



CORNERSTONE

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August 22, 2012

Mr. Jerry Parker, R.S.
Environmental Engineer
Ohio EPA

Division of Materials and Waste Management
Northeast District Office
21110 E. Aurora Road
Twinsburg, Ohio 44087

Entity: LORAIN COUNTY II LANDFILL LLC

Doc Type: PLAN

Doc Subtype: APPLICATION & SUPPORT

Program: MSWL

County: LORAIN

Secondary ID: MSWL 018801

RECEIVED

AUG 23 2012

OHIO EPA NEDO

Re: Lorain County Landfill
Design and Operational Evaluation, Landfill Gas Collection and Control System

Dear Mr. Parker:

On behalf of Browning-Ferris Industries of Ohio, Inc. and Lorain County Landfill II, LLC, (Lorain County Landfill) the Cornerstone Environmental Group, LLC (Cornerstone) respectfully submits this revised evaluation of the landfill gas collection and control system at the Lorain County Landfill, Oberlin, Ohio. This document has been revised to address comments expressed by your office in meetings with Lorain County Landfill on February 9 and August 7, 2012.

The original DFFO Evaluation was provided to OEPA on March 2, 2007, with subsequent revisions as requested by the OEPA submitted on June 8, 2007, January 3, 2008, February 26, 2010 and July 28, 2010.

Your comments, along with the associated responses to them, are included below and in the attached modifications to the Design and Operational Evaluation (Evaluation). Changes to existing Evaluation pages are highlighted and presented on colored paper for ease of reference.

I. COMMENT ONE WELLFIELD COVERAGE WELL SPACING

Comment 1.1

Although Republic typically records quarterly surface emissions that are below the federal NSPS threshold of 500 ppm, Ohio EPA has been onsite when surface

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I. COMMENT ONE WELLFIELD COVERAGE WELL SPACING

Comment 1.1

Although Republic typically records quarterly surface emissions that are below the federal NSPS threshold of 500 ppm, Ohio EPA has been onsite when surface

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emissions are present at levels that are very odorous and could pose a public nuisance when off-site migration occurs. As stated in the May 27th, 2010 NOD letter, it is possible that the active gas extraction wells are not spaced adequately to maintain compliance with the public nuisance requirements in Ohio Administrative Code 3745-15-07(A) and 3745-27-19(B).

Response 1.1

In the event that localized site conditions dictate that wellfield modifications are required to maintain operational control of odors and/or surficial emissions, Republic will advise the OEPA of such a condition and the remedy(ies) being taken to address this condition. Potential remedies may include, but not be limited too, the installation of additional LFG collectors, upgrading existing LFG collectors, and upgrading the cover conditions.

Comment 1.2

Republic was directed to insert Table 5-1, "Summary of Suggested Collector Density", in Section 2.4.2., "Vertical LFG Extraction Wells", of the revised evaluation. The table was presented at a North Carolina State University landfill gas training course. In addition to the table, an introductory paragraph was also provided on page 2-4. The paragraph included the following sentence: "...The Lorain II well spacings, per the January 2009 GCCS Design Plan, are approximately 215 feet to 240 feet under Final Development conditions..." Appendix A-2, "Radius of Influence and Well Spacing Calculations", of that document, provides calculations for spacings between 204 feet and 223 feet. A more recent version of the design plan, with the same appendix, was submitted to the district office on November 18, 2010. In addition to the text being updated to reflect the current report, the appendix should also be added to the subsequent evaluation.

Response 1.2

Section 2.4.2 of the Evaluation has been updated to incorporate the text from the Section 2.4.2 of the November 2010 GCCS Design Plan. Additionally, Appendix A-2, Radius of Influence and Well Spacing Calculations of the November 2010 GCCS Design Plan has been incorporated into the Evaluation as Attachment 14 (updated per Response 1.6 of this submittal).

Comment 1.3

Given the critical nature of well spacing, DSIWM-NEDO conducted a review of

the appendix and various questions arose. First, it is written at the top of page 1 of 6 that the EMCON and NSPS methods were used to determine the radius of influence. Republic is asked to explain the rationale for utilizing these specific methods.

Response 1.3

A number of methodologies have been utilized within the LFG industry for purposes of well spacing approximation. Both of these methods have been utilized extensively throughout the world since their publication. They are utilized because they provide representative results over a range of operating and climactic conditions.

The EMCON Methodology was presented in Methane Generation and Recovery From Landfills, page 81, EMCON Associates, 1982. This methodology was the first commercial Radius of Influence calculation published and was the definitive method for determining this design component until the development of the MSW Landfill NSPS.

The NSPS Methodology was initially presented in Air Emissions from Municipal Solid Waste Landfills – Background Information for Proposed Standards and Guidelines, Appendix G, Theoretical Collection System Design, EPA-450/3-90-011a, March, 1991. This is the only desktop calculation methodology for determining the “radius of influence” for LFG extraction wells provided by the USEPA as part of the MSW Landfill NSPS.

The EMCON Methodology generally provides a slightly more conservative value than the NSPS Methodology, i.e. a smaller projected radius of influence and thus a tighter well spacing. This, in turn, provides a more conservative design basis.

Comment 1.4

Second, on page 6 of 6, the section on “Site Specific Calculations”, reflects that the calculations were based on well depths, ranging from 40 feet to 100 feet. Since some of the wells at the landfill are deeper than 100 feet, an explanation is requested for the limiting the depth to 100 feet. The range of well depths (40, 60, 80 and 100 feet) is also provided on Table A-2 of the appendix.

Response 1.4

As well depths and the corresponding design rate of LFG extraction, increase, the projected radius of influence for an extraction well increases. Beyond the depths presented in the noted calculations, the projected radius of influence

exceeds the design and actual well spacing of the Lorain II wellfield. This indicates a conservative method of wellfield design, especially for relatively deeper extraction well installations.

The modified Table A-2, updated per Response 1.6, has been expanded to include well depths of 120 feet and 140 feet for comparison purposes and is include in Attachment 14 of the Evaluation.

Comment 1.5

Third, Table A-2 provides a column titled "LFG Flow Rate (scfm)" which contains the following flow rates for the different depths: 20, 30 and 40 scfm (40 feet well depth); 40, 50 and 60 scfm (60 feet well depth); 60, 70 and 80 scfm (80 feet – well depth) and 80, 90 and 100 scfm (100 feet – well depth). An explanation is requested for the designation of the various flow rates at the different depths.

Response 1.5

The form of the calculation requires that a design flow rate for each well configuration be entered in order to determine the projected radius of influence. As LFG well extraction rates vary with time and site conditions, providing well-specific data and calculating a radius of influence for each extraction point becomes an exercise with little real value. Instead, the calculations are generally performed for a range of operations at select well configurations. These ranges reflect the general configuration of wells anticipated for a given landfill and anticipated LFG extraction rates.

Design flow rates are typically approximated at a rate of 0.5 to 2.0 scfm per lineal feet of perforations, based on historical field experience and real-world applications. The calculations presented were originally provided as part of the November 2010 GCCS Design Plan (Appendix A-2), prepared in accordance with NSPS and DAPC requirements. The calculations have been expanded to incorporate a greater range of potential well construction and are included in Attachment 14 of the Evaluation.

Additionally, the overall design of the Lorain County II vertical extraction wells, compiled as part of the GCCS Design Plan, is included as Attachment 9 of the Evaluation and projects a total perforated casing length of approximately 24,925 lineal feet. Combined with the existing 1,661 lineal feet for Lorain I extraction wells, the total site should realize approximately 26,586 lineal feet of perforated well casing at final development conditions. When applied to the design LFG generation rate of 17,524 scfm (Attachment 2 of the Evaluation), an average unitary flow rate of approximately 0.66 scfm per lineal feet of perforations (17,524

scfm / 26,586 lineal feet) is realized at peak LFG generation conditions.

Comment 1.6

Lastly, the following six input parameters are provided below the table: "MSW Design Capacity", "MSW Design Tonnage", "MSW Design Volume", "LFG Generation Rate", "Refuse Density" and "NSPS Collection Efficiency". Based on the following comments, Republic is directed to provide the source of the assigned values for each individual parameter. A value of 36,056,631 Mg is used for the "MSW Design Capacity", whereas, the LandGEM model utilized 37,059,162 Mg. The "MSW Design Volume" is specified as 45,046,717 cubic yards. On February 26, 2010, Cornerstone responded to Deficiency One on page 2 and Deficiency Five on page 8 with the following statement: "...The currently permitted capacity of the landfill has been confirmed at 58.4 million cubic yards, including 52.6 million cubic yards within the Lorain 2 footprint (as of the 2003 permit modification)..." The "V-Fill" Permit # 02-15346, which was approved on April 4, 2003, also cited in Volume III of IV, Section C4A of the permit, a volume of 52.6 million cubic yards for the Lorain II Landfill. The remaining 5.8 million yards was placed in the closed Lorain I Landfill.

Also, "MSW Design Tonnage" specifies a value of 39,753,728 tons in the table, however, a tonnage of 39.4 million is cited on page 2-2 of the evaluation and 40.7 million tons was utilized as the input data for the LandGEM model in Attachment 2 of the report. A LFG generation rate of 21,000 scfm is also provided in the table. Upon review of the "LFG Generation Recovery Potential Summary" table in Attachment 2 of the evaluation, the maximum total site gas generation is either 16,204 scfm or 17,524 scfm depending on the scenario.

Response 1.6

The MSW Design Tonnage should be noted at approximately 40.7 million tons, consistent with Attachment 2 – LFG Generation and Recovery Projections. The text on Page 2-2 has been updated accordingly. Table A-2 has been updated accordingly. These changes provide a minor increase (approximately 2 feet) to the calculated well spacing and do not impact the overall design parameters for the wellfield layout.

Comment 1.7

Finally, the NSPS Collection Efficiency is specified as 75%. In addition to providing the source of this efficiency, Republic is directed to provide similar information for all other input data.

Response 1.7

The value of 75% is provided as a default average by the USEPA AP-42, Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume I, Chapter 2, Section 2.4.2 - Controlled Emissions, et al.

2.4.4.2 Controlled Emissions — Emissions from landfills are typically controlled by installing a gas collection system, and combusting the collected gas through the use of internal combustion engines, flares, or turbines. Gas collection systems are not 100 percent efficient in collecting landfill gas, so emissions of CH₄ and NMOC at a landfill with a gas recovery system still occur. To estimate controlled emissions of CH₄, NMOC, and other constituents in landfill gas, the collection efficiency of the system must first be estimated. Reported collection efficiencies typically range from 60 to 85 percent, with an average of 75 percent most commonly assumed.

In this calculation format, the greater degree of efficiency employed, the smaller the radius of influence, and thus the well spacing, calculated.

With respect to the other parameters questioned above:

- a. LFG Generation Rate – This is the design flow rate as defined in Section 3 of the Evaluation and is greater than the greatest, projected LFG generation rate for conservancy in design.
- b. Refuse Density – 2009 estimated refuse density per 2009 Annual Report Landfill Capacity Calculation (Attachment 12)
- c. NSPS Collection Efficiency – 75% - average value per AP-42 (noted previously)
- d. MSW Design Capacity – Conversion of tonnage to megagrams (Tonnage * 0.907 Mg/ton)
- e. MSW Design Volume – Conversion of tons to consumed volume (Tonnage * 2,000 lb/ton / Refuse Density)

The MSW Design Volume of 46.2 million cubic yards is approximately 6.4 million cubic yards less than the total capacity potential noted of 52.6 million cubic yards. This represents an offset of approximately 12% that is reserved for daily and intermediate cover soil materials. A literature review indicates that waste:soil ratios typically vary from 6:1 to 3:1 (approximately 17% to 33%) are common. Site records indicate a soil usage of approximately 15% to 20% over the past several years. The use of a 12% allowance for soil is fairly aggressive and provides a conservative estimate of total MSW placement and thus LFG generation.

II. COMMENT TWO KY-GAS ANALYSIS

Comment 2.1

Attachment 3 of the evaluation is titled: "KY-Gas Analysis, Lorain I and Lorain II Header Systems, (Final Development Conditions – 21,000 scfm flow)". At the bottom of the first page of the attachment, the text states: "...The design process begins with development of the LFG flow rates for use in the program. The LFG flow is determined from the USEPA LandGEM LFG model...The second step involves evaluating the conceptual design of the LFG system to be installed..." Ohio EPA has several comments. First, although the analysis presents a "flow" column beginning on page 20, an explanation is requested as to the process for utilizing the LandGEM flow data in this analysis.

Response 2.1

The "Flow" values noted as beginning on Page KYG-20 represent aggregate gas flow rates through designated sections of piping. These values are noted as + or – depending upon which direction the gas is flowing in the piping and does not denote flow added or subtracted at a given point.

The flow rates modeled for individual extraction points is shown beginning on Page KYG-12, under the column denoted "DEMAND". Each extraction point has a flow value assigned to it for modeling purposes. For this analysis, the Lorain I extraction wells were modeled with an average flow rate of approximately 14 scfm per well while the Lorain II extraction wells were modeled with an average flow rate of approximately 70 scfm per well. These values result in a total modeled LFG extraction rate of 21,000 scfm – reflecting the design flow rate defined under "Section 3 – LFG Reserves" of the Evaluation.

To determine the design flow rate or "DEMAND" for each well, the total rate of LFG generation for each disposal area was averaged across the projected number of extraction wells for that area, yielding average flow rates of approximately 14 scfm per well for Lorain I and 70 scfm per well for Lorain II

Comment 2.2

The second comment relates to the time frame in which the analysis was performed. According to the cover page of Attachment Three, it indicates that a flow of 21,000 scfm is used for final development conditions. Republic should clarify if the current GCCS is adequate to convey the existing gas flow rate.

Response 2.2

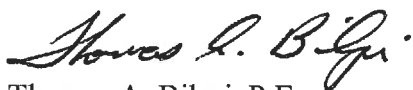
The loss analyses (KYGAS) presented in Attachment 3 of the Evaluation reflects the Final Development conditions of the landfill as provided for in the NSPS GCCS Design Plan. As the "current" conditions of a landfill are ever changing, any analyses provided during an interim operational period needs to be viewed specifically for that period in time.

An analysis of the current wellfield conditions as of July 1, 2012 has been prepared and included as a subset of Attachment 3. The analysis of Final Development conditions is now noted as Attachment 3.1, while the Analysis of current conditions is noted as Attachment 3.2 of the revised Evaluation. The current gas extraction rate is approximately 8,000 scfm. The analysis was completed using a value of 8,800 scfm, or 110% of the monitored flow rate. This analysis demonstrates that the current wellfield piping is adequate to convey gas flow rates in excess of the current gas flow rate while providing available vacuum in excess of 40 inches of water column ("wc) throughout the wellfield.

Copies of the revised Evaluation have been included as part of this submittal. Pages or sections that have been modified are noted with a revision date of August 22, 2012. If you have any questions or comments, or require additional information regarding this evaluation, please do not hesitate to contact my office at (630) 633-5505 or via e-mail at tom.bilgri@cornerstoneeg.com.

Sincerely,

Cornerstone Environmental Group, LLC



Thomas A. Bilgri, P.E.
Manager – LFG Engineering Services

Enclosure: Modifications to the Design and Operational Evaluation

cc: Carl Mussenden, OEPA-DMWM CO (w/encl)
 Erik Bewley, OEPA-DAPC (w/encl)
 Nicholas Bryan, Ohio AGO(w/encl)
 Chris Jaquet & Rick Kostelnick (Site Operating Record – 3 copies)

**DESIGN AND OPERATIONAL EVALUATION
LANDFILL GAS COLLECTION AND CONTROL
SYSTEM**

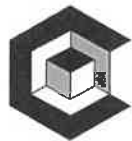
**LORAIN COUNTY LANDFILL
OBERLIN, OHIO**

Prepared for

Lorain County Landfill II, LLC
43502 Oberlin-Elyria Road
Oberlin, Ohio 44074

Submitted March 2, 2007
Revised June 8, 2007
Revised January 3, 2008
Revised February 26, 2010
Revised July 28, 2010
Revised August 22, 2012

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- 3 KY-GAS ANALYSES
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DRAWINGS

(INCLUDED WITHIN ATTACHMENT 1 – FACILITY DEVELOPMENT PLANS)

1EDI FACILITY

2LORAIN I EXISTING CONDITIONS

3 LORAIN II 2012 GCCS – EXISTING CONDITIONS PLAN

4LORAIN II GCCS FINAL DEVELOPMENT

1 INTRODUCTION

This document serves as an evaluation of the current site conditions and landfill gas (LFG) collection and control potential for the Lorain County Landfill, Oberlin, Ohio. The owner and operator of this facility, Lorain County Landfill II, LLC (Lorain County Landfill), has authorized the Cornerstone Environmental Group, LLC (Cornerstone) to prepare this evaluation in accordance with the Findings and Orders issued by the Ohio EPA, dated December 5, 2006. Specifically, this evaluation addresses Order Number 7:

7. *Respondent shall conduct a complete evaluation of the Facility's explosive gas extraction system to determine if it is adequate for controlling gas at the Facility. Respondent shall provide the findings of this evaluation along with all supporting documentation to Ohio EPA in writing within ninety (90) days after the effective date of these orders.*

The goals of the gas collection and control system are:

1. Maintain a safe working environment for the landfill operations personnel and visitors to this facility;
2. Comply with regulatory restrictions, including ORC Chapter 3734, and the Federal New Source Performance Standards (NSPS), and;
3. Maintain a "nuisance free" environment for the landfill's immediate neighbors.

This evaluation is based upon records provided to Cornerstone by Lorain County Landfill and observations of the facility by Cornerstone personnel. The original DFFO Evaluation was provided to OEPA on March 2, 2007, with subsequent revisions as requested by the OEPA submitted on June 8, 2007, January 3, 2008, February 26, 2010 and July 28, 2010. An updated GCCS Design Plan was submitted in accordance with the Federal NSPS on January 27 2009 and revised November 17, 2010.

It is the professional opinion of Lorain County Landfill, II, LLC that the Gas Collection and Control System at the Lorain County Landfill is adequately designed to comply with the applicable regulatory constraints and the DFFO. It is also the opinion of Lorain County Landfill, II, LLC that the source of nuisance odors has been largely attributable to operational issues which may be corrected with a more timely and pro-active coordination between the gas-electric developer and the landfill operator. Steps to address these issues have been taken, as well as discussed with OEPA DISWM and DAPC and the Lorain County Health Department. The incidence of verifiable complaints is significantly reduced from previous years and continues to decline as

additional operational changes are implemented. The operational changes, including a more frequent review of the sub-surface conditions of individual extraction wells and differential settlement of header piping, are reviewed in greater detail within this submittal.

2 EXISTING SITE CONDITIONS

2.1 Facility Description

The Lorain County Landfill is owned and operated by Lorain County Landfill II, LLC. Located in north, central Ohio, the surrounding area is largely rural, with several residences located within one-half mile of the landfill limits.



Figure 1 - Regional Location Map

The landfill facility is comprised of two distinct waste disposal areas; Lorain I and Lorain II. Lorain I is a closed disposal area, encompassing approximately 90 acres, which operated from 1974 to 1984. This unit contains approximately 4.3 million tons of MSW. Waste placement in the Lorain II disposal area began in 1985, and is expected to remain in operation into approximately 2032, based upon the projected rates of waste intake (not AMDWR) – 22.2 years of remaining life as of December 31, 2009. Lorain II has a total

MSW design capacity of approximately 40.7 million tons and a permitted footprint of approximately 269 acres. Of this area, approximately 190 acres have currently been developed for waste disposal. As of December 31, 2009, it was estimated that approximately 22,146,441 tons were remaining for waste placement, based on the 2009 compaction ratio.

The MSW Design Volume of 46.2 million cubic yards is approximately 6.4 million cubic yards less than the total capacity potential noted of 52.6 million cubic yards. This represents an offset of approximately 12% that is reserved for daily and intermediate cover soil materials. A literature review indicates that waste:soil ratios typically vary from 6:1 to 3:1 (approximately 17% to 33%) are common. Site records indicate a soil usage of approximately 15% to 20% over the past several years. The use of a 12% allowance for soil is fairly aggressive and provides a conservative estimate of total MSW placement and thus LFG generation.

Both disposal areas accept(ed) waste from residential, commercial and non-liquid, non-hazardous industrial sources. The landfill currently accepts MSW under PTI No. 02-15346, approved April 4, 2003. LFG generation projections consider all incoming waste as MSW for modeling purposes.

2.2 Landfill Cover System

The landfill cover installed in Lorain County Landfill I is constructed of compacted soils, while the final cover design for Lorain County Landfill II will incorporate a composite geosynthetic/low permeability soil barrier. The primary purpose of the final cover system units is to preclude precipitation infiltration that would generate additional leachate. Additionally, the final cover system design also provides a significant barrier to LFG emission and air infiltration when combined with an active LFG collection and control system (GCCS). The GCCS will provide components for collecting LFG or relieving pressures from LFG from beneath the landfill covers.

The final cover has been installed over the entirety of the Lorain I disposal area. Approximately 60 acres of final cover have been installed over the Lorain II disposal area, resulting in approximately 130 acres under interim soil cover or undergoing active waste placement at the present time. A site plan depicting the current extent of final cover placement is included as Attachment 10.

2.3 Liquids Management Systems

Leachate management in both the Lorain I and Lorain II landfill areas is accomplished through the use of an engineered leachate collection and management system (LCS). Liquids are drained via gravity to select collection points and pumped via force main to a centralized storage facility. Leachate from Lorain I is collected in tank near the Lorain I flare facility and discharged to City of Oberlin gravity sewer system. Leachate from

Lorain II is collected in above-ground storage tanks located near the Lorain II flare facility and periodically trucked to the French Creek Township Waste Water Treatment Plant (WWTP). The LCS is designed according to Subtitle D standards (40 CFR§257 and §258) and is part of the Solid Waste Disposal Permit.

The Lorain I LCS is also supplemented by a series of pneumatic pumps installed in vertical LFG extraction wells. Primarily utilizing QED Model AP-4 pumps, these locations discharge to the centralized leachate storage facility via the force main system, for subsequent disposal. There are 35 pumps installed in vertical extraction wells, as of December 2006. Please refer to the May, 2007 Construction Certification Report submitted by Brown and Caldwell under separate cover.

2.4 Gas Collection and Control System

Generally, landfill gas (LFG) is extracted from the Lorain I and Lorain II landfills via the landfill gas collection and control system (GCCS). All extracted LFG is transported to central points where it is either destroyed via a flare or utilized as a fuel source for the generation of electricity. The electrical generating facility is owned and operated by Energy Developments, Inc. (EDI), based in Houston, TX.

LFG travels from the Lorain II well field via an 18"Ø HDPE common header to a point near the EDI facility. It is combined with a 12"Ø HDPE main from the Lorain I wellfield and transferred into a 24"Ø HDPE header. This common 24"Ø HDPE header transfers all extracted LFG from both Lorain I and II to the EDI facility and/or a utility flare.

Please note Drawing No. 1 for a display of the EDI facility.

2.4.1 Wellfield Components

In 1996, an active LFG recovery system was installed at the Lorain I site. Vertical extraction wells were drilled into the waste mass and the wells were interconnected via buried, HDPE piping to an enclosed flare station (EF-1) located at the southern end of the Lorain I disposal area. The Lorain I GCCS currently includes approximately seventy-two (72) vertical extraction wells. Please reference Drawing No. 2 for the extent of the current Lorain I GCCS.

The Lorain II GCCS construction was initiated in 1995, and continued progressively as fill placement advanced. The GCCS generally consists of approximately one hundred, forty-four (144) extraction wells, approximately four thousand, one hundred (4,100) lineal feet of horizontal LFG collectors and a below ground header network. In general, the header network is comprised of an 18"Ø HDPE main along the western slope and a portion of the northern slope, a 24"Ø HDPE main along the southern and eastern slopes of the disposal area.

The vertical collectors are staged across the majority of the existing waste mass, while the horizontal collectors are generally limited to the southeastern portion of the disposal area. The wells were interconnected via buried, HDPE piping to the LFG control facilities.

Please reference Drawing No. 3 for the extent of the current Lorain II GCCS.

The current LFG control components include an enclosed flare in the southeastern portion of Lorain I Landfill, the power generating facility that accepts LFG from both Lorain I and II Landfills located east of Lorain I and southwest of Lorain II and two enclosed flares east of the Lorain II Landfill footprint, adjacent to the leachate storage facility. A utility flare that was previously utilized by EDI is still in place at the power generating facility, but is disconnected from the GCCS and currently inoperable. It is not anticipated that this flare will be made operational in the future and that it will eventually be removed from the facility.

2.4.2 Vertical LFG Extraction Wells

Lorain I landfill gas wells have been installed on a spacing of approximately 200 feet to 350 feet. Wells on the Lorain II Landfill are spaced at a frequency of approximately 200 feet to 250 feet. The wells generally consist of 36" diameter borings through the waste mass, to within approximately 10 feet of the top of the landfill base grade. A perforated vertical casing, generally 6"ø HDPE or PVC piping, is installed within the boring, to allow the extraction of LFG, and the perforated section is backfilled with a low-carbonate washed stone. The backfill stone nominally ranges in size from approximately 1-inch to 3-inches in diameter.

The design for the Lorain II well spacings are approximately 215 feet to 240 feet under Final Development conditions. These calculations were originally provided as part of the November 2010 GCCS Design Plan, (Table A-2) prepared in accordance with NSPS and DAPC requirements. The calculations have been expanded to incorporate a greater range of potential well construction and are included in Attachment 14 of the Evaluation.

A number of methodologies have been utilized within the LFG industry for purposes of well spacing approximation. Both of these methods have been utilized extensively throughout the world since their publication. They are utilized because they provide representative results over a range of operating and climactic conditions.

The EMCON Methodology was presented in Methane Generation and Recovery From Landfills, page 81, EMCON Associates, 1982. This methodology was the first commercial Radius of Influence calculation published and was the definitive method for determining this design component until the development of the MSW Landfill NSPS.

The NSPS Methodology was initially presented in Air Emissions from Municipal Solid

Waste Landfills – Background Information for Proposed Standards and Guidelines, Appendix G, Theoretical Collection System Design, EPA-450/3-90-011a, March, 1991. This is the only desktop calculation methodology for determining the “radius of influence” for LFG extraction wells provided by the USEPA as part of the MSW Landfill NSPS.

The EMCON Methodology generally provides a slightly more conservative value than the NSPS Methodology, i.e. a smaller projected radius of influence and thus a tighter well spacing. This, in turn, provides a more conservative design basis.

As well depths and the corresponding design rate of LFG extraction, increase, the projected radius of influence for an extraction well increases. Beyond the depths presented in the noted calculations, the projected radius of influence exceeds the design and actual well spacing of the Lorain II wellfield. This indicates a conservative method of wellfield design, especially for relatively deeper extraction well installations.

Well spacing guidelines are presented in *Table 5-1, Summary of Suggested Collector Density, Training Course for Landfill Gas NSPS/EG Regulatory Personnel to Review GCCS Design Submittals, North Carolina State University, September, 1998*. The well spacings proposed by the North Carolina State University document reflects a frequency of approximately 300 feet in wet, post-Subtitle D landfills. This reference most closely approximates the conditions present at the Lorain County Landfill.

Table 5-1
Summary of Suggested Collector Density

** Type of Landfill Conditions	* Approx. Spacing of Vertical Collectors (wells)
Migration control for adjacent structures	100' to 200'
Migration control for deep vadose zone	200' to 300'
Post Subtitle D wet waste	250' to 300'
Post Subtitle D dry waste	350' to 400'
Post Subtitle D horizontal collectors	30' to 50' vertically and 150' to 300' horizontally

*Use the lower value in wet waste or critical areas

**Refer to Section 5.1 for a complete description

The top +/- 20 feet of the casing is comprised of solid casing pipe and backfilled with low-permeability on-site soils and bentonitic clays. This configuration serves to prevent the infiltration of surface water and ambient air during the LFG extraction process, as well as to mitigate the potential for uncontrolled LFG emissions. Wells located in areas of composite final cap are also booted to the final cap geomembrane using mechanical clamps, to further mitigate the potential for air intrusion or uncontrolled LFG emissions.

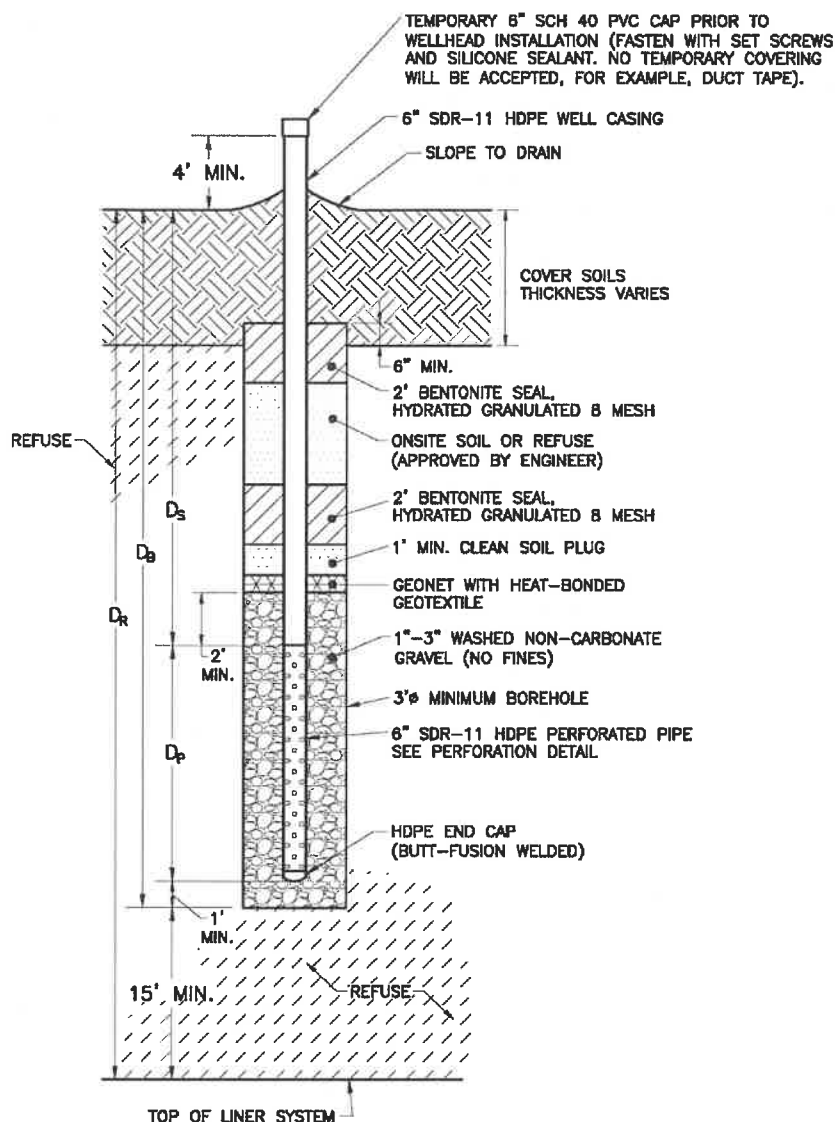


Figure 2 – Typical Vertical LFG Extraction Well

2.4.3 Horizontal LFG Extraction Wells

Horizontal LFG extraction wells have not been installed on the Lorain I disposal area. Horizontal LFG extraction wells have been installed on the Lorain II disposal area as an interim control measure, in areas that have not yet reached final waste placement grades. These wells are spaced at a frequency of approximately 200 feet to 250 feet. The wells generally consist of 36" wide trenches excavated through the waste mass, to a length of up to 300 feet. A perforated casing, generally 6"ø HDPE or PVC piping, is installed

within the excavation, to allow the extraction of LFG, and the perforated section is backfilled with a low-carbonate washed stone. The backfill stone nominally ranges in size from approximately 1-inch to 3-inches in diameter.

The outer 50 feet to 100 feet of the casing is comprised of solid casing pipe and backfilled with low-permeability on-site soils and bentonitic clays. This configuration serves to prevent the infiltration of surface water and ambient air during the LFG extraction process, as well as to mitigate the potential for uncontrolled LFG emissions. Wells located in areas of composite final cap are also booted to the final cap geomembrane using mechanical clamps, to further mitigate the potential for air intrusion or uncontrolled LFG emissions.

The existing horizontal gas collectors (HGCs) will be decommissioned as they cease to be productive gas extraction components. The HGCs are planned to be ultimately replaced with vertical extraction wells throughout the entire footprint of the disposal area, however the HGCs may be operated in concert with the vertical well system as long as they are productive. Currently, HGCs 16 and 17 are connected to the GCCS and being used for LFG extraction. The balance of the HGCs have been decommissioned and sealed against ambient air intrusion. HGCs 16 and 17 will continue to be utilized as long as they are viable gas collectors – they will then be decommissioned and the OEPA and Health Department notified accordingly.

Lorain County Landfill may elect to utilize HGCs as an interim LFG collector at a future date, depending upon the need for LFG collection and the topography of the waste mass at the time.

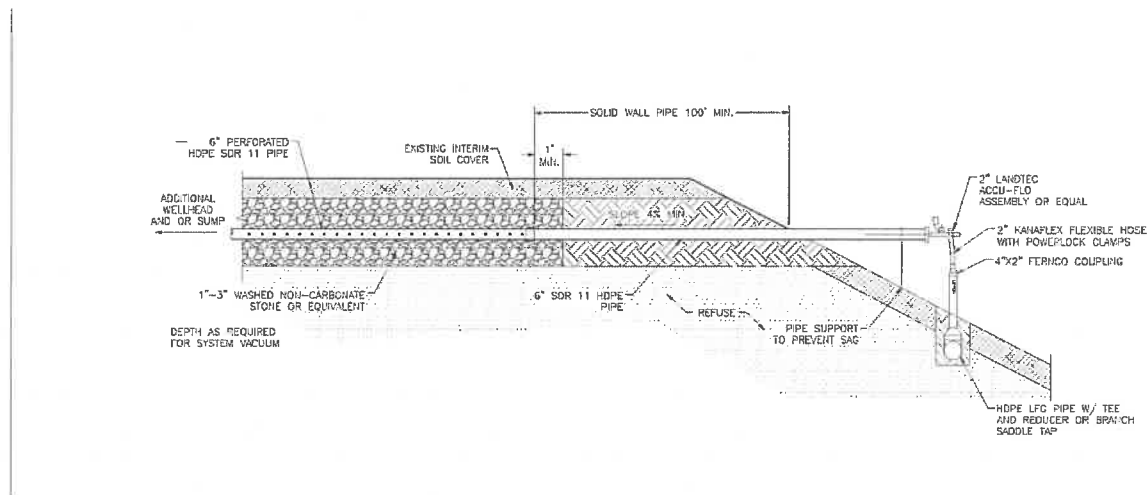


Figure 3 – Typical Horizontal LFG Extraction Well

2.4.4 Wellheads

In order to regulate the application of vacuum to the extraction wells and the flow of LFG

from the extraction wells to the LFG control facilities, each of the extraction wells are fitted with wellheads. These wellheads utilize a flow control valve and possess fittings to accommodate liquid level, gas quality and vacuum application readings. Each wellhead is pre-fabricated by Landtec (Colton, CA) or is of comparable composition.

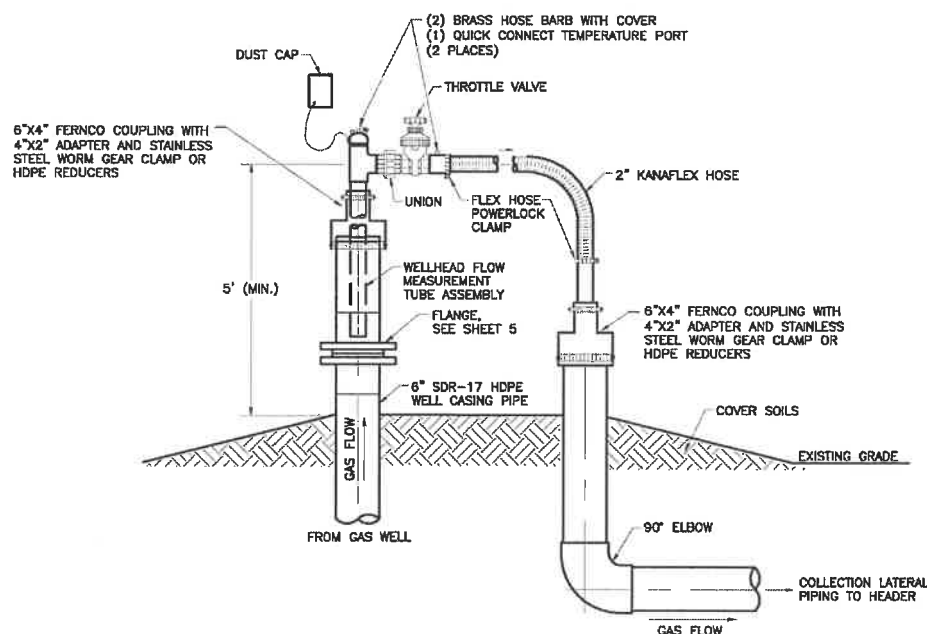


Figure 4 – Typical Wellhead Assembly

2.4.5 Header and Lateral Piping

The existing header and lateral piping consists generally of an HDPE main header ranging in size from 24"ø to 8"ø, with 6"ø HDPE laterals. The piping allows vacuum developed by the blower at the LFG control facilities to be directed to the individual extraction wells and provides a means for the extracted LFG to be transported to the LFG control facilities for combustion. The piping is installed on an engineered gradient, to allow condensate formed during the extraction process to be managed at engineered low points within the GCCS.

HDPE piping is the sole material used for buried header and lateral piping components with the GCCS, with the exception of steel or ductile iron mechanical fasteners (i.e. backup rings for flanges, bolts, nuts, washers, etc.). Additional materials may be used for gas transport in and around the control devices; however these areas are not subject to

differential settlement as they are outside the limits of waste placement.

2.4.6 Lorain I Flare Station

The Lorain I flare station includes a moisture separator, centrifugal blower, enclosed flare, valves and ancillary components. The Lorain I flare system has a nominal capacity of 2,000 scfm and sufficient vacuum capacity to exert 30 inches of water column (30"wc) vacuum on the wellfield.

This facility is located to the south to the Lorain I footprint.

2.4.7 Lorain II Flare Station

The Lorain II flare facility is located to the east of the Lorain II footprint. This facility currently consists of two (2) 5,500 scfm enclosed flares. The flare systems feature a fail-closed valve, a main condensate knockout, a flow meter, and a control valve for each blower for each of the flare systems. The blowers are multi-stage centrifugal LFG blowers with 460 VAC, three phase motors, and the capability of generating 60" w.c. inlet vacuum and 15" w.c. discharge pressure.

The utility flare that was previously in operation at this location, under a Director's Environmentally Beneficial Exemption, is no longer in service.

2.4.8 Electrical Generating Facility

A LFG-electric generating facility is owned and operated by a third party (EDI) at the landfill. This facility utilizes approximately 3,680 scfm of LFG to generate electricity via six (6) internal combustion engine generators.

The supplemental utility flare that was previously in operation at this location is no longer in service.

2.5 Gas Collection and Control System Monitoring

GCCS monitoring is conducted on a regular basis by EDI personnel. EDI maintains a permanent staff at the landfill, to operate and maintain the electrical generating facility as well as the wellfield components. Wellfield components and ancillary systems, including wellheads, blowers, compressors, and condensate management systems, are typically inspected for damage or malfunction on a daily basis, and key systems such as engine and flare operation are automatically monitored with remote sensing and notification systems.

