system upgrade should be a significant step toward reducing odor emissions from the landfill. Again, snow covered much of the landfill surface and could not be inspected at the time of the site visit. Thus some of the recommendations below may have been implemented by WM. In addition to the actions take by WM, HDR has identified several items which should help further reduce the potential for significant off-site odor emissions from the landfill. These include the following:

1) WM should develop a proactive procedure to identify conditions that might lead to potential future odor emissions and an odor response action plan that includes the identification of corrective actions to respond quickly to odor complaints. Such a procedure should identify on-site and off-site detection events, events that lead to odor generation, and the series of responses or actions to be undertaken to prevent off-site migration. Any corrective actions implemented should be recorded. This documentation will allow WM to track odor sources, evaluate if corrective actions are effective, and modify current practices to reduce the occurrence of off-site odor emissions in the future.

2) WM should document on-site and off-site odor complaints and for each complaint WM should, to the extent possible, identify the source of odor emissions and correct the problem.

3) WM should review current waste acceptance practices and adopt acceptance and handling procedures to further limit wastes that are prone to significant odor generation. Where such wastes are accepted, WM should adopt written procedures to minimize the exposure of these material to moisture or conditions in the landfill that would result in their exposure to anaerobic conditions or conditions which might produce landfill gas. WM has stated they

have implemented revised waste acceptance procedures to prevent future deliveries of large quantities of gypsum material. Similar waste acceptance restriction might be extended to other known waste types that are often associated with odor generation including wastes from construction and demolition waste recycling facilities, and certain sludges. Procedures that have been adopted and should continue to be followed include:

- Ensuring that waste restrictions are clearly posted on site signage and distribution of information to customers informing them of the waste restriction.
- Burying particularly malodorous waste immediately upon receipt.
- Cover wastes subject to odor generation when exposed to moisture in a manner that minimizes exposure to moisture, e.g. cover gypsum with 6" of soil.

4) The Client and WM should jointly review all applicable procedures and where appropriate develop methods, procedures, rules or supplement permit condition that better ensure these materials will not contribute to significant future odor generation. WM should evaluate the effectiveness of these procedures every 3 months and revise procedures, if necessary.

5) Landfill operating staff should be further educated on odor detection and gas emissions and be obligated to report such conditions to management personnel.

6) WM should review site conditions, which may contribute to precipitation infiltration and implement improvements designed to minimize moisture infiltration

7) The Client and WM should review the current SEM path and monitoring plan procedures and identify odor problem areas on the site.

8) WM should undertake a comprehensive review of the current LFGCS every 3 months (historic and new active gas collection wells and system components) to ensure that they are properly designed, constructed, operated and maintained to achieve not only regulatory compliance but to control the release of odors. Where deficiencies are identified they should be corrected as soon as possible. As noted above, the current regulatory compliant basis of design and operation is based on controlling emissions of certain gases.

9) The seals on new wells (especially, 202 through 210, 212 and 213) should be further evaluated (and if necessary upgraded) to ensure sufficient vacuum can be applied to the well to capture gas from within the entire projected radius of influence of the wells. If current seals are ineffective they should be repaired or modified. Examples of modifications might include installation of additional low permeability soil or an impermeable barrier (such as a synthetic liner) around top of the wells to improve well seals. For future well installation, WM should install 2-foot bentonite seals with hydration as specified by the material manufacturer.

10) The gas extraction wells within the area of apparent odors emission should be monitored on a weekly basis until the wells have stabilized and the odor problem has been determined to be under control. Vacuum pressures should be increased on wells in the area of identified and anticipated concern as necessary to increase the collection of the landfill gas and further prevent off-site emissions. Monitoring should also insure that vacuum pressure does not cause excess oxygen intrusion or high temperatures. For new well installation, weekly gas

well monitoring and adjustment should be made for a three month period to ensure the gas extraction well has stabilized.

11) WM should ensure that they are monitoring liquid levels quarterly in extraction wells, removing such liquids, and monitoring performance of installed pumps in wells with high liquid level. Monitoring and liquid removal should be designed to increase the radius of influence of the landfill gas collection wells and as such increase gas collection.