EDI also provides a monthly summary report on wellfield and generating facility operations to the Lorain Landfill, in addition to maintaining operational logs under the site's Startup, Shutdown and Malfunction (SSM) Plan – required pursuant to the Maximum Achievable Control Technology (MACT) standards for Municipal Solid

Waste Landfills.

3 LFG RESERVES

3.1 LFG Model Development

The LFG model projection (USEPA LandGEM v3.02) indicates a substantial potential for LFG generation and recovery throughout the projected life of the disposal area. The specific details of the LFG modeling projection are presented herein.

The content of the waste stream can be a large factor in determining the rate of LFG generation. This model projection incorporates only the municipal solid waste (MSW) portion of the waste stream.

The site location in north central Ohio reflects a fairly high rate of annual precipitation – 35 inches per year (889 mm per year). The climactic factors indicate that a relatively high degree of moisture is being naturally applied to the waste mass. This degree of moisture indicates a relatively rapid rate of waste decomposition, though not as rapid as would be noted in a more temperate climate condition.

A moderately-rapid decomposition rate creates a larger volume of gas generation during the operating phase of the landfill than would a facility with less moisture in the waste mass. However, since more of the organic material is decomposed prior to closure, less organic material, and thus a lower rate of gas generation, is present after site closure. This rate of relative growth and decay can be visualized on the attached LFG generation and recovery curve.

Historical and future MSW acceptance rates, through the projected site closure in 2032, have been projected by Lorain County Landfill. Future growth in waste intake, beyond 2009, is projected to remain relatively static through closure, at a rate of approximately 997,586 tons per year (22,146,441 tons over a period of approximately 22.2 years).

It is understood that the wellfield will be extended as waste placement proceeds and interim fill elevations sufficient for the installation of additional LFG collectors are achieved.

The LFG generation and recovery model projections reflect the currently permitted disposal area and status of operations, and provides a long-term view of future LFG generation and recovery potentials.

Landfill gas generation projections have been made utilizing the USEPA's Landfill Gas

Emission Model (LandGEM) V3.02. LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of land filled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at <http://www.epa.gov/ttnatw01/landfill/landflpg.html>.

First Order Decomposition Rate Equation

$$Q_{CH_4} = \sum_{i=1}^n \sum_{j=0.1}^1 k L_0 \left[\frac{M_i}{10} \right] (e^{-k t_{ij}})$$

Where:

- Q_{CH_4} = annual methane generation in the year of the calculation ($m^3/year$)
- i = 1-year time increment
- n = (year of the calculation) – (initial year of waste acceptance)
- j = 0.1-year time increment
- k = methane generation rate ($year^{-1}$)
- M_i = mass of waste accepted in the i^{th} year (Mg)
- t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (*decimal years*, e.g., 3.2 years)
- L_0 = potential methane generation capacity (m^3/Mg)

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate.

There are two variables within this equation – k and L_0 . These factors vary based upon refuse types and the moisture of the waste mass. The USEPA provides the following guidance on these factors in their Compilation of Air Pollutant Emission Factors, Section 2.4 (AP-42):

<i>Scenario</i>	<i>k value</i>	<i>L₀ value</i>
• <i>NSPS Compliance</i>	<i>0.05/yr</i>	<i>170 m³/Mg</i>
• <i>Typical Landfills</i>	<i>0.04/yr</i>	<i>100 m³/Mg</i>
• <i>Arid Landfills</i>	<i>0.02/yr</i>	<i>100 m³/Mg</i>

Note: Arid Sites are considered those receiving less than 635 mm/year (25"/yr) of precipitation.

Based upon the characteristics of the local waste mass, and experience at similar facilities in comparable climactic areas of the United States, values of $k=0.07/\text{year}$ and $L_0=140\text{m}^3/\text{Mg}$ were utilized for the LFG generation projections. These values represent the overall methane yield to be expected from a disposal facility in this area and correspond to the actual rate of recovery observed. This also provides a more conservative estimate of LFG generation than would the use of the default values of $k=0.04/\text{year}$ and $L_0=100\text{m}^3/\text{Mg}$.

Another mechanism used to more accurately reflect the actual field conditions experienced at a specific landfill is to "factor" the results of the AP-42 projections to accommodate site-specific conditions. In the case of the Lorain County Landfill, a factor of 175% of the AP-42 projected values is reflective of actual field conditions. The use of 175% of the AP-42 based projection provides a greater peak rate of LFG generation than does the projection utilizing values of " $k=0.07 / \text{yr}$ " and " $L_0 = 140 \text{ m}^3 / \text{Mg}$ " – i.e. the revised projection is more conservative since it requires the GCCS to be designed for a greater flow rate.

The values provided by the utilizing 175% of the AP-42 projection were established during the process of permitting the expanded control system for the GCCS with the OEPA DAPC-NEDO, specifically with Mr. Joe Loucek. The final permit to install the 5,500 scfm enclosed flare (existing) and subsequent flares was issued on October 8, 2008. This rationale was developed as the most applicable and appropriate means to determine that the site maintained sufficient control capacity in order to maintain its compliance obligations.

The LFG modeling information provided by Lorain County Landfill II, LLC is consistent with the information provide in the October 15, 2007 Enclosed Flare PTI Application and subsequent October 8, 2008 PTI Approval. This model was developed specifically for the Lorain County Landfill by reviewing actual operational data for the GCCS (provided by Lorain County Landfill II, LLC and EDI) and modifying the LandGEM input parameters accordingly to fit the observed data. As previously discussed, the use of the standard AP-42 factors ($k=0.04/\text{year}$ and $L_0=100\text{m}^3/\text{Mg}$) significantly under-predicts the volume of LFG generation versus the observed rate of recovery. This feature is likely

due to the noted leachate recirculation that was previously employed at the facility (between 2002 and 2005) and the general rate of precipitation received in the local area. Please note that recirculation activities ceased in 2005 and are not planned for any future period at this facility.

In order to more accurately represent the conditions of the site, two modeling mechanisms have been employed:

- Adjust the k and L_0 factors, or
- Utilize the standard AP-42 k and L_0 factors and apply a “factor” to the results.

Both mechanisms have been developed for the Lorain County Landfill, providing comparable short-term and long-term results. The observed recovery rates represent approximately 75% of the projected rate of LFG generation. As noted in Attachment 2 of the submittal, actual recovery data has been compared to the projected rates of generation and recovery from 2002 through 2010.

At issue is the “adequacy” of the modeling projections in accounting for the current and future rates of LFG generation, which subsequently drive the “sizing” of the individual system components. The peak rate of generation is projected to be between approximately 16,200 scfm and 17,500 scfm, regardless of which of the noted calculation methods is applied to LandGEM. Based upon these projections, and a “typical” extraction efficiency of 75%, the facility should anticipate a peak rate of recovery of about 14,704 scfm. The gas collection and control systems have been sized for a flow rate of 21,000 scfm – a rate approximately 8% higher than the projected peak rate of **generation** and 44% higher than the projected peak rate of **recovery**.

The applicability of these projections has previously been confirmed by the OEPA Division of Air Pollution Control, both in a March 27, 2008 letter from Joe Loucek (OEPA – DAPC) to Chris Jaquet (BFIO) in which Mr. Loucek stated “I think we have adequately addressed the future emissions from both the flare and the diesel engines” and the issuance of Permit Number 02-22821 (October 8, 2008) based upon the noted LFG generation and recovery projections. Excerpts from these documents are included in Attachment 13 of this submittal, including:

- March 27, 2008 letter from DAPC-CO referenced above
- March 28, 2008 Email from DSIWM-NEDO deferring to DAPC-CO for the resolution of LandGEM projections
- October 2007 Enclosed Flare PTI Application
- Graphic showing that the proposed modeling approach (175% of the AP-42 default value projection) provides a more conservative design basis than utilizing previous values.

Considering that the LFG modeling is driven by recent historical operations, i.e. a period of time that was impacted by leachate recirculation, and that recirculation is no longer occurring, **the long-term LFG generation projections are anticipated to be in excess of what will be realized by the facility.** This mechanism leads to a gas collection and control system that is over-designed from a capacity perspective.

Lorain County Landfill II, LLC is committed to maintaining the capacity to effectively manage the projected rate of LFG generation, as evidenced by the installation of blower and flare capacity that is redundant to the usage capacity of the EDI facilities. Lorain County Landfill II, LLC will continue to monitor the actual recovery of LFG versus the projected generation and recovery rates, to insure that their long-term extraction and treatment obligations are being met.

The LFG recovery potential is estimated, based upon knowledge of current wellfield construction and operations, the condition of the landfill cover and reviews of data regarding leachate levels within the waste mass. The anticipated recovery efficiency of Lorain I is projected at 90%, considering the placement of final cover and the lack of surface emissions above the NSPS thresholds. The anticipated recovery efficiency of Lorain II during active GCCS operations, i.e. from system start-up through closure, is estimated to be in the range between 75% and 90%, depending upon the extent of final cover and GCCS construction progression. An October 2007 report prepared for the Solid Waste Association of North America (SWANA) indicates an average recovery efficiency of approximately 91% for sites with clay or geomembrane covers.

Based upon these parameters, the following projections of LFG generation and recovery can be made:

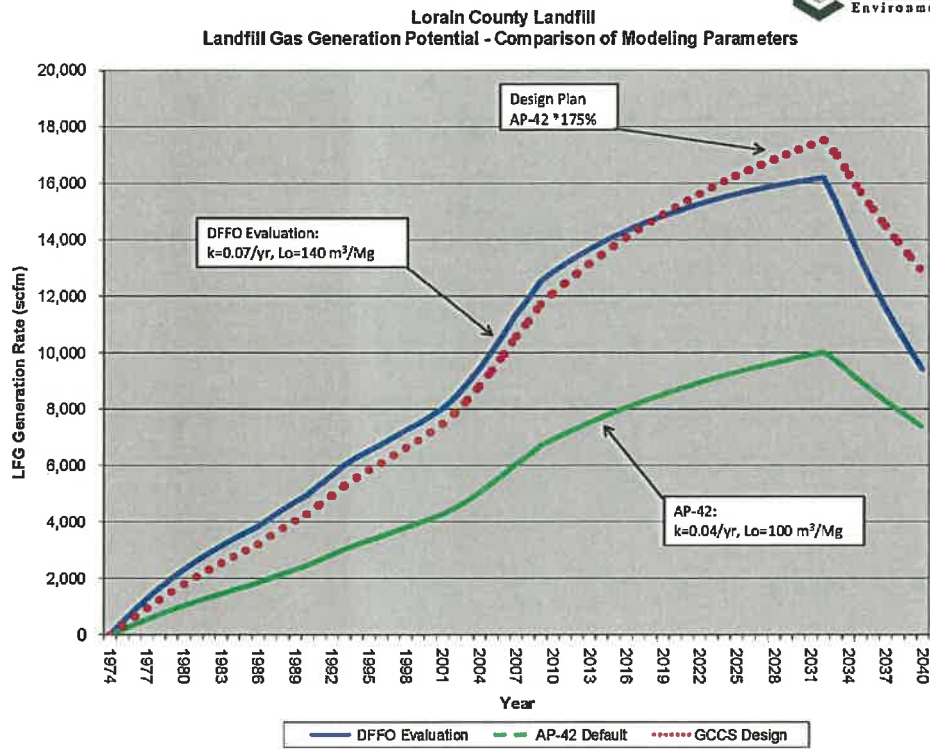


Figure 5 – LFG Generation Projections

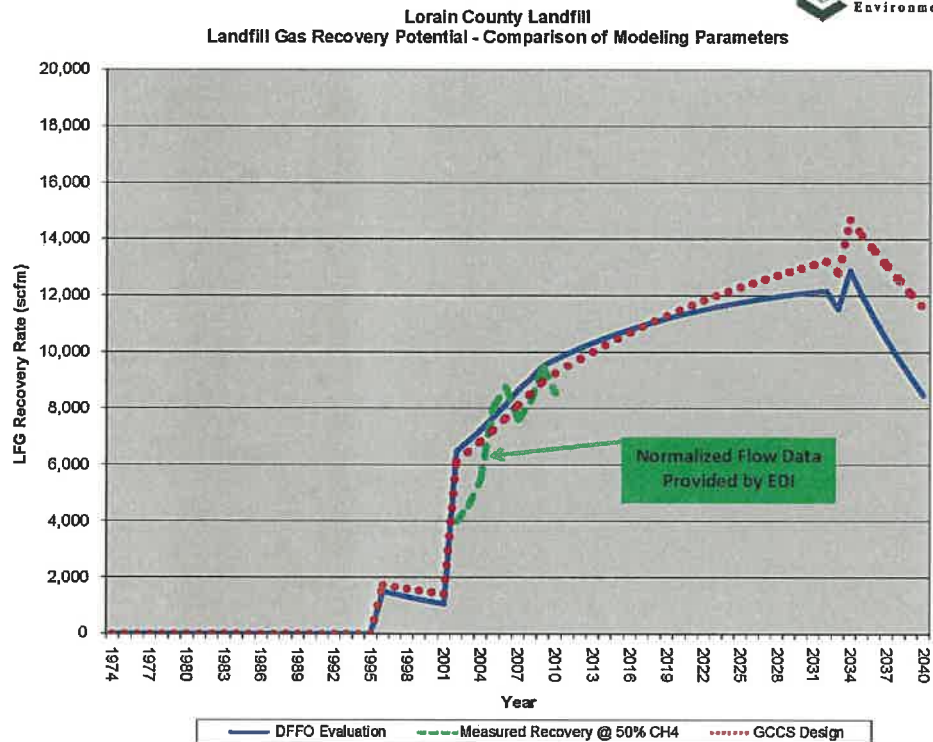


Figure 6 – LFG Recovery Projections

- Notes:**
1. Refuse intake rates and characteristics provided by Lorain County Landfill staff.
 2. Please note that these models, like any other mathematical projection, should be used only as a tool, and not an absolute declaration of the rate of LFG generation. Fluctuations in the rate and types of incoming waste, site operating conditions, refuse moisture and temperature may provide substantial variations in the actual rates of LFG generation and recovery.

Because the site consists of two segregated fill areas, two LandGEM runs were performed for each modeling scenario to assess the LFG generation rates at the facility. These two runs were compiled to create a projection for the facility as a whole. For comparative purposes, LandGEM projections for both Lorain I and Lorain II were prepared using values of $k=0.07$ / yr and $L_0 = 140 \text{ m}^3 / \text{Mg}$ and AP-42 values ($k=0.04$ / yr and $L_0 = 100 \text{ m}^3 / \text{Mg}$) – factored at 175%. A tabular comparison of the modeling results, as well as the four LandGEM projections, are included in Attachment 2 of this submittal.

Combining the LFG flows from both disposal areas, it is anticipated that approximately

12,098 scfm will be generated in 2010, with an anticipated recovery rate of approximately 9,238 scfm. The projected generation rate for 2009 was approximately 11,718 scfm with a projected recovery rate of approximately 8,960 scfm. The December 2009 LFG recovery rate was approximately 9,481 scfm, or 81% of the anticipated generation rate. Considering that the LandGEM projections assume “end of year” values, the rate of actual LFG recovery compares well with the anticipated availability of fuel. Note that all LFG flow data is normalized to a methane quality of 50% by volume for comparison purposes.

3.2 Data Normalization

The “normalization” of data to a common standard is a common practice in the LFG industry. It allows a valid comparison of different data sets by converting them to a common value – rather analogous to utilizing the lowest common denominator when comparing fractions – and does not result in an underestimate of LFG generation or recovery values.

Data is generally normalized to a value of 50% methane (by volume) for comparative purposes. This is also the default concentration used by LandGEM. Normalizing flow data to a common methane content is analogous to converting all of the data into a thermal basis, such as BTU per minute. Either way, a common basis is developed.

A set of example calculations has been provided as Attachment 6 of this evaluation. The calculations demonstrate the equivalence of two flow streams on a heating value basis:

1. 1,000 scfm @ 60% methane, and
2. 1,200 scfm @ 50% methane.

Both of these flow streams have an equivalent heating value of 608,400 BTU per minute. By using the normalized value for design purposes, the system is actually designed for a higher “volume” of flow, creating a more conservative approach.

Landfill gas generation projections are provided in Attachment 2.

4 CONCLUSIONS

The evaluation of the Lorain County Landfill and the existing GCCS provides a basis for the development of the proposed GCCS components and beneficial-use facilities. The following sections outline measures to be taken in order to effectively develop the proposed facilities in a comprehensive and cost-effective manner.

4.1 LFG Treatment Capacity

The LFG generation and recovery projections presented in Section 3 of this report indicate a projected 2010 generation rate of approximately 12,100 scfm and a corresponding recovery rate of approximately 9,238 scfm. The current LFG flaring components are sized for approximately 13,000 scfm:

- 2,000 scfm enclosed flare at Lorain I
- (2) 5,500 scfm enclosed flares on the east end of the Lorain II disposal area.

The previously installed 3,000 scfm utility flare on the east end of Lorain II was removed upon the installation of the first 6,000 scfm enclosed flare. Please reference Figure 6 for the projection of LFG recovery rates and Figure 7 for a comparison of LFG treatment capacity versus projected LFG recovery rates.

There is also a supplemental 3,000 scfm utility flare previous in operation at the EDI compound. This device is no longer in service.

Prior to the approval of the 2008 PTI for, and subsequent installation of, the enclosed flares, if a portion of the EDI facility dropped off-line, or if one of the flares was taken out of service for maintenance, the Lorain Landfill may not have had sufficient capacity to mitigate odors related to LFG generation. This phenomenon was observed during the fourth quarter of 2006 (see Figure 8). The timing of odor complaints was compared to the rate of LFG extraction. It was observed that the majority of the odor complaints coincided with drops in total GCCS flow rates.

This issue has been resolved with the installation of the two enclosed flares to provide redundant treatment capacity. The installation of the two, 5,500 scfm enclosed flares has addressed the issue of "Treatment Capacity". This installation, along with the companion blowers and wellfield piping that feeds gas to the flares, provides the Landfill with the ability to treat the anticipated volume of LFG available from the wellfield.

The installation of the flares and ancillary components does not in and of itself provide for the mitigation of LFG-related odors. However, the lack of these components, or in-kind treatment devices, was a definitive issue in previous years since the Landfill did not have the ability to combust additional LFG, regardless of how much gas was being generated or extracted. This was the impetus for the previous installation of a temporary utility flare and the subsequent installation of the two enclosed flares at Lorain II. Additionally, an Odor Complaint Log is being maintained by the site, documenting the date, time and location of odors, as well as the operational conditions of the GCCS, utility outages, relative weather conditions and the response to the complaint. A copy of the current template for the Odor Complaint Log is included as Attachment 4.

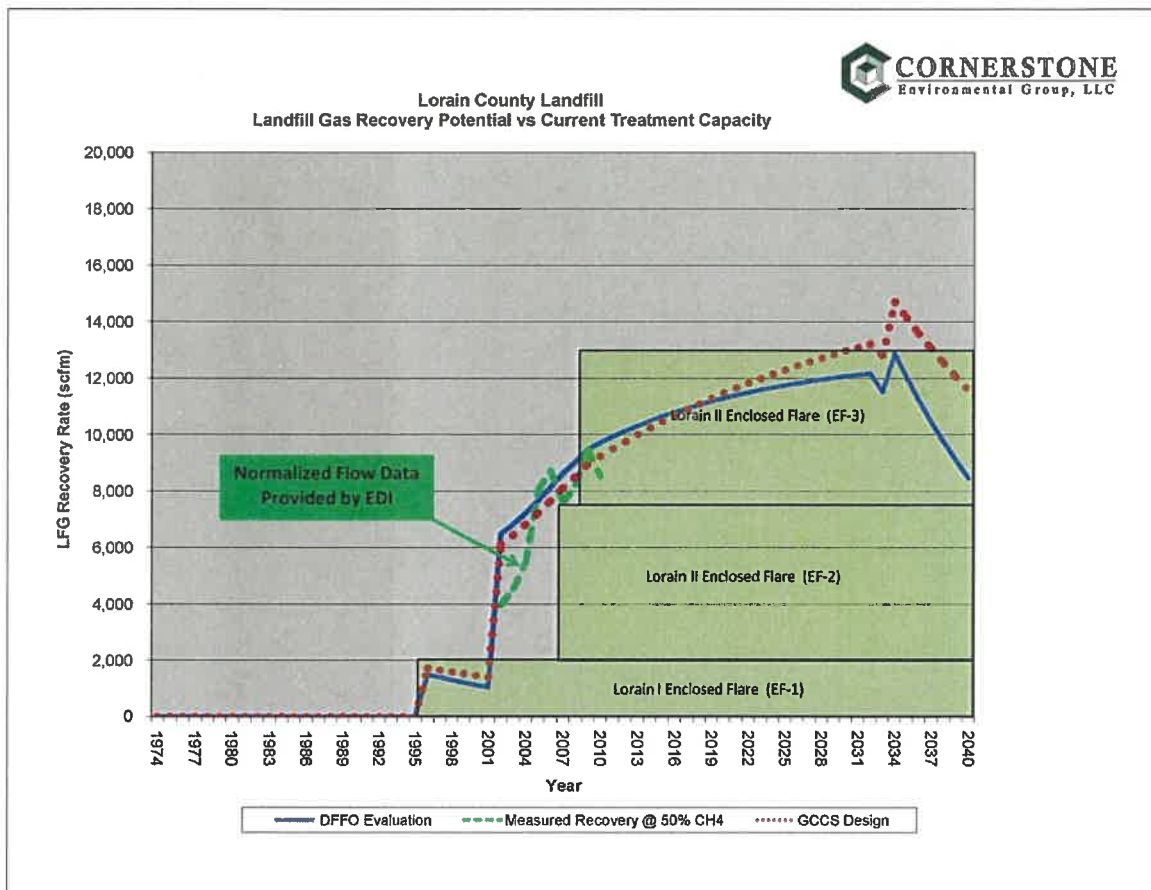


Figure 7 – Relative Treatment Capacity

**Lorain County Landfill
GCCS Flow Rate Summary
4Q 2006 - Summary**

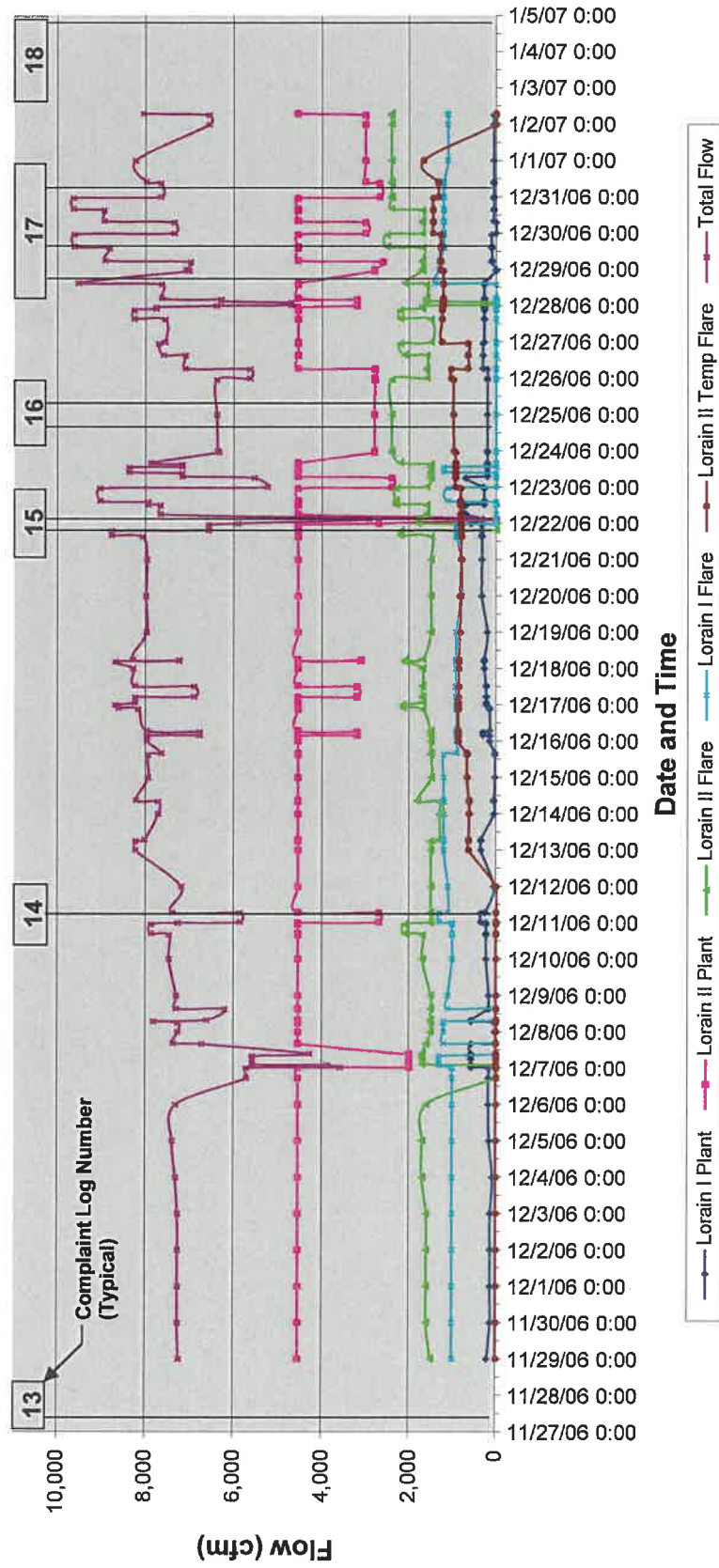


Figure 8 – Relative LFG Flow versus Odor Complaints

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A review of operating data for these time periods provides the following review of operational conditions:

<i>Date</i>	<i>Odor Complaint Log Number</i>	<i>Operating Notations</i>
12/7/06	No Complaint	Seven engines on-line 7 am to 11 pm (½ hr shut-down) and miscellaneous faults during day. Maximum of three engines were off line 11 pm to 7 am for maintenance. Lorain I flare flow increased. Lorain II flare off-line – restarted and previous flow rate re-established.
12/11/06	Log No. 14	Seven engines on-line 7 am to 11 pm (engine #3 off-line three times for approximately 1.5 hours total). Full station off-line for approximately 30 minutes due to loss of main breakers. Lorain I flare flow increased. Lorain II flare flow increased.
12/22/06	Log No. 15	Eight engines on-line 7 am to 11 pm. Rotating engine shutdown for scheduled maintenance 11 pm to 7 am. Lorain I flare off-line. Lorain II flare flow increased. Interim utility flare flow increased.
12/25/06	Log No. 16	Seven engines off-line most of the day. Rotating engine shutdown for scheduled maintenance 11 pm to 7 am. Lorain I flare off-line. Lorain II flare flow increased. Interim utility flare flow increased.
12/28/06	Log No. 17	Eight engines on-line 7 am to 11 pm (½ hour shutdowns on engines 3, 4 and 6). Rotating engine shutdown for scheduled maintenance 11 pm to 7 am. Lorain I flare off-line. Lorain II flare off-line. Both restarted. Interim utility flare flow increased.
12/29/06	Log No. 17	Seven engines on-line 7 am to 11 pm (½ hour shutdown for engine #4 and two ½ hour shutdowns for engine #6). Rotating engine shutdown for scheduled maintenance 11 pm to 7 am. Lorain I flare flow maintained. Lorain II flare flow increased. Interim utility flare flow increased.
12/30/06	Log No. 17	Seven engines on-line 7 am to 11 pm (½ hour shutdown for engine #6). Rotating engine shutdown for scheduled maintenance 11 pm to 7 am. Lorain I flare flow maintained. Lorain II flare flow increased. Interim utility flare flow increased.

A more review of more recent complaints (January-June, 2010) indicates that the majority of recent complaints related to gas are due to on-going construction at the landfill, such as

the installation of new or replacement wells or maintenance of wellheads and other components. Refer to Attachment 4. Many of the noted complaints could not be verified by an inspection conducted within 10-30 minutes of the receipt of the complaint. As such, it is difficult to qualify the source of the reported odors.

4.2 Header Piping

4.2.1 Condensate Management

All proposed header and lateral piping installed within the footprint of the disposal area is designed to promote positive drainage of condensate and reduce the potential effects of differential settlement. LFG piping grades are maximized where practical to reduce the impact of differential settlement and promote positive condensate drainage.

GCCS header and lateral piping is installed to slope towards engineered low points, for the systematic removal of condensate. Installations within the limits of waste placement are subject to the differential settlement of the waste mass while installations outside the limits of waste mass are relatively stable since they are constructed within engineered fill and native strata. Header and lateral piping installed within the limits of waste placement will eventually experience differential settlement in excess of the installed slope of the piping, in select locations.

These locations are, however, impossible to identify beforehand due to the heterogeneous nature of the waste mass and differing rates of waste decomposition. The piping will be excavated and re-pitched, or replaced, in the event that operational issues such as surging of vacuums are detected. There is no methodology available to insure permanent pitch to pipelines installed within decomposable strata.

The estimated value of 8,075 gallons per day of condensate formation is projected at a conservative rate of 20,000 scfm, in excess of the peak LFG generation rate of 19,478 scfm. This reflects an average condensate generation rate of 5.6 gallons per minute. Under the final development conditions of the GCCS, there are approximately 15 condensate sumps (pump stations) that directly drain the header system (these do not include the sumps in the blower inlet lines), each with a storage capacity in excess of 100 gallons. Each sump is designed to utilize a pneumatic pump, such as a QED Model AP-4, with a minimum pumping capacity of 2 gallons per minute. Under these conditions, the condensate management system should be capable of collecting and evacuating the liquids to the leachate management system at a rate of at least 30 gallons per minute or 43,200 gallons per day. Projected condensate generation rates are provided as Attachment 11.

4.2.2 Sizing

The piping system should be sized to accommodate the anticipated LFG extraction rates, with allowances for future expansion of the GCCS. However, in the process of expanding and developing the disposal area, existing GCCS components may be utilized “as-is”, as

opposed to the replacement of entire sections of header piping. This is especially true of the Lorain II header system. The original point of vacuum application was the northern side of the Lorain II disposal area. As such, the original header piping design graduated the size of the header piping as the piping moved away from the vacuum source. When the EDI facility was installed, the original flare installation was also moved to the southwestern corner of the Lorain II disposal area – effectively reversing the flow of LFG through several sections of the header system.

An evaluation of the existing header system was conducted by Cornerstone, utilizing the KY-GAS computer simulation - a program that evaluates pressure/vacuum distribution systems by means of the Darcy-Weisbach Equation. The original (2007) evaluation confirmed that the Lorain II header system, as configured, was not adequately sized for the present and anticipated LFG recovery rates at that time .

The Lorain I header system was determined to be sized adequately, based upon currently projected LFG recovery rates and the configuration of the piping system. The LFG generation rate in Lorain I is markedly on the decline, from its peak rate of production circa 1985. As such, no further capacity increases are anticipated to be required for this portion of the facility.

As part of the DFFO efforts, the Lorain II header system was redesigned to provide greater surety of vacuum distribution. This redesign was presented as part of the January 2009 GCCS Design Plan submittal to OEPA, and includes the following attributes:

- The frictional head loss analysis is provided in Attachment 3.1 of this submittal.
- The Lorain II header and lateral system has been sized to accommodate approximately 21,000 scfm of LFG extraction under final development conditions, including the LFG flow from both the Lorain II and Lorain I disposal areas. In the event that the EDI facility and Lorain I enclosed flare were no longer in operation, or in their present locations, all LFG from the combined facility could be transported to the area east of the Lorain II footprint, where the (2) 5,500 scfm enclosed flares are presently located.
- A summary of the minimum and maximum velocities, frictional loss and pressures are provided on page KYG-38. This page also denotes the design flow rate of the system in its final development configuration – 21,000 scfm – labeled as “Net System Demand (USFU).
- The following information is provided on page KYG-3 of the head loss analysis, for informational purposes:
 - USER SPECIFIED FLOW UNITS (USFU) = SCF/MIN (STANDARD CUBIC FEET PER MINUTE)

- USER SPECIFIED PRESSURE UNITS (USPU) = INCHES OF WATER (GAUGE)
- The relationship between counter-current and con-current flow conditions and the relative velocity through a specific section of header piping must be made by comparing the KYGAS output files to the topographic site plan. KYGAS does not discriminate between the flow conditions – it is a manual comparison. To aid in this comparison, graphical representations of the KYGAS analysis results are provided on pages KYG-39 through KYG-42.
- Considering the design vacuum application of 60 inches of water column at the blowers and the resultant available vacuum, per KYGAS, of 27.78 inches of water column, the net pressure drop is 32.22 inches of water column (gauge). This would occur near well W33 (Node J-88) in the Lorain I wellfield. The minimum vacuum availability in the Lorain II wellfield would occur near well 62R (Node J-189)
- Questions regarding individual piping sections must be addressed on a specific basis upon request.

An analysis of the current wellfield conditions as of July 1, 2012 has been prepared and included as a subset of Attachment 3. The analysis of Final Development conditions is now noted as Attachment 3.1, while the Analysis of current conditions is noted as Attachment 3.2 of the revised Evaluation. The current gas extraction rate is approximately 8,000 scfm. The analysis was completed using a value of 8,800 scfm, or 110% of the monitored flow rate. This analysis demonstrates that the current wellfield piping is adequate to convey gas flow rates in excess of the current gas flow rate while providing available vacuum in excess of 40 inches of water column ("w.c) throughout the wellfield, with a vacuum application of approximately 60 inches of water column at the blower facility.

4.3 Wellfield Coverage

The coverage of the extraction wells meets the regulatory requirements of the OAC and Federal NSPS regulations. Surface emissions monitoring, as reported to the OEPA, has demonstrated that the extent of extraction points is sufficient to achieve regulatory compliance with respect to surficial emissions.

The well spacings, per the January 2009 GCCS Design Plan, are approximately 215 feet to 240 feet under Final Development conditions. The well spacings proposed by the North Carolina State University document reflects a frequency of approximately 300 feet in wet, post-Subtitle D landfills. This reference most closely approximates the conditions present at the Lorain County Landfill.

There currently exists a footprint on the northern slope of Lorain II which has wells constructed at a greater spacing than noted above. This area was recently subjected to active waste placement activities and was scheduled for the installation of additional collectors later this year. It is anticipated that an additional ten (10) vertical wells will be installed in this area. Since this area will eventually be overlain by additional waste placement, these wells will be interim in nature and replaced in the future as operational needs dictate. A construction plan will be developed for the installation of these wells and their connection to the GCCS.

The balance of the Lorain II wellfield is constructed within the noted guidelines and no further modifications are proposed at this time with regard to well spacing.

Some portions of the Lorain I wellfield possess well spacings greater than 300 feet, however the advanced age of this disposal area (waste operations ceased in 1984), declining rate of LFG production and the full clay cap constructed over the disposal area limit the potential for nuisance odors from this disposal area. Additionally, the Lorain I disposal area employs an active GCCS, combined leachate and gas extraction from the vertical well casings and surface emissions monitoring in accordance with the Federal NSPS to insure that surficial emissions are not occurring.

Additionally, all areas of waste placement greater than five years of age appear to have LFG collectors installed and operating within them. This includes both vertical extraction wells and interim horizontal LFG collectors. Based upon this information, the design of the wellfield is considered adequate to prevent odor nuisance(s) pursuant to Order #7 of the DFFOs.

4.4 Vacuum Regulation and Flow Control

Vacuum regulation and flow control is accomplished via wellhead controls at each extraction point. Each wellhead incorporates a control valve and sampling points to measure the degree of vacuum application to the collector and the gas quality from each collector. A typical wellhead is shown in Figure 4 of this submittal. Several older collectors on Lorain II, less than 30 of the approximately 138 collection points, utilize an older wellhead design, incorporating a 4"Ø PVC ball valve to manage vacuum application and LFG extraction rates. These wellheads are being replaced as replacement components are available.

In order to further assist in regulating the overall flow from the wellfield, the Landfill has recently installed a pressure transducer system for the blowers at the enclosed flare station. These transducers will monitor the vacuum applied to the wellfield and increase/decrease the rate of gas extraction to maintain a vacuum set point condition. This modulation will be accomplished via variable frequency drives (VFDs) connected to the blower motors, allowing them to be accelerated or decelerated to maintain a consistent operating condition.

This application is not required under normal operating conditions, however it should serve to maintain consistent wellfield operations in the event that operations at the EDI facility change, i.e. an engine is taken off-line for maintenance or brought back on-line. Changes in the extraction rate at the EDI facility result in changes in the overall applied vacuum to the wellfield. The installation of the pressure transducer system will monitor these changes and automatically modulate blower/flare operations to compensate for these variations.

The start-up of this system is scheduled to be completed by the end of July.

5 RECOMMENDATIONS AND ACTIONS

Lorain County Landfill's goal is to create and maintain an operable and effective GCCS, in compliance with OAC and Federal NSPS regulations. To this end, the following recommendations have been made and associated actions taken:

1. All header and lateral components that have already been identified (Drawing Nos. 4 and 5), or are identified in the future, as subject to differential settlement and the collection of condensate, should be either (a) excavated, placed to the appropriate grade and re-buried or (b) replaced with an equivalent piping section. The second option may be advisable in cases where the subject piping is more than ten feet in depth or if the area is within the limits of certified final cover placement.

BFI has engaged a contractor to excavate and re-pitch the header and lateral piping in the locations shown on Drawing Nos. 4 and 5. These items have been completed. These items have been completed. Please refer to the May 2007 Construction Certification Reports submitted by Brown and Caldwell under separate cover.

***Update:** The modifications are functioning as designed and no further actions in this regard are currently anticipated.*

2. Lorain I condensate sumps CS-5 and CS-6 should be repaired or replaced, including the drainage lines from the main header to the individual sumps.

BFI has engaged a contractor to replace the Lorain I condensate sumps CS-5 and CS-6. The existing components will be replaced with newly fabricated structures and new, pneumatic pumps installed. Along with these replacements, isolation valves in the accompanying compressed air main and liquid force main will be installed adjacent to these two sumps. These items have been completed. Please refer to the May, 2007 Construction Certification Report submitted by Brown and Caldwell under separate cover.

***Update:** The modifications are functioning as designed and no further actions in this regard are currently anticipated.*

3. The header piping system should be re-evaluated to insure that the components are sized properly, not only for the current operations but also for the expansion of the Lorain II disposal area, as applicable. This should not impact the Lorain I

pipng system since this area is closed and the LFG generation rate is declining yearly.

BFI has engaged Cornerstone to modify the design of the existing header system to accommodate the projected flow of LFG to the existing and anticipated LFG treatment components. The modification of these components is currently under development and should be completed by the end of October of this year. The design for these modifications is included as Drawing 6.

An 8"ø header along the southern slope of the disposal area was previously identified as a restriction to LFG extraction. This portion of the header system was replaced in the Fall of 2006 with a 24"ø header – a section of approximately 3,500 lineal feet in length.

Upon the completion of these modifications, the Federal NSPS GCCS Design Plan will be updated and submitted to the OEPA.

Update: *The noted modifications were completed and the Construction Certification Reports submitted to the OEPA. A revised GCCS Design Plan was submitted to the OEPA on January 27, 2009, in accordance with the DFFO and 40 CFR Part 60, Subpart WWW, NSPS for Municipal Solid Waste Landfills. Review and approval of this plan is pending.*

4. The phased installation of LFG collectors should be made in advance of the five-year waste placement requirement under the NSPS, wherever practical and as filling allows.

As a proactive measure, BFI intends to install extraction wells throughout the Lorain II disposal area, including portions of the waste mass that are less than five years old and are not yet required to be included in GCCS operations. Construction will be completed in phases as filling operations, site conditions and LFG treatment capacity allows. The design for these modifications is included as Drawing No. 6. These modifications are anticipated to be completed by the end of October of this year.