12) It is suggested that WM review the potential gas generation quantities, as estimated in their past design, and evaluate if increased gas collection can be achieved with a more aggressive gas collection system operation. WM should calculate the average monthly gas flow rate collected and compare this flow rate to the gas generation estimate in the GCCS plan. These flow rates should be presented as the gas collection system efficiency for the GCCS to monitor trends of increasing and decreasing gas collection. The difference in actual waste acceptance from the GCCS plan should be noted. This documentation should be submitted to the Client for their records.

13) Operational provisions should be developed that ensure downtime for the flare station not to exceed 5 percent downtime for the year and less than 2 days in any one month, with the exception of unforeseen and uncontrollable circumstances. SWALCO should be notified immediately of all down-time events and schedule for correction.

14) WM should evaluate the existing flare station and provide documentation of scheduled maintenance upgrades or component replacement for the next five years. System maintenance and replacement should be coordinated with the LFGTE plant maintenance schedule to allow landfill gas combustion from the wellfield by either the flare or the LFGTE at all times. Flare station flow capacity should be reviewed on an annual basis and system upgrades scheduled to increase flow capacity before the maximum flow rate capacity is reached.

15) WM should develop additional protocol with the third party LFGTE company to ensure that WM can plan for scheduled system shutdowns and more rapidly respond to unscheduled shut-downs. WM should evaluate and where feasible implement an automated system to detect decreasing flow to the LFGTE facility and automatically respond by increasing flow to the flare station, with a goal of maintaining consistent wellfield vacuum pressure. The Client would like to see both entities transmit as much gas as possible to the LFGTE facility and should begin evaluating the need and feasibility of adding another engine.

16) If significant off-site odor complaints continue to be reported, the Client and WM should consider undertaking definitive odor measurements. The Client and WM should develop odor standards for measurement. These measurements should be similar to the procedures for odor measurements in Title 35, Subchapter 1, Part 245 regarding other odor sources.

In addition to recent corrective action, the above recommendations provide a strategy to address the short- and long-term options and strategies to prevent off-site odor issues at the Countryside Landfill.

The Client and WM should jointly develop and reach agreement on the timeframe for implementation of these recommendations. All actions taken should be documented and such

documentation should be distributed to the Client. Any procedures developed by WM should be submitted to the Client for approval. The SWALCO and WM should review their 1994 disposal agreement to determine the proper protocol for adding these terms and procedures.

The Lake County Health Department has increased site inspections and is in the process of purchasing a portable analyzer to measure hydrogen sulfide concentration. Any measurements from these devices should be provided to all parties to document results and correlate them to complaints and corrective actions.

If these measures prove to be inadequate it is likely that the data collection efforts from these actions will provide the information necessary to define additional controls. Further gas collection system expansions should be evaluated if the odor levels are not adequately reduced.

ATTACHMENT A

WM SUPPLIED GAS COLLECTION SYSTEM FIGURES

N

SCALE 0' 150' 300'

LEGEND

- PROPERTY BOUNDARY
- PERMITTED LIMITS OF WASTE
- 6" HEADER OR LATERAL PIPELINE
- W-145 GAS EXTRACTION WELL
- APPROXIMATE LIMITS OF COMPOSITE GEOMEMBRANE FINAL COVER
- APPROXIMATE LIMITS OF INTERIM GEOMEMBRANE COVER

NORTH EXPANSION AREA

EXISTING UNIT

EXISTING UNIT

SOUTH EXPANSION AREA

Cell 5B

Cell 5C

Cell 5A

BLOWER AND ENCLOSED FLARE UNIT

CONNECTION TO GAS-TO-ELECTRICITY FACILITY

FIGURE 2

AUGUST 2008
GAS MANAGEMENT SYSTEM
COUNTRYSIDE LANDFILL
LAKE COUNY, ILLINOIS

N

SCALE 0' 150' 300'

LEGEND

- PROPERTY BOUNDARY
- PERMITTED LIMITS OF WASTE
- 6" HEADER OR LATERAL PIPELINE
- W-145 GAS EXTRACTION WELL
- APPROXIMATE LIMITS OF COMPOSITE GEOMEMBRANE FINAL COVER
- APPROXIMATE LIMITS OF INTERIM GEOMEMBRANE COVER