Update: *The entire Lorain II footprint has LFG collection components installed and operating, regardless of the age of waste placement. The exception is Cell A in the Northern Expansion area, which began accepting waste in 2008. The current Lorain II GCCS is depicted on Drawing No. 3.*

5. A long-term plan for the development of LFG treatment capacity, including backup capacity in the event that the EDI facility or other components are down due to maintenance or other damage, should be created to insure that the requirements of the facility are anticipated and met in a timely manner.

In order to combat this issue, and minimize the potential for future LFG odors during treatment component down-time, BFI has committed to permitting, purchasing and installing a 6,000 scfm enclosed flare as a supplemental control device. This unit, along with associated blowers, controls and monitoring equipment, developed in accordance with OAC and Federal NSPS regulations, is proposed for construction along the eastern perimeter of the Lorain II disposal area, to the south of the existing maintenance facility. The DAPC permit for this installation was verbally approved in December 2007 and installation of the flare and its ancillary components is anticipated to be completed during the second quarter of 2008.

Please refer to Drawing No. 6 for the location of the proposed flaring components. Additional treatment capacity will be installed as the requirements of the GCCS indicate need.

An interim utility flare (3,000 scfm capacity) has been installed to provide additional LFG treatment capacity, as reflected in Drawing No. 6. A request to extend the operating period for this interim utility flare has been made to the OEPA.

The Lorain County Landfill also intends to phase out the operation of all utility (open) flares at the landfill in favor of enclosed combustors, i.e. flares, IC engines, etc. This will include the removal of one of the existing utility flares upon the commissioning of the 6,000 scfm enclosed flare referenced above. It is also anticipated that a second 6,000 scfm enclosed flare will be installed during the second quarter of 2009, depending upon actual LFG flow rates realized and OEPA approval.

In order to minimize the potential for LFG-related odor complaints in the short-term, EDI has agreed to limit scheduled maintenance to no more than two (2) engines at a given time, to the extent practical. This reduction of LFG usage by the EDI facility is within the excess capacity limits of the current flaring system.

It should be noted that the Lorain Landfill has no contractual or legal mechanism available to enforce this agreement with EDI, and that it is made in good faith by both parties. Separate air emissions permits are issued for both the Lorain Landfill and EDI. It is understood, however, that it is in the interest of all parties involved to minimize the potential for LFG-related odors at this facility and that all parties will work towards this mutually-beneficial goal.

Update: *Lorain County Landfill has installed two 5,500 scfm enclosed flares for LFG treatment. The capacity of these flares was defined by the OEPA-DAPC in the final Permit To Install issued October 8, 2008. The 3,000 scfm interim utility flare is no longer in service and has been removed.*

6. It is recommended that older style wellheads (utilizing 4"ø PVC ball valves) be replaced, in phases, with Landtec or equivalent units. Some of the originally installed wellhead components are beginning to fail with age and usage, and BFI is in the process of proactively replacing these components. Such a replacement should allow for a more uniform application of vacuum and hence LFG extraction. Data acquisition from the replacement wellheads should also be improved, both in terms of the quality of data obtained as well as the period of time required by the monitoring technician.

BFI purchased and installed approximately thirty-five (35) new wellheads in the Lorain II wellfield in January 2007. At the present time, approximately sixty-eight (68) of the total one hundred fourteen (114) wellheads in Lorain II are utilizing new wellheads. Additional wellheads will be purchased and installed as stocks are available from the manufacturer and landfill operations dictate need.

One of the benefits to replacement is the ability to acquire more accurate information on flow rates from individual extraction points. The configuration of the new wellheads allows data to be quickly acquired and stored electronically by field personnel. This data can then be utilized by BFI and EDI to determine if additional management techniques are required for individual extraction wells.

Update: *Approximately 114 of the 138 LFG collection points on Lorain II are utilizing Landtec wellheads. The balance will be replaced as stocks are available from the manufacturer and landfill operations dictate need.*

7. It is recommended that the Landfill obtain and record liquid levels in all vertical extraction wells on a regular basis, in order to insure that perforated casing is available for LFG extraction

As part of EDI's contract, they are responsible for obtaining liquid level data twice per year. Wells that are found to be negatively impacted by elevated liquid levels are schedule for the installation of a dewatering pump. Any wells that have leachate completely covering the perforated casing are modified with a pneumatic pump as quickly as a contractor can be engaged to do so. Spare pumps are maintained on site for such occurrences.

Update: *The most recent round of liquid level data was acquired in March 2010. . Based upon this information and a review of wellfield operations and extraction well conditions, the Landfill elected to replace twenty-two (22) existing vertical wells, install an additional five (5) vertical extraction wells and add pumping systems to fourteen (14) vertical wells in the Lorain II area. Please reference Attachment 1 of this submittal for information regarding the design and extent of this installation.*

As of the submittal of this report, the extraction wells and pumps noted have been installed and are connected to their respective infrastructure. Construction of some ancillary components is ongoing and has not yet been completed. It is anticipated that the record drawings and Certification Report will be prepared for submittal in August 2010.

The bulk of this phase of construction is taking place in the central and northwestern portions of Lorain II. A greater rate of extraction from the central portion of the waste mass should serve to increase the overall production of the gas collection system. Increased efficiency in the northwestern corner of the waste mass should serve to directly impact the source of odor complaints since 81% (17 of 21) of the 2010 odor complaints documented by the Landfill (see Odor Log, Attachment 7) are directly attributable to two locations directly northwest of the Lorain II disposal area.

6 LIMITATIONS

The work product included in the attached was undertaken in full conformity with generally accepted professional consulting principles and practices and to the fullest extent as allowed by law we expressly disclaim all warranties, express or implied, including warranties of merchantability or fitness for a particular purpose. The work product was completed in full conformity with the contract with our client and this document is solely for the use and reliance of our client (unless previously agreed upon that a third party could rely on the work product) and any reliance on this work product by an unapproved outside party is at such party's risk.

The work product herein (including opinions, conclusions, suggestions, etc.) was based on the situations and circumstances as found at the time, location, scope and goal of our performance and thus should be relied upon and used by our client recognizing these considerations and limitations. Cornerstone shall not be liable for the consequences of any change in environmental standards, practices, or regulations following the completion of our work and there is no warrant to the veracity of information provided by third parties, or the partial utilization of this work product.

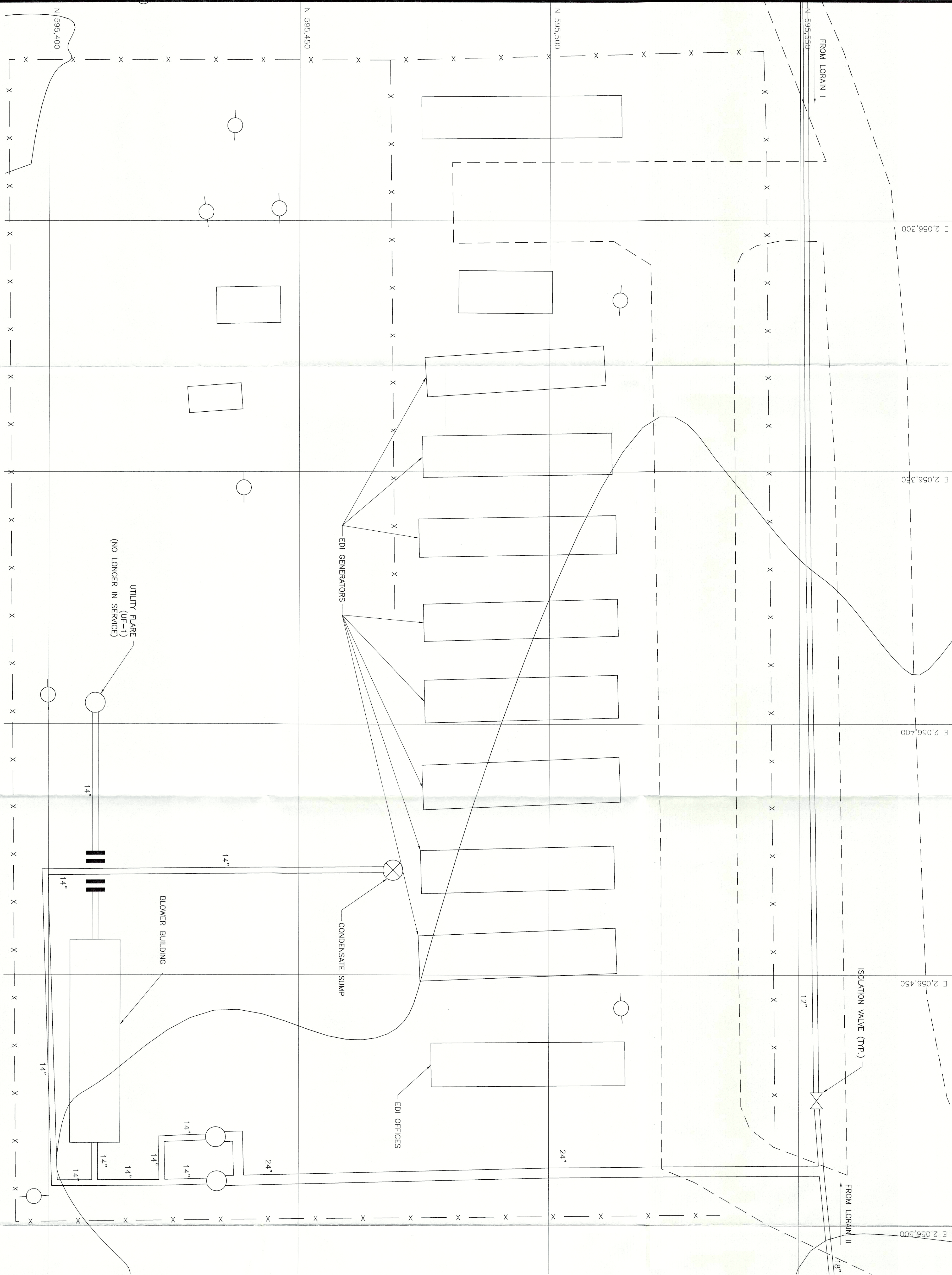
The modeling techniques used by Cornerstone and the LFG industry are, by definition, hypothetical, and can only be used as a very general tool for producing a range of estimates to aid in determining the direction of further investigations. Actual LFG generation and collection rates are dependent on many variables, including: refuse composition, moisture, pH, cover soil permeability, well spacing, continuing fill rates, etc... Typically these parameters are not well defined at the time of modeling and/or differ somewhat from those actually experienced during future site operation.

The modeling provided herein was performed with today's current standards of practice and no warranty or representation, expressed or implied, is made, as to the actual LFG production that will occur in the future. Opinions and recommendations contained in this report are based on the information available and certain assumptions that were deemed reasonable when our services were performed. We are not responsible for the impacts of any changes in information, site operations or methods that may change in the future.

ATTACHMENT 1

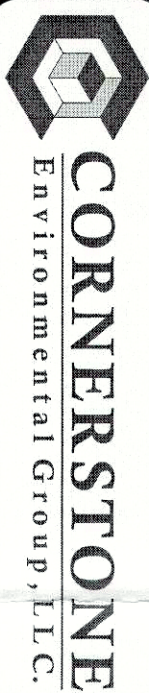
FACILITY DEVELOPMENT PLANS

**(DRAWING C-1 REPLACED WITH DRAWING 4, AUGUST 2012)
(DRAWINGS 5 AND 6 SUPERSEDED BY PREVIOUS REVISIONS)**



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SCALE IN FEET

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		DESIGNED BY	KJK						



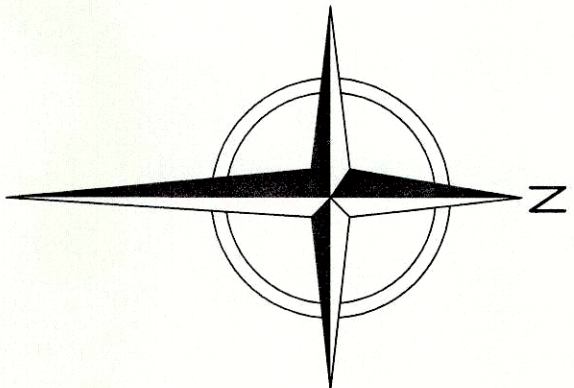
CORNERSTONE
Environmental Group, LLC

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LORAIN COUNTY LANDFILL
LORAIN COUNTY, OHIO

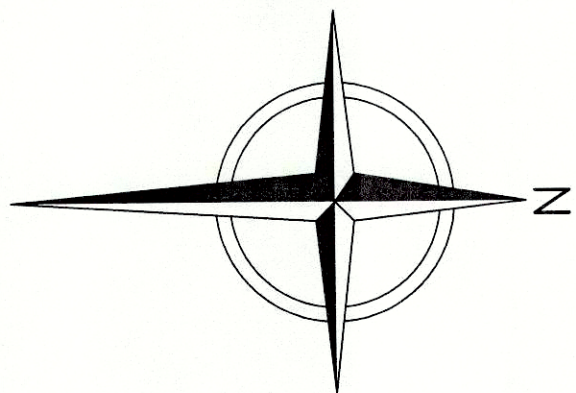
EDI FACILITY

LEGEND
810
EXISTING 10' CONTOUR
EXISTING 2' CONTOUR
12"
EXISTING LANDFILL GAS HEADER



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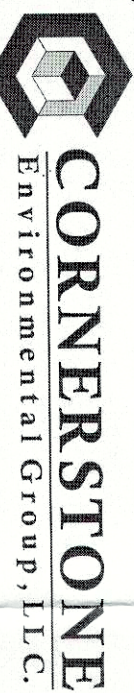
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- SOLID WASTE BOUNDARY
- EXISTING LIMITS OF FINAL COVER PLACEMENT
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- EXISTING LANDFILL GAS HEADER
- EXISTING HORIZONTAL LFG COLLECTOR
- EXISTING FORCE MAIN
- EXISTING AIRLINE
- EXISTING LFG EXTRACTION WELL WITH LANDTEC WELLHEAD
- EW-90A
- EW-1
- EW-45
- EXISTING COMBINATION WELL
- EXISTING REMOTE WELLHEAD
- EXISTING HEADER ACCESS RISER
- EXISTING CONTROL VALVE
- EXISTING BLIND FLANGE
- EXISTING FLANGE CONNECTION
- EXISTING CONDENSATE DRIPLUG
- EXISTING CONDENSATE PUMP STATION
- EXISTING GAS MONITORING PROBE
- EXISTING GROUNDWATER MONITORING WELL
- GW-1B
- GW-2
- MW-2

NOTES:

- TOPOGRAPHIC MAP REPRESENTS THE 1-28-2008 AERIAL PHOTOGRAPH.
- GCCS COMPONENT AS-BUILTS PROVIDED BY CEC.
- LORAIN I PERIMETER HEADER TRENCH CONTAINS A 2" HDPE COMPRESSED AIR MAIN FOR LIQUIDS MANAGEMENT.
- ALL HEADER AND LATERAL PIPING OUTSIDE THE LIMITS OF WASTE TO BE INSTALLED AT A MINIMUM 0.5% SLOPE, UNLESS OTHERWISE NOTED.
- ALL HEADER AND LATERAL PIPING INSIDE THE LIMITS OF WASTE TO BE INSTALLED AT A MINIMUM 3.0% SLOPE, UNLESS OTHERWISE NOTED.

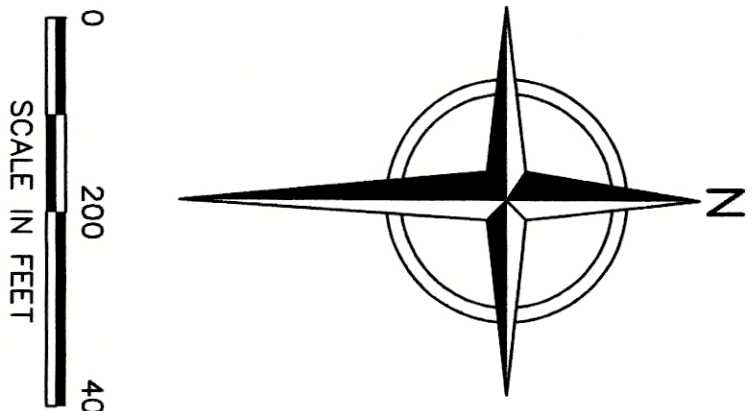
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LORAIN COUNTY LANDFILL
LORAIN COUNTY, OHIO
LANDFILL GAS COLLECTION & CONTROL SYSTEM
LORAIN I EXISTING CONDITIONS SITE PLAN

SHEET NO.
2
PROJECT NO.
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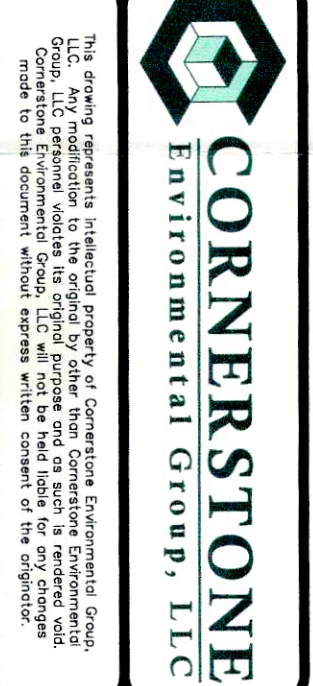


- LEGEND
- PROPERTY BOUNDARY
 - PERMITTED SOLID WASTE BOUNDARY
 - EXISTING LIMITS OF FINAL COVER PLACEMENT
 - FINAL COVER PLACEMENT AREA
 - EXISTING 10' CONTOUR
 - EXISTING 2' CONTOUR
 - EXISTING COMMUNICATION CONDUIT
 - EXISTING FORCEMAIN
 - EXISTING AIR LINE
 - EXISTING LPG EXTRACTION WELL WITH PUMP
 - EXISTING LPG EXTRACTION WELL
 - EXISTING REMOTE WELLHEAD
 - EXISTING HEADER ACCESS RISER
 - EXISTING CONTROL VALVE
 - EXISTING BLIND FLANGE
 - EXISTING FLANGE CONNECTION
 - EXISTING CONDENSATE DRIPLES
 - EXISTING CONDENSATE PUMP STATION
 - PROPOSED LANDFILL GAS HEADER

- NOTES
- LANDFILL CONTOURS PROVIDED BY BROWN AND CALDWELL. MAP COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY PERFORMED BY CORNERSTONE ENVIRONMENTAL GROUP, LLC. COORDINATE SYSTEM IS BASED ON NGS MEAN SEA LEVEL. CONTOUR INTERVAL 2 FT. GRID BASED ON LOCAL COORDINATE SYSTEM.
 - GCS COMPONENT AS-BUILTS PROVIDED BY BROWN AND CALDWELL.

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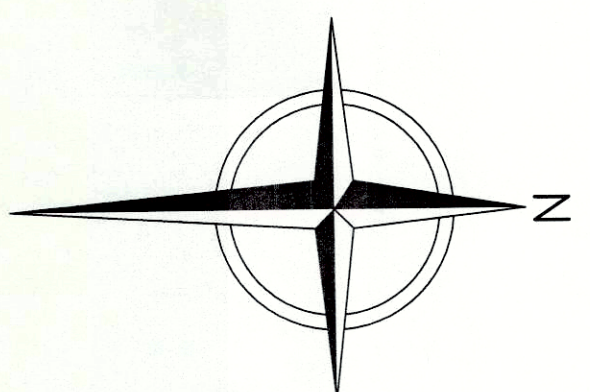
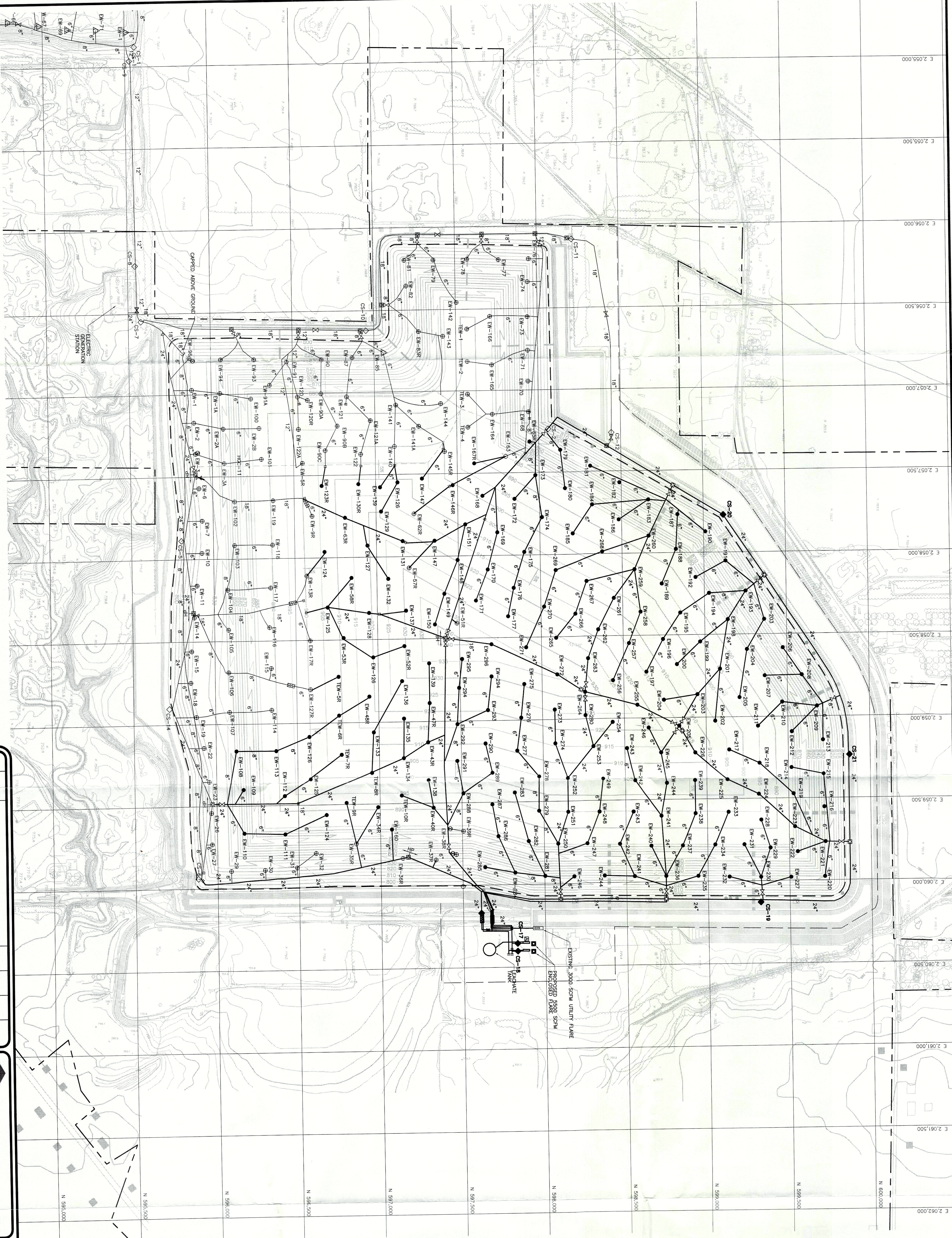
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LORAIN COUNTY LANDFILL
LORAIN COUNTY, OHIO

LORAIN II - 2012 GCS
EXISTING CONDITIONS PLAN

SHEET NO.
3
PROJECT NO.
120479



LEGEND

- PROPERTY BOUNDARY
- PERMITTED SOLID WASTE BOUNDARY
- EXISTING LIMITS OF FINAL COVER PLACEMENT
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- EXISTING LANDFILL GAS HEADER
- EXISTING LFG EXTRACTION WELL
- EXISTING REMOTE WELLHEAD
- EXISTING HEADER ACCESS RISER
- EXISTING CONTROL VALVE
- EXISTING BLIND FLANGE
- EXISTING FLANGE CONNECTION
- EXISTING CONDENSATE DRIPLEG
- EXISTING CONDENSATE PUMP STATION
- PROPOSED LANDFILL GAS HEADER
- PROPOSED LFG EXTRACTION WELL
- PROPOSED HEADER ACCESS RISER
- PROPOSED CONTROL VALVE
- PROPOSED BLIND FLANGE
- PROPOSED FLANGE CONNECTION
- PROPOSED REDUCER FITTING
- PROPOSED CONDENSATE PUMP STATION
- PROPOSED ROAD CROSSING
- PROPOSED HEADER HIGH POINT

NOTES:

1. LANDFILL CONTOURS REPRESENT FINAL COVER GRADING ELEVATIONS AT CLOSURE.
2. GCCS COMPONENT AS-BUILT PROVIDED BY CCC.
3. ALL HEADER AND LATERAL PIPELINES WITHIN THE LIMITS OF WASTE TO BE INSTALLED AT A MINIMUM 3% SLOPE UNLESS OTHERWISE NOTED.
4. ALL HEADER AND LATERAL PIPELINES OUTSIDE THE LIMITS OF WASTE TO BE INSTALLED AT A MINIMUM 0.5% SLOPE UNLESS OTHERWISE NOTED.
5. LOCATION OF PROPOSED GCCS COMPONENTS IS APPROXIMATE AND MAY VARY TO MEET FIELD CONDITIONS AT THE TIME OF CONSTRUCTION. ALL HORIZONTAL AND VERTICAL DATUM TO BE VERIFIED PRIOR TO CONSTRUCTION.
6. FUTURE CONSTRUCTION PHASES TO BE PREPARED AND COMPLETED IN ACCORDANCE WITH NEW SOURCE PERFORMANCE STANDARDS (NSPS) INSTALLATION SCHEDULES.
7. ALL HEADER AND LATERAL PIPELINES TO BE SDR 17 HDPE OR ENGINEER APPROVED EQUAL.
8. ALL PROPOSED HEADER AND LATERAL PIPELINES SHALL BE CONNECTED TO THE EXISTING SYSTEM VIA TEE OR BRANCH SADDLE CONNECTIONS.

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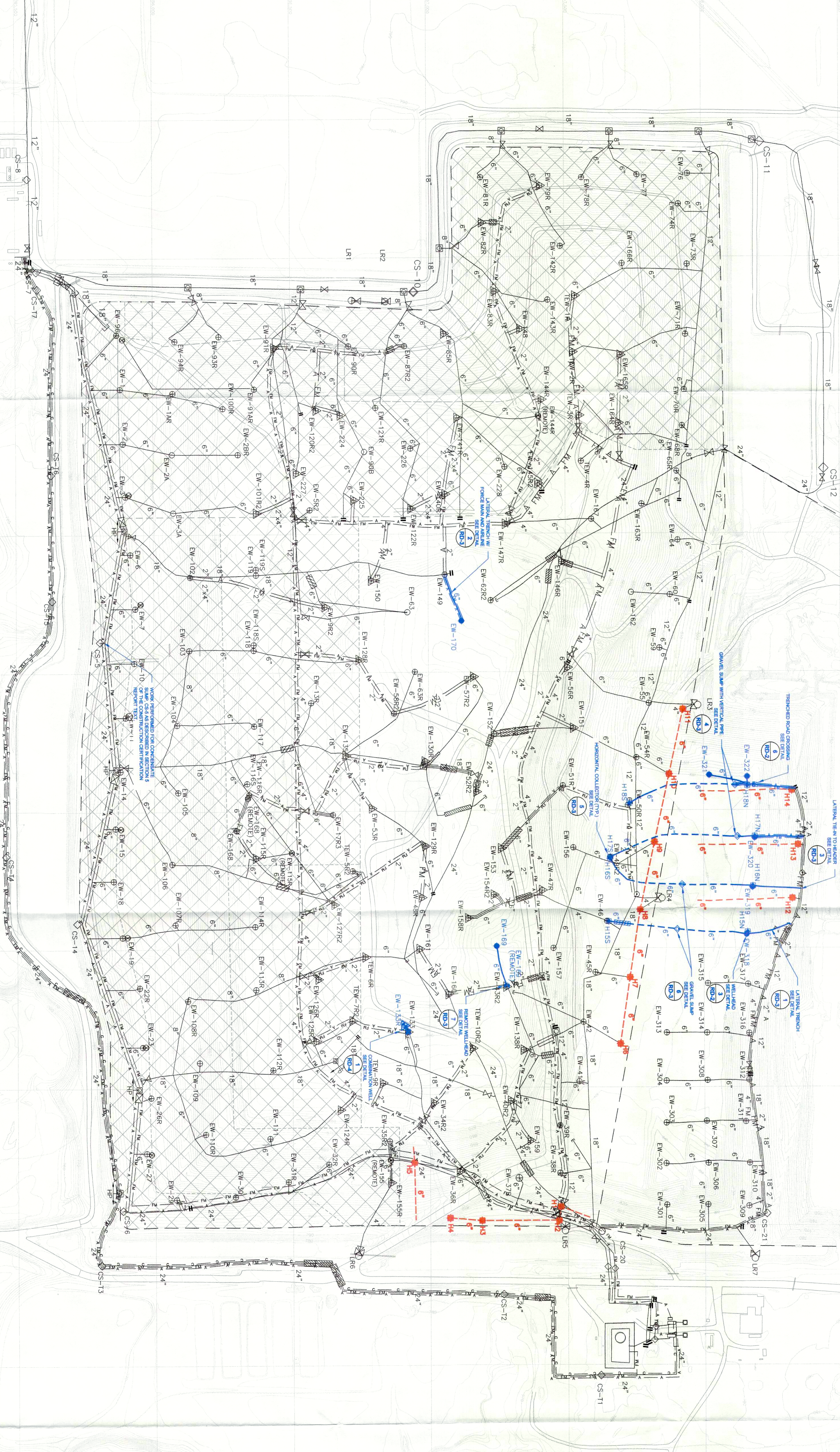
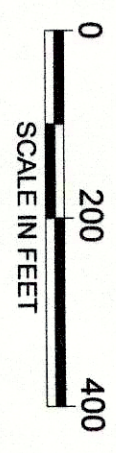
LORAIN COUNTY LANDFILL, LLC
LORAIN COUNTY, OHIO

LANDFILL GAS COLLECTION & CONTROL SYSTEM
FINAL DEVELOPMENT SITE PLAN

SHEET NO.
4

PROJECT NO.
070170

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[illegible]A circular professional engineer seal for the State of Illinois. The outer ring contains the text "STATE OF ILLINOIS" at the top and "PROFESSIONAL ENGINEER" at the bottom. Inside the ring, the name "RICHARD S. MACLEAN" is written in a stylized font, with "RICHARD" and "MACLEAN" on the top line and "S." in the middle. Below the name, the license number "E-5704" is printed. The seal is stamped in red ink.[illegible]

2012 GCCS PHASE 2
 PROJECT RECORD DRAWINGS
 PLAN VIEW

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 OHIO EMBL

2012 PHASE 2 RD-1 DWG BC PROJECT NUMBER 142487	CLIENT PROJECT NUMBER
DRAWING NUMBER RD-1	SHEET NUMBER 1 OF 4

NOTES:

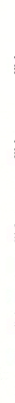
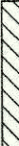
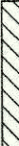
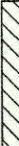
1. LFG EXTRACTION WELLS WERE ABANDONED IN PLACE BY THE FOLLOWING METHOD:
EXCAVATED DOWN TO REFUSE OR A MAXIMUM OF 4 FEET IF REFUSE WAS NOT ENCOUNTERED.
CUT OFF EXISTING WELL CASING AND INSTALLED A PVC CAP BY APPLYING A BEAD OF SILICONE
GEL INSIDE THE PVC CAP AND ATTACHED TO THE WELL CASING WITH 3 LAG SCREENS. ON SITE
SOIL BACKFILL WAS USED TO FILL IN AREA TO GROUND SURFACE.
2. THIS MAP HAS BEEN COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL
PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. DATED FEBRUARY 3, 2012. AND
QUARTERLY FIELD SURVEYS PERFORMED BY THE WELTELL CORPORATION ON APRIL 4, 2012
AND JUNE 28, 2012. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. CONTOUR INTERVAL 2
FT. GRID BASED ON LOCAL COORDINATE SYSTEM.

This image shows a blank, aged, cream-colored page, likely an endpaper or flyleaf of a book. The paper has a slightly textured appearance with some faint smudges and discoloration, characteristic of old paper. The left edge of the page shows the binding of the book, and the overall tone is a warm, off-white or light cream.

5

	6"	LANDFILL GAS HEADER/LATERAL
	6"	HORIZONTAL COLLECTOR
		ROAD CROSSING
	EW-320	LFG EXTRACTION WELL
	EW-133R	LFG COMBINATION WELL - REDRILL
		REMOTE WELLHEAD
	H155	HORIZONTAL COLLECTOR WELLHEAD
		HORIZONTAL COLLECTOR GRAVEL SLUMP

⊕	EW-122	EXISTING LFG EXTRACTION WELL
△	EW-45	EXISTING COMBINATION WELL
⊗		EXISTING REMOTE WELHEAD
⊗		EXISTING HORIZONTAL COLLECTOR WELHEAD
⊗	H6	EXISTING HEADER ACCESS RISER
⊗		EXISTING CONTROL VALVE
⊗		EXISTING BLIND FLANGE
⊗		EXISTING FLANGE CONNECTION
⊗		EXISTING CONDENSATE DRIFTEG
⊗		EXISTING CONDENSATE SLUMP STATION

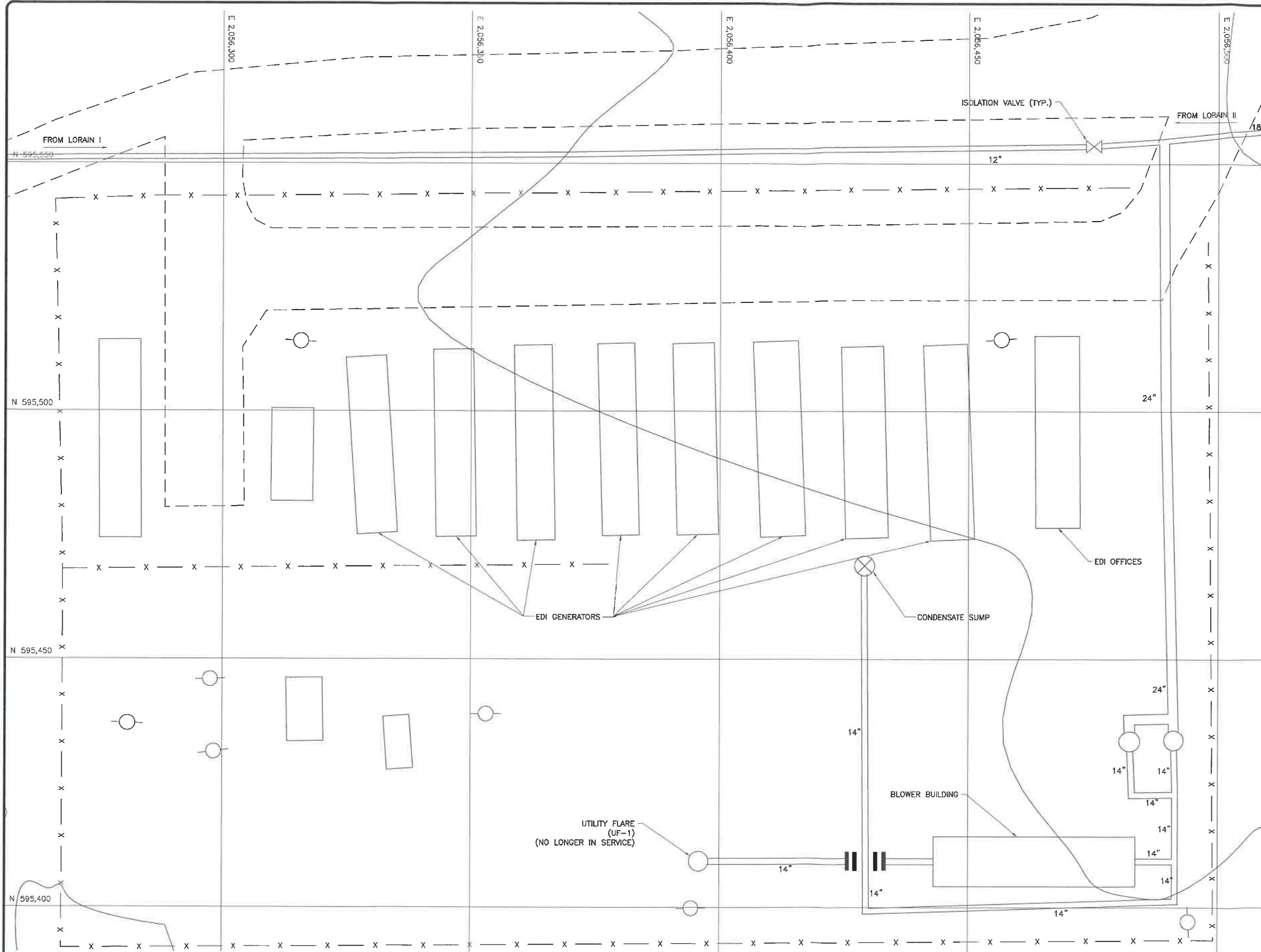
EXISTING 2' CONTOUR	EXISTING AREA OF FINAL COVER PLACEMENT	EXISTING LANDFILL GAS HEADER	EXISTING HORIZONTAL COLLECTOR	EXISTING CONDENSATE FORCEMAIN	EXISTING LEACHATE FORCE MAIN	EXISTING AIRLINE	EXISTING COMMUNICATIONS CONDUIT	EXISTING ROAD CROSSING	EXISTING 12" DUCTORION WITH 1" WITH
									

LEGEND

PROPERTY BOUNDARY

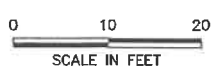
EXISTING SOLID WASTE CELL BOUNDARY

File: C:\PROJETS\LORAIN\10008 - 2010 GCOS ENGINEERING\PROJECT\MAINVIEW\DWG\LORAIN_10008.dwg User: Peter Lorenz Aug 20, 2012 - 12:25pm



LEGEND

- 800 EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- 12" EXISTING LANDFILL GAS HEADER



REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY
1	01/02/08	ADDED TWO GENERATORS	TSS	TAB	TAB	TAB
DATE OF ISSUE: 02/24/10						
DRAWN BY: P.J.L.			CHECKED BY: TAB			
DESIGNED BY: K.J.R.			APPROVED BY: TAB			

CORNERSTONE
Environmental Group, LLC

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LORAIN COUNTY LANDFILL, LLC
LORAIN COUNTY LANDFILL
LORAIN COUNTY, OHIO

EDI FACILITY

SHEET NO.
1
PROJECT NO.
100068



0 200 400
SCALE IN FEET

LEGEND

- PROPERTY BOUNDARY
- PERMITTED SOLID WASTE BOUNDARY
- EXISTING LIMITS OF FINAL COVER PLACEMENT
- FINAL COVER PLACEMENT AREA
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- 12" EXISTING LANDFILL GAS HEADER
- EXISTING COMMUNICATION CONDUIT
- EXISTING FORCEMAIN
- EXISTING AIR LINE
- △ TEW-6R EXISTING LFG EXTRACTION WELL WITH PUMP
- ⊕ EW-1 EXISTING LFG EXTRACTION WELL
- ⊕ EXISTING REMOTE WELLHEAD
- ⊕ EXISTING HEADER ACCESS RISER
- ⊕ EXISTING CONTROL VALVE
- ⊕ EXISTING BLIND FLANGE
- ⊕ EXISTING FLANGE CONNECTION
- ⊕ EXISTING CONDENSATE DRIPLEG
- ⊕ EXISTING CONDENSATE PUMP STATION
- 16" PROPOSED LANDFILL GAS HEADER

NOTES:

1. LANDFILL CONTOURS PROVIDED BY BROWN AND CALDWELL. MAP COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY PERFORMED BY COOPER AERIAL SURVEYS CO. DATED FEBRUARY 3, 2012. VERTICAL DATUM BASED ON NGS MEAN SEA LEVEL. CONTOUR INTERVAL 2 FT. GRID BASED ON LOCAL COORDINATE SYSTEM.
2. GCCS COMPONENT AS-BUILTS PROVIDED BY BROWN AND CALDWELL.