NORTH EXPANSION AREA

SOUTH EXPANSION AREA

EXISTING UNIT

EXISTING UNIT

Cell 5B

Cell 5C

Cell 5A

Significant Odors Observed

Significant Odors Observed

AFFECTED AREA

BLOWER AND ENCLOSED FLARE UNIT

CONNECTION TO GAS-TO-ELECTRICITY FACILITY

FIGURE 3

SEPTEMBER 2008
GAS MANAGEMENT SYSTEM
COUNTRYSIDE LANDFILL
LAKE COUNY, ILLINOIS

N

SCALE 0' 150' 300'

LEGEND

- PROPERTY BOUNDARY
- PERMITTED LIMITS OF WASTE
- 6" HEADER OR LATERAL PIPELINE
- W-145 GAS EXTRACTION WELL
- APPROXIMATE LIMITS OF COMPOSITE GEOMEMBRANE FINAL COVER
- APPROXIMATE LIMITS OF INTERIM GEOMEMBRANE COVER

NORTH EXPANSION AREA

EXISTING UNIT

EXISTING UNIT

SOUTH EXPANSION AREA

Cell 5B

Cell 5C

Cell 5A

Significant Odors Observed

Significant Odors Observed

AFFECTED AREA

BLOWER AND ENCLOSED FLARE UNIT

CONNECTION TO GAS-TO-ELECTRICITY FACILITY

FIGURE 4

DECEMBER 2008
GAS MANAGEMENT SYSTEM
COUNTRYSIDE LANDFILL
LAKE COUNY, ILLINOIS

ATTACHMENT B

WM SUPPLIED GAS COLLECTION SYSTEM WELLFIELD MONITORING DATA

Monthly Gas Well Monitoring Results
Countryside Landfill
2008

Gas Well	Date	Oxygen (%)	Static Pressure (inches WC)	Temperature (ºF)
COUW0101	1/10/2008 7:33	1.3	-44.9	43
COUW0101	2/1/2008 9:32	3	-21.2	20
COUW0101	3/5/2008 14:39	1.9	-25.7	43
COUW0101	4/9/2008 7:51	1	-24.3	48
COUW0101	5/1/2008 9:46	1.3	-16	65
COUW0101	6/3/2008 9:13	1.7	-27.6	66
COUW0101	7/2/2008 9:50	1.2	-22.7	87
COUW0101	8/1/2008 8:24	0.8	-29	75
COUW0101	9/2/2008 8:05	0.5	-16.6	75
COUW0101	10/1/2008 9:01	3.2	-23	55
COUW0104	9/30/2008 16:30	0	-18.1	73
COUW0104*	10/1/2008 10:07	0	-6.1	79
COUW0104*	10/3/2008 8:26	0	-12.5	82
COUW0104*	10/7/2008 13:51	0	-17.9	83
COUW0104*	11/4/2008 9:15	0	-7.1	85
COUW0104*	11/19/2008 10:14	0	-20.8	83
COUW0104*	11/25/2008 11:50	0	-22.6	84
COUW0104*	11/26/2008 11:08	0	-14.7	88
COUW0104*	12/1/2008 13:17	0	-19.3	85
COUW0104*	12/10/2008 12:35	0	-14.9	84
COUW0105	9/30/2008 16:01	1.1	-8.1	88
COUW0105*	10/1/2008 9:58	0.6	-1.7	89
COUW0105*	10/3/2008 8:31	0.5	-1.7	90
COUW0105*	10/7/2008 14:01	0.1	-1.8	93
COUW0105*	11/4/2008 9:07	0	-0.8	93
COUW0105*	11/19/2008 10:09	0	-0.4	90
COUW0105*	12/1/2008 13:12	0	-1.3	89
COUW0105*	12/10/2008 12:43	0	-1.4	90
COUW0107	8/7/2008 10:42	0	-4.2	92
COUW0107	9/3/2008 12:43	0.1	-3.4	94
COUW0107	10/1/2008 9:52	0	-5.9	94
COUW0107	11/4/2008 9:04	0	-10.5	93
COUW0107	11/19/2008 9:54	0	-5	92
COUW0107	12/1/2008 11:30	0	-13.8	90
COUW0107	12/10/2008 10:20	0.1	-15.1	92
COUW0108	8/7/2008 10:39	0.2	-0.5	88
COUW0108	9/3/2008 12:47	0	-0.3	88
COUW0108	10/1/2008 9:50	0	-2.1	89
COUW0108	11/4/2008 9:00	0	-3.6	89
COUW0108	11/19/2008 9:49	0	-0.3	88
COUW0108	12/1/2008 11:25	0	-8.4	88
COUW0108	12/10/2008 12:58	0	-8.1	89
COUW0109	1/9/2008 9:44	0	-6	89
COUW0109	2/1/2008 9:03	0.2	-1.6	83
COUW0109	3/5/2008 14:10	0	-4.6	88
COUW0109	4/9/2008 14:31	0	-13.1	82
COUW0109	5/1/2008 9:10	0	-1.8	90
COUW0109	6/3/2008 8:41	0	-2.4	90
COUW0109	7/2/2008 7:22	0	-1.4	89
COUW0109	8/1/2008 8:02	0	-3.7	93