1" = 1/2" 0' 100' 200' 300' 400' 500' 600' 700' 800' 900' 1000'

REV	DATE	DESCRIPTION	CHK BY	DES BY	CHK BY	APP BY
1	8/3/2012	DESIGNED BY TAB	CHK BY TAB	DES BY TAB	CHK BY TAB	APP BY TAB

CORNERSTONE
Environmental Group, LLC

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LORAIN COUNTY LANDFILL, LLC
LORAIN COUNTY LANDFILL
LORAIN COUNTY, OHIO

**LORAIN II - 2012 GCCS
EXISTING CONDITIONS PLAN**

SHEET NO.
3
PROJECT NO.
120479

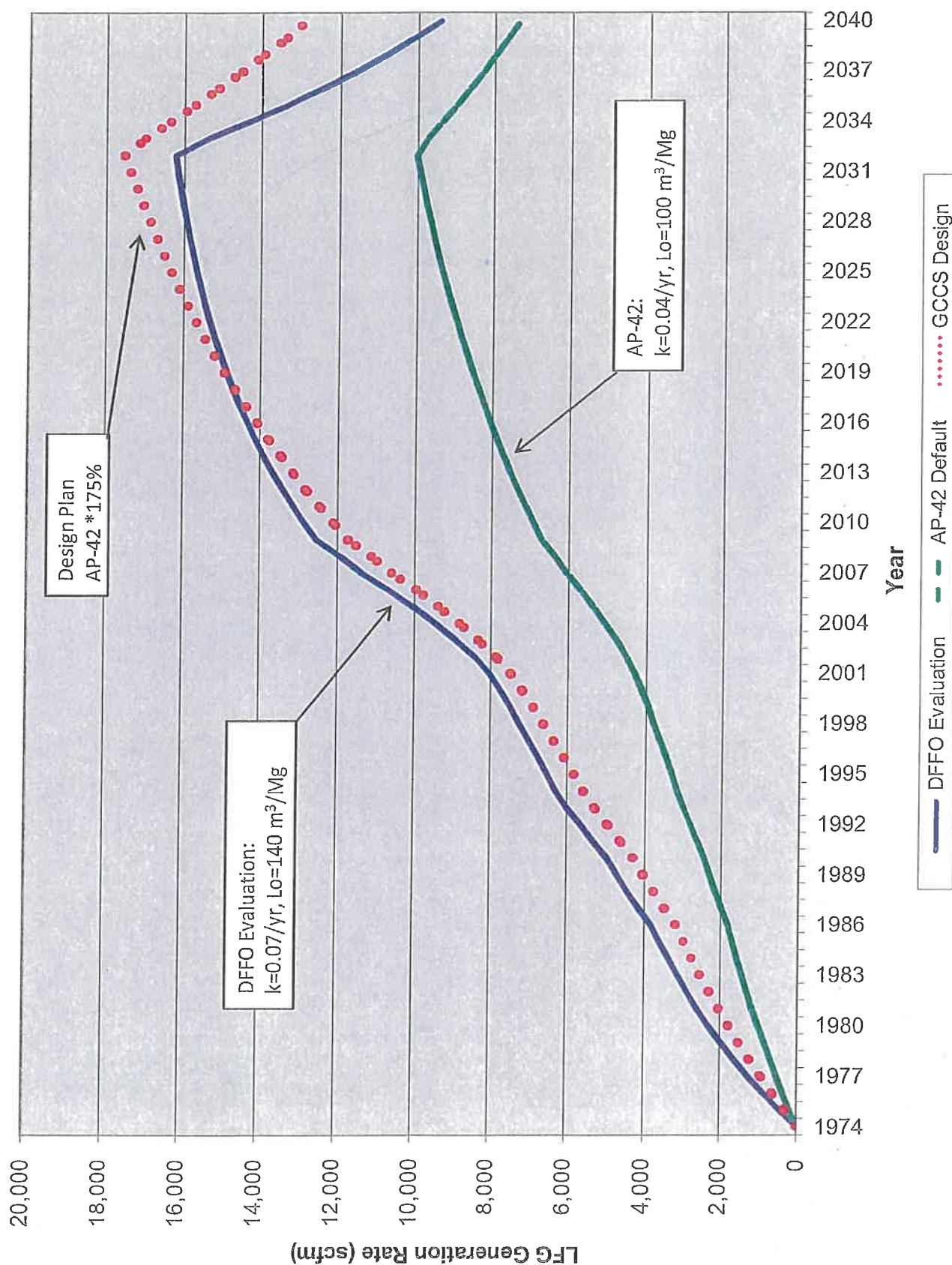
ATTACHMENT 2

LANDFILL GAS GENERATION AND RECOVERY PROJECTIONS

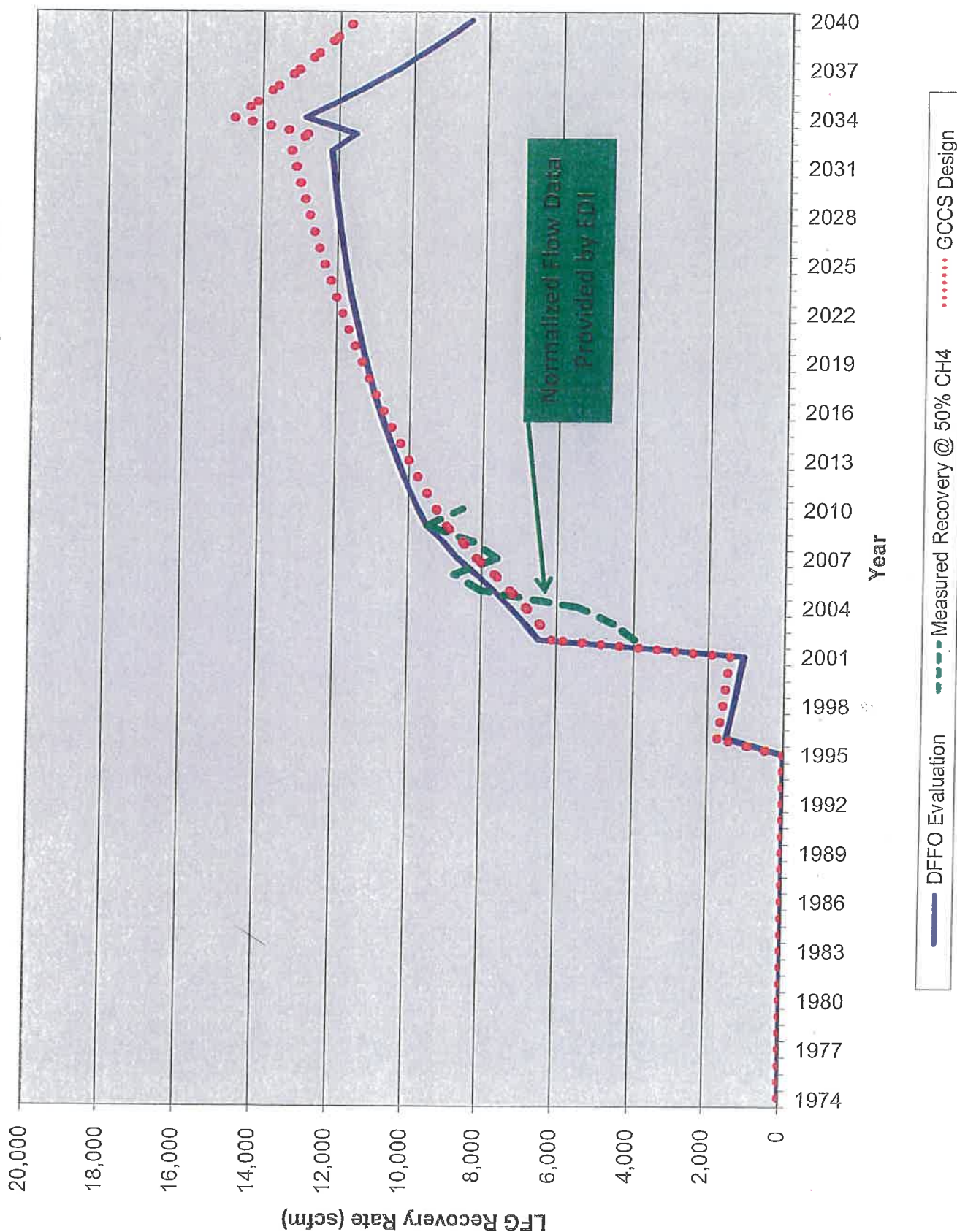
Lorain County Landfill
LFG Generation Recovery Potential Summary
Project #100068

Year	Lorain I Waste Accepted (short tons/year)	Lorain II Waste Accepted (short tons/year)	Total Site Waste-In-Place (short tons)	Lorain I (DFFO) LFG Generation (cfm)	Lorain I LFG Recovery Efficiency (%)	Lorain I (DFFO) LFG Recovery Potential (cfm)	Lorain II (DFFO) LFG Generation (cfm)	Lorain II LFG Recovery Efficiency (%)	Lorain II (DFFO) LFG Recovery Potential (cfm)	Total Site (DFFO) LFG Generation (cfm)	Total Site (DFFO) LFG Recovery Potential (cfm)	Lorain I (AP-42) LFG Generation (cfm)	Lorain II (AP-42) LFG Generation (cfm)	Total Site (AP-42) LFG Generation (cfm)	Design Factor (%)	GCCS Design Plan LFG Generation (cfm)	Projected Lorain I LFG Recovery (cfm)	Projected Lorain II LFG Recovery (cfm)	Projected Aggregate LFG Recovery (cfm)	Annual Recovery from EDI Records (cfm)
1974	391,400		391,400	0	0%	0				0	0	0		0	175%	0	0	0	0	
1975	391,400		782,800	454	0%	0				454	0	188		188	175%	329	0	0	0	
1976	391,400		1,174,200	878	0%	0				878	0	368		368	175%	645	0	0	0	
1977	391,400		1,565,600	1,272	0%	0				1,272	0	542		542	175%	943	0	0	0	
1978	391,400		1,957,000	1,641	0%	0				1,641	0	708		708	175%	1,240	0	0	0	
1979	391,400		2,348,400	1,984	0%	0				1,984	0	868		868	175%	1,520	0	0	0	
1980	391,400		2,739,800	2,304	0%	0				2,304	0	1,022		1,022	175%	1,789	0	0	0	
1981	391,400		3,131,200	2,602	0%	0				2,602	0	1,170		1,170	175%	2,048	0	0	0	
1982	391,400		3,522,600	2,880	0%	0				2,880	0	1,312		1,312	175%	2,296	0	0	0	
1983	391,400		3,914,000	3,140	0%	0				3,140	0	1,448		1,448	175%	2,535	0	0	0	
1984	391,400		4,305,400	3,382	0%	0				3,382	0	1,580		1,580	175%	2,764	0	0	0	
1985		400,100	4,705,500	3,607	0%	0	0	0%	0	3,607	0	1,705	0	1,705	175%	2,985	0	0	0	
1986		495,659	5,201,159	3,383	0%	0	464	0%	0	3,828	0	1,639	192	1,831	175%	3,204	0	0	0	
1987		494,141	5,695,300	3,138	0%	0	1,008	0%	0	4,144	0	1,574	422	1,997	175%	3,494	0	0	0	
1988		489,820	6,185,120	2,924	0%	0	1,513	0%	0	4,437	0	1,513	643	2,156	175%	3,772	0	0	0	
1989		491,028	6,676,148	2,726	0%	0	1,979	0%	0	4,706	0	1,453	853	2,306	175%	4,036	0	0	0	
1990		600,330	7,276,478	2,542	0%	0	2,415	0%	0	4,957	0	1,396	1,055	2,451	175%	4,290	0	0	0	
1991		598,975	7,875,453	2,370	0%	0	2,948	0%	0	5,319	0	1,342	1,302	2,643	175%	4,626	0	0	0	
1992		636,465	8,511,918	2,210	0%	0	3,444	0%	0	5,654	0	1,289	1,538	2,827	175%	4,948	0	0	0	
1993		589,469	9,101,387	2,080	0%	0	3,950	0%	0	6,010	0	1,238	1,784	3,022	175%	5,288	0	0	0	
1994		562,963	9,684,350	1,921	0%	0	4,367	0%	0	6,288	0	1,190	1,997	3,186	175%	5,576	0	0	0	
1995		577,163	10,241,513	1,791	0%	0	4,725	0%	0	6,516	0	1,143	2,188	3,332	175%	5,830	0	0	0	
1996		610,211	10,851,724	1,670	90%	1,503	5,075	0%	0	6,745	1,503	1,098	2,380	3,478	175%	6,086	1,730	0	1,730	
1997		619,996	11,471,720	1,557	90%	1,402	5,440	0%	0	6,997	1,402	1,055	2,579	3,635	175%	6,360	1,682	0	1,682	
1998		611,650	12,083,570	1,452	90%	1,307	5,792	0%	0	7,244	1,307	1,014	2,776	3,790	175%	6,632	1,597	0	1,597	
1999		667,955	12,751,525	1,354	90%	1,218	6,110	0%	0	7,464	1,218	974	2,960	3,935	175%	6,886	1,534	0	1,534	
2000		694,511	13,446,036	1,262	90%	1,136	6,472	0%	0	7,734	1,136	936	3,165	4,101	175%	7,177	1,474	0	1,474	
2001		805,706	14,251,742	1,177	90%	1,059	6,840	0%	0	8,017	1,059	899	3,374	4,274	175%	7,479	1,416	0	1,416	
2002		914,164	15,165,906	1,087	90%	988	7,313	75%	5,484	8,410	6,472	864	3,629	4,493	175%	7,862	1,361	4,763	6,123	3972
2003		976,600	16,142,506	1,023	90%	921	7,879	75%	5,909	8,902	6,830	830	3,925	4,755	175%	8,322	1,307	5,152	6,459	4532
2004		1,071,458	17,213,964	954	90%	859	8,479	75%	6,360	9,433	7,218	798	4,240	5,038	175%	8,816	1,256	5,565	6,821	5452
2005		1,128,407	18,342,371	890	90%	801	9,149	75%	6,862	10,039	7,663	766	4,588	5,354	175%	9,370	1,207	6,022	7,229	8014
2006		1,224,932	19,567,303	829	90%	746	9,840	75%	7,380	10,670	8,127	736	4,950	5,686	175%	9,950	1,160	6,486	7,656	8730
2007		1,120,508	20,687,811	773	90%	696	10,596	75%	7,847	11,370	8,643	707	5,344	6,051	175%	10,589	1,114	7,013	8,128	7592
2008		1,236,676	21,924,487	721	90%	649	11,180	75%	8,385	11,901	9,034	680	5,672	6,351	175%	11,115	1,070	7,444	8,515	8235
2009		999,550	22,924,037	672	90%	605	11,859	75%	8,894	12,531	9,499	653	6,043	6,696	175%	11,718	1,028	7,931	8,960	9481
2010		997,587	23,921,624	627	90%	564	12,217	75%	9,163	12,844	9,727	627	6,286	6,913	175%	12,098	988	8,250	9,238	8525
2011		997,587	24,919,211	584	90%	526	12,549	75%	9,412	13,133	9,938	603	6,518	7,121	175%	12,462	949	8,555	9,504	
2012		997,587	25,916,798	545	90%	490	12,858	75%	9,643	13,403	10,134	579	6,741	7,321	175%	12,811	912	8,848	9,760	
2013		997,587	26,914,385	508	90%	457	13,146	75%	9,860	13,654	10,317	556	6,956	7,512	175%	13,147	876	9,130	10,006	
2014		997,587	27,911,972	474	90%	426	13,415	75%	10,061	13,889	10,487	535	7,162	7,697	175%	13,469	842	9,400	10,242	
2015		997,587	28,909,559	442	90%	398	13,665	75%	10,249	14,107	10,647	514	7,360	7,874	175%	13,779	809	9,660	10,469	
2016		997,587	29,907,146	412	90%	371	13,899	75%	10,424	14,311	10,795	494	7,550	8,044	175%	14,076	777	9,910	10,687	
2017		997,587	30,904,733	384	90%	346	14,117	75%	10,588	14,501	10,933	474	7,733	8,207	175%	14,362	747	10,149	10,896	
2018		997,587	31,902,320	358	90%	322	14,320	75%	10,740	14,678	11,062	456	7,908	8,364	175%	14,637	718	10,380	11,097	
2019		997,587	32,899,907	334	90%	300	14,509	75%	10,882	14,843	11,183	438	8,077	8,515	175%	14,901	689	10,601	11,291	
2020		997,587	33,897,494	311	90%	280	14,686	75%	11,015	14,997	11,295	421	8,239	8,660	175%	15,155	662	10,814	11,476	
2021		997,587	34,895,081	290	90%	261	14,851	75%	11,138	15,141	11,399	404	8,395	8,799	175%	15,395	636	11,018	11,655	
2022		997,587	35,892,668	271	90%	244	15,004	75%	11,253	15,275	11,497	388	8,545	8,933	175%	15,633	611	11,215	11,826	
2023		997,587	36,890,255	252	90%	227	15,147	75%	11,360	15,400	11,588	373	8,688	9,061	175%	15,858	587	11,404	11,991	
2024		997,587	37,887,842	235	90%	212	15,281	75%	11,461	15,516	11,672	358	8,827	9,185	175%	16,074	564	11,585	12,149	
2025		997,587	38,885,429	219	90%	197	15,405	75%	11,554	15,625	11,751	344	8,959	9,304	175%	16,281	542	11,759	12,301	
2026		997,587	39,883,016	205	90%	184	15,521	75%	11,641	15,726	11,825	331	9,087	9,418	175%	16,481	521	11,926	12,447	
2027		997,587	40,880,603	191	90%	172	15,629	75%	11,722	15,820	11,894	318	9,209	9,527	175%	16,673	501	12,087	12,588	
2028		997,587	41,878,190	178	90%	160	15,730	75%	11,798	15,908	11,958	305	9,327	9,632	175%	16,857	481	12,242	12,723	
2029		997,587	42,875,777	165	90%	149	15,824	75%	11,868	15,990	12,017	293	9,440	9,734	175%	17,034	462	12,390	12,852	
2030		997,587	43,873,364	155	90%	139	15,912	75%	11,934	16,067	12,073	282	9,549	9,831	175%	17,204	444	12,533	12,977	
2031		997,587	44,870,951	144	90%	130	15,994	75%	11,995	16,138	12,125	271	9,653	9,924	175%	17,367	427	12,670	13,096	
2032		199,527	45,070,478	134	90%	121	16,070	75%	12,053	16,204	12,173	260	9,753	10,014	175%	17,524	410	12,801	13,211	
2033			45,070,478	125	90%	113	15,215	75%	11,411	15,340	11,524	250	9,467	9,717	175%	17,004	394	12,425	12,819	
2034			45,070,478	117	90%	105	14,186	90%	12,768	14,303	12,873	240	9,096	9,336	175%	16,338	378	14,326	14,704	
2035			45,070,478	109	90%	98	13,227	90%	11,905	13,336	12,003	231	8,739	8,970	175%	15,697	364	13,764	14,127	
2036			45,070,478	102	90%	91	12,333	90%	11,100	12,435	11,191	222	8,396	8,618	175%	15,082	349	13,224	13,573	
2037			45,070,478	95	90%	85	11,499	90%	10,349	10,435	10,435	213	8,067	8,280	175%	14,490	336	12,706	13,041	
2038																				

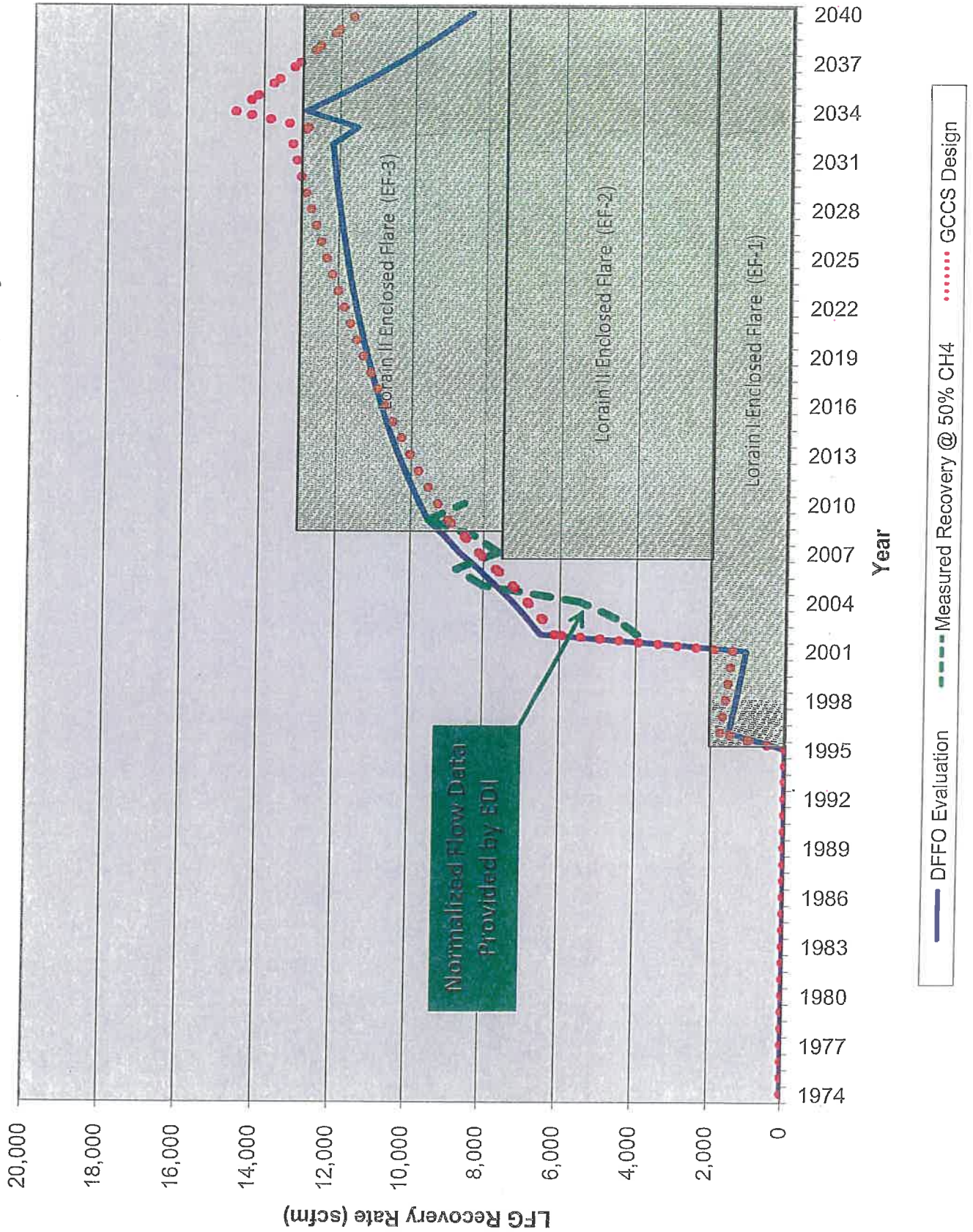
Lorain County Landfill
Landfill Gas Generation Potential - Comparison of Modeling Parameters



Lorain County Landfill
Landfill Gas Recovery Potential - Comparison of Modeling Parameters



Lorain County Landfill
Landfill Gas Recovery Potential vs Current Treatment Capacity





Summary Report

Landfill Name or Identifier: Lorain County Landfill I 1001 AP42

Date: Wednesday, February 24, 2010

Description/Comments:

Annual waste intake reflect information provided by Lorain County Landfill personnel and OEPA Solid Waste Facility Data Reports. Tonnages include a summary of General, Industrial and Exempt waste masses. Pollutant Parameters (pages 4 and 5) not calculated in this report.

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^n \sum_{j=0.1}^1 k L_o \left(\frac{M_i}{10} \right) e^{-k t_{ij}}$$

Where,

Q_{CH_4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (decimal years, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at <http://www.epa.gov/ttnatw01/landfill/landfpg.html>.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for conventional landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review**LANDFILL CHARACTERISTICS**

Landfill Open Year	1974	
Landfill Closure Year (with 80-year limit)	1984	
Actual Closure Year (without limit)	1984	
Have Model Calculate Closure Year?	No	
Waste Design Capacity	4,305,400	short tons

MODEL PARAMETERS

Methane Generation Rate, k	0.040	year ⁻¹
Potential Methane Generation Capacity, L ₀	100	m ³ /Mg
NMOC Concentration	600	ppmv as hexane
Methane Content	50	% by volume

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	Total landfill gas
Gas / Pollutant #2:	
Gas / Pollutant #3:	
Gas / Pollutant #4:	

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
1974	355,818	391,400	0	0
1975	355,818	391,400	355,818	391,400
1976	355,818	391,400	711,636	782,800
1977	355,818	391,400	1,067,455	1,174,200
1978	355,818	391,400	1,423,273	1,565,600
1979	355,818	391,400	1,779,091	1,957,000
1980	355,818	391,400	2,134,909	2,348,400
1981	355,818	391,400	2,490,727	2,739,800
1982	355,818	391,400	2,846,545	3,131,200
1983	355,818	391,400	3,202,364	3,522,600
1984	355,818	391,400	3,558,182	3,914,000
1985	0	0	3,914,000	4,305,400
1986	0	0	3,914,000	4,305,400
1987	0	0	3,914,000	4,305,400
1988	0	0	3,914,000	4,305,400
1989	0	0	3,914,000	4,305,400
1990	0	0	3,914,000	4,305,400
1991	0	0	3,914,000	4,305,400
1992	0	0	3,914,000	4,305,400
1993	0	0	3,914,000	4,305,400
1994	0	0	3,914,000	4,305,400
1995	0	0	3,914,000	4,305,400
1996	0	0	3,914,000	4,305,400
1997	0	0	3,914,000	4,305,400
1998	0	0	3,914,000	4,305,400
1999	0	0	3,914,000	4,305,400
2000	0	0	3,914,000	4,305,400
2001	0	0	3,914,000	4,305,400
2002	0	0	3,914,000	4,305,400
2003	0	0	3,914,000	4,305,400
2004	0	0	3,914,000	4,305,400
2005	0	0	3,914,000	4,305,400
2006	0	0	3,914,000	4,305,400
2007	0	0	3,914,000	4,305,400
2008	0	0	3,914,000	4,305,400
2009	0	0	3,914,000	4,305,400
2010	0	0	3,914,000	4,305,400
2011	0	0	3,914,000	4,305,400
2012	0	0	3,914,000	4,305,400
2013	0	0	3,914,000	4,305,400

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2014	0	0	3,914,000	4,305,400
2015	0	0	3,914,000	4,305,400
2016	0	0	3,914,000	4,305,400
2017	0	0	3,914,000	4,305,400
2018	0	0	3,914,000	4,305,400
2019	0	0	3,914,000	4,305,400
2020	0	0	3,914,000	4,305,400
2021	0	0	3,914,000	4,305,400
2022	0	0	3,914,000	4,305,400
2023	0	0	3,914,000	4,305,400
2024	0	0	3,914,000	4,305,400
2025	0	0	3,914,000	4,305,400
2026	0	0	3,914,000	4,305,400
2027	0	0	3,914,000	4,305,400
2028	0	0	3,914,000	4,305,400
2029	0	0	3,914,000	4,305,400
2030	0	0	3,914,000	4,305,400
2031	0	0	3,914,000	4,305,400
2032	0	0	3,914,000	4,305,400
2033	0	0	3,914,000	4,305,400
2034	0	0	3,914,000	4,305,400
2035	0	0	3,914,000	4,305,400
2036	0	0	3,914,000	4,305,400
2037	0	0	3,914,000	4,305,400
2038	0	0	3,914,000	4,305,400
2039	0	0	3,914,000	4,305,400
2040	0	0	3,914,000	4,305,400
2041	0	0	3,914,000	4,305,400
2042	0	0	3,914,000	4,305,400
2043	0	0	3,914,000	4,305,400
2044	0	0	3,914,000	4,305,400
2045	0	0	3,914,000	4,305,400
2046	0	0	3,914,000	4,305,400
2047	0	0	3,914,000	4,305,400
2048	0	0	3,914,000	4,305,400
2049	0	0	3,914,000	4,305,400
2050	0	0	3,914,000	4,305,400
2051	0	0	3,914,000	4,305,400
2052	0	0	3,914,000	4,305,400
2053	0	0	3,914,000	4,305,400

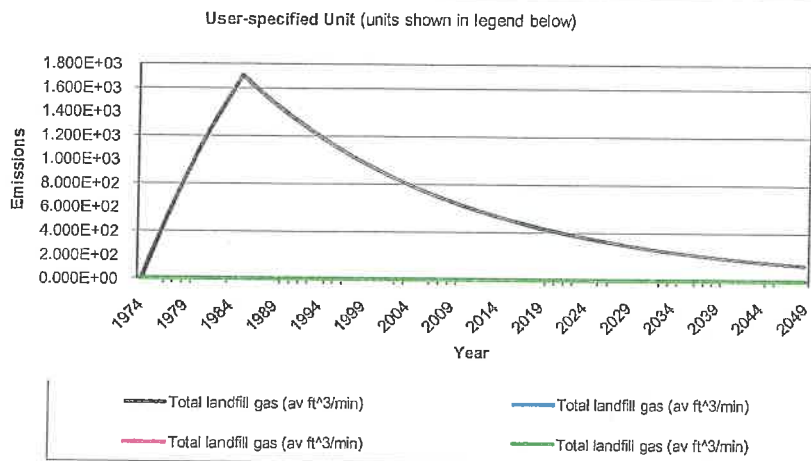
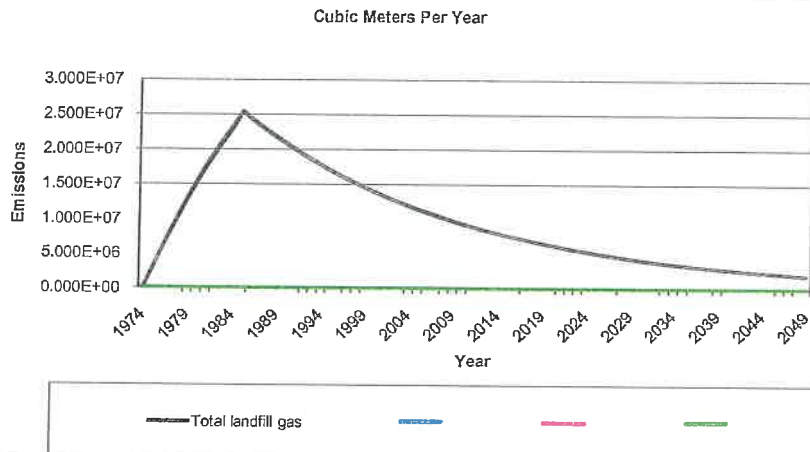
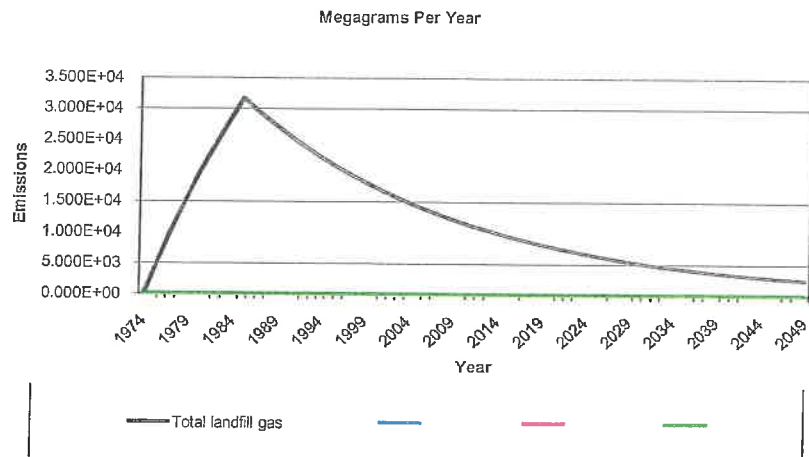
Pollutant Parameters

Gas / Pollutant Default Parameters:				User-specified Pollutant Parameters:	
	Compound	Concentration (ppmv)	Molecular Weight	Concentration (ppmv)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

Pollutant Parameters (Continued)

<i>Gas / Pollutant Default Parameters:</i>				<i>User-specified Pollutant Parameters:</i>	
Pollutants	Compound	Concentration (ppmv)	Molecular Weight	Concentration (ppmv)	Molecular Weight
	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs



Results

Year	Total landfill gas			(Mg/year)	(m ³ /year)	(av ft ³ /min)
	(Mg/year)	(m ³ /year)	(av ft ³ /min)			
1974	0	0	0	0	0	0
1975	3.492E+03	2.796E+06	1.879E+02	0.000E+00	0.000E+00	0.000E+00
1976	6.846E+03	5.482E+06	3.684E+02	0.000E+00	0.000E+00	0.000E+00
1977	1.007E+04	8.063E+06	5.418E+02	0.000E+00	0.000E+00	0.000E+00
1978	1.317E+04	1.054E+07	7.084E+02	0.000E+00	0.000E+00	0.000E+00
1979	1.614E+04	1.293E+07	8.685E+02	0.000E+00	0.000E+00	0.000E+00
1980	1.900E+04	1.521E+07	1.022E+03	0.000E+00	0.000E+00	0.000E+00
1981	2.175E+04	1.741E+07	1.170E+03	0.000E+00	0.000E+00	0.000E+00
1982	2.439E+04	1.953E+07	1.312E+03	0.000E+00	0.000E+00	0.000E+00
1983	2.692E+04	2.156E+07	1.448E+03	0.000E+00	0.000E+00	0.000E+00
1984	2.936E+04	2.351E+07	1.580E+03	0.000E+00	0.000E+00	0.000E+00
1985	3.170E+04	2.538E+07	1.705E+03	0.000E+00	0.000E+00	0.000E+00
1986	3.046E+04	2.439E+07	1.639E+03	0.000E+00	0.000E+00	0.000E+00
1987	2.926E+04	2.343E+07	1.574E+03	0.000E+00	0.000E+00	0.000E+00
1988	2.811E+04	2.251E+07	1.513E+03	0.000E+00	0.000E+00	0.000E+00
1989	2.701E+04	2.163E+07	1.453E+03	0.000E+00	0.000E+00	0.000E+00
1990	2.595E+04	2.078E+07	1.396E+03	0.000E+00	0.000E+00	0.000E+00
1991	2.493E+04	1.997E+07	1.342E+03	0.000E+00	0.000E+00	0.000E+00
1992	2.396E+04	1.918E+07	1.289E+03	0.000E+00	0.000E+00	0.000E+00
1993	2.302E+04	1.843E+07	1.238E+03	0.000E+00	0.000E+00	0.000E+00
1994	2.212E+04	1.771E+07	1.190E+03	0.000E+00	0.000E+00	0.000E+00
1995	2.125E+04	1.701E+07	1.143E+03	0.000E+00	0.000E+00	0.000E+00
1996	2.041E+04	1.635E+07	1.098E+03	0.000E+00	0.000E+00	0.000E+00
1997	1.961E+04	1.571E+07	1.055E+03	0.000E+00	0.000E+00	0.000E+00
1998	1.885E+04	1.509E+07	1.014E+03	0.000E+00	0.000E+00	0.000E+00
1999	1.811E+04	1.450E+07	9.742E+02	0.000E+00	0.000E+00	0.000E+00
2000	1.740E+04	1.393E+07	9.360E+02	0.000E+00	0.000E+00	0.000E+00
2001	1.671E+04	1.338E+07	8.993E+02	0.000E+00	0.000E+00	0.000E+00
2002	1.606E+04	1.286E+07	8.640E+02	0.000E+00	0.000E+00	0.000E+00
2003	1.543E+04	1.235E+07	8.301E+02	0.000E+00	0.000E+00	0.000E+00
2004	1.482E+04	1.187E+07	7.976E+02	0.000E+00	0.000E+00	0.000E+00
2005	1.424E+04	1.141E+07	7.663E+02	0.000E+00	0.000E+00	0.000E+00
2006	1.368E+04	1.096E+07	7.363E+02	0.000E+00	0.000E+00	0.000E+00
2007	1.315E+04	1.053E+07	7.074E+02	0.000E+00	0.000E+00	0.000E+00
2008	1.263E+04	1.012E+07	6.796E+02	0.000E+00	0.000E+00	0.000E+00
2009	1.214E+04	9.719E+06	6.530E+02	0.000E+00	0.000E+00	0.000E+00
2010	1.166E+04	9.338E+06	6.274E+02	0.000E+00	0.000E+00	0.000E+00
2011	1.120E+04	8.972E+06	6.028E+02	0.000E+00	0.000E+00	0.000E+00
2012	1.076E+04	8.620E+06	5.792E+02	0.000E+00	0.000E+00	0.000E+00
2013	1.034E+04	8.282E+06	5.564E+02	0.000E+00	0.000E+00	0.000E+00
2014	9.937E+03	7.957E+06	5.346E+02	0.000E+00	0.000E+00	0.000E+00
2015	9.547E+03	7.645E+06	5.137E+02	0.000E+00	0.000E+00	0.000E+00
2016	9.173E+03	7.345E+06	4.935E+02	0.000E+00	0.000E+00	0.000E+00
2017	8.813E+03	7.057E+06	4.742E+02	0.000E+00	0.000E+00	0.000E+00
2018	8.468E+03	6.781E+06	4.556E+02	0.000E+00	0.000E+00	0.000E+00
2019	8.136E+03	6.515E+06	4.377E+02	0.000E+00	0.000E+00	0.000E+00
2020	7.817E+03	6.259E+06	4.206E+02	0.000E+00	0.000E+00	0.000E+00
2021	7.510E+03	6.014E+06	4.041E+02	0.000E+00	0.000E+00	0.000E+00
2022	7.216E+03	5.778E+06	3.882E+02	0.000E+00	0.000E+00	0.000E+00
2023	6.933E+03	5.551E+06	3.730E+02	0.000E+00	0.000E+00	0.000E+00

Results (Continued)

Year	Total landfill gas			(Mg/year)	(m ³ /year)	(av ft ³ /min)
	(Mg/year)	(m ³ /year)	(av ft ³ /min)			
2024	6.661E+03	5.334E+06	3.584E+02	0.000E+00	0.000E+00	0.000E+00
2025	6.400E+03	5.125E+06	3.443E+02	0.000E+00	0.000E+00	0.000E+00
2026	6.149E+03	4.924E+06	3.308E+02	0.000E+00	0.000E+00	0.000E+00
2027	5.908E+03	4.731E+06	3.178E+02	0.000E+00	0.000E+00	0.000E+00
2028	5.676E+03	4.545E+06	3.054E+02	0.000E+00	0.000E+00	0.000E+00
2029	5.453E+03	4.367E+06	2.934E+02	0.000E+00	0.000E+00	0.000E+00
2030	5.240E+03	4.196E+06	2.819E+02	0.000E+00	0.000E+00	0.000E+00
2031	5.034E+03	4.031E+06	2.709E+02	0.000E+00	0.000E+00	0.000E+00
2032	4.837E+03	3.873E+06	2.602E+02	0.000E+00	0.000E+00	0.000E+00
2033	4.647E+03	3.721E+06	2.500E+02	0.000E+00	0.000E+00	0.000E+00
2034	4.465E+03	3.575E+06	2.402E+02	0.000E+00	0.000E+00	0.000E+00
2035	4.290E+03	3.435E+06	2.308E+02	0.000E+00	0.000E+00	0.000E+00
2036	4.122E+03	3.300E+06	2.218E+02	0.000E+00	0.000E+00	0.000E+00
2037	3.960E+03	3.171E+06	2.131E+02	0.000E+00	0.000E+00	0.000E+00
2038	3.805E+03	3.047E+06	2.047E+02	0.000E+00	0.000E+00	0.000E+00
2039	3.656E+03	2.927E+06	1.967E+02	0.000E+00	0.000E+00	0.000E+00
2040	3.512E+03	2.812E+06	1.890E+02	0.000E+00	0.000E+00	0.000E+00
2041	3.375E+03	2.702E+06	1.816E+02	0.000E+00	0.000E+00	0.000E+00
2042	3.242E+03	2.596E+06	1.744E+02	0.000E+00	0.000E+00	0.000E+00
2043	3.115E+03	2.494E+06	1.676E+02	0.000E+00	0.000E+00	0.000E+00
2044	2.993E+03	2.397E+06	1.610E+02	0.000E+00	0.000E+00	0.000E+00
2045	2.876E+03	2.303E+06	1.547E+02	0.000E+00	0.000E+00	0.000E+00
2046	2.763E+03	2.212E+06	1.486E+02	0.000E+00	0.000E+00	0.000E+00
2047	2.655E+03	2.126E+06	1.428E+02	0.000E+00	0.000E+00	0.000E+00
2048	2.550E+03	2.042E+06	1.372E+02	0.000E+00	0.000E+00	0.000E+00
2049	2.450E+03	1.962E+06	1.318E+02	0.000E+00	0.000E+00	0.000E+00
2050	2.354E+03	1.885E+06	1.267E+02	0.000E+00	0.000E+00	0.000E+00
2051	2.262E+03	1.811E+06	1.217E+02	0.000E+00	0.000E+00	0.000E+00
2052	2.173E+03	1.740E+06	1.169E+02	0.000E+00	0.000E+00	0.000E+00
2053	2.088E+03	1.672E+06	1.123E+02	0.000E+00	0.000E+00	0.000E+00
2054	2.006E+03	1.608E+06	1.079E+02	0.000E+00	0.000E+00	0.000E+00
2055	1.928E+03	1.544E+06	1.037E+02	0.000E+00	0.000E+00	0.000E+00
2056	1.852E+03	1.483E+06	9.964E+01	0.000E+00	0.000E+00	0.000E+00
2057	1.779E+03	1.425E+06	9.573E+01	0.000E+00	0.000E+00	0.000E+00
2058	1.710E+03	1.369E+06	9.198E+01	0.000E+00	0.000E+00	0.000E+00
2059	1.643E+03	1.315E+06	8.837E+01	0.000E+00	0.000E+00	0.000E+00
2060	1.578E+03	1.264E+06	8.491E+01	0.000E+00	0.000E+00	0.000E+00
2061	1.516E+03	1.214E+06	8.158E+01	0.000E+00	0.000E+00	0.000E+00
2062	1.457E+03	1.167E+06	7.838E+01	0.000E+00	0.000E+00	0.000E+00
2063	1.400E+03	1.121E+06	7.531E+01	0.000E+00	0.000E+00	0.000E+00
2064	1.345E+03	1.077E+06	7.235E+01	0.000E+00	0.000E+00	0.000E+00
2065	1.292E+03	1.035E+06	6.952E+01	0.000E+00	0.000E+00	0.000E+00
2066	1.241E+03	9.941E+05	6.679E+01	0.000E+00	0.000E+00	0.000E+00
2067	1.193E+03	9.551E+05	6.417E+01	0.000E+00	0.000E+00	0.000E+00
2068	1.146E+03	9.176E+05	6.166E+01	0.000E+00	0.000E+00	0.000E+00
2069	1.101E+03	8.817E+05	5.924E+01	0.000E+00	0.000E+00	0.000E+00
2070	1.058E+03	8.471E+05	5.692E+01	0.000E+00	0.000E+00	0.000E+00
2071	1.016E+03	8.139E+05	5.468E+01	0.000E+00	0.000E+00	0.000E+00
2072	9.765E+02	7.820E+05	5.254E+01	0.000E+00	0.000E+00	0.000E+00
2073	9.382E+02	7.513E+05	5.048E+01	0.000E+00	0.000E+00	0.000E+00
2074	9.015E+02	7.218E+05	4.850E+01	0.000E+00	0.000E+00	0.000E+00

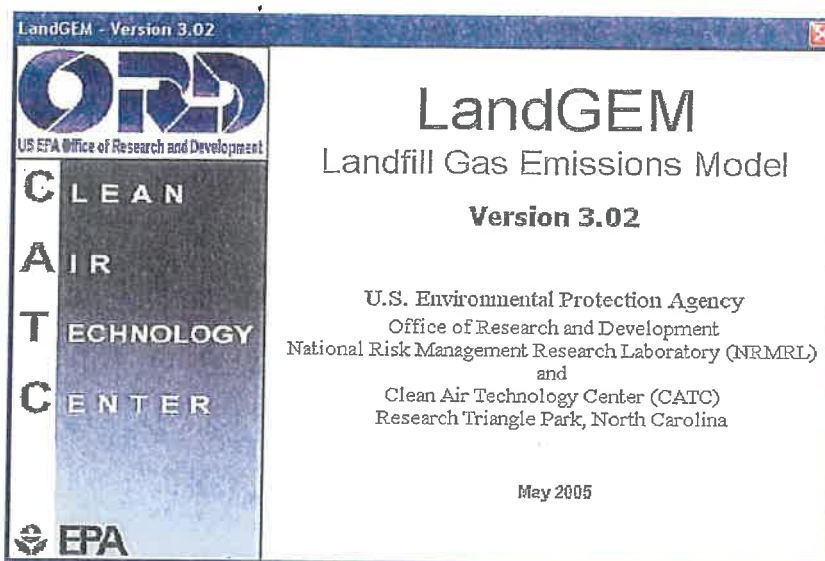
Results (Continued)

Year	Total landfill gas			(Mg/year)	(m ³ /year)	(av ft ³ /min)
	(Mg/year)	(m ³ /year)	(av ft ³ /min)			
2075	8.661E+02	6.935E+05	4.660E+01	0.000E+00	0.000E+00	0.000E+00
2076	8.321E+02	6.663E+05	4.477E+01	0.000E+00	0.000E+00	0.000E+00
2077	7.995E+02	6.402E+05	4.302E+01	0.000E+00	0.000E+00	0.000E+00
2078	7.682E+02	6.151E+05	4.133E+01	0.000E+00	0.000E+00	0.000E+00
2079	7.381E+02	5.910E+05	3.971E+01	0.000E+00	0.000E+00	0.000E+00
2080	7.091E+02	5.678E+05	3.815E+01	0.000E+00	0.000E+00	0.000E+00
2081	6.813E+02	5.456E+05	3.666E+01	0.000E+00	0.000E+00	0.000E+00
2082	6.546E+02	5.242E+05	3.522E+01	0.000E+00	0.000E+00	0.000E+00
2083	6.289E+02	5.036E+05	3.384E+01	0.000E+00	0.000E+00	0.000E+00
2084	6.043E+02	4.839E+05	3.251E+01	0.000E+00	0.000E+00	0.000E+00
2085	5.806E+02	4.649E+05	3.124E+01	0.000E+00	0.000E+00	0.000E+00
2086	5.578E+02	4.467E+05	3.001E+01	0.000E+00	0.000E+00	0.000E+00
2087	5.359E+02	4.292E+05	2.883E+01	0.000E+00	0.000E+00	0.000E+00
2088	5.149E+02	4.123E+05	2.770E+01	0.000E+00	0.000E+00	0.000E+00
2089	4.947E+02	3.962E+05	2.662E+01	0.000E+00	0.000E+00	0.000E+00
2090	4.753E+02	3.806E+05	2.557E+01	0.000E+00	0.000E+00	0.000E+00
2091	4.567E+02	3.657E+05	2.457E+01	0.000E+00	0.000E+00	0.000E+00
2092	4.388E+02	3.514E+05	2.361E+01	0.000E+00	0.000E+00	0.000E+00
2093	4.216E+02	3.376E+05	2.268E+01	0.000E+00	0.000E+00	0.000E+00
2094	4.051E+02	3.243E+05	2.179E+01	0.000E+00	0.000E+00	0.000E+00
2095	3.892E+02	3.116E+05	2.094E+01	0.000E+00	0.000E+00	0.000E+00
2096	3.739E+02	2.994E+05	2.012E+01	0.000E+00	0.000E+00	0.000E+00
2097	3.592E+02	2.877E+05	1.933E+01	0.000E+00	0.000E+00	0.000E+00
2098	3.452E+02	2.764E+05	1.857E+01	0.000E+00	0.000E+00	0.000E+00
2099	3.316E+02	2.656E+05	1.784E+01	0.000E+00	0.000E+00	0.000E+00
2100	3.186E+02	2.551E+05	1.714E+01	0.000E+00	0.000E+00	0.000E+00
2101	3.061E+02	2.451E+05	1.647E+01	0.000E+00	0.000E+00	0.000E+00
2102	2.941E+02	2.355E+05	1.582E+01	0.000E+00	0.000E+00	0.000E+00
2103	2.826E+02	2.263E+05	1.520E+01	0.000E+00	0.000E+00	0.000E+00
2104	2.715E+02	2.174E+05	1.461E+01	0.000E+00	0.000E+00	0.000E+00
2105	2.609E+02	2.089E+05	1.404E+01	0.000E+00	0.000E+00	0.000E+00
2106	2.506E+02	2.007E+05	1.348E+01	0.000E+00	0.000E+00	0.000E+00
2107	2.408E+02	1.928E+05	1.296E+01	0.000E+00	0.000E+00	0.000E+00
2108	2.314E+02	1.853E+05	1.245E+01	0.000E+00	0.000E+00	0.000E+00
2109	2.223E+02	1.780E+05	1.196E+01	0.000E+00	0.000E+00	0.000E+00
2110	2.136E+02	1.710E+05	1.149E+01	0.000E+00	0.000E+00	0.000E+00
2111	2.052E+02	1.643E+05	1.104E+01	0.000E+00	0.000E+00	0.000E+00
2112	1.972E+02	1.579E+05	1.061E+01	0.000E+00	0.000E+00	0.000E+00
2113	1.894E+02	1.517E+05	1.019E+01	0.000E+00	0.000E+00	0.000E+00
2114	1.820E+02	1.457E+05	9.792E+00	0.000E+00	0.000E+00	0.000E+00

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[illegible]

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Summary Report

Landfill Name or Identifier: Lorain County Landfill II 1002 AP-42

Date: Wednesday, July 21, 2010

Description/Comments:

Annual waste intake reflect information provided by Lorain County Landfill personnel and OEPA Solid Waste Facility Data Reports. Tonnages include a summary of General, Industrial and Exempt waste masses. Pollutant Parameters (pages 4 and 5) not calculated in this report. The 2009 Annual Report noted a balance of 22,146,441 tons remaining for Waste Placement as of 12/31/2009.

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^n \sum_{j=0.1}^1 k L_o \left(\frac{M_i}{10} \right) e^{-k t_{ij}}$$

Where,

Q_{CH_4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Ma)

M_i = mass of waste accepted in the i^{th} year (Ma)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (decimal years... e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at <http://www.epa.gov/ttnatw01/landfill/landflpg.html>.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for conventional landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review

LANDFILL CHARACTERISTICS

Landfill Open Year	1985	
Landfill Closure Year (with 80-year limit)	2032	
Actual Closure Year (without limit)	2032	
Have Model Calculate Closure Year?	No	
Waste Design Capacity	40,765,078	short tons

MODEL PARAMETERS

Methane Generation Rate, k	0.040	year ⁻¹
Potential Methane Generation Capacity, L ₀	100	m ³ /Mg
NMOC Concentration	600	ppmv as hexane
Methane Content	50	% by volume

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	Total landfill gas
Gas / Pollutant #2:	
Gas / Pollutant #3:	
Gas / Pollutant #4:	

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
1985	363,727	400,100	0	0
1986	450,599	495,659	363,727	400,100
1987	449,219	494,141	814,326	895,759
1988	445,291	489,820	1,263,545	1,389,900
1989	446,389	491,028	1,708,836	1,879,720
1990	545,755	600,330	2,155,225	2,370,748
1991	544,523	598,975	2,700,980	2,971,078
1992	578,605	636,465	3,245,503	3,570,053
1993	535,881	589,469	3,824,107	4,206,518
1994	511,785	562,963	4,359,988	4,795,987
1995	524,694	577,163	4,871,773	5,358,950
1996	554,737	610,211	5,396,466	5,936,113
1997	563,633	619,996	5,951,204	6,546,324
1998	556,227	611,850	6,514,836	7,166,320
1999	607,232	667,955	7,071,064	7,778,170
2000	631,374	694,511	7,678,295	8,446,125
2001	732,460	805,706	8,309,669	9,140,636
2002	831,058	914,164	9,042,129	9,946,342
2003	887,818	976,600	9,873,187	10,860,506
2004	974,053	1,071,458	10,761,005	11,837,106
2005	1,025,825	1,128,407	11,735,058	12,908,564
2006	1,113,575	1,224,932	12,760,883	14,036,971
2007	1,018,644	1,120,508	13,874,457	15,261,903
2008	1,124,251	1,236,676	14,893,101	16,382,411
2009	908,682	999,550	16,017,352	17,619,087
2010	906,897	997,587	16,926,034	18,618,637
2011	906,897	997,587	17,832,931	19,616,224
2012	906,897	997,587	18,739,828	20,613,811
2013	906,897	997,587	19,646,725	21,611,398
2014	906,897	997,587	20,553,623	22,608,985
2015	906,897	997,587	21,460,520	23,606,572
2016	906,897	997,587	22,367,417	24,604,159
2017	906,897	997,587	23,274,315	25,601,746
2018	906,897	997,587	24,181,212	26,599,333
2019	906,897	997,587	25,088,109	27,596,920
2020	906,897	997,587	25,995,006	28,594,507
2021	906,897	997,587	26,901,904	29,592,094
2022	906,897	997,587	27,808,801	30,589,681
2023	906,897	997,587	28,715,698	31,587,268
2024	906,897	997,587	29,622,595	32,584,855

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2025	906,897	997,587	30,529,493	33,582,442
2026	906,897	997,587	31,436,390	34,580,029
2027	906,897	997,587	32,343,287	35,577,616
2028	906,897	997,587	33,250,185	36,575,203
2029	906,897	997,587	34,157,082	37,572,790
2030	906,897	997,587	35,063,979	38,570,377
2031	906,897	997,587	35,970,876	39,567,964
2032	181,388	199,527	36,877,774	40,565,551
2033	0	0	37,059,162	40,765,078
2034	0	0	37,059,162	40,765,078
2035	0	0	37,059,162	40,765,078
2036	0	0	37,059,162	40,765,078
2037	0	0	37,059,162	40,765,078
2038	0	0	37,059,162	40,765,078
2039	0	0	37,059,162	40,765,078
2040	0	0	37,059,162	40,765,078
2041	0	0	37,059,162	40,765,078
2042	0	0	37,059,162	40,765,078
2043	0	0	37,059,162	40,765,078
2044	0	0	37,059,162	40,765,078
2045	0	0	37,059,162	40,765,078
2046	0	0	37,059,162	40,765,078
2047	0	0	37,059,162	40,765,078
2048	0	0	37,059,162	40,765,078
2049	0	0	37,059,162	40,765,078
2050	0	0	37,059,162	40,765,078
2051	0	0	37,059,162	40,765,078
2052	0	0	37,059,162	40,765,078
2053	0	0	37,059,162	40,765,078
2054	0	0	37,059,162	40,765,078
2055	0	0	37,059,162	40,765,078
2056	0	0	37,059,162	40,765,078
2057	0	0	37,059,162	40,765,078
2058	0	0	37,059,162	40,765,078
2059	0	0	37,059,162	40,765,078
2060	0	0	37,059,162	40,765,078
2061	0	0	37,059,162	40,765,078
2062	0	0	37,059,162	40,765,078
2063	0	0	37,059,162	40,765,078
2064	0	0	37,059,162	40,765,078

Pollutant Parameters**Gas / Pollutant Default Parameters:****User-specified Pollutant Parameters:**

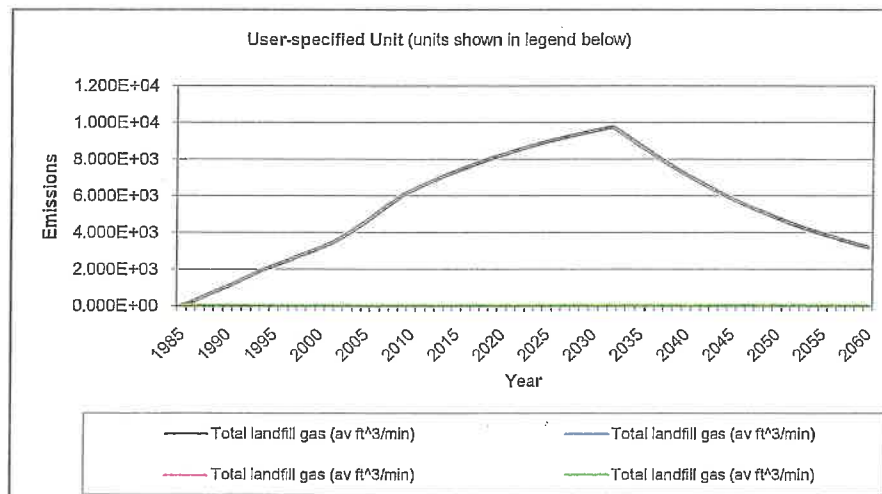
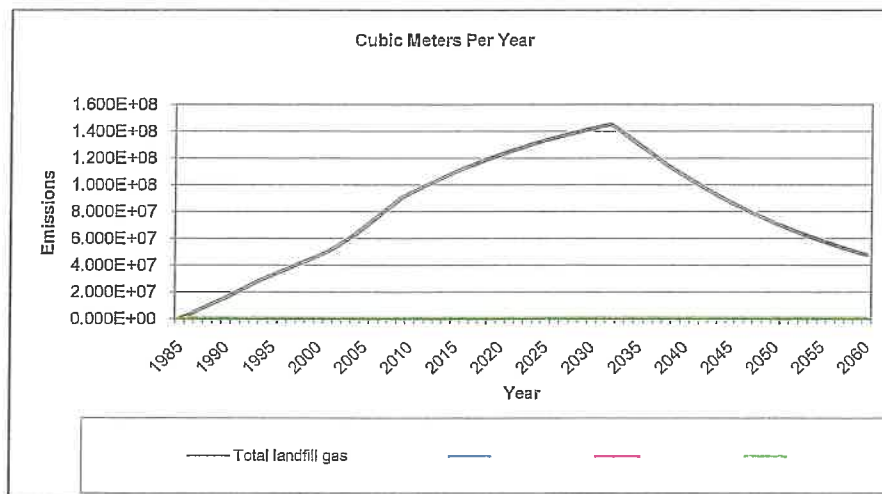
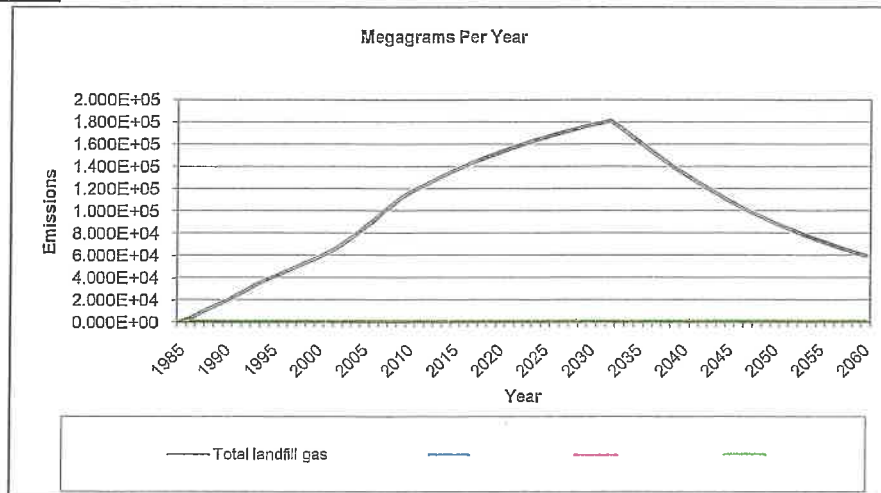
	Compound	Concentration (ppmv)	Molecular Weight	User-specified Pollutant Parameters:	
				Concentration (ppmv)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2- Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

Gas / Pollutant Default Parameters:

User-specified Pollutant Parameters:

Pollutants

Graphs



Results

Year	Total landfill gas					
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
1985	0	0	0	0	0	0
1986	3.569E+03	2.858E+06	1.920E+02	0.000E+00	0.000E+00	0.000E+00
1987	7.851E+03	6.287E+06	4.224E+02	0.000E+00	0.000E+00	0.000E+00
1988	1.195E+04	9.570E+06	6.430E+02	0.000E+00	0.000E+00	0.000E+00
1989	1.585E+04	1.269E+07	8.529E+02	0.000E+00	0.000E+00	0.000E+00
1990	1.961E+04	1.570E+07	1.055E+03	0.000E+00	0.000E+00	0.000E+00
1991	2.420E+04	1.938E+07	1.302E+03	0.000E+00	0.000E+00	0.000E+00
1992	2.859E+04	2.290E+07	1.538E+03	0.000E+00	0.000E+00	0.000E+00
1993	3.315E+04	2.654E+07	1.784E+03	0.000E+00	0.000E+00	0.000E+00
1994	3.711E+04	2.971E+07	1.997E+03	0.000E+00	0.000E+00	0.000E+00
1995	4.068E+04	3.257E+07	2.188E+03	0.000E+00	0.000E+00	0.000E+00
1996	4.423E+04	3.542E+07	2.380E+03	0.000E+00	0.000E+00	0.000E+00
1997	4.794E+04	3.839E+07	2.579E+03	0.000E+00	0.000E+00	0.000E+00
1998	5.159E+04	4.131E+07	2.776E+03	0.000E+00	0.000E+00	0.000E+00
1999	5.503E+04	4.406E+07	2.960E+03	0.000E+00	0.000E+00	0.000E+00
2000	5.883E+04	4.711E+07	3.165E+03	0.000E+00	0.000E+00	0.000E+00
2001	6.272E+04	5.022E+07	3.374E+03	0.000E+00	0.000E+00	0.000E+00
2002	6.744E+04	5.401E+07	3.629E+03	0.000E+00	0.000E+00	0.000E+00
2003	7.295E+04	5.842E+07	3.925E+03	0.000E+00	0.000E+00	0.000E+00
2004	7.881E+04	6.310E+07	4.240E+03	0.000E+00	0.000E+00	0.000E+00
2005	8.527E+04	6.828E+07	4.588E+03	0.000E+00	0.000E+00	0.000E+00
2006	9.200E+04	7.367E+07	4.950E+03	0.000E+00	0.000E+00	0.000E+00
2007	9.932E+04	7.953E+07	5.344E+03	0.000E+00	0.000E+00	0.000E+00
2008	1.054E+05	8.441E+07	5.672E+03	0.000E+00	0.000E+00	0.000E+00
2009	1.123E+05	8.994E+07	6.043E+03	0.000E+00	0.000E+00	0.000E+00
2010	1.168E+05	9.355E+07	6.286E+03	0.000E+00	0.000E+00	0.000E+00
2011	1.211E+05	9.701E+07	6.518E+03	0.000E+00	0.000E+00	0.000E+00
2012	1.253E+05	1.003E+08	6.741E+03	0.000E+00	0.000E+00	0.000E+00
2013	1.293E+05	1.035E+08	6.956E+03	0.000E+00	0.000E+00	0.000E+00
2014	1.331E+05	1.066E+08	7.162E+03	0.000E+00	0.000E+00	0.000E+00
2015	1.368E+05	1.095E+08	7.360E+03	0.000E+00	0.000E+00	0.000E+00
2016	1.403E+05	1.124E+08	7.550E+03	0.000E+00	0.000E+00	0.000E+00
2017	1.437E+05	1.151E+08	7.733E+03	0.000E+00	0.000E+00	0.000E+00
2018	1.470E+05	1.177E+08	7.908E+03	0.000E+00	0.000E+00	0.000E+00
2019	1.501E+05	1.202E+08	8.077E+03	0.000E+00	0.000E+00	0.000E+00
2020	1.531E+05	1.226E+08	8.239E+03	0.000E+00	0.000E+00	0.000E+00
2021	1.560E+05	1.249E+08	8.395E+03	0.000E+00	0.000E+00	0.000E+00
2022	1.588E+05	1.272E+08	8.545E+03	0.000E+00	0.000E+00	0.000E+00
2023	1.615E+05	1.293E+08	8.688E+03	0.000E+00	0.000E+00	0.000E+00
2024	1.641E+05	1.314E+08	8.827E+03	0.000E+00	0.000E+00	0.000E+00
2025	1.665E+05	1.333E+08	8.959E+03	0.000E+00	0.000E+00	0.000E+00
2026	1.689E+05	1.352E+08	9.087E+03	0.000E+00	0.000E+00	0.000E+00
2027	1.712E+05	1.371E+08	9.209E+03	0.000E+00	0.000E+00	0.000E+00
2028	1.734E+05	1.388E+08	9.327E+03	0.000E+00	0.000E+00	0.000E+00
2029	1.755E+05	1.405E+08	9.440E+03	0.000E+00	0.000E+00	0.000E+00
2030	1.775E+05	1.421E+08	9.549E+03	0.000E+00	0.000E+00	0.000E+00
2031	1.794E+05	1.437E+08	9.653E+03	0.000E+00	0.000E+00	0.000E+00
2032	1.813E+05	1.452E+08	9.753E+03	0.000E+00	0.000E+00	0.000E+00
2033	1.760E+05	1.409E+08	9.467E+03	0.000E+00	0.000E+00	0.000E+00
2034	1.691E+05	1.354E+08	9.096E+03	0.000E+00	0.000E+00	0.000E+00

Results (Continued)

Year	Total landfill gas			(Mg/year)	(m ³ /year)	(av ft ³ /min)
	(Mg/year)	(m ³ /year)	(av ft ³ /min)			
2035	1.624E+05	1.301E+08	8.739E+03	0.000E+00	0.000E+00	0.000E+00
2036	1.561E+05	1.250E+08	8.396E+03	0.000E+00	0.000E+00	0.000E+00
2037	1.499E+05	1.201E+08	8.067E+03	0.000E+00	0.000E+00	0.000E+00
2038	1.441E+05	1.154E+08	7.751E+03	0.000E+00	0.000E+00	0.000E+00
2039	1.384E+05	1.108E+08	7.447E+03	0.000E+00	0.000E+00	0.000E+00
2040	1.330E+05	1.065E+08	7.155E+03	0.000E+00	0.000E+00	0.000E+00
2041	1.278E+05	1.023E+08	6.874E+03	0.000E+00	0.000E+00	0.000E+00
2042	1.228E+05	9.830E+07	6.605E+03	0.000E+00	0.000E+00	0.000E+00
2043	1.179E+05	9.445E+07	6.346E+03	0.000E+00	0.000E+00	0.000E+00
2044	1.133E+05	9.074E+07	6.097E+03	0.000E+00	0.000E+00	0.000E+00
2045	1.089E+05	8.718E+07	5.858E+03	0.000E+00	0.000E+00	0.000E+00
2046	1.046E+05	8.377E+07	5.628E+03	0.000E+00	0.000E+00	0.000E+00
2047	1.005E+05	8.048E+07	5.408E+03	0.000E+00	0.000E+00	0.000E+00
2048	9.657E+04	7.733E+07	5.195E+03	0.000E+00	0.000E+00	0.000E+00
2049	9.278E+04	7.429E+07	4.992E+03	0.000E+00	0.000E+00	0.000E+00
2050	8.914E+04	7.138E+07	4.796E+03	0.000E+00	0.000E+00	0.000E+00
2051	8.565E+04	6.858E+07	4.608E+03	0.000E+00	0.000E+00	0.000E+00
2052	8.229E+04	6.589E+07	4.427E+03	0.000E+00	0.000E+00	0.000E+00
2053	7.906E+04	6.331E+07	4.254E+03	0.000E+00	0.000E+00	0.000E+00
2054	7.596E+04	6.083E+07	4.087E+03	0.000E+00	0.000E+00	0.000E+00
2055	7.298E+04	5.844E+07	3.927E+03	0.000E+00	0.000E+00	0.000E+00
2056	7.012E+04	5.615E+07	3.773E+03	0.000E+00	0.000E+00	0.000E+00
2057	6.737E+04	5.395E+07	3.625E+03	0.000E+00	0.000E+00	0.000E+00
2058	6.473E+04	5.183E+07	3.483E+03	0.000E+00	0.000E+00	0.000E+00
2059	6.219E+04	4.980E+07	3.346E+03	0.000E+00	0.000E+00	0.000E+00
2060	5.975E+04	4.785E+07	3.215E+03	0.000E+00	0.000E+00	0.000E+00
2061	5.741E+04	4.597E+07	3.089E+03	0.000E+00	0.000E+00	0.000E+00
2062	5.516E+04	4.417E+07	2.968E+03	0.000E+00	0.000E+00	0.000E+00
2063	5.300E+04	4.244E+07	2.851E+03	0.000E+00	0.000E+00	0.000E+00
2064	5.092E+04	4.077E+07	2.740E+03	0.000E+00	0.000E+00	0.000E+00
2065	4.892E+04	3.917E+07	2.632E+03	0.000E+00	0.000E+00	0.000E+00
2066	4.700E+04	3.764E+07	2.529E+03	0.000E+00	0.000E+00	0.000E+00
2067	4.516E+04	3.616E+07	2.430E+03	0.000E+00	0.000E+00	0.000E+00
2068	4.339E+04	3.474E+07	2.334E+03	0.000E+00	0.000E+00	0.000E+00
2069	4.169E+04	3.338E+07	2.243E+03	0.000E+00	0.000E+00	0.000E+00
2070	4.005E+04	3.207E+07	2.155E+03	0.000E+00	0.000E+00	0.000E+00
2071	3.848E+04	3.082E+07	2.071E+03	0.000E+00	0.000E+00	0.000E+00
2072	3.697E+04	2.961E+07	1.989E+03	0.000E+00	0.000E+00	0.000E+00
2073	3.552E+04	2.845E+07	1.911E+03	0.000E+00	0.000E+00	0.000E+00
2074	3.413E+04	2.733E+07	1.836E+03	0.000E+00	0.000E+00	0.000E+00
2075	3.279E+04	2.626E+07	1.764E+03	0.000E+00	0.000E+00	0.000E+00
2076	3.151E+04	2.523E+07	1.695E+03	0.000E+00	0.000E+00	0.000E+00
2077	3.027E+04	2.424E+07	1.629E+03	0.000E+00	0.000E+00	0.000E+00
2078	2.909E+04	2.329E+07	1.565E+03	0.000E+00	0.000E+00	0.000E+00
2079	2.794E+04	2.238E+07	1.503E+03	0.000E+00	0.000E+00	0.000E+00
2080	2.685E+04	2.150E+07	1.445E+03	0.000E+00	0.000E+00	0.000E+00
2081	2.580E+04	2.066E+07	1.388E+03	0.000E+00	0.000E+00	0.000E+00
2082	2.478E+04	1.985E+07	1.333E+03	0.000E+00	0.000E+00	0.000E+00
2083	2.381E+04	1.907E+07	1.281E+03	0.000E+00	0.000E+00	0.000E+00
2084	2.288E+04	1.832E+07	1.231E+03	0.000E+00	0.000E+00	0.000E+00
2085	2.198E+04	1.760E+07	1.183E+03	0.000E+00	0.000E+00	0.000E+00

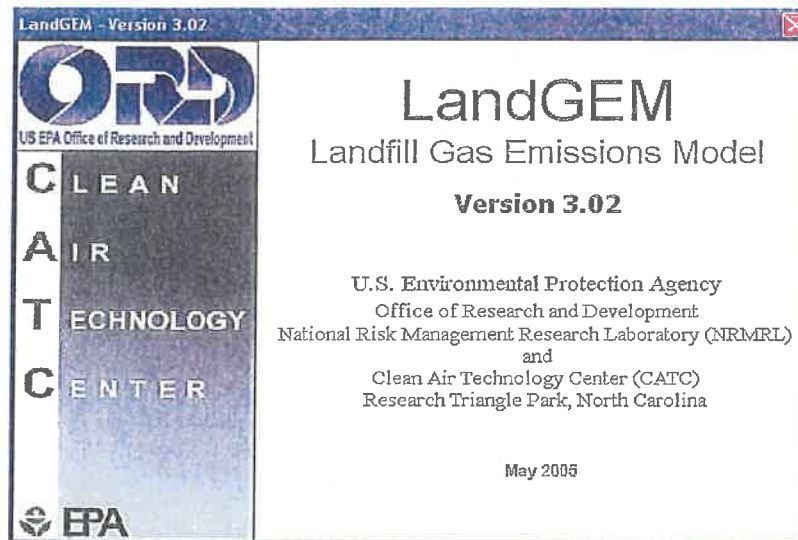
Results (Continued)

Year	Total landfill gas			(Mg/year)	(m ³ /year)	(av ft ³ /min)
	(Mg/year)	(m ³ /year)	(av ft ³ /min)			
2086	2.112E+04	1.691E+07	1.136E+03	0.000E+00	0.000E+00	0.000E+00
2087	2.029E+04	1.625E+07	1.092E+03	0.000E+00	0.000E+00	0.000E+00
2088	1.950E+04	1.561E+07	1.049E+03	0.000E+00	0.000E+00	0.000E+00
2089	1.873E+04	1.500E+07	1.008E+03	0.000E+00	0.000E+00	0.000E+00
2090	1.800E+04	1.441E+07	9.683E+02	0.000E+00	0.000E+00	0.000E+00
2091	1.729E+04	1.385E+07	9.303E+02	0.000E+00	0.000E+00	0.000E+00
2092	1.661E+04	1.330E+07	8.939E+02	0.000E+00	0.000E+00	0.000E+00
2093	1.596E+04	1.278E+07	8.588E+02	0.000E+00	0.000E+00	0.000E+00
2094	1.534E+04	1.228E+07	8.251E+02	0.000E+00	0.000E+00	0.000E+00
2095	1.474E+04	1.180E+07	7.928E+02	0.000E+00	0.000E+00	0.000E+00
2096	1.416E+04	1.134E+07	7.617E+02	0.000E+00	0.000E+00	0.000E+00
2097	1.360E+04	1.089E+07	7.318E+02	0.000E+00	0.000E+00	0.000E+00
2098	1.307E+04	1.046E+07	7.031E+02	0.000E+00	0.000E+00	0.000E+00
2099	1.256E+04	1.005E+07	6.756E+02	0.000E+00	0.000E+00	0.000E+00
2100	1.206E+04	9.660E+06	6.491E+02	0.000E+00	0.000E+00	0.000E+00
2101	1.159E+04	9.282E+06	6.236E+02	0.000E+00	0.000E+00	0.000E+00
2102	1.114E+04	8.918E+06	5.992E+02	0.000E+00	0.000E+00	0.000E+00
2103	1.070E+04	8.568E+06	5.757E+02	0.000E+00	0.000E+00	0.000E+00
2104	1.028E+04	8.232E+06	5.531E+02	0.000E+00	0.000E+00	0.000E+00
2105	9.877E+03	7.909E+06	5.314E+02	0.000E+00	0.000E+00	0.000E+00
2106	9.490E+03	7.599E+06	5.106E+02	0.000E+00	0.000E+00	0.000E+00
2107	9.118E+03	7.301E+06	4.906E+02	0.000E+00	0.000E+00	0.000E+00
2108	8.760E+03	7.015E+06	4.713E+02	0.000E+00	0.000E+00	0.000E+00
2109	8.417E+03	6.740E+06	4.528E+02	0.000E+00	0.000E+00	0.000E+00
2110	8.087E+03	6.475E+06	4.351E+02	0.000E+00	0.000E+00	0.000E+00
2111	7.770E+03	6.222E+06	4.180E+02	0.000E+00	0.000E+00	0.000E+00
2112	7.465E+03	5.978E+06	4.016E+02	0.000E+00	0.000E+00	0.000E+00
2113	7.172E+03	5.743E+06	3.859E+02	0.000E+00	0.000E+00	0.000E+00
2114	6.891E+03	5.518E+06	3.708E+02	0.000E+00	0.000E+00	0.000E+00
2115	6.621E+03	5.302E+06	3.562E+02	0.000E+00	0.000E+00	0.000E+00
2116	6.361E+03	5.094E+06	3.423E+02	0.000E+00	0.000E+00	0.000E+00
2117	6.112E+03	4.894E+06	3.288E+02	0.000E+00	0.000E+00	0.000E+00
2118	5.872E+03	4.702E+06	3.159E+02	0.000E+00	0.000E+00	0.000E+00
2119	5.642E+03	4.518E+06	3.035E+02	0.000E+00	0.000E+00	0.000E+00
2120	5.421E+03	4.341E+06	2.916E+02	0.000E+00	0.000E+00	0.000E+00
2121	5.208E+03	4.170E+06	2.802E+02	0.000E+00	0.000E+00	0.000E+00
2122	5.004E+03	4.007E+06	2.692E+02	0.000E+00	0.000E+00	0.000E+00
2123	4.808E+03	3.850E+06	2.587E+02	0.000E+00	0.000E+00	0.000E+00
2124	4.619E+03	3.699E+06	2.485E+02	0.000E+00	0.000E+00	0.000E+00
2125	4.438E+03	3.554E+06	2.388E+02	0.000E+00	0.000E+00	0.000E+00

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Summary Report

Landfill Name or Identifier: Lorain County Landfill | 0701 - DFFO

Date: Wednesday, February 24, 2010

Description/Comments:

Annual waste intake reflect information provided by Lorain County Landfill personnel and OEPA Solid Waste Facility Data Reports. Tonnages include a summary of General, Industrial and Exempt waste masses. Pollutant Parameters (pages 4 and 5) not calculated in this report.