Monthly Gas Well Monitoring Results
Countryside Landfill
2008

Gas Well	Date	Oxygen (%)	Static Pressure (inches WC)	Temperature (ºF)
COUW0109	9/2/2008 7:46	0	-2.1	91
COUW0109	10/1/2008 9:47	0	-5.9	93
COUW0109	11/10/2008 9:28	2	-9.9	88
COUW0109	11/19/2008 9:45	0	-4	89
COUW0109	12/1/2008 11:21	0	-11.9	89
COUW0109	12/10/2008 13:04	0	-9.4	89
COUW0110	1/9/2008 9:41	0	-9.3	76
COUW0110	2/1/2008 8:59	0.3	-3.5	76
COUW0110	3/5/2008 14:06	0	-6	80
COUW0110	4/9/2008 14:35	0	-6.3	93
COUW0110	5/1/2008 9:07	0	-4.7	92
COUW0110	6/3/2008 8:38	0	-6	82
COUW0110	7/2/2008 7:18	0	-3.5	83
COUW0110	8/1/2008 7:58	0	-5.5	89
COUW0110	9/2/2008 7:43	0	-2.5	90
COUW0110	10/1/2008 9:44	0	-7.4	89
COUW0110	11/4/2008 8:55	0	-9.4	90
COUW0110	11/19/2008 9:41	0	-3.6	91
COUW0110	12/1/2008 11:18	0	-8.1	89
COUW0110	12/10/2008 13:11	0	-5.8	90
COUW0111	1/9/2008 9:35	0	-13.6	89
COUW0111	2/1/2008 8:53	0	-7.2	88
COUW0111	3/5/2008 14:03	0	-7	88
COUW0111	4/9/2008 14:27	0	-15.6	89
COUW0111	5/1/2008 9:03	0	-6	90
COUW0111	6/3/2008 8:35	0	-7.3	91
COUW0111	7/2/2008 7:14	0	-3.9	91
COUW0111	8/1/2008 8:42	0	-5.4	95
COUW0111	9/2/2008 7:40	0.2	-0.1	92
COUW0111	10/1/2008 9:41	0	-8.8	93
COUW0111	11/4/2008 8:51	0.2	-4.7	65
COUW0111	11/19/2008 9:36	0	-0.3	32
COUW0111	12/1/2008 11:13	1	-5.3	30
COUW0122	1/9/2008 9:58	0.1	-2.4	84
COUW0122	2/1/2008 8:34	0.5	-0.2	75
COUW0122	3/6/2008 8:41	0.1	-1.2	76
COUW0122	4/9/2008 14:56	0	-1.6	85
COUW0122	5/1/2008 9:34	0	-0.1	87
COUW0122	6/3/2008 9:01	0	-0.4	91
COUW0122	7/2/2008 7:57	0	-0.6	91
COUW0122	8/1/2008 8:14	0	-0.2	94
COUW0122	9/2/2008 7:56	0	-0.1	95
COUW0122	10/1/2008 10:42	0	-1	93
COUW0122	11/4/2008 9:49	0	-0.3	96
COUW0122	12/1/2008 14:00	0.3	-1	93
COUW0123	8/7/2008 10:46	0	-5.2	99
COUW0123	9/3/2008 12:52	0	-4.1	100
COUW0123	10/1/2008 10:19	0	-6.7	99
COUW0123	11/4/2008 9:32	0	-11.3	99