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^n \sum_{j=0.1}^1 k L_o \left(\frac{M_i}{10} \right) e^{-k t_{ij}}$$

Where,

Q_{CH_4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mq)

M_i = mass of waste accepted in the i^{th} year (Mq)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (decimal years, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at <http://www.epa.gov/ttnatw01/landfill/landfillpg.html>.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for conventional landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review**LANDFILL CHARACTERISTICS**

Landfill Open Year	1974	
Landfill Closure Year (with 80-year limit)	1984	
Actual Closure Year (without limit)	1984	
Have Model Calculate Closure Year?	No	
Waste Design Capacity	4,305,400	short tons

MODEL PARAMETERS

Methane Generation Rate, k	0.070	year ⁻¹
Potential Methane Generation Capacity, L ₀	140	m ³ /Mg
NMOC Concentration	600	ppmv as hexane
Methane Content	50	% by volume

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1: Total landfill gas
 Gas / Pollutant #2:
 Gas / Pollutant #3:
 Gas / Pollutant #4:

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
1974	355,818	391,400	0	0
1975	355,818	391,400	355,818	391,400
1976	355,818	391,400	711,636	782,800
1977	355,818	391,400	1,067,455	1,174,200
1978	355,818	391,400	1,423,273	1,565,600
1979	355,818	391,400	1,779,091	1,957,000
1980	355,818	391,400	2,134,909	2,348,400
1981	355,818	391,400	2,490,727	2,739,800
1982	355,818	391,400	2,846,545	3,131,200
1983	355,818	391,400	3,202,364	3,522,600
1984	355,818	391,400	3,558,182	3,914,000
1985	0	0	3,914,000	4,305,400
1986	0	0	3,914,000	4,305,400
1987	0	0	3,914,000	4,305,400
1988	0	0	3,914,000	4,305,400
1989	0	0	3,914,000	4,305,400
1990	0	0	3,914,000	4,305,400
1991	0	0	3,914,000	4,305,400
1992	0	0	3,914,000	4,305,400
1993	0	0	3,914,000	4,305,400
1994	0	0	3,914,000	4,305,400
1995	0	0	3,914,000	4,305,400
1996	0	0	3,914,000	4,305,400
1997	0	0	3,914,000	4,305,400
1998	0	0	3,914,000	4,305,400
1999	0	0	3,914,000	4,305,400
2000	0	0	3,914,000	4,305,400
2001	0	0	3,914,000	4,305,400
2002	0	0	3,914,000	4,305,400
2003	0	0	3,914,000	4,305,400
2004	0	0	3,914,000	4,305,400
2005	0	0	3,914,000	4,305,400
2006	0	0	3,914,000	4,305,400
2007	0	0	3,914,000	4,305,400
2008	0	0	3,914,000	4,305,400
2009	0	0	3,914,000	4,305,400
2010	0	0	3,914,000	4,305,400
2011	0	0	3,914,000	4,305,400
2012	0	0	3,914,000	4,305,400
2013	0	0	3,914,000	4,305,400

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2014	0	0	3,914,000	4,305,400
2015	0	0	3,914,000	4,305,400
2016	0	0	3,914,000	4,305,400
2017	0	0	3,914,000	4,305,400
2018	0	0	3,914,000	4,305,400
2019	0	0	3,914,000	4,305,400
2020	0	0	3,914,000	4,305,400
2021	0	0	3,914,000	4,305,400
2022	0	0	3,914,000	4,305,400
2023	0	0	3,914,000	4,305,400
2024	0	0	3,914,000	4,305,400
2025	0	0	3,914,000	4,305,400
2026	0	0	3,914,000	4,305,400
2027	0	0	3,914,000	4,305,400
2028	0	0	3,914,000	4,305,400
2029	0	0	3,914,000	4,305,400
2030	0	0	3,914,000	4,305,400
2031	0	0	3,914,000	4,305,400
2032	0	0	3,914,000	4,305,400
2033	0	0	3,914,000	4,305,400
2034	0	0	3,914,000	4,305,400
2035	0	0	3,914,000	4,305,400
2036	0	0	3,914,000	4,305,400
2037	0	0	3,914,000	4,305,400
2038	0	0	3,914,000	4,305,400
2039	0	0	3,914,000	4,305,400
2040	0	0	3,914,000	4,305,400
2041	0	0	3,914,000	4,305,400
2042	0	0	3,914,000	4,305,400
2043	0	0	3,914,000	4,305,400
2044	0	0	3,914,000	4,305,400
2045	0	0	3,914,000	4,305,400
2046	0	0	3,914,000	4,305,400
2047	0	0	3,914,000	4,305,400
2048	0	0	3,914,000	4,305,400
2049	0	0	3,914,000	4,305,400
2050	0	0	3,914,000	4,305,400
2051	0	0	3,914,000	4,305,400
2052	0	0	3,914,000	4,305,400
2053	0	0	3,914,000	4,305,400

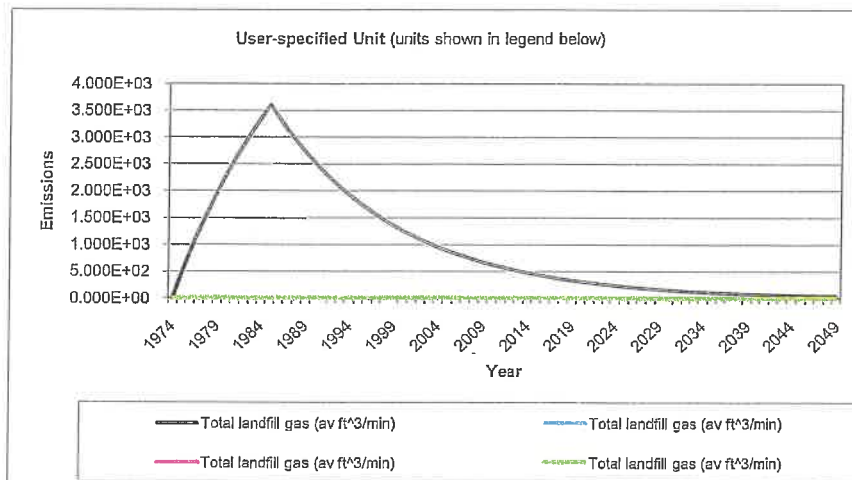
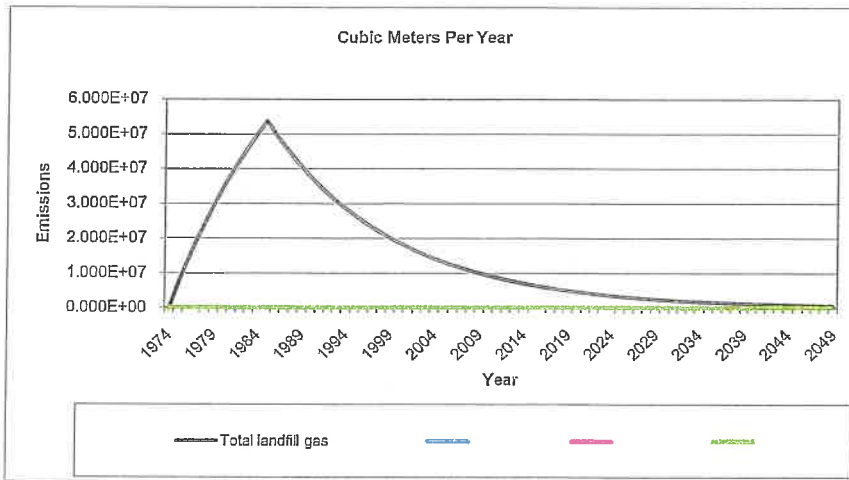
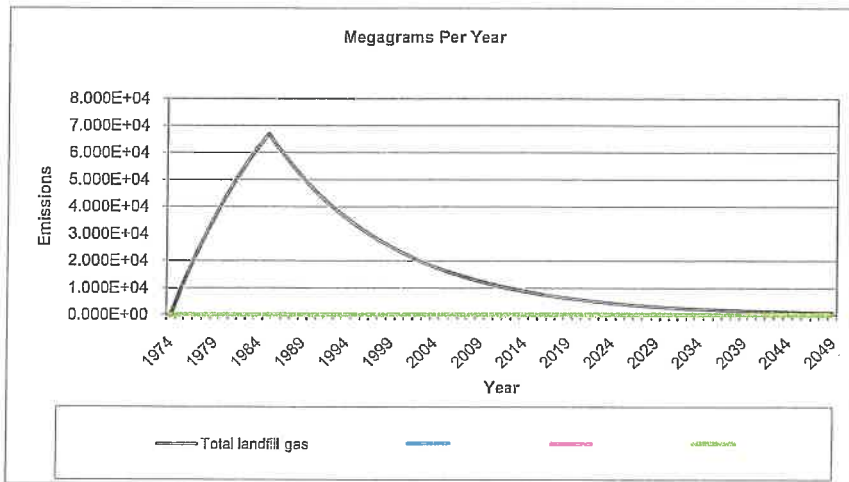
Pollutant Parameters**Gas / Pollutant Default Parameters:****User-specified Pollutant Parameters:**

	Compound	Concentration (ppmv)	Molecular Weight	Concentration (ppmv)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2- Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

Pollutant Parameters (Continued)

<i>Gas / Pollutant Default Parameters:</i>				<i>User-specified Pollutant Parameters:</i>	
	Compound	Concentration (ppmv)	Molecular Weight	Concentration (ppmv)	Molecular Weight
Pollutants	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs



Results

Year	Total landfill gas			(Mg/year)	(m ³ /year)	(av ft ³ /min)
	(Mg/year)	(m ³ /year)	(av ft ³ /min)			
1974	0	0	0	0	0	0
1975	8.441E+03	6.759E+06	4.541E+02	0.000E+00	0.000E+00	0.000E+00
1976	1.631E+04	1.306E+07	8.776E+02	0.000E+00	0.000E+00	0.000E+00
1977	2.365E+04	1.894E+07	1.272E+03	0.000E+00	0.000E+00	0.000E+00
1978	3.049E+04	2.442E+07	1.641E+03	0.000E+00	0.000E+00	0.000E+00
1979	3.687E+04	2.952E+07	1.984E+03	0.000E+00	0.000E+00	0.000E+00
1980	4.282E+04	3.429E+07	2.304E+03	0.000E+00	0.000E+00	0.000E+00
1981	4.837E+04	3.873E+07	2.602E+03	0.000E+00	0.000E+00	0.000E+00
1982	5.354E+04	4.287E+07	2.880E+03	0.000E+00	0.000E+00	0.000E+00
1983	5.836E+04	4.673E+07	3.140E+03	0.000E+00	0.000E+00	0.000E+00
1984	6.285E+04	5.033E+07	3.382E+03	0.000E+00	0.000E+00	0.000E+00
1985	6.705E+04	5.369E+07	3.607E+03	0.000E+00	0.000E+00	0.000E+00
1986	6.251E+04	5.006E+07	3.363E+03	0.000E+00	0.000E+00	0.000E+00
1987	5.829E+04	4.667E+07	3.136E+03	0.000E+00	0.000E+00	0.000E+00
1988	5.435E+04	4.352E+07	2.924E+03	0.000E+00	0.000E+00	0.000E+00
1989	5.067E+04	4.058E+07	2.726E+03	0.000E+00	0.000E+00	0.000E+00
1990	4.725E+04	3.783E+07	2.542E+03	0.000E+00	0.000E+00	0.000E+00
1991	4.405E+04	3.527E+07	2.370E+03	0.000E+00	0.000E+00	0.000E+00
1992	4.107E+04	3.289E+07	2.210E+03	0.000E+00	0.000E+00	0.000E+00
1993	3.830E+04	3.067E+07	2.060E+03	0.000E+00	0.000E+00	0.000E+00
1994	3.571E+04	2.859E+07	1.921E+03	0.000E+00	0.000E+00	0.000E+00
1995	3.329E+04	2.666E+07	1.791E+03	0.000E+00	0.000E+00	0.000E+00
1996	3.104E+04	2.486E+07	1.670E+03	0.000E+00	0.000E+00	0.000E+00
1997	2.894E+04	2.318E+07	1.557E+03	0.000E+00	0.000E+00	0.000E+00
1998	2.699E+04	2.161E+07	1.452E+03	0.000E+00	0.000E+00	0.000E+00
1999	2.516E+04	2.015E+07	1.354E+03	0.000E+00	0.000E+00	0.000E+00
2000	2.346E+04	1.879E+07	1.262E+03	0.000E+00	0.000E+00	0.000E+00
2001	2.188E+04	1.752E+07	1.177E+03	0.000E+00	0.000E+00	0.000E+00
2002	2.040E+04	1.633E+07	1.097E+03	0.000E+00	0.000E+00	0.000E+00
2003	1.902E+04	1.523E+07	1.023E+03	0.000E+00	0.000E+00	0.000E+00
2004	1.773E+04	1.420E+07	9.540E+02	0.000E+00	0.000E+00	0.000E+00
2005	1.653E+04	1.324E+07	8.895E+02	0.000E+00	0.000E+00	0.000E+00
2006	1.542E+04	1.234E+07	8.294E+02	0.000E+00	0.000E+00	0.000E+00
2007	1.437E+04	1.151E+07	7.733E+02	0.000E+00	0.000E+00	0.000E+00
2008	1.340E+04	1.073E+07	7.210E+02	0.000E+00	0.000E+00	0.000E+00
2009	1.250E+04	1.001E+07	6.723E+02	0.000E+00	0.000E+00	0.000E+00
2010	1.165E+04	9.329E+06	6.268E+02	0.000E+00	0.000E+00	0.000E+00
2011	1.086E+04	8.699E+06	5.845E+02	0.000E+00	0.000E+00	0.000E+00
2012	1.013E+04	8.111E+06	5.449E+02	0.000E+00	0.000E+00	0.000E+00
2013	9.444E+03	7.562E+06	5.081E+02	0.000E+00	0.000E+00	0.000E+00
2014	8.805E+03	7.051E+06	4.738E+02	0.000E+00	0.000E+00	0.000E+00
2015	8.210E+03	6.574E+06	4.417E+02	0.000E+00	0.000E+00	0.000E+00
2016	7.655E+03	6.130E+06	4.119E+02	0.000E+00	0.000E+00	0.000E+00
2017	7.138E+03	5.715E+06	3.840E+02	0.000E+00	0.000E+00	0.000E+00
2018	6.655E+03	5.329E+06	3.581E+02	0.000E+00	0.000E+00	0.000E+00
2019	6.205E+03	4.969E+06	3.339E+02	0.000E+00	0.000E+00	0.000E+00
2020	5.786E+03	4.633E+06	3.113E+02	0.000E+00	0.000E+00	0.000E+00
2021	5.394E+03	4.320E+06	2.902E+02	0.000E+00	0.000E+00	0.000E+00
2022	5.030E+03	4.028E+06	2.706E+02	0.000E+00	0.000E+00	0.000E+00
2023	4.690E+03	3.755E+06	2.523E+02	0.000E+00	0.000E+00	0.000E+00

Results (Continued)

Year	Total landfill gas			(Mg/year)	(m ³ /year)	(av ft ³ /min)
	(Mg/year)	(m ³ /year)	(av ft ³ /min)			
2024	4.373E+03	3.501E+06	2.353E+02	0.000E+00	0.000E+00	0.000E+00
2025	4.077E+03	3.265E+06	2.194E+02	0.000E+00	0.000E+00	0.000E+00
2026	3.801E+03	3.044E+06	2.045E+02	0.000E+00	0.000E+00	0.000E+00
2027	3.544E+03	2.838E+06	1.907E+02	0.000E+00	0.000E+00	0.000E+00
2028	3.305E+03	2.646E+06	1.778E+02	0.000E+00	0.000E+00	0.000E+00
2029	3.081E+03	2.467E+06	1.658E+02	0.000E+00	0.000E+00	0.000E+00
2030	2.873E+03	2.301E+06	1.546E+02	0.000E+00	0.000E+00	0.000E+00
2031	2.679E+03	2.145E+06	1.441E+02	0.000E+00	0.000E+00	0.000E+00
2032	2.498E+03	2.000E+06	1.344E+02	0.000E+00	0.000E+00	0.000E+00
2033	2.329E+03	1.866E+06	1.253E+02	0.000E+00	0.000E+00	0.000E+00
2034	2.171E+03	1.739E+06	1.168E+02	0.000E+00	0.000E+00	0.000E+00
2035	2.025E+03	1.621E+06	1.089E+02	0.000E+00	0.000E+00	0.000E+00
2036	1.888E+03	1.512E+06	1.016E+02	0.000E+00	0.000E+00	0.000E+00
2037	1.760E+03	1.409E+06	9.470E+01	0.000E+00	0.000E+00	0.000E+00
2038	1.641E+03	1.314E+06	8.830E+01	0.000E+00	0.000E+00	0.000E+00
2039	1.530E+03	1.225E+06	8.233E+01	0.000E+00	0.000E+00	0.000E+00
2040	1.427E+03	1.142E+06	7.676E+01	0.000E+00	0.000E+00	0.000E+00
2041	1.330E+03	1.065E+06	7.157E+01	0.000E+00	0.000E+00	0.000E+00
2042	1.240E+03	9.932E+05	6.673E+01	0.000E+00	0.000E+00	0.000E+00
2043	1.156E+03	9.260E+05	6.222E+01	0.000E+00	0.000E+00	0.000E+00
2044	1.078E+03	8.634E+05	5.801E+01	0.000E+00	0.000E+00	0.000E+00
2045	1.005E+03	8.051E+05	5.409E+01	0.000E+00	0.000E+00	0.000E+00
2046	9.374E+02	7.506E+05	5.044E+01	0.000E+00	0.000E+00	0.000E+00
2047	8.740E+02	6.999E+05	4.703E+01	0.000E+00	0.000E+00	0.000E+00
2048	8.150E+02	6.526E+05	4.385E+01	0.000E+00	0.000E+00	0.000E+00
2049	7.599E+02	6.085E+05	4.088E+01	0.000E+00	0.000E+00	0.000E+00
2050	7.085E+02	5.673E+05	3.812E+01	0.000E+00	0.000E+00	0.000E+00
2051	6.608E+02	5.290E+05	3.554E+01	0.000E+00	0.000E+00	0.000E+00
2052	6.159E+02	4.932E+05	3.314E+01	0.000E+00	0.000E+00	0.000E+00
2053	5.743E+02	4.599E+05	3.090E+01	0.000E+00	0.000E+00	0.000E+00
2054	5.355E+02	4.288E+05	2.881E+01	0.000E+00	0.000E+00	0.000E+00
2055	4.993E+02	3.998E+05	2.686E+01	0.000E+00	0.000E+00	0.000E+00
2056	4.655E+02	3.728E+05	2.505E+01	0.000E+00	0.000E+00	0.000E+00
2057	4.340E+02	3.476E+05	2.335E+01	0.000E+00	0.000E+00	0.000E+00
2058	4.047E+02	3.241E+05	2.177E+01	0.000E+00	0.000E+00	0.000E+00
2059	3.773E+02	3.022E+05	2.030E+01	0.000E+00	0.000E+00	0.000E+00
2060	3.518E+02	2.817E+05	1.893E+01	0.000E+00	0.000E+00	0.000E+00
2061	3.280E+02	2.627E+05	1.765E+01	0.000E+00	0.000E+00	0.000E+00
2062	3.059E+02	2.449E+05	1.646E+01	0.000E+00	0.000E+00	0.000E+00
2063	2.852E+02	2.284E+05	1.534E+01	0.000E+00	0.000E+00	0.000E+00
2064	2.659E+02	2.129E+05	1.431E+01	0.000E+00	0.000E+00	0.000E+00
2065	2.479E+02	1.985E+05	1.334E+01	0.000E+00	0.000E+00	0.000E+00
2066	2.312E+02	1.851E+05	1.244E+01	0.000E+00	0.000E+00	0.000E+00
2067	2.155E+02	1.726E+05	1.160E+01	0.000E+00	0.000E+00	0.000E+00
2068	2.010E+02	1.609E+05	1.081E+01	0.000E+00	0.000E+00	0.000E+00
2069	1.874E+02	1.500E+05	1.008E+01	0.000E+00	0.000E+00	0.000E+00
2070	1.747E+02	1.399E+05	9.400E+00	0.000E+00	0.000E+00	0.000E+00
2071	1.629E+02	1.304E+05	8.764E+00	0.000E+00	0.000E+00	0.000E+00
2072	1.519E+02	1.216E+05	8.172E+00	0.000E+00	0.000E+00	0.000E+00
2073	1.416E+02	1.134E+05	7.619E+00	0.000E+00	0.000E+00	0.000E+00
2074	1.320E+02	1.057E+05	7.104E+00	0.000E+00	0.000E+00	0.000E+00

Results (Continued)

Year	Total landfill gas			(Mg/year)	(m ³ /year)	(av ft ³ /min)
	(Mg/year)	(m ³ /year)	(av ft ³ /min)			
2075	1.231E+02	9.859E+04	6.624E+00	0.000E+00	0.000E+00	0.000E+00
2076	1.148E+02	9.192E+04	6.176E+00	0.000E+00	0.000E+00	0.000E+00
2077	1.070E+02	8.571E+04	5.759E+00	0.000E+00	0.000E+00	0.000E+00
2078	9.980E+01	7.991E+04	5.369E+00	0.000E+00	0.000E+00	0.000E+00
2079	9.305E+01	7.451E+04	5.006E+00	0.000E+00	0.000E+00	0.000E+00
2080	8.676E+01	6.947E+04	4.668E+00	0.000E+00	0.000E+00	0.000E+00
2081	8.089E+01	6.478E+04	4.352E+00	0.000E+00	0.000E+00	0.000E+00
2082	7.542E+01	6.040E+04	4.058E+00	0.000E+00	0.000E+00	0.000E+00
2083	7.033E+01	5.631E+04	3.784E+00	0.000E+00	0.000E+00	0.000E+00
2084	6.557E+01	5.251E+04	3.528E+00	0.000E+00	0.000E+00	0.000E+00
2085	6.114E+01	4.896E+04	3.289E+00	0.000E+00	0.000E+00	0.000E+00
2086	5.700E+01	4.565E+04	3.067E+00	0.000E+00	0.000E+00	0.000E+00
2087	5.315E+01	4.256E+04	2.860E+00	0.000E+00	0.000E+00	0.000E+00
2088	4.956E+01	3.968E+04	2.666E+00	0.000E+00	0.000E+00	0.000E+00
2089	4.621E+01	3.700E+04	2.486E+00	0.000E+00	0.000E+00	0.000E+00
2090	4.308E+01	3.450E+04	2.318E+00	0.000E+00	0.000E+00	0.000E+00
2091	4.017E+01	3.217E+04	2.161E+00	0.000E+00	0.000E+00	0.000E+00
2092	3.745E+01	2.999E+04	2.015E+00	0.000E+00	0.000E+00	0.000E+00
2093	3.492E+01	2.796E+04	1.879E+00	0.000E+00	0.000E+00	0.000E+00
2094	3.256E+01	2.607E+04	1.752E+00	0.000E+00	0.000E+00	0.000E+00
2095	3.036E+01	2.431E+04	1.633E+00	0.000E+00	0.000E+00	0.000E+00
2096	2.831E+01	2.267E+04	1.523E+00	0.000E+00	0.000E+00	0.000E+00
2097	2.639E+01	2.113E+04	1.420E+00	0.000E+00	0.000E+00	0.000E+00
2098	2.461E+01	1.971E+04	1.324E+00	0.000E+00	0.000E+00	0.000E+00
2099	2.295E+01	1.837E+04	1.235E+00	0.000E+00	0.000E+00	0.000E+00
2100	2.139E+01	1.713E+04	1.151E+00	0.000E+00	0.000E+00	0.000E+00
2101	1.995E+01	1.597E+04	1.073E+00	0.000E+00	0.000E+00	0.000E+00
2102	1.860E+01	1.489E+04	1.001E+00	0.000E+00	0.000E+00	0.000E+00
2103	1.734E+01	1.389E+04	9.330E-01	0.000E+00	0.000E+00	0.000E+00
2104	1.617E+01	1.295E+04	8.700E-01	0.000E+00	0.000E+00	0.000E+00
2105	1.508E+01	1.207E+04	8.111E-01	0.000E+00	0.000E+00	0.000E+00
2106	1.406E+01	1.126E+04	7.563E-01	0.000E+00	0.000E+00	0.000E+00
2107	1.311E+01	1.050E+04	7.052E-01	0.000E+00	0.000E+00	0.000E+00
2108	1.222E+01	9.786E+03	6.575E-01	0.000E+00	0.000E+00	0.000E+00
2109	1.139E+01	9.124E+03	6.131E-01	0.000E+00	0.000E+00	0.000E+00
2110	1.062E+01	8.507E+03	5.716E-01	0.000E+00	0.000E+00	0.000E+00
2111	9.906E+00	7.932E+03	5.330E-01	0.000E+00	0.000E+00	0.000E+00
2112	9.236E+00	7.396E+03	4.959E-01	0.000E+00	0.000E+00	0.000E+00
2113	8.612E+00	6.896E+03	4.633E-01	0.000E+00	0.000E+00	0.000E+00
2114	8.030E+00	6.430E+03	4.320E-01	0.000E+00	0.000E+00	0.000E+00

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Summary Report

Landfill Name or Identifier: Lorain County Landfill II - DFFO

Date: Wednesday, July 21, 2010

Description/Comments:

Annual waste intake reflect information provided by Lorain County Landfill personnel and OEPA Solid Waste Facility Data Reports. Tonnages include a summary of General, Industrial and Exempt waste masses. Pollutant Parameters (pages 4 and 5) not calculated in this report. The 2009 Annual Report noted a balance of 22,146,441 tons remaining for Waste Placement as of 12/31/2009.

About LandGEM:

First-Order Decomposition Rate Equation:

$$Q_{CH_4} = \sum_{i=1}^n \sum_{j=0.1}^1 k L_o \left(\frac{M_i}{10} \right) e^{-k t_{ij}}$$

Where,

Q_{CH_4} = annual methane generation in the year of the calculation ($m^3/year$)

i = 1-year time increment

n = (year of the calculation) - (initial year of waste acceptance)

j = 0.1-year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Ma)

M_i = mass of waste accepted in the i^{th} year (Ma)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (decimal years, e.g., 3.2 years)

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in municipal solid waste (MSW) landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, Clean Air Act (CAA) regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at <http://www.epa.gov/ttnatw01/landfill/landfig.html>.

LandGEM is considered a screening tool — the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for conventional landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates.

Input Review**LANDFILL CHARACTERISTICS**

Landfill Open Year	1985	
Landfill Closure Year (with 80-year limit)	2032	
Actual Closure Year (without limit)	2032	
Have Model Calculate Closure Year?	No	
Waste Design Capacity	40,765,078	short tons

MODEL PARAMETERS

Methane Generation Rate, k	0.070	year ⁻¹
Potential Methane Generation Capacity, L ₀	140	m ³ /Mg
NMOC Concentration	600	ppmv as hexane
Methane Content	50	% by volume

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	Total landfill gas
Gas / Pollutant #2:	
Gas / Pollutant #3:	
Gas / Pollutant #4:	

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
1985	363,727	400,100	0	0
1986	450,599	495,659	363,727	400,100
1987	449,219	494,141	814,326	895,759
1988	445,291	489,820	1,263,545	1,389,900
1989	446,389	491,028	1,708,836	1,879,720
1990	545,755	600,330	2,155,225	2,370,748
1991	544,523	598,975	2,700,980	2,971,078
1992	578,605	636,465	3,245,503	3,570,053
1993	535,881	589,469	3,824,107	4,206,518
1994	511,785	562,963	4,359,988	4,795,987
1995	524,694	577,163	4,871,773	5,358,950
1996	554,737	610,211	5,396,466	5,936,113
1997	563,633	619,996	5,951,204	6,546,324
1998	556,227	611,850	6,514,836	7,166,320
1999	607,232	667,955	7,071,064	7,778,170
2000	631,374	694,511	7,678,295	8,446,125
2001	732,460	805,706	8,309,669	9,140,635
2002	831,058	914,164	9,042,129	9,946,342
2003	887,818	976,600	9,873,187	10,860,506
2004	974,053	1,071,458	10,761,005	11,837,106
2005	1,025,825	1,128,407	11,735,058	12,908,564
2006	1,113,575	1,224,932	12,760,883	14,036,971
2007	1,018,644	1,120,508	13,874,457	15,261,903
2008	1,124,251	1,236,676	14,893,101	16,382,411
2009	908,682	999,550	16,017,352	17,619,087
2010	906,897	997,587	16,926,034	18,618,637
2011	906,897	997,587	17,832,931	19,616,224
2012	906,897	997,587	18,739,828	20,613,811
2013	906,897	997,587	19,646,725	21,611,398
2014	906,897	997,587	20,553,623	22,608,985
2015	906,897	997,587	21,460,520	23,606,572
2016	906,897	997,587	22,367,417	24,604,159
2017	906,897	997,587	23,274,315	25,601,746
2018	906,897	997,587	24,181,212	26,599,333
2019	906,897	997,587	25,088,109	27,596,920
2020	906,897	997,587	25,995,006	28,594,507
2021	906,897	997,587	26,901,904	29,592,094
2022	906,897	997,587	27,808,801	30,589,681
2023	906,897	997,587	28,715,698	31,587,268
2024	906,897	997,587	29,622,595	32,584,855

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2025	906,897	997,587	30,529,493	33,582,442
2026	906,897	997,587	31,436,390	34,580,029
2027	906,897	997,587	32,343,287	35,577,616
2028	906,897	997,587	33,250,185	36,575,203
2029	906,897	997,587	34,157,082	37,572,790
2030	906,897	997,587	35,063,979	38,570,377
2031	906,897	997,587	35,970,876	39,567,964
2032	181,388	199,527	36,877,774	40,565,551
2033	0	0	37,059,162	40,765,078
2034	0	0	37,059,162	40,765,078
2035	0	0	37,059,162	40,765,078
2036	0	0	37,059,162	40,765,078
2037	0	0	37,059,162	40,765,078
2038	0	0	37,059,162	40,765,078
2039	0	0	37,059,162	40,765,078
2040	0	0	37,059,162	40,765,078
2041	0	0	37,059,162	40,765,078
2042	0	0	37,059,162	40,765,078
2043	0	0	37,059,162	40,765,078
2044	0	0	37,059,162	40,765,078
2045	0	0	37,059,162	40,765,078
2046	0	0	37,059,162	40,765,078
2047	0	0	37,059,162	40,765,078
2048	0	0	37,059,162	40,765,078
2049	0	0	37,059,162	40,765,078
2050	0	0	37,059,162	40,765,078
2051	0	0	37,059,162	40,765,078
2052	0	0	37,059,162	40,765,078
2053	0	0	37,059,162	40,765,078
2054	0	0	37,059,162	40,765,078
2055	0	0	37,059,162	40,765,078
2056	0	0	37,059,162	40,765,078
2057	0	0	37,059,162	40,765,078
2058	0	0	37,059,162	40,765,078
2059	0	0	37,059,162	40,765,078
2060	0	0	37,059,162	40,765,078
2061	0	0	37,059,162	40,765,078
2062	0	0	37,059,162	40,765,078
2063	0	0	37,059,162	40,765,078
2064	0	0	37,059,162	40,765,078

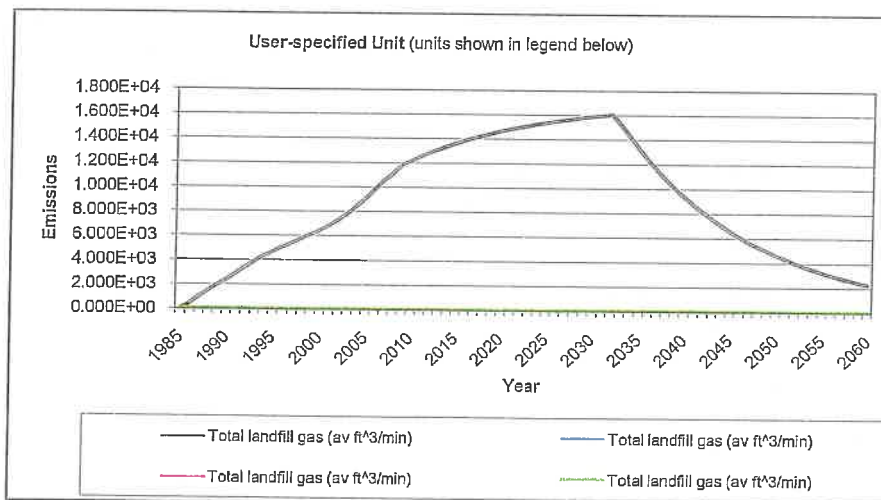
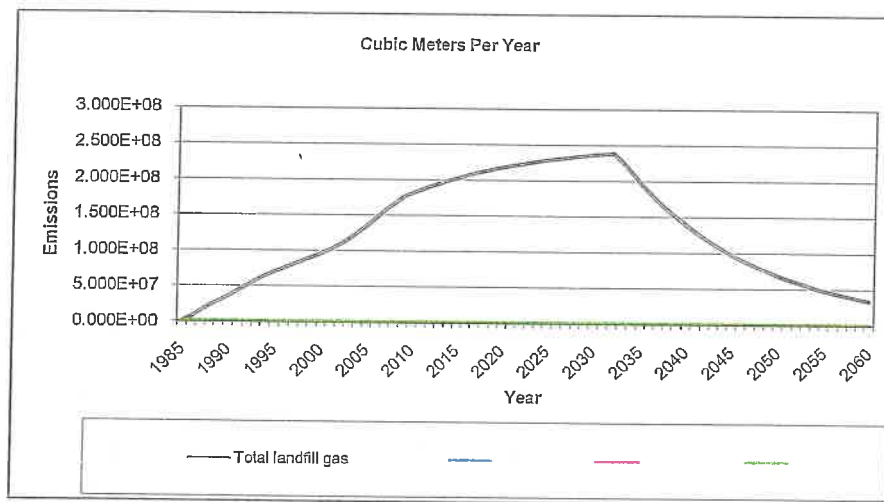
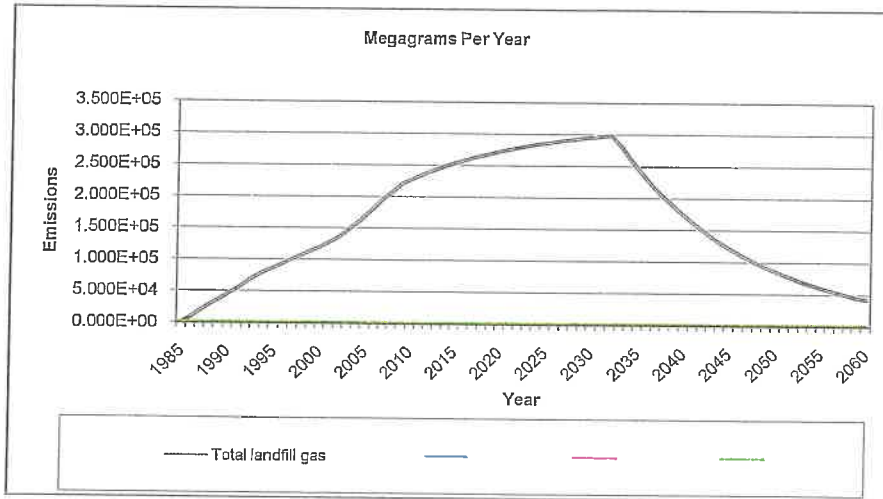
Pollutant Parameters**Gas / Pollutant Default Parameters:****User-specified Pollutant Parameters:**

	Compound	Gas / Pollutant Default Parameters:		User-specified Pollutant Parameters:	
		Concentration (ppmv)	Molecular Weight	Concentration (ppmv)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl chloroform) - HAP	0.48	133.41		
	1,1,2,2-Tetrachloroethane - HAP/VOC	1.1	167.85		
	1,1-Dichloroethane (ethylidene dichloride) - HAP/VOC	2.4	98.97		
	1,1-Dichloroethene (vinylidene chloride) - HAP/VOC	0.20	96.94		
	1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	0.41	98.96		
	1,2-Dichloropropane (propylene dichloride) - HAP/VOC	0.18	112.99		
	2-Propanol (isopropyl alcohol) - VOC	50	60.11		
	Acetone	7.0	58.08		
	Acrylonitrile - HAP/VOC	6.3	53.06		
	Benzene - No or Unknown Co-disposal - HAP/VOC	1.9	78.11		
	Benzene - Co-disposal - HAP/VOC	11	78.11		
	Bromodichloromethane - VOC	3.1	163.83		
	Butane - VOC	5.0	58.12		
	Carbon disulfide - HAP/VOC	0.58	76.13		
	Carbon monoxide	140	28.01		
	Carbon tetrachloride - HAP/VOC	4.0E-03	153.84		
	Carbonyl sulfide - HAP/VOC	0.49	60.07		
	Chlorobenzene - HAP/VOC	0.25	112.56		
	Chlorodifluoromethane	1.3	86.47		
	Chloroethane (ethyl chloride) - HAP/VOC	1.3	64.52		
	Chloroform - HAP/VOC	0.03	119.39		
	Chloromethane - VOC	1.2	50.49		
	Dichlorobenzene - (HAP for para isomer/VOC)	0.21	147		
	Dichlorodifluoromethane	16	120.91		
	Dichlorofluoromethane - VOC	2.6	102.92		
	Dichloromethane (methylene chloride) - HAP	14	84.94		
	Dimethyl sulfide (methyl sulfide) - VOC	7.8	62.13		
	Ethane	890	30.07		
	Ethanol - VOC	27	46.08		

Pollutant Parameters (Continued)

Gas / Pollutant Default Parameters:				User-specified Pollutant Parameters:	
Pollutants	Compound	Concentration (ppmv)	Molecular Weight	Concentration (ppmv)	Molecular Weight
	Ethyl mercaptan (ethanethiol) - VOC	2.3	62.13		
	Ethylbenzene - HAP/VOC	4.6	106.16		
	Ethylene dibromide - HAP/VOC	1.0E-03	187.88		
	Fluorotrichloromethane - VOC	0.76	137.38		
	Hexane - HAP/VOC	6.6	86.18		
	Hydrogen sulfide	36	34.08		
	Mercury (total) - HAP	2.9E-04	200.61		
	Methyl ethyl ketone - HAP/VOC	7.1	72.11		
	Methyl isobutyl ketone - HAP/VOC	1.9	100.16		
	Methyl mercaptan - VOC	2.5	48.11		
	Pentane - VOC	3.3	72.15		
	Perchloroethylene (tetrachloroethylene) - HAP	3.7	165.83		
	Propane - VOC	11	44.09		
	t-1,2-Dichloroethene - VOC	2.8	96.94		
	Toluene - No or Unknown Co-disposal - HAP/VOC	39	92.13		
	Toluene - Co-disposal - HAP/VOC	170	92.13		
	Trichloroethylene (trichloroethene) - HAP/VOC	2.8	131.40		
	Vinyl chloride - HAP/VOC	7.3	62.50		
	Xylenes - HAP/VOC	12	106.16		