Monthly Gas Well Monitoring Results
Countryside Landfill
2008

Gas Well	Date	Oxygen (%)	Static Pressure (inches WC)	Temperature (ºF)
COUW0123	11/19/2008 10:37	0	-5.6	98
COUW0123	12/1/2008 13:36	0	-15.3	98
COUW0124	8/7/2008 10:53	0	-5.6	97
COUW0124	9/3/2008 13:31	0.1	-5.1	98
COUW0124	10/1/2008 10:30	0	-7.2	97
COUW0124	11/4/2008 9:40	0	-11.8	100
COUW0124	11/19/2008 10:44	0	-7	100
COUW0124	12/1/2008 13:47	0	-14.4	102
COUW0124	12/8/2008 11:32	0	-14.4	104
COUW0125	8/7/2008 10:50	0	-6.6	79
COUW0125	9/3/2008 12:55	0	-5.8	79
COUW0125	10/1/2008 10:23	0	-8.2	79
COUW0125	11/4/2008 9:36	0	-13.1	80
COUW0125	11/19/2008 10:40	0	-7.9	79
COUW0125	12/1/2008 13:42	0.3	-17	80
COUW0125	12/10/2008 12:07	0	-17.4	80
COUW0126	1/9/2008 9:53	0.1	-4.6	76
COUW0126	2/1/2008 8:42	0	-1	64
COUW0126	3/5/2008 14:20	0	-0.8	60
COUW0126	4/9/2008 14:52	0	-4.9	75
COUW0126	5/1/2008 9:30	0	-0.4	84
COUW0126	6/3/2008 8:58	0.1	-0.8	74
COUW0126	7/2/2008 7:50	0	-1	114
COUW0126	8/1/2008 8:09	0	-0.3	96
COUW0126	9/2/2008 7:52	0	-0.5	110
COUW0126	10/1/2008 10:39	0	-0.5	104
COUW0126	11/4/2008 9:44	0	-0.3	89
COUW0126	12/1/2008 13:53	0	-1.4	108
COUW0127	1/9/2008 9:31	0.2	-20.6	69
COUW0127	2/1/2008 8:48	0	-13.4	69
COUW0127	3/5/2008 13:59	0	-11.1	69
COUW0127	4/9/2008 14:22	0	-22.9	70
COUW0127	5/1/2008 9:00	0	-9.7	70
COUW0127	6/3/2008 8:30	0	-11	71
COUW0127	7/2/2008 7:11	0	-6.5	71
COUW0127	8/1/2008 7:52	0	-8.6	72
COUW0127	9/2/2008 7:36	0.1	-0.1	72
COUW0127	10/1/2008 10:34	0	-11.7	70
COUW0127	11/4/2008 8:46	0.2	-19.5	72
COUW0127	11/19/2008 9:31	0	-15.4	71
COUW0127	12/1/2008 11:07	0	-16.8	70
COUW0127	12/10/2008 11:48	0	-16	70
COUW0155*	9/30/2008 16:26	0	-21.9	56
COUW0155*	10/1/2008 10:12	0.5	-13.6	60
COUW0155*	10/3/2008 8:43	0.1	-18.9	53
COUW0155*	10/7/2008 13:55	1.3	-20.5	62
COUW0155*	11/4/2008 9:20	2.2	-24.6	62
COUW0155*	11/19/2008 10:19	3.6	-23.1	42
COUW0155*	11/25/2008 12:01	0	-24.7	67

Monthly Gas Well Monitoring Results
Countryside Landfill
2008

Gas Well	Date	Oxygen (%)	Static Pressure (inches WC)	Temperature (ºF)
COUW0155*	12/1/2008 13:23	2.7	-20.7	28
COUW0155*	12/10/2008 12:24	0.7	-15.6	34
COUW0156*	9/30/2008 16:06	0	-8.5	109
COUW0156*	10/1/2008 10:02	0	-1.9	110
COUW0156*	10/3/2008 8:37	0.2	-4.1	112
COUW0156*	10/7/2008 14:07	0	-2.2	110
COUW0156*	11/4/2008 9:11	0	-2.9	115
COUW0156*	11/19/2008 9:59	0	-2	111
COUW0156*	12/1/2008 12:59	0	-2.8	115
COUW0156*	12/10/2008 10:54	0	-0.6	113
COUW0156*	12/29/2008 14:19	0	-6	115
COUW0157*	9/30/2008 16:17	0	-16.4	104
COUW0157*	10/1/2008 10:15	0	-1.6	102
COUW0157*	10/3/2008 8:49	0	-12.8	103
COUW0157*	10/7/2008 14:15	0	-19.8	101
COUW0157*	11/4/2008 9:24	0	-23.8	100
COUW0157*	11/19/2008 10:30	0	-24.2	99
COUW0157*	11/21/2008 15:13	0	-25	103
COUW0157*	11/22/2008 10:36	0	-24.2	103
COUW0157*	12/1/2008 13:27	0	-19.7	98
COUW0157*	12/8/2008 11:56	0	-14.7	100
COUW0157*	12/10/2008 12:14	0	-14.3	100
COUW0158*	9/30/2008 16:11	0	-13.7	111
COUW0158*	10/1/2008 10:27	0	-4.3	105
COUW0158*	10/3/2008 8:53	0	-11.4	104
COUW0158*	10/7/2008 14:19	0	-13.4	104
COUW0158*	11/4/2008 9:28	0	-16.8	105
COUW0158*	11/22/2008 10:40	0	-19.8	104
COUW0158*	12/1/2008 13:31	0	-16.2	105
COUW0158*	12/8/2008 11:22	0	-14.4	105
COUW0201*	12/7/2008 10:36	0	-5.3	104
COUW0201*	12/8/2008 11:15	0	-4.5	100
COUW0201*	12/10/2008 11:00	0	-6	100
COUW0201*	12/18/2008 13:42	0	-7.7	101
COUW0201*	12/24/2008 11:30	0	-5.2	101
COUW0202*	12/8/2008 11:43	0	-2.2	76
COUW0202*	12/10/2008 11:55	0	-2.7	67
COUW0202*	12/18/2008 10:03	0	-1.4	77
COUW0202*	12/29/2008 14:44	0	-4.4	95
COUW0203*	12/7/2008 10:29	1	-5.3	50
COUW0203*	12/8/2008 11:27	0	-3.7	75
COUW0203*	12/10/2008 11:12	0	-4.7	83
COUW0203*	12/24/2008 11:25	0	-6.1	89
COUW0203*	12/29/2008 14:36	0	-8.9	85
COUW0204*	12/8/2008 11:49	1.4	-3.4	76
COUW0204*	12/10/2008 12:01	3.4	-4	74
COUW0204*	12/24/2008 11:21	0.6	-5.8	84
COUW0204*	12/29/2008 14:40	0	-9.2	83
COUW0206*	12/18/2008 10:17	4.6	-7.1	89

Monthly Gas Well Monitoring Results
Countryside Landfill
2008

Gas Well	Date	Oxygen (%)	Static Pressure (inches WC)	Temperature (ºF)
COUW0208*	12/10/2008 12:49	0	-2	75
COUW0208*	12/18/2008 10:28	0	-3.9	88
COUW0209*	12/24/2008 11:11	1.5	-7.7	72
COUW0209*	12/29/2008 13:58	0.1	-8.0	73
COUW0210*	12/23/2008 15:42	0	-0.6	81
COUW0210*	12/24/2008 11:15	0	-1.2	86
COUW0210*	12/29/2008 13:53	0	-1.8	86
COUW0211*	12/24/2008 10:54	0	-0.5	70
COUW0211*	12/29/2008 13:35	0.3	-1.7	70
COUW0212*	12/8/2008 11:06	0	-5.8	66
COUW0212*	12/10/2008 12:29	0	-10	71
COUW0212*	12/18/2008 13:36	0	-9.8	80
COUW0212*	12/19/2008 10:26	0	-14.2	67
COUW0213*	12/8/2008 10:50	0	-6.8	69
COUW0213*	12/10/2008 12:19	0	-10.3	76
COUW0213*	12/18/2008 13:32	0.1	-5.3	85
COUW0213*	12/19/2008 10:32	0.3	-11.6	77
COUW0213*	12/29/2008 14:23	0	-10.7	78
COUW0214*	12/29/2008 13:39	0	-0.1	80
COUW101R	10/2/2008 12:47	0.1	-18.9	90
COUW101R	11/4/2008 11:13	0.2	-10.9	97
COUW101R	12/2/2008 8:29	0	-15.1	91
COUW111R	12/7/2008 9:57	0	-4.5	54
COUW111R	12/8/2008 14:19	0	-1	62
COUW111R	12/10/2008 11:42	0	-3.5	79