Graphs



Results

Year	Total landfill gas					
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
1985	0	0	0	0	0	0
1986	8.629E+03	6.909E+06	4.642E+02	0.000E+00	0.000E+00	0.000E+00
1987	1.873E+04	1.500E+07	1.008E+03	0.000E+00	0.000E+00	0.000E+00
1988	2.812E+04	2.252E+07	1.513E+03	0.000E+00	0.000E+00	0.000E+00
1989	3.679E+04	2.946E+07	1.979E+03	0.000E+00	0.000E+00	0.000E+00
1990	4.489E+04	3.595E+07	2.415E+03	0.000E+00	0.000E+00	0.000E+00
1991	5.480E+04	4.388E+07	2.948E+03	0.000E+00	0.000E+00	0.000E+00
1992	6.401E+04	5.126E+07	3.444E+03	0.000E+00	0.000E+00	0.000E+00
1993	7.341E+04	5.879E+07	3.950E+03	0.000E+00	0.000E+00	0.000E+00
1994	8.116E+04	6.499E+07	4.367E+03	0.000E+00	0.000E+00	0.000E+00
1995	8.782E+04	7.032E+07	4.725E+03	0.000E+00	0.000E+00	0.000E+00
1996	9.433E+04	7.553E+07	5.075E+03	0.000E+00	0.000E+00	0.000E+00
1997	1.011E+05	8.096E+07	5.440E+03	0.000E+00	0.000E+00	0.000E+00
1998	1.076E+05	8.620E+07	5.792E+03	0.000E+00	0.000E+00	0.000E+00
1999	1.136E+05	9.094E+07	6.110E+03	0.000E+00	0.000E+00	0.000E+00
2000	1.203E+05	9.632E+07	6.472E+03	0.000E+00	0.000E+00	0.000E+00
2001	1.271E+05	1.018E+08	6.840E+03	0.000E+00	0.000E+00	0.000E+00
2002	1.359E+05	1.088E+08	7.313E+03	0.000E+00	0.000E+00	0.000E+00
2003	1.464E+05	1.173E+08	7.879E+03	0.000E+00	0.000E+00	0.000E+00
2004	1.576E+05	1.262E+08	8.479E+03	0.000E+00	0.000E+00	0.000E+00
2005	1.701E+05	1.362E+08	9.149E+03	0.000E+00	0.000E+00	0.000E+00
2006	1.829E+05	1.465E+08	9.840E+03	0.000E+00	0.000E+00	0.000E+00
2007	1.969E+05	1.577E+08	1.060E+04	0.000E+00	0.000E+00	0.000E+00
2008	2.078E+05	1.664E+08	1.118E+04	0.000E+00	0.000E+00	0.000E+00
2009	2.204E+05	1.765E+08	1.186E+04	0.000E+00	0.000E+00	0.000E+00
2010	2.271E+05	1.818E+08	1.222E+04	0.000E+00	0.000E+00	0.000E+00
2011	2.332E+05	1.868E+08	1.255E+04	0.000E+00	0.000E+00	0.000E+00
2012	2.390E+05	1.914E+08	1.286E+04	0.000E+00	0.000E+00	0.000E+00
2013	2.443E+05	1.957E+08	1.315E+04	0.000E+00	0.000E+00	0.000E+00
2014	2.493E+05	1.997E+08	1.341E+04	0.000E+00	0.000E+00	0.000E+00
2015	2.540E+05	2.034E+08	1.367E+04	0.000E+00	0.000E+00	0.000E+00
2016	2.583E+05	2.069E+08	1.390E+04	0.000E+00	0.000E+00	0.000E+00
2017	2.624E+05	2.101E+08	1.412E+04	0.000E+00	0.000E+00	0.000E+00
2018	2.662E+05	2.131E+08	1.432E+04	0.000E+00	0.000E+00	0.000E+00
2019	2.697E+05	2.159E+08	1.451E+04	0.000E+00	0.000E+00	0.000E+00
2020	2.730E+05	2.186E+08	1.469E+04	0.000E+00	0.000E+00	0.000E+00
2021	2.760E+05	2.210E+08	1.485E+04	0.000E+00	0.000E+00	0.000E+00
2022	2.789E+05	2.233E+08	1.500E+04	0.000E+00	0.000E+00	0.000E+00
2023	2.815E+05	2.254E+08	1.515E+04	0.000E+00	0.000E+00	0.000E+00
2024	2.840E+05	2.274E+08	1.528E+04	0.000E+00	0.000E+00	0.000E+00
2025	2.863E+05	2.293E+08	1.541E+04	0.000E+00	0.000E+00	0.000E+00
2026	2.885E+05	2.310E+08	1.552E+04	0.000E+00	0.000E+00	0.000E+00
2027	2.905E+05	2.326E+08	1.563E+04	0.000E+00	0.000E+00	0.000E+00
2028	2.924E+05	2.341E+08	1.573E+04	0.000E+00	0.000E+00	0.000E+00
2029	2.941E+05	2.355E+08	1.582E+04	0.000E+00	0.000E+00	0.000E+00
2030	2.957E+05	2.368E+08	1.591E+04	0.000E+00	0.000E+00	0.000E+00
2031	2.973E+05	2.380E+08	1.599E+04	0.000E+00	0.000E+00	0.000E+00
2032	2.987E+05	2.392E+08	1.607E+04	0.000E+00	0.000E+00	0.000E+00
2033	2.828E+05	2.264E+08	1.522E+04	0.000E+00	0.000E+00	0.000E+00
2034	2.637E+05	2.111E+08	1.419E+04	0.000E+00	0.000E+00	0.000E+00

Results (Continued)

Year	Total landfill gas					
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2035	2.459E+05	1.969E+08	1.323E+04	0.000E+00	0.000E+00	0.000E+00
2036	2.292E+05	1.836E+08	1.233E+04	0.000E+00	0.000E+00	0.000E+00
2037	2.137E+05	1.711E+08	1.150E+04	0.000E+00	0.000E+00	0.000E+00
2038	1.993E+05	1.596E+08	1.072E+04	0.000E+00	0.000E+00	0.000E+00
2039	1.858E+05	1.488E+08	9.997E+03	0.000E+00	0.000E+00	0.000E+00
2040	1.732E+05	1.387E+08	9.321E+03	0.000E+00	0.000E+00	0.000E+00
2041	1.615E+05	1.293E+08	8.691E+03	0.000E+00	0.000E+00	0.000E+00
2042	1.506E+05	1.206E+08	8.103E+03	0.000E+00	0.000E+00	0.000E+00
2043	1.404E+05	1.125E+08	7.556E+03	0.000E+00	0.000E+00	0.000E+00
2044	1.309E+05	1.048E+08	7.045E+03	0.000E+00	0.000E+00	0.000E+00
2045	1.221E+05	9.776E+07	6.569E+03	0.000E+00	0.000E+00	0.000E+00
2046	1.138E+05	9.115E+07	6.124E+03	0.000E+00	0.000E+00	0.000E+00
2047	1.061E+05	8.499E+07	5.710E+03	0.000E+00	0.000E+00	0.000E+00
2048	9.896E+04	7.924E+07	5.324E+03	0.000E+00	0.000E+00	0.000E+00
2049	9.227E+04	7.389E+07	4.964E+03	0.000E+00	0.000E+00	0.000E+00
2050	8.603E+04	6.889E+07	4.629E+03	0.000E+00	0.000E+00	0.000E+00
2051	8.022E+04	6.423E+07	4.316E+03	0.000E+00	0.000E+00	0.000E+00
2052	7.479E+04	5.989E+07	4.024E+03	0.000E+00	0.000E+00	0.000E+00
2053	6.974E+04	5.584E+07	3.752E+03	0.000E+00	0.000E+00	0.000E+00
2054	6.502E+04	5.207E+07	3.498E+03	0.000E+00	0.000E+00	0.000E+00
2055	6.063E+04	4.855E+07	3.262E+03	0.000E+00	0.000E+00	0.000E+00
2056	5.653E+04	4.526E+07	3.041E+03	0.000E+00	0.000E+00	0.000E+00
2057	5.271E+04	4.220E+07	2.836E+03	0.000E+00	0.000E+00	0.000E+00
2058	4.914E+04	3.935E+07	2.644E+03	0.000E+00	0.000E+00	0.000E+00
2059	4.582E+04	3.669E+07	2.465E+03	0.000E+00	0.000E+00	0.000E+00
2060	4.272E+04	3.421E+07	2.299E+03	0.000E+00	0.000E+00	0.000E+00
2061	3.983E+04	3.190E+07	2.143E+03	0.000E+00	0.000E+00	0.000E+00
2062	3.714E+04	2.974E+07	1.998E+03	0.000E+00	0.000E+00	0.000E+00
2063	3.463E+04	2.773E+07	1.863E+03	0.000E+00	0.000E+00	0.000E+00
2064	3.229E+04	2.586E+07	1.737E+03	0.000E+00	0.000E+00	0.000E+00
2065	3.011E+04	2.411E+07	1.620E+03	0.000E+00	0.000E+00	0.000E+00
2066	2.807E+04	2.248E+07	1.510E+03	0.000E+00	0.000E+00	0.000E+00
2067	2.617E+04	2.096E+07	1.408E+03	0.000E+00	0.000E+00	0.000E+00
2068	2.440E+04	1.954E+07	1.313E+03	0.000E+00	0.000E+00	0.000E+00
2069	2.275E+04	1.822E+07	1.224E+03	0.000E+00	0.000E+00	0.000E+00
2070	2.122E+04	1.699E+07	1.141E+03	0.000E+00	0.000E+00	0.000E+00
2071	1.978E+04	1.584E+07	1.064E+03	0.000E+00	0.000E+00	0.000E+00
2072	1.844E+04	1.477E+07	9.923E+02	0.000E+00	0.000E+00	0.000E+00
2073	1.720E+04	1.377E+07	9.252E+02	0.000E+00	0.000E+00	0.000E+00
2074	1.603E+04	1.284E+07	8.627E+02	0.000E+00	0.000E+00	0.000E+00
2075	1.495E+04	1.197E+07	8.044E+02	0.000E+00	0.000E+00	0.000E+00
2076	1.394E+04	1.116E+07	7.500E+02	0.000E+00	0.000E+00	0.000E+00
2077	1.300E+04	1.041E+07	6.993E+02	0.000E+00	0.000E+00	0.000E+00
2078	1.212E+04	9.704E+06	6.520E+02	0.000E+00	0.000E+00	0.000E+00
2079	1.130E+04	9.048E+06	6.079E+02	0.000E+00	0.000E+00	0.000E+00
2080	1.054E+04	8.436E+06	5.668E+02	0.000E+00	0.000E+00	0.000E+00
2081	9.823E+03	7.866E+06	5.285E+02	0.000E+00	0.000E+00	0.000E+00
2082	9.169E+03	7.334E+06	4.928E+02	0.000E+00	0.000E+00	0.000E+00
2083	8.540E+03	6.838E+06	4.595E+02	0.000E+00	0.000E+00	0.000E+00
2084	7.962E+03	6.376E+06	4.284E+02	0.000E+00	0.000E+00	0.000E+00
2085	7.424E+03	5.945E+06	3.994E+02	0.000E+00	0.000E+00	0.000E+00

Results (Continued)

Year	Total landfill gas					
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)	(av ft ³ /min)
2086	6.922E+03	5.543E+06	3.724E+02	0.000E+00	0.000E+00	0.000E+00
2087	6.454E+03	5.168E+06	3.472E+02	0.000E+00	0.000E+00	0.000E+00
2088	6.018E+03	4.819E+06	3.238E+02	0.000E+00	0.000E+00	0.000E+00
2089	5.611E+03	4.493E+06	3.019E+02	0.000E+00	0.000E+00	0.000E+00
2090	5.232E+03	4.189E+06	2.815E+02	0.000E+00	0.000E+00	0.000E+00
2091	4.878E+03	3.906E+06	2.624E+02	0.000E+00	0.000E+00	0.000E+00
2092	4.548E+03	3.642E+06	2.447E+02	0.000E+00	0.000E+00	0.000E+00
2093	4.241E+03	3.396E+06	2.282E+02	0.000E+00	0.000E+00	0.000E+00
2094	3.954E+03	3.166E+06	2.127E+02	0.000E+00	0.000E+00	0.000E+00
2095	3.687E+03	2.952E+06	1.984E+02	0.000E+00	0.000E+00	0.000E+00
2096	3.437E+03	2.753E+06	1.849E+02	0.000E+00	0.000E+00	0.000E+00
2097	3.205E+03	2.566E+06	1.724E+02	0.000E+00	0.000E+00	0.000E+00
2098	2.988E+03	2.393E+06	1.608E+02	0.000E+00	0.000E+00	0.000E+00
2099	2.786E+03	2.231E+06	1.499E+02	0.000E+00	0.000E+00	0.000E+00
2100	2.598E+03	2.080E+06	1.398E+02	0.000E+00	0.000E+00	0.000E+00
2101	2.422E+03	1.940E+06	1.303E+02	0.000E+00	0.000E+00	0.000E+00
2102	2.259E+03	1.809E+06	1.215E+02	0.000E+00	0.000E+00	0.000E+00
2103	2.106E+03	1.686E+06	1.133E+02	0.000E+00	0.000E+00	0.000E+00
2104	1.963E+03	1.572E+06	1.056E+02	0.000E+00	0.000E+00	0.000E+00
2105	1.831E+03	1.466E+06	9.850E+01	0.000E+00	0.000E+00	0.000E+00
2106	1.707E+03	1.367E+06	9.184E+01	0.000E+00	0.000E+00	0.000E+00
2107	1.592E+03	1.274E+06	8.563E+01	0.000E+00	0.000E+00	0.000E+00
2108	1.484E+03	1.188E+06	7.984E+01	0.000E+00	0.000E+00	0.000E+00
2109	1.384E+03	1.108E+06	7.444E+01	0.000E+00	0.000E+00	0.000E+00
2110	1.290E+03	1.033E+06	6.941E+01	0.000E+00	0.000E+00	0.000E+00
2111	1.203E+03	9.632E+05	6.472E+01	0.000E+00	0.000E+00	0.000E+00
2112	1.122E+03	8.981E+05	6.034E+01	0.000E+00	0.000E+00	0.000E+00
2113	1.046E+03	8.374E+05	5.626E+01	0.000E+00	0.000E+00	0.000E+00
2114	9.750E+02	7.808E+05	5.246E+01	0.000E+00	0.000E+00	0.000E+00
2115	9.091E+02	7.280E+05	4.891E+01	0.000E+00	0.000E+00	0.000E+00
2116	8.477E+02	6.788E+05	4.561E+01	0.000E+00	0.000E+00	0.000E+00
2117	7.904E+02	6.329E+05	4.252E+01	0.000E+00	0.000E+00	0.000E+00
2118	7.369E+02	5.901E+05	3.965E+01	0.000E+00	0.000E+00	0.000E+00
2119	6.871E+02	5.502E+05	3.697E+01	0.000E+00	0.000E+00	0.000E+00
2120	6.406E+02	5.130E+05	3.447E+01	0.000E+00	0.000E+00	0.000E+00
2121	5.973E+02	4.783E+05	3.214E+01	0.000E+00	0.000E+00	0.000E+00
2122	5.570E+02	4.460E+05	2.997E+01	0.000E+00	0.000E+00	0.000E+00
2123	5.193E+02	4.158E+05	2.794E+01	0.000E+00	0.000E+00	0.000E+00
2124	4.842E+02	3.877E+05	2.605E+01	0.000E+00	0.000E+00	0.000E+00
2125	4.515E+02	3.615E+05	2.429E+01	0.000E+00	0.000E+00	0.000E+00

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ATTACHMENT 3.1
KY-GAS ANALYSES
LORAIN I AND LORAIN II HEADER SYSTEMS
(FINAL DEVELOPMENT CONDITIONS – 21,000 SCFM FLOW)

KYGAS HEADLOSS CALCULATIONS

KYGAS was developed by Dr. Don J. Wood and Dr. James E. Funk at the University of Kentucky. The program was modeled after KYPIPE, which models water distribution systems. KYGAS is used to determine head losses, system pressures, and velocities in piping systems controlled under vacuum. KYGAS operates under the assumptions that all flow in the piping system is steady, one-dimensional, isothermal flow for an ideal gas. The program uses the Darcy-Weisbach equation for head losses related to incompressible flow and the Ideal Gas Law for pressure-temperature-density relationships.

KYGAS has several useful options to develop a LFG system. The program allows the user to model any type of piping system material or configuration to coincide with field conditions. The program includes tabular and graphic interfaces for the input of information regarding the system. Multiple blower locations may be used in the program to simulate actual field conditions. In addition, blower performance curves may be entered into the program for comparison to operational and actual field conditions. KYGAS is capable of running multiple scenarios for any piping configuration including looped header systems. LFG flow units and pressure values at the wells are user specified for comparison to values obtained in the field.

The following parameters are required for operation of KYGAS.

- Pipe inside diameter
- Pipe length
- Minor loss coefficient
- Roughness within the pipe
- LFG flow rate into the system at each well or node
- LFG operating temperature (120°F)
- Specific gravity of the LFG (1.036)
- Ratio of specific heats (1.303)
- Absolute viscosity of LFG (2.82×10^{-7} lb*sec/ft²)

The design process begins with the development of the LFG flow rates for use in the program. The LFG flow is determined from the USEPA LandGEM LFG model. The LFG model is developed based on site specific information relating to waste inflow,



composition, landfill capacity, and site life. The second step involves evaluating the conceptual design of the LFG system to be installed. Based on the conceptual design and a general understanding of the planned phasing of the landfill, the total LFG flow for a landfill is divided into various amounts to simulate varied flow rates at the wellheads over the life of the site.

As mentioned before, KYGAS allows the user to input information in either a tabular or graphical method. The graphical method is called KYCAD. KYCAD allows the user to input the piping network to scale in an AutoCAD format. The user constructs the system in the computer by drawing the system as it will appear in the field, and then adjusts the necessary pipe lengths and locations of wells (nodes) as required. Site-specific conditions are considered when laying out a system. No elevations are used for the various nodes in this analysis. It is assumed that all LFG flow will proceed through the system regardless of node elevations.

Once all of the required information is in the program, the user can begin to evaluate the system. Evaluation of the system is an iterative process. The initial design is based on the engineer's previous design experience for similar sized systems. Once the results of the initial model are reviewed, the iterative process begins by balancing the system to control LFG velocity, pressure loss, and pipe diameter for various parts of the system. The initial flow rates and their input locations into the system remain unchanged throughout this process. The main factor adjusted for every iteration is the pipe diameter. The inside pipe diameter determines the LFG velocity and pressure drop in each pipe. Once the velocities in the system piping and the vacuum pressure remaining at the furthest node meet design requirements, the engineer may proceed with developing and finalizing the system for construction.

The design criteria for the header system are:

<i>Maximum Con-Current Velocity</i>	<i>55 fps</i>
<i>Maximum Counter-Current Velocity</i>	<i>35 fps</i>
<i>Maximum Pressure Drop</i>	<i>1" w.c. per 100 feet of pipe</i>

The results of the KYGAS analysis indicate a total system pressure drop of approximately 32" w.c. Please refer to the attached KYGAS output files. This should occur at Node J-88. The maximum con-current velocity is 52.85 fps (Pipe P-77), and the maximum counter-current flow is 33.69 fps (Pipe P-70). All values are well within allowable operational ranges.

The design flow used for the KYGAS analysis is 21,000 standard cubic feet per minute (scfm).



Lorain County Landfill

*** GAS2000 Version 1.1 ***
 GAS DISTRIBUTION NETWORK ANALYSIS
 COPYRIGHT 2000 - DON J. WOOD, JAMES E. FUNK
 LEXINGTON, KY
 Updated April 2000

INPUT DATA FILE NAME FOR THIS SIMULATION = J:\LORAIN~1\2007GC~1_PROJE~2\GCCSD
 E~1\KYGas\Lorain.DAT
 OUTPUT DATA FILE NAME FOR THIS SIMULATION = J:\LORAIN~1\2007GC~1_PROJE~2\GCCSD
 E~1\KYGas\Lorain.OT2

DATE FOR THIS COMPUTER RUN : 9-20-2007
 START TIME FOR THIS COMPUTER RUN : 10:59:13:98

SUMMARY OF DISTRIBUTION SYSTEM CHARACTERISTICS:

NUMBER OF PIPES = 519
 NUMBER OF JUNCTION NODES = 503
 UNITS SPECIFIED = ENGLISH

PROPERTIES OF THE GAS FOR THIS ANALYSIS ARE:

OPERATING TEMPERATURE = 120.00 DEGREES FAHRENHEIT
 REFERENCE DENSITY (@ STD. PRESSURE) = .71E-01 POUNDS / CUBIC FOOT
 GAS MOLECULAR WEIGHT = 30.01
 GAS SPECIFIC GRAVITY = 1.04
 RATIO OF SPECIFIC HEATS = 1.30
 GAS CONSTANT = 51.49
 ABSOLUTE VISCOSITY = .28E-06 POUND SECONDS/SQUARE FOOT

USER SPECIFIED FLOW UNITS (USFU) = SCF / MIN.
 USER SPECIFIED PRESSURE UNITS (USPU) = INCHES OF WATER (GAUGE)

----- SUMMARY OF PIPE NETWORK GEOMETRIC AND OPERATING DATA -----

PIPE NAME	NODE #1	NODE #2	LENGTH (FT.)	DIAM. (IN.)	ROUGHNESS (MILLIFEET)	SUM-M FACT.	PUMP ID	ELEVATION CHANGE
P- 204	J-283	J-282	140.0	5.8	.100	1.8	0	.0
P- 205	J-296	J-297	196.0	5.8	.100	1.8	0	.0
P- 206	J-292	J-293	205.0	7.6	.100	1.8	0	.0
P- 89	J-313	J-95	62.0	21.0	.100	1.8	0	.0
P- 91	J-95	J-405	259.0	21.0	.100	1.8	0	.0
P- 92	J-238	J-222	194.0	21.0	.100	1.8	0	.0
P- 93	J-245	J-229	255.0	21.0	.100	1.8	0	.0
P- 96	J-52	J-245	48.0	21.0	.100	1.8	0	.0

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P- 97	J-229	J-400	625.0	21.0	.100	1.8	0	.0
P-1	J-209	J-361	43.0	21.0	.100	1.8	0	.0
P-10	J-197	J-26	199.0	21.0	.100	1.8	0	.0
P-100	J-350	J-373	148.0	21.0	.100	1.8	0	.0
P-101	J-192	J-191	219.0	5.8	.100	1.8	0	.0
P-102	J-196	J-195	229.0	5.8	.100	1.8	0	.0
P-103	J-289	J-290	190.0	5.8	.100	1.8	0	.0
P-104	J-210	J-11	416.0	21.0	.100	1.8	0	.0
P-105	J-211	J-210	35.0	5.8	.100	1.8	0	.0
P-106	J-204	J-203	78.0	5.8	.100	1.8	0	.0
P-107	J-286	J-295	166.0	5.8	.100	1.8	0	.0
P-108	J-295	J-294	220.0	5.8	.100	1.8	0	.0
P-109	J-186	J-183	192.0	5.8	.100	1.8	0	.0
P-11	J-6	J-16	145.0	5.8	.100	1.8	0	.0
P-110	J-287	J-288	278.0	5.8	.100	1.8	0	.0
P-111	J-247	J-3	84.0	21.0	.100	1.8	0	.0
P-112	J-250	J-302	192.0	5.8	.100	1.8	0	.0
P-113	J-35	J-1192	174.0	9.4	.100	1.8	0	.0
P-114	J-252	J-465	202.0	5.8	.100	1.8	0	.0
P-115	J-301	J-463	176.0	5.8	.100	1.8	0	.0
P-116	J-303	J-450	271.0	5.8	.100	1.8	0	.0
P-117	J-123	J-124	59.0	5.8	.100	1.8	0	.0
P-118	J-64	J-8	302.0	5.8	.100	1.8	0	.0
P-119	J-19	J-160	57.0	11.2	.100	1.8	0	.0
P-12	J-376	J-244	157.0	5.8	.100	1.8	0	.0
P-120	J-73	J-74	99.0	5.8	.100	1.8	0	.0
P-121	J-1192	J-1193	29.0	5.8	.100	1.8	0	.0
P-122	J-33	J-34	81.0	5.8	.100	1.8	0	.0
P-123	J-160	J-161	101.0	5.8	.100	1.8	0	.0
P-124	J-158	J-159	55.0	5.8	.100	1.8	0	.0
P-125	J-156	J-157	37.0	5.8	.100	1.8	0	.0
P-126	J-145	J-22	1614.0	11.2	.100	1.8	0	.0
P-127	J-152	J-153	21.0	5.8	.100	1.8	0	.0
P-128	J-148	J-149	41.0	5.8	.100	1.8	0	.0
P-129	J-146	J-147	78.0	5.8	.100	1.8	0	.0
P-13	J-35	J-17	50.0	5.8	.100	1.8	0	.0
P-130	J-143	J-144	76.0	5.8	.100	1.8	0	.0
P-131	J-141	J-142	75.0	5.8	.100	1.8	0	.0
P-132	J-137	J-138	49.0	5.8	.100	1.8	0	.0
P-133	J-134	J-135	60.0	5.8	.100	1.8	0	.0
P-134	J-129	J-130	31.0	5.8	.100	1.8	0	.0
P-135	J-125	J-126	39.0	5.8	.100	1.8	0	.0
P-136	J-121	J-122	53.0	5.8	.100	1.8	0	.0
P-137	J-119	J-120	69.0	5.8	.100	1.8	0	.0
P-138	J-111	J-114	27.0	5.8	.100	1.8	0	.0
P-139	J-107	J-108	45.0	5.8	.100	1.8	0	.0
P-14	J-287	J-289	50.0	7.6	.100	1.8	0	.0
P-140	J-103	J-104	78.0	5.8	.100	1.8	0	.0
P-141	J-99	J-100	26.0	5.8	.100	1.8	0	.0
P-142	J-91	J-92	64.0	5.8	.100	1.8	0	.0
P-143	J-84	J-85	81.0	5.8	.100	1.8	0	.0
P-144	J-82	J-83	95.0	5.8	.100	1.8	0	.0
P-145	J-80	J-81	20.0	5.8	.100	1.8	0	.0
P-146	J-78	J-79	49.0	5.8	.100	1.8	0	.0
P-147	J-76	J-77	74.0	5.8	.100	1.8	0	.0
P-148	J-70	J-71	14.0	5.8	.100	1.8	0	.0
P-149	J-68	J-69	18.0	5.8	.100	1.8	0	.0
P-15	J-48	J-45	64.0	11.2	.100	1.8	0	.0
P-150	J-65	J-66	26.0	5.8	.100	1.8	0	.0
P-151	J-8	J-63	28.0	5.8	.100	1.8	0	.0
P-152	J-59	J-60	20.0	5.8	.100	1.8	0	.0
P-153	J-56	J-57	25.0	5.8	.100	1.8	0	.0

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P-154	J-54	J-55	35.0	5.8	.100	1.8	0	.0
P-155	J-41	J-42	42.0	5.8	.100	1.8	0	.0
P-156	J-46	J-47	58.0	5.8	.100	1.8	0	.0
P-157	J-68	J-67	46.0	5.8	.100	1.8	0	.0
P-158	J-136	J-137	69.0	5.8	.100	1.8	0	.0
P-159	J-131	J-132	350.0	5.8	.100	1.8	0	.0
P-16	J-10	J-253	1625.0	15.8	.100	1.8	0	.0
P-160	J-127	J-128	363.0	5.8	.100	1.8	0	.0
P-161	J-115	J-116	69.0	5.8	.100	1.8	0	.0
P-162	J-116	J-117	390.0	5.8	.100	1.8	0	.0
P-163	J-105	J-106	393.0	5.8	.100	1.8	0	.0
P-164	J-101	J-102	317.0	5.8	.100	1.8	0	.0
P-165	J-97	J-98	319.0	5.8	.100	1.8	0	.0
P-166	J-86	J-87	73.0	5.8	.100	1.8	0	.0
P-167	J-58	J-59	55.0	5.8	.100	1.8	0	.0
P-168	J-1192	J-37	200.0	9.4	.100	1.8	0	.0
P-169	J-14	J-148	47.0	5.8	.100	1.8	0	.0
P-17	J-53	J-174	181.0	5.8	.100	1.8	0	.0
P-170	J-152	J-151	18.0	5.8	.100	1.8	0	.0
P-171	J-18	J-156	176.0	9.4	.100	1.8	0	.0
P-172	J-19	J-499	116.0	11.2	.100	1.8	0	.0
P-173	J-50	J-51	58.0	5.8	.100	1.8	0	.0
P-174	J-38	J-39	19.0	5.8	.100	1.8	0	.0
P-175	J-305	J-447	212.0	5.8	.100	1.8	0	.0
P-176	J-187	J-181	205.0	21.0	.100	1.8	0	.0
P-177	J-308	J-307	219.0	5.8	.100	1.8	0	.0
P-178	J-22	J-9	76.0	15.8	.100	1.8	0	.0
P-179	J-167	J-476	263.0	5.8	.100	1.8	0	.0
P-18	J-217	J-389	160.0	5.8	.100	1.8	0	.0
P-180	J-309	J-460	235.0	5.8	.100	1.8	0	.0
P-181	J-311	J-446	196.0	5.8	.100	1.8	0	.0
P-182	J-314	J-443	222.0	5.8	.100	1.8	0	.0
P-183	J-249	J-275	219.0	21.0	.100	1.8	0	.0
P-184	J-318	J-440	198.0	5.8	.100	1.8	0	.0
P-185	J-320	J-457	246.0	5.8	.100	1.8	0	.0
P-186	J-322	J-444	228.0	5.8	.100	1.8	0	.0
P-187	J-324	J-325	315.0	5.8	.100	1.8	0	.0
P-188	J-326	J-438	296.0	5.8	.100	1.8	0	.0
P-189	J-328	J-432	202.0	5.8	.100	1.8	0	.0
P-19	J-392	J-474	195.0	5.8	.100	1.8	0	.0
P-190	J-221	J-226	149.0	5.8	.100	1.8	0	.0
P-191	J-330	J-430	200.0	5.8	.100	1.8	0	.0
P-192	J-332	J-436	206.0	5.8	.100	1.8	0	.0
P-193	J-29	J-9	132.0	15.8	.100	1.8	0	.0
P-194	J-304	J-334	218.0	5.8	.100	1.8	0	.0
P-195	J-336	J-317	218.0	5.8	.100	1.8	0	.0
P-196	J-338	J-339	226.0	5.8	.100	1.8	0	.0
P-197	J-182	J-181	109.0	5.8	.100	1.8	0	.0
P-198	J-183	J-182	174.0	5.8	.100	1.8	0	.0
P-199	J-171	J-29	297.0	21.0	.100	1.8	0	.0
P-2	J-230	J-94	255.0	5.8	.100	1.8	0	.0
P-20	J-4	J-242	332.0	21.0	.100	1.8	0	.0
P-200	J-340	J-424	214.0	5.8	.100	1.8	0	.0
P-201	J-344	J-343	167.0	5.8	.100	1.8	0	.0
P-202	J-345	J-346	187.0	5.8	.100	1.8	0	.0
P-203	J-347	J-427	205.0	5.8	.100	1.8	0	.0
P-206	J-3	J-439	223.0	5.8	.100	1.8	0	.0
P-207	J-349	J-414	204.0	5.8	.100	1.8	0	.0
P-208	J-231	J-238	190.0	5.8	.100	1.8	0	.0
P-209	J-351	J-422	212.0	5.8	.100	1.8	0	.0
P-21	J-395	J-394	209.0	5.8	.100	1.8	0	.0
P-210	J-353	J-243	107.0	5.8	.100	1.8	0	.0

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P-211	J-38	J-41	162.0	7.6	.100	1.8	0	.0
P-212	J-41	J-46	173.0	7.6	.100	1.8	0	.0
P-213	J-46	J-50	176.0	7.6	.100	1.8	0	.0
P-214	J-50	J-54	156.0	7.6	.100	1.8	0	.0
P-215	J-54	J-56	153.0	7.6	.100	1.8	0	.0
P-216	J-56	J-58	132.0	7.6	.100	1.8	0	.0
P-217	J-62	J-58	144.0	7.6	.100	1.8	0	.0
P-218	J-61	J-59	285.0	5.8	.100	1.8	0	.0
P-219	J-62	J-65	174.0	7.6	.100	1.8	0	.0
P-22	J-72	J-70	304.0	5.8	.100	1.8	0	.0
P-220	J-65	J-67	186.0	7.6	.100	1.8	0	.0
P-221	J-73	J-76	335.0	7.6	.100	1.8	0	.0
P-222	J-67	J-73	168.0	7.6	.100	1.8	0	.0
P-223	J-76	J-78	196.0	7.6	.100	1.8	0	.0
P-224	J-78	J-80	174.0	7.6	.100	1.8	0	.0
P-225	J-80	J-82	370.0	7.6	.100	1.8	0	.0
P-226	J-82	J-84	174.0	7.6	.100	1.8	0	.0
P-227	J-84	J-86	179.0	7.6	.100	1.8	0	.0
P-228	J-91	J-97	175.0	7.6	.100	1.8	0	.0
P-229	J-86	J-91	184.0	7.6	.100	1.8	0	.0
P-23	J-397	J-494	240.0	5.8	.100	1.8	0	.0
P-230	J-97	J-99	188.0	7.6	.100	1.8	0	.0
P-231	J-99	J-101	152.0	7.6	.100	1.8	0	.0
P-232	J-101	J-103	210.0	7.6	.100	1.8	0	.0
P-233	J-103	J-105	194.0	7.6	.100	1.8	0	.0
P-234	J-105	J-107	172.0	7.6	.100	1.8	0	.0
P-235	J-107	J-109	184.0	7.6	.100	1.8	0	.0
P-236	J-111	J-115	195.0	7.6	.100	1.8	0	.0
P-237	J-115	J-119	182.0	7.6	.100	1.8	0	.0
P-238	J-119	J-121	289.0	7.6	.100	1.8	0	.0
P-239	J-121	J-123	180.0	7.6	.100	1.8	0	.0
P-24	J-399	J-493	354.0	5.8	.100	1.8	0	.0
P-240	J-123	J-125	163.0	7.6	.100	1.8	0	.0
P-241	J-125	J-127	157.0	7.6	.100	1.8	0	.0
P-242	J-127	J-129	158.0	7.6	.100	1.8	0	.0
P-243	J-129	J-131	198.0	7.6	.100	1.8	0	.0
P-244	J-131	J-134	139.0	7.6	.100	1.8	0	.0
P-245	J-134	J-136	112.0	7.6	.100	1.8	0	.0
P-246	J-136	J-141	156.0	7.6	.100	1.8	0	.0
P-247	J-141	J-143	172.0	7.6	.100	1.8	0	.0
P-248	J-143	J-145	132.0	7.6	.100	1.8	0	.0
P-249	J-145	J-146	185.0	7.6	.100	1.8	0	.0
P-25	J-401	J-402	239.0	5.8	.100	1.8	0	.0
P-250	J-146	J-14	151.0	7.6	.100	1.8	0	.0
P-251	J-14	J-151	237.0	7.6	.100	1.8	0	.0
P-252	J-151	J-155	170.0	7.6	.100	1.8	0	.0
P-253	J-181	J-171	74.0	21.0	.100	1.8	0	.0
P-254	J-150	J-148	290.0	5.8	.100	1.8	0	.0
P-255	J-155	J-18	193.0	7.6	.100	1.8	0	.0
P-256	J-18	J-20	364.0	5.8	.100	1.8	0	.0
P-257	J-193	J-164	127.0	21.0	.100	1.8	0	.0
P-258	J-156	J-158	182.0	9.4	.100	1.8	0	.0
P-259	J-154	J-152	379.0	5.8	.100	1.8	0	.0
P-26	J-404	J-403	208.0	5.8	.100	1.8	0	.0
P-260	J-158	J-160	227.0	9.4	.100	1.8	0	.0
P-261	J-62	J-8	294.0	5.8	.100	1.8	0	.0
P-262	J-70	J-68	311.0	5.8	.100	1.8	0	.0
P-263	J-17	J-40	319.0	5.8	.100	1.8	0	.0
P-264	J-118	J-116	255.0	5.8	.100	1.8	0	.0
P-265	J-140	J-137	310.0	5.8	.100	1.8	0	.0
P-266	J-37	J-38	171.0	7.6	.100	1.8	0	.0
P-267	J-74	J-75	159.0	5.8	.100	1.8	0	.0

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P-268	J-87	J-88	206.0	5.8	.100	1.8	0	.0
P-269	J-109	J-110	179.0	7.6	.100	1.8	0	.0
P-27	J-406	J-407	60.0	5.8	.100	1.8	0	.0
P-270	J-110	J-111	176.0	7.6	.100	1.8	0	.0
P-271	J-132	J-133	341.0	5.8	.100	1.8	0	.0
P-272	J-197	J-24	199.0	21.0	.100	1.8	0	.0
P-273	J-199	J-26	198.0	21.0	.100	1.8	0	.0
P-274	J-199	J-215	167.0	21.0	.100	1.8	0	.0
P-275	J-203	J-201	195.0	21.0	.100	1.8	0	.0
P-276	J-201	J-30	211.0	21.0	.100	1.8	0	.0
P-277	J-203	J-205	216.0	21.0	.100	1.8	0	.0
P-278	J-207	J-1	223.0	21.0	.100	1.8	0	.0
P-279	J-1	J-205	202.0	21.0	.100	1.8	0	.0
P-28	J-11	J-15	208.0	21.0	.100	1.8	0	.0
P-280	J-162	J-173	410.0	15.8	.100	1.8	0	.0
P-281	J-354	J-429	179.0	5.8	.100	1.8	0	.0
P-282	J-356	J-359	205.0	5.8	.100	1.8	0	.0
P-283	J-162	J-163	85.0	5.8	.100	1.8	0	.0
P-284	J-190	J-187	71.0	5.8	.100	1.8	0	.0
P-285	J-28	J-163	150.0	5.8	.100	1.8	0	.0
P-286	J-254	J-257	139.0	11.2	.100	1.8	0	.0
P-287	J-264	J-265	218.0	5.8	.100	1.8	0	.0
P-288	J-257	J-259	216.0	11.2	.100	1.8	0	.0
P-289	J-259	J-263	209.0	11.2	.100	1.8	0	.0
P-29	J-408	J-409	97.0	5.8	.100	1.8	0	.0
P-290	J-263	J-267	189.0	11.2	.100	1.8	0	.0
P-291	J-253	J-276	326.0	15.8	.100	1.8	0	.0
P-292	J-276	J-165	51.0	5.8	.100	1.8	0	.0
P-293	J-165	J-277	136.0	5.8	.100	1.8	0	.0
P-294	J-276	J-278	392.0	15.8	.100	1.8	0	.0
P-295	J-278	J-168	51.0	5.8	.100	1.8	0	.0
P-296	J-168	J-166	143.0	5.8	.100	1.8	0	.0
P-297	J-278	J-281	625.0	15.8	.100	1.8	0	.0
P-298	J-281	J-170	48.0	5.8	.100	1.8	0	.0
P-299	J-329	J-335	89.0	21.0	.100	1.8	0	.0
P-3	J-210	J-209	205.0	21.0	.100	1.8	0	.0
P-30	J-411	J-410	46.0	5.8	.100	1.8	0	.0
P-300	J-360	J-331	214.0	5.8	.100	1.8	0	.0
P-301	J-281	J-48	254.0	15.8	.100	1.8	0	.0
P-302	J-45	J-43	141.0	9.4	.100	1.8	0	.0
P-303	J-48	J-173	377.0	15.8	.100	1.8	0	.0
P-304	J-191	J-190	183.0	5.8	.100	1.8	0	.0
P-305	J-174	J-173	88.0	11.2	.100	1.8	0	.0
P-306	J-362	J-363	222.0	5.8	.100	1.8	0	.0
P-307	J-176	J-174	82.0	11.2	.100	1.8	0	.0
P-308	J-176	J-299	638.0	11.2	.100	1.8	0	.0
P-309	J-364	J-495	176.0	5.8	.100	1.8	0	.0
P-31	J-341	J-475	233.0	5.8	.100	1.8	0	.0
P-310	J-194	J-193	33.0	5.8	.100	1.8	0	.0
P-311	J-195	J-194	184.0	5.8	.100	1.8	0	.0
P-312	J-184	J-371	216.0	7.6	.100	1.8	0	.0
P-313	J-368	J-273	204.0	5.8	.100	1.8	0	.0
P-314	J-241	J-245	102.0	5.8	.100	1.8	0	.0
P-315	J-370	J-496	184.0	5.8	.100	1.8	0	.0
P-316	J-372	J-387	197.0	5.8	.100	1.8	0	.0
P-317	J-374	J-375	187.0	5.8	.100	1.8	0	.0
P-318	J-265	J-266	154.0	5.8	.100	1.8	0	.0
P-319	J-256	J-272	188.0	7.6	.100	1.8	0	.0
P-32	J-90	J-139	586.0	21.0	.100	1.8	0	.0
P-320	J-267	J-256	182.0	11.2	.100	1.8	0	.0
P-321	J-412	J-413	196.0	5.8	.100	1.8	0	.0
P-322	J-279	J-168	138.0	5.8	.100	1.8	0	.0

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P-323	J-377	J-419	204.0	5.8	.100	1.8	0	.0
P-324	J-379	J-386	307.0	5.8	.100	1.8	0	.0
P-325	J-381	J-420	206.0	5.8	.100	1.8	0	.0
P-326	J-383	J-243	71.0	21.0	.100	1.8	0	.0
P-327	J-384	J-426	203.0	5.8	.100	1.8	0	.0
P-328	J-5	J-236	656.0	21.0	.100	1.8	0	.0
P-329	J-36	J-411	314.0	21.0	.100	1.8	0	.0
P-33	J-32	J-291	267.0	5.8	.100	1.8	0	.0
P-330	J-367	J-404	174.0	5.8	.100	1.8	0	.0
P-331	J-52	J-489	206.0	5.8	.100	1.8	0	.0
P-332	J-224	J-313	366.0	9.4	.100	1.8	0	.0
P-333	J-244	J-284	119.0	7.6	.100	1.8	0	.0
P-334	J-413	J-112	132.0	5.8	.100	1.8	0	.0
P-335	J-365	J-184	384.0	21.0	.100	1.8	0	.0
P-336	J-184	J-409	21.0	21.0	.100	1.8	0	.0
P-337	J-409	J-411	146.0	21.0	.100	1.8	0	.0
P-338	J-237	J-15	198.0	21.0	.100	1.8	0	.0
P-339	J-501	R-1	712.0	21.0	.100	1.8	0	.0
P-34	J-179	J-89	213.0	5.8	.100	1.8	0	.0
P-340	J-236	J-93	444.0	21.0	.100	1.8	0	.0
P-341	J-175	J-407	726.0	21.0	.100	1.8	0	.0
P-342	J-501	J-36	15.0	21.0	.100	1.8	0	.0
P-343	J-93	R-1	671.0	21.0	.100	1.8	0	.0
P-344	J-36	J-4	7.0	21.0	.100	1.8	0	.0
P-345	J-5	J-383	648.0	21.0	.100	1.8	0	.0
P-346	J-352	J-21	202.0	7.6	.100	1.8	0	.0
P-347	J-5	J-21	80.0	21.0	.100	1.8	0	.0
P-348	J-96	J-385	205.0	5.8	.100	1.8	0	.0
P-349	J-21	J-96	60.0	21.0	.100	1.8	0	.0
P-35	J-93	J-501	33.0	21.0	.100	1.8	0	.0
P-350	J-5	J-355	591.0	21.0	.100	1.8	0	.0
P-351	J-355	J-391	842.0	21.0	.100	1.8	0	.0
P-352	J-391	J-333	894.0	21.0	.100	1.8	0	.0
P-353	J-333	J-247	868.0	21.0	.100	1.8	0	.0
P-354	J-247	J-246	801.0	21.0	.100	1.8	0	.0
P-355	J-10	J-246	473.0	21.0	.100	1.8	0	.0
P-356	J-10	J-310	456.0	21.0	.100	1.8	0	.0
P-357	J-407	J-90	66.0	21.0	.100	1.8	0	.0
P-358	J-212	J-175	173.0	21.0	.100	1.8	0	.0
P-359	J-212	J-300	94.0	5.8	.100	1.8	0	.0
P-36	J-52	J-361	91.0	21.0	.100	1.8	0	.0
P-360	J-233	J-188	38.0	5.8	.100	1.8	0	.0
P-361	J-310	J-233	90.0	21.0	.100	1.8	0	.0
P-362	J-233	J-212	368.0	21.0	.100	1.8	0	.0
P-363	J-302	J-233	199.0	7.6	.100	1.8	0	.0
P-364	J-306	J-323	97.0	7.6	.100	1.8	0	.0
P-365	J-323	J-312	210.0	5.8	.100	1.8	0	.0
P-366	J-308	J-306	104.0	7.6	.100	1.8	0	.0
P-367	J-306	J-246	106.0	21.0	.100	1.8	0	.0
P-368	J-235	J-306	235.0	21.0	.100	1.8	0	.0
P-369	J-248	J-451	302.0	5.8	.100	1.8	0	.0
P-37	J-35	J-33	182.0	9.4	.100	1.8	0	.0
P-370	J-235	J-248	222.0	21.0	.100	1.8	0	.0
P-371	J-315	J-319	205.0	21.0	.100	1.8	0	.0
P-372	J-275	J-251	188.0	21.0	.100	1.8	0	.0
P-373	J-248	J-453	225.0	21.0	.100	1.8	0	.0
P-374	J-274	J-458	330.0	21.0	.100	1.8	0	.0
P-375	J-331	J-391	122.0	21.0	.100	1.8	0	.0
P-376	J-365	J-369	247.0	7.6	.100	1.8	0	.0
P-377	J-315	J-3	66.0	21.0	.100	1.8	0	.0
P-378	J-319	J-325	304.0	21.0	.100	1.8	0	.0
P-379	J-325	J-249	209.0	21.0	.100	1.8	0	.0

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P-38	J-164	J-468	292.0	21.0	.100	1.8	0	.0
P-380	J-249	J-316	208.0	5.8	.100	1.8	0	.0
P-381	J-339	J-337	201.0	5.8	.100	1.8	0	.0
P-382	J-317	J-339	216.0	5.8	.100	1.8	0	.0
P-383	J-304	J-317	38.0	7.6	.100	1.8	0	.0
P-384	J-317	J-333	116.0	11.2	.100	1.8	0	.0
P-385	J-251	J-435	259.0	21.0	.100	1.8	0	.0
P-386	J-335	J-331	27.0	21.0	.100	1.8	0	.0
P-387	J-335	J-358	181.0	5.8	.100	1.8	0	.0
P-388	J-359	J-357	185.0	5.8	.100	1.8	0	.0
P-389	J-363	J-359	52.0	7.6	.100	1.8	0	.0
P-39	J-178	J-89	111.0	5.8	.100	1.8	0	.0
P-390	J-359	J-355	89.0	9.4	.100	1.8	0	.0
P-391	J-348	J-96	366.0	21.0	.100	1.8	0	.0
P-392	J-352	J-342	184.0	5.8	.100	1.8	0	.0
P-393	J-373	J-243	59.0	21.0	.100	1.8	0	.0
P-394	J-375	J-380	184.0	7.6	.100	1.8	0	.0
P-395	J-380	J-373	88.0	7.6	.100	1.8	0	.0
P-396	J-350	J-378	58.0	21.0	.100	1.8	0	.0
P-397	J-274	J-421	141.0	21.0	.100	1.8	0	.0
P-398	J-382	J-346	248.0	21.0	.100	1.8	0	.0
P-399	J-378	J-415	202.0	21.0	.100	1.8	0	.0
P-4	J-7	J-11	71.0	5.8	.100	1.8	0	.0
P-40	J-180	J-286	212.0	5.8	.100	1.8	0	.0
P-400	J-274	J-459	205.0	21.0	.100	1.8	0	.0
P-401	J-369	J-273	205.0	5.8	.100	1.8	0	.0
P-402	J-371	J-366	204.0	5.8	.100	1.8	0	.0
P-403	J-404	J-184	135.0	5.8	.100	1.8	0	.0
P-404	J-400	J-402	213.0	21.0	.100	1.8	0	.0
P-405	J-402	J-398	176.0	21.0	.100	1.8	0	.0
P-406	J-398	J-139	109.0	21.0	.100	1.8	0	.0
P-407	J-361	J-207	149.0	21.0	.100	1.8	0	.0
P-408	J-94	J-232	259.0	5.8	.100	1.8	0	.0
P-409	J-216	J-313	122.0	7.6	.100	1.8	0	.0
P-41	J-185	J-467	201.0	5.8	.100	1.8	0	.0
P-410	J-390	J-480	259.0	5.8	.100	1.8	0	.0
P-411	J-238	J-405	208.0	21.0	.100	1.8	0	.0
P-412	J-222	J-482	217.0	5.8	.100	1.8	0	.0
P-413	J-222	J-484	251.0	21.0	.100	1.8	0	.0
P-414	J-217	J-90	428.0	21.0	.100	1.8	0	.0
P-415	J-214	J-470	122.0	21.0	.100	1.8	0	.0
P-416	J-395	J-393	214.0	21.0	.100	1.8	0	.0
P-417	J-214	J-472	284.0	21.0	.100	1.8	0	.0
P-418	J-393	J-175	142.0	21.0	.100	1.8	0	.0
P-419	J-89	J-285	75.0	5.8	.100	1.8	0	.0
P-42	J-189	J-49	241.0	5.8	.100	1.8	0	.0
P-420	J-386	J-380	233.0	5.8	.100	1.8	0	.0
P-421	J-387	J-375	243.0	5.8	.100	1.8	0	.0
P-422	J-388	J-350	184.0	5.8	.100	1.8	0	.0
P-423	J-414	J-388	206.0	5.8	.100	1.8	0	.0
P-424	J-415	J-382	209.0	21.0	.100	1.8	0	.0
P-425	J-416	J-378	231.0	7.6	.100	1.8	0	.0
P-426	J-417	J-416	212.0	7.6	.100	1.8	0	.0
P-427	J-418	J-417	207.0	5.8	.100	1.8	0	.0
P-428	J-419	J-418	201.0	5.8	.100	1.8	0	.0
P-429	J-420	J-382	224.0	5.8	.100	1.8	0	.0
P-43	J-396	J-405	96.0	5.8	.100	1.8	0	.0
P-430	J-421	J-346	193.0	21.0	.100	1.8	0	.0
P-431	J-422	J-352	217.0	5.8	.100	1.8	0	.0
P-432	J-423	J-21	205.0	5.8	.100	1.8	0	.0
P-433	J-424	J-423	217.0	5.8	.100	1.8	0	.0
P-434	J-425	J-96	211.0	5.8	.100	1.8	0	.0

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P-435	J-426	J-425	210.0	5.8	.100	1.8	0	.0
P-436	J-427	J-348	270.0	5.8	.100	1.8	0	.0
P-437	J-348	J-428	203.0	21.0	.100	1.8	0	.0
P-438	J-428	J-344	193.0	21.0	.100	1.8	0	.0
P-439	J-429	J-363	187.0	5.8	.100	1.8	0	.0
P-44	J-213	J-471	240.0	5.8	.100	1.8	0	.0
P-440	J-430	J-498	193.0	5.8	.100	1.8	0	.0
P-441	J-431	J-329	276.0	5.8	.100	1.8	0	.0
P-442	J-432	J-431	282.0	5.8	.100	1.8	0	.0
P-443	J-433	J-329	118.0	21.0	.100	1.8	0	.0
P-444	J-434	J-433	294.0	21.0	.100	1.8	0	.0
P-445	J-435	J-434	212.0	21.0	.100	1.8	0	.0
P-446	J-436	J-304	214.0	5.8	.100	1.8	0	.0
P-447	J-437	J-3	224.0	5.8	.100	1.8	0	.0
P-448	J-438	J-437	211.0	5.8	.100	1.8	0	.0
P-449	J-439	J-327	209.0	5.8	.100	1.8	0	.0
P-45	J-215	J-313	102.0	21.0	.100	1.8	0	.0
P-450	J-440	J-319	217.0	5.8	.100	1.8	0	.0
P-451	J-441	J-315	224.0	7.6	.100	1.8	0	.0
P-452	J-442	J-441	213.0	5.8	.100	1.8	0	.0
P-453	J-443	J-442	192.0	5.8	.100	1.8	0	.0
P-454	J-444	J-445	211.0	5.8	.100	1.8	0	.0
P-455	J-445	J-323	28.0	5.8	.100	1.8	0	.0
P-456	J-446	J-306	311.0	5.8	.100	1.8	0	.0
P-457	J-447	J-308	346.0	5.8	.100	1.8	0	.0
P-458	J-448	J-235	300.0	7.6	.100	1.8	0	.0
P-459	J-449	J-448	305.0	5.8	.100	1.8	0	.0
P-46	J-218	J-222	226.0	5.8	.100	1.8	0	.0
P-460	J-450	J-449	233.0	5.8	.100	1.8	0	.0
P-461	J-451	J-452	209.0	5.8	.100	1.8	0	.0
P-462	J-452	J-321	187.0	5.8	.100	1.8	0	.0
P-463	J-453	J-454	206.0	21.0	.100	1.8	0	.0
P-464	J-454	J-455	184.0	21.0	.100	1.8	0	.0
P-465	J-455	J-274	204.0	21.0	.100	1.8	0	.0
P-466	J-456	J-248	260.0	5.8	.100	1.8	0	.0
P-467	J-457	J-456	204.0	5.8	.100	1.8	0	.0
P-468	J-458	J-275	285.0	21.0	.100	1.8	0	.0
P-469	J-459	J-466	435.0	21.0	.100	1.8	0	.0
P-47	J-220	J-481	209.0	5.8	.100	1.8	0	.0
P-470	J-460	J-310	143.0	5.8	.100	1.8	0	.0
P-471	J-461	J-302	258.0	7.6	.100	1.8	0	.0
P-472	J-462	J-461	236.0	5.8	.100	1.8	0	.0
P-473	J-463	J-462	228.0	5.8	.100	1.8	0	.0
P-474	J-464	J-212	274.0	5.8	.100	1.8	0	.0
P-475	J-465	J-464	233.0	5.8	.100	1.8	0	.0
P-476	J-466	J-90	285.0	21.0	.100	1.8	0	.0
P-477	J-467	J-244	103.0	5.8	.100	1.8	0	.0
P-478	J-468	J-469	240.0	21.0	.100	1.8	0	.0
P-479	J-469	J-226	157.0	21.0	.100	1.8	0	.0
P-48	J-172	J-163	160.0	5.8	.100	1.8	0	.0
P-480	J-470	J-226	307.0	21.0	.100	1.8	0	.0
P-481	J-471	J-214	122.0	5.8	.100	1.8	0	.0
P-482	J-472	J-395	172.0	21.0	.100	1.8	0	.0
P-483	J-473	J-393	221.0	5.8	.100	1.8	0	.0
P-484	J-474	J-473	221.0	5.8	.100	1.8	0	.0
P-485	J-475	J-216	317.0	5.8	.100	1.8	0	.0
P-486	J-476	J-216	70.0	5.8	.100	1.8	0	.0
P-487	J-477	J-224	45.0	7.6	.100	1.8	0	.0
P-488	J-478	J-477	260.0	5.8	.100	1.8	0	.0
P-489	J-479	J-478	280.0	5.8	.100	1.8	0	.0
P-49	J-176	J-23	50.0	5.8	.100	1.8	0	.0
P-490	J-480	J-224	245.0	5.8	.100	1.8	0	.0

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P-491	J-481	J-238	199.0	5.8	.100	1.8	0	.0
P-492	J-482	J-483	214.0	5.8	.100	1.8	0	.0
P-493	J-483	J-219	202.0	5.8	.100	1.8	0	.0
P-494	J-484	J-217	73.0	21.0	.100	1.8	0	.0
P-495	J-485	J-52	330.0	7.6	.100	1.8	0	.0
P-496	J-486	J-485	245.0	7.6	.100	1.8	0	.0
P-497	J-487	J-486	237.0	5.8	.100	1.8	0	.0
P-498	J-488	J-487	201.0	5.8	.100	1.8	0	.0
P-499	J-489	J-490	252.0	5.8	.100	1.8	0	.0
P-5	J-12	J-15	60.0	5.8	.100	1.8	0	.0
P-50	J-44	J-45	171.0	9.4	.100	1.8	0	.0
P-500	J-490	J-227	278.0	5.8	.100	1.8	0	.0
P-501	J-491	J-229	70.0	5.8	.100	1.8	0	.0
P-502	J-492	J-491	189.0	5.8	.100	1.8	0	.0
P-503	J-493	J-400	243.0	5.8	.100	1.8	0	.0
P-504	J-494	J-398	238.0	5.8	.100	1.8	0	.0
P-505	J-495	J-369	218.0	5.8	.100	1.8	0	.0
P-506	J-496	J-371	218.0	5.8	.100	1.8	0	.0
P-507	J-497	J-242	161.0	21.0	.100	1.8	0	.0
P-508	J-344	J-275	196.0	21.0	.100	1.8	0	.0
P-509	J-498	J-331	224.0	5.8	.100	1.8	0	.0
P-51	J-267	J-268	22.0	5.8	.100	1.8	0	.0
P-510	R-1	J-4	784.0	21.0	.100	1.8	0	.0
P-511	J-383	J-236	12.0	21.0	.100	1.8	0	.0
P-512	J-215	J-30	29.0	21.0	.100	1.8	0	.0
P-513	J-164	J-24	87.0	21.0	.100	1.8	0	.0
P-52	J-169	J-170	149.0	5.8	.100	1.8	0	.0
P-53	J-280	J-279	303.0	5.8	.100	1.8	0	.0
P-54	J-113	J-165	153.0	5.8	.100	1.8	0	.0
P-55	J-49	J-413	386.0	5.8	.100	1.8	0	.0
P-56	J-254	J-255	88.0	5.8	.100	1.8	0	.0
P-57	J-257	J-258	79.0	5.8	.100	1.8	0	.0
P-58	J-259	J-260	59.0	5.8	.100	1.8	0	.0
P-59	J-263	J-264	65.0	5.8	.100	1.8	0	.0
P-6	J-36	R-1	736.0	21.0	.100	1.8	0	.0
P-60	J-272	J-112	37.0	7.6	.100	1.8	0	.0
P-61	J-223	J-479	181.0	5.8	.100	1.8	0	.0
P-62	J-9	J-162	555.0	15.8	.100	1.8	0	.0
P-63	J-19	J-33	248.0	11.2	.100	1.8	0	.0
P-64	J-225	J-488	222.0	5.8	.100	1.8	0	.0
P-65	J-22	J-239	55.0	21.0	.100	1.8	0	.0
P-66	J-228	J-492	244.0	5.8	.100	1.8	0	.0
P-67	J-290	J-291	175.0	5.8	.100	1.8	0	.0
P-68	J-293	J-285	210.0	7.6	.100	1.8	0	.0
P-69	J-43	J-292	225.0	9.4	.100	1.8	0	.0
P-7	J-23	J-296	229.0	5.8	.100	1.8	0	.0
P-70	J-234	J-497	294.0	21.0	.100	1.8	0	.0
P-71	J-294	J-53	213.0	5.8	.100	1.8	0	.0
P-72	J-260	J-261	232.0	5.8	.100	1.8	0	.0
P-73	J-261	J-262	165.0	5.8	.100	1.8	0	.0
P-74	J-271	J-269	136.0	5.8	.100	1.8	0	.0
P-75	J-269	J-256	270.0	5.8	.100	1.8	0	.0
P-76	J-94	J-234	146.0	5.8	.100	1.8	0	.0
P-77	J-501	J-383	470.0	21.0	.100	1.8	0	.0
P-78	J-13	J-95	113.0	5.8	.100	1.8	0	.0
P-79	J-237	J-234	394.0	21.0	.100	1.8	0	.0
P-8	J-202	J-201	41.0	5.8	.100	1.8	0	.0
P-80	J-193	J-187	195.0	21.0	.100	1.8	0	.0
P-81	J-269	J-270	165.0	5.8	.100	1.8	0	.0
P-82	J-177	J-171	170.0	5.8	.100	1.8	0	.0
P-83	J-25	J-24	37.0	5.8	.100	1.8	0	.0
P-84	J-198	J-197	89.0	5.8	.100	1.8	0	.0

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P-85	J-27	J-26	98.0	5.8	.100	1.8	0	.0
P-86	J-200	J-199	43.0	5.8	.100	1.8	0	.0
P-87	J-31	J-30	11.0	5.8	.100	1.8	0	.0
P-88	J-240	J-242	49.0	5.8	.100	1.8	0	.0
P-89	J-206	J-205	126.0	5.8	.100	1.8	0	.0
P-9	J-6	J-237	55.0	7.6	.100	1.8	0	.0
P-90	J-2	J-1	93.0	5.8	.100	1.8	0	.0
P-91	J-208	J-207	38.0	5.8	.100	1.8	0	.0
P-92	J-298	J-23	177.0	5.8	.100	1.8	0	.0
P-94	J-139	J-365	166.0	21.0	.100	1.8	0	.0
P-95	J-44	J-287	271.0	9.4	.100	1.8	0	.0
P-96	J-289	J-284	250.0	7.6	.100	1.8	0	.0
P-98	J-282	J-170	250.0	5.8	.100	1.8	0	.0
P-99	J-253	J-254	162.0	11.2	.100	1.8	0	.0

JUNCTION NAME	NODE TITLE	DEMAND (USEU)	FPN PRESSURE
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J-100	W28	-14.00	
J-101	W26	-14.00	
J-102	W27	-14.00	
J-103		.00	
J-104	W25	-14.00	
J-105	W23	-14.00	
J-106	W24	-14.00	
J-107		.00	
J-108	W22	-14.00	
J-109	W21	-14.00	
J-11		.00	
J-110	W19	-14.00	
J-111		.00	
J-112		.00	
J-113	77	-70.00	
J-114	W18	-14.00	
J-115		.00	
J-116	W16	-14.00	
J-117	W20	-14.00	
J-118	W17	-14.00	
J-119		.00	
J-1192		.00	
J-1193	W57	-14.00	
J-12	30	-70.00	
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J-121		.00	
J-122	W14	-14.00	
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J-124	W13	-14.00	
J-125		.00	
J-126	W12	-14.00	
J-127	W11	-14.00	
J-128	W10	-14.00	
J-129		.00	
J-13	105	-70.00	
J-130	W9	-14.00	
J-131	W6	-15.00	
J-132	W7	-14.00	
J-133	W8	-14.00	
J-134		.00	
J-135	W5	-15.00	

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J-136		.00
J-137		.00
J-138	W3	-15.00
J-139		.00
J-14		.00
J-140	W4	-15.00
J-141		.00
J-142	W2	-15.00
J-143		.00
J-144	W1	-15.00
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J-146		.00
J-147	W71	-14.00
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J-149	W69	-14.00
J-15		.00
J-150	W70	-14.00
J-151		.00
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J-153	W67	-14.00
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J-16	32	-70.00
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J-161	W61	-14.00
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J-166	81	-70.00
J-167	117	-70.00
J-168		.00
J-169	82	-70.00
J-17	W58	-14.00
J-170		.00
J-171		.00
J-172	94	-70.00
J-173		.00
J-174		.00
J-175		.00
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J-177	96	-70.00
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J-18	W64	-14.00
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J-187		.00
J-188	65R	-70.00
J-189	62R	-70.00
J-19		.00
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J-191	2A	-70.00

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J-223	T5R	-70.00
J-224		.00
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J-227	124	-70.00
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J-229		.00
J-23	91	-70.00
J-230	T9	-70.00
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J-247		.00

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J-250	W	-71.00
J-251	W	-71.00
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J-260	73	-70.00
J-261	166	-70.00
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J-263		.00
J-264	71	-70.00
J-265	165	-70.00
J-266	T2	-70.00
J-267		.00
J-268	70	-70.00
J-269	164	-70.00
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J-270	T3	-70.00
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J-399	136	-71.00
J-4		.00
J-40	W59	-14.00
J-400	T8R	-71.00
J-401	135	-71.00
J-402	134	-71.00
J-403	T10R	-71.00
J-404	40R	-71.00
J-405		.00
J-406	51R	-71.00
J-407		.00
J-408	39R	-71.00
J-409		.00
J-41		.00
J-410	38R	-71.00
J-411		.00
J-412	167R	-71.00
J-413	163	-71.00
J-414	W	-71.00

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J-415	W	-71.00
J-416	W	-71.00
J-417	W	-71.00
J-418	W	-71.00
J-419	W	-71.00
J-42	W54	-14.00
J-420	W	-71.00
J-421	W	-71.00
J-422	W	-71.00
J-423	W	-71.00
J-424	W	-71.00
J-425	W	-71.00
J-426	W	-71.00
J-427	W	-71.00
J-428	W	-71.00
J-429	W	-71.00
J-43	87	-71.00
J-430	W	-71.00
J-431	W	-71.00
J-432	W	-71.00
J-433	W	-71.00
J-434	W	-71.00
J-435	W	-71.00
J-436	W	-71.00
J-437	W	-71.00
J-438	W	-71.00
J-439	W	-71.00
J-44	85	-71.00
J-440	W	-71.00
J-441	W	-71.00
J-442	W	-71.00
J-443	W	-71.00
J-444	W	-71.00
J-445	W	-71.00
J-446	W	-71.00
J-447	W	-71.00
J-448	W	-71.00
J-449	W	-71.00
J-45		.00
J-450	W	-71.00
J-451	W	-71.00
J-452	W	-71.00
J-453	W	-71.00
J-454	W	-71.00
J-455	W	-71.00
J-456	W	-71.00
J-457	W	-71.00
J-458	W	-71.00
J-459	W	-71.00
J-46		.00
J-460	W	-71.00
J-461	W	-71.00
J-462	W	-71.00
J-463	W	-71.00
J-464	W	-71.00
J-465	W	-71.00
J-466	W	-71.00
J-467	126	-71.00
J-468	102	-71.00
J-469	119	-71.00
J-47	W53	-14.00
J-470	63R	-71.00

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J-471	62	-71.00
J-472	131	-71.00
J-473	148	-71.00
J-474	149	-71.00
J-475	103	-71.00
J-476	104	-71.00
J-477	106	-71.00
J-478	115	-71.00
J-479	127	-71.00
J-48		.00
J-480	107	-71.00
J-481	13R	-71.00
J-482	53R	-71.00
J-483	126	-71.00
J-484	128	-71.00
J-485	108	-71.00
J-486	113	-71.00
J-487	126	-71.00
J-488	T6R	-71.00
J-489	110	-71.00
J-49	146R	-71.00
J-490	111	-71.00
J-491	112	-71.00
J-492	125	-71.00
J-493	133	-71.00
J-494	47R	-71.00
J-495	W	-71.00
J-496	W	-71.00
J-497	36R	-71.00
J-498	W	-71.00
J-499	L1 Flare	.00
J-5		.00
J-50		.00
J-501		.00
J-51	W52	-14.00
J-52		.00
J-53	90	-70.00
J-54		.00
J-55	W51	-14.00
J-56		.00
J-57	W50	-14.00
J-58		.00
J-59		.00
J-6	31	-70.00
J-60	W48	-14.00
J-61	W49	-14.00
J-62	W45	-14.00
J-63	W46	-14.00
J-64	W47	-14.00
J-65		.00
J-66	W44	-14.00
J-67		.00
J-68		.00
J-69	W41	-14.00
J-7	29	-70.00
J-70		.00
J-71	W42	-14.00
J-72	W43	-14.00
J-73		.00
J-74	W39	-14.00
J-75	W40	-14.00
J-76		.00

J-77	W38	-14.00
J-78		.00
J-79	W37	-14.00
J-8		.00
J-80		.00
J-81	W36	-14.00
J-82		.00
J-83	W35	-14.00
J-84		.00
J-85	W34	-14.00
J-86		.00
J-87	W32	-14.00
J-88	W33	-14.00
J-89		.00
J-9		.00
J-90		.00
J-91		.00
J-92	W31	-14.00
J-93		.00
J-94	35R	-70.00
J-95		.00
J-96	W	-71.00
J-97	W29	-14.00
J-98	W30	-14.00
J-99		.00
R-1	FLARE COMPOUND	.00
		-60.00

===== RESULTS FOR THIS SIMULATION FOLLOW =====

PIPE NO.	NODE #1	NODE #2	FLOW (USFU)	LOSS (USFU)	VELOCITY (FT/S)	DENSITY (#/CF)	FRICTION FACTOR	AREA RATIO
P- 204	J-283	J-282	70.000	.11	7.92	.064	.0246	.012
P- 205	J-296	J-297	-70.000	.14	7.91	.064	.0246	.012
P- 206	J-292	J-293	-280.000	.54	18.67	.064	.0194	.028
P- 89	J-313	J-95	988.945	.03	8.70	.062	.0180	.013
P- 91	J-95	J-405	1058.944	.07	9.31	.062	.0178	.014
P- 92	J-238	J-222	1340.944	.10	11.80	.062	.0170	.018
P- 93	J-245	J-229	91.413	.00	.81	.062	.0314	.001
P- 96	J-52	J-245	21.413	.00	.19	.062	.0490	.000
P- 97	J-229	J-400	303.413	.01	2.68	.062	.0232	.004
P-1	J-209	J-361	-3133.618	.31	27.73	.062	.0148	.042
P-10	J-197	J-26	2310.977	.27	20.29	.063	.0155	.031
P-100	J-350	J-373	3705.191	.61	32.96	.062	.0144	.050
P-101	J-192	J-191	70.000	.16	8.00	.063	.0246	.012
P-102	J-196	J-195	70.000	.16	8.01	.063	.0246	.012
P-103	J-289	J-290	-210.000	1.02	23.57	.064	.0197	.036
P-104	J-210	J-11	3273.618	.83	29.06	.062	.0147	.044
P-105	J-211	J-210	70.000	.04	8.13	.062	.0246	.012
P-106	J-204	J-203	70.000	.07	8.08	.062	.0246	.012
P-107	J-286	J-295	140.000	.43	15.63	.064	.0213	.024
P-108	J-295	J-294	210.000	1.15	23.50	.064	.0197	.036
P-109	J-186	J-183	70.000	.14	7.99	.063	.0246	.012
P-11	J-6	J-16	-70.000	.11	8.18	.062	.0246	.012
P-110	J-287	J-288	-70.000	.19	7.88	.064	.0246	.012

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P-111	J-247	J-3	624.537	.02	5.50	.062	.0198	.008
P-112	J-250	J-302	71.000	.14	8.15	.063	.0245	.012
P-113	J-35	J-1192	-314.697	.21	13.14	.066	.0197	.020
P-114	J-252	J-465	71.000	.15	8.13	.063	.0245	.012
P-115	J-301	J-463	71.000	.13	8.09	.063	.0245	.012
P-116	J-303	J-450	71.000	.19	8.12	.063	.0245	.012
P-117	J-123	J-124	-14.000	.00	1.54	.065	.0373	.002
P-118	J-64	J-8	14.000	.01	1.53	.066	.0373	.002
P-119	J-19	J-160	356.697	.07	10.60	.065	.0197	.016
P-12	J-376	J-244	71.000	.12	7.96	.064	.0245	.012
P-120	J-73	J-74	-28.000	.01	3.05	.066	.0308	.005
P-121	J-1192	J-1193	-14.000	.00	1.54	.066	.0373	.002
P-122	J-33	J-34	-14.000	.00	1.54	.065	.0373	.002
P-123	J-160	J-161	-14.000	.00	1.54	.065	.0373	.002
P-124	J-158	J-159	-14.000	.00	1.54	.065	.0373	.002
P-125	J-156	J-157	-14.000	.00	1.54	.065	.0373	.002
P-126	J-145	J-22	1000.000	5.40	30.56	.064	.0165	.047
P-127	J-152	J-153	-14.000	.00	1.55	.065	.0373	.002
P-128	J-148	J-149	-14.000	.00	1.56	.065	.0373	.002
P-129	J-146	J-147	-14.000	.00	1.57	.064	.0373	.002
P-13	J-35	J-17	-28.000	.01	3.08	.065	.0308	.005
P-130	J-143	J-144	-15.000	.00	1.68	.064	.0366	.003
P-131	J-141	J-142	-15.000	.00	1.67	.065	.0366	.003
P-132	J-137	J-138	-15.000	.00	1.67	.065	.0366	.003
P-133	J-134	J-135	-15.000	.00	1.66	.065	.0366	.003
P-134	J-129	J-130	-14.000	.00	1.55	.065	.0373	.002
P-135	J-125	J-126	-14.000	.00	1.54	.065	.0373	.002
P-136	J-121	J-122	-14.000	.00	1.54	.066	.0373	.002
P-137	J-119	J-120	-14.000	.00	1.53	.066	.0373	.002
P-138	J-111	J-114	-14.000	.00	1.53	.066	.0373	.002
P-139	J-107	J-108	-14.000	.00	1.53	.066	.0373	.002
P-14	J-287	J-289	-562.000	.85	37.34	.064	.0173	.057
P-140	J-103	J-104	-14.000	.00	1.53	.066	.0373	.002
P-141	J-99	J-100	-14.000	.00	1.53	.066	.0373	.002
P-142	J-91	J-92	-14.000	.00	1.53	.066	.0373	.002
P-143	J-84	J-85	-14.000	.00	1.52	.066	.0373	.002
P-144	J-82	J-83	-14.000	.00	1.52	.066	.0373	.002
P-145	J-80	J-81	-14.000	.00	1.53	.066	.0373	.002
P-146	J-78	J-79	-14.000	.00	1.53	.066	.0373	.002
P-147	J-76	J-77	-14.000	.00	1.53	.066	.0373	.002
P-148	J-70	J-71	-14.000	.00	1.53	.066	.0373	.002
P-149	J-68	J-69	-14.000	.00	1.53	.066	.0373	.002
P-15	J-48	J-45	-1124.000	.66	34.44	.063	.0162	.052
P-150	J-65	J-66	-14.000	.00	1.53	.066	.0373	.002
P-151	J-8	J-63	-14.000	.00	1.53	.066	.0373	.002
P-152	J-59	J-60	-14.000	.00	1.53	.066	.0373	.002
P-153	J-56	J-57	-14.000	.00	1.53	.066	.0373	.002
P-154	J-54	J-55	-14.000	.00	1.53	.066	.0373	.002
P-155	J-41	J-42	-14.000	.00	1.53	.066	.0373	.002
P-156	J-46	J-47	-14.000	.00	1.53	.066	.0373	.002
P-157	J-68	J-67	42.000	.02	4.58	.066	.0277	.007
P-158	J-136	J-137	-30.000	.01	3.34	.065	.0302	.005
P-159	J-131	J-132	-28.000	.04	3.10	.065	.0308	.005
P-16	J-10	J-253	-2211.929	4.55	34.35	.063	.0151	.052
P-160	J-127	J-128	-14.000	.01	1.54	.065	.0373	.002
P-161	J-115	J-116	-42.000	.02	4.60	.066	.0277	.007
P-162	J-116	J-117	-14.000	.01	1.53	.066	.0373	.002
P-163	J-105	J-106	-14.000	.01	1.53	.066	.0373	.002
P-164	J-101	J-102	-14.000	.01	1.53	.066	.0373	.002
P-165	J-97	J-98	-14.000	.01	1.53	.066	.0373	.002
P-166	J-86	J-87	-28.000	.01	3.05	.066	.0308	.005
P-167	J-58	J-59	-28.000	.01	3.05	.066	.0308	.005

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P-168	J-1192	J-37	-300.697	.21	12.54	.066	.0198	.019
P-169	J-14	J-148	-28.000	.01	3.12	.065	.0308	.005
P-17	J-53	J-174	350.000	2.57	39.59	.064	.0182	.060
P-170	J-152	J-151	28.000	.01	3.11	.065	.0308	.005
P-171	J-18	J-156	-398.697	.33	16.70	.065	.0188	.025
P-172	J-19	J-499	.000	.00	.00	.065	.0000	.000
P-173	J-50	J-51	-14.000	.00	1.53	.066	.0373	.002
P-174	J-38	J-39	-14.000	.00	1.53	.066	.0373	.002
P-175	J-305	J-447	71.000	.16	8.16	.063	.0245	.012
P-176	J-187	J-181	-2785.070	.40	24.34	.063	.0151	.037
P-177	J-308	J-307	-71.000	.16	8.18	.062	.0245	.012
P-178	J-22	J-9	1000.000	.13	15.46	.063	.0172	.024
P-179	J-167	J-476	70.000	.18	8.05	.063	.0246	.012
P-18	J-217	J-389	-71.000	.12	8.20	.062	.0245	.012
P-180	J-309	J-460	71.000	.17	8.17	.063	.0245	.012
P-181	J-311	J-446	71.000	.15	8.17	.063	.0245	.012
P-182	J-314	J-443	71.000	.16	8.15	.063	.0245	.012
P-183	J-249	J-275	1831.537	.19	16.16	.062	.0161	.025
P-184	J-318	J-440	71.000	.15	8.19	.062	.0245	.012
P-185	J-320	J-457	71.000	.18	8.15	.063	.0245	.012
P-186	J-322	J-444	71.000	.17	8.16	.063	.0245	.012
P-187	J-324	J-325	71.000	.22	8.20	.062	.0245	.013
P-188	J-326	J-438	71.000	.21	8.16	.063	.0245	.012
P-189	J-328	J-432	71.000	.15	8.17	.063	.0245	.012
P-19	J-392	J-474	71.000	.15	8.13	.063	.0245	.012
P-190	J-221	J-226	70.000	.11	8.05	.063	.0246	.012
P-191	J-330	J-430	71.000	.15	8.18	.062	.0245	.012
P-192	J-332	J-436	71.000	.15	8.18	.062	.0245	.012
P-193	J-29	J-9	-2505.070	.94	38.80	.063	.0148	.059
P-194	J-304	J-334	-71.000	.16	8.19	.062	.0245	.012
P-195	J-336	J-317	71.000	.16	8.20	.062	.0245	.012
P-196	J-338	J-339	71.000	.17	8.17	.063	.0245	.012
P-197	J-182	J-181	210.000	.68	24.02	.063	.0197	.037
P-198	J-183	J-182	140.000	.46	15.99	.063	.0213	.024
P-199	J-171	J-29	-2505.070	.40	21.85	.063	.0153	.033
P-2	J-230	J-94	70.000	.18	8.18	.062	.0246	.012
P-20	J-4	J-242	-3904.618	1.02	35.12	.061	.0143	.054
P-200	J-340	J-424	71.000	.16	8.22	.062	.0245	.013
P-201	J-344	J-343	-71.000	.13	8.22	.062	.0245	.013
P-202	J-345	J-346	71.000	.14	8.23	.062	.0245	.013
P-203	J-347	J-427	71.000	.15	8.22	.062	.0245	.013
P-206	J-3	J-439	-142.000	.58	16.39	.062	.0212	.025
P-207	J-349	J-414	71.000	.15	8.23	.062	.0245	.013
P-208	J-231	J-238	70.000	.14	8.07	.062	.0246	.012
P-209	J-351	J-422	71.000	.16	8.24	.062	.0245	.013
P-21	J-395	J-394	-71.000	.15	8.17	.063	.0245	.012
P-210	J-353	J-243	71.000	.09	8.30	.062	.0245	.013
P-211	J-38	J-41	-272.697	.42	17.64	.066	.0195	.027
P-212	J-41	J-46	-258.697	.40	16.71	.066	.0197	.025
P-213	J-46	J-50	-244.697	.36	15.79	.066	.0199	.024
P-214	J-50	J-54	-230.697	.30	14.87	.066	.0201	.023
P-215	J-54	J-56	-216.697	.26	13.96	.066	.0204	.021
P-216	J-56	J-58	-202.697	.21	13.05	.066	.0207	.020
P-217	J-62	J-58	174.697	.17	11.24	.066	.0213	.017
P-218	J-61	J-59	14.000	.01	1.53	.066	.0373	.002
P-219	J-62	J-65	-132.697	.12	8.54	.066	.0225	.013
P-22	J-72	J-70	14.000	.01	1.53	.066	.0373	.002
P-220	J-65	J-67	-118.697	.10	7.63	.066	.0231	.012
P-221	J-73	J-76	-48.697	.03	3.13	.066	.0284	.005
P-222	J-67	J-73	-76.697	.04	4.93	.066	.0255	.008
P-223	J-76	J-78	-34.697	.01	2.23	.066	.0311	.003
P-224	J-78	J-80	-20.697	.00	1.33	.066	.0359	.002

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P-225	J-80	J-82	-6.697	.00	.43	.066	.0169	.001
P-226	J-82	J-84	7.303	.00	.47	.066	.0499	.001
P-227	J-84	J-86	21.303	.00	1.37	.066	.0356	.002
P-228	J-91	J-97	63.303	.03	4.07	.066	.0267	.006
P-229	J-86	J-91	49.303	.02	3.17	.066	.0284	.005
P-23	J-397	J-494	71.000	.18	8.21	.062	.0245	.013
P-230	J-97	J-99	91.303	.06	5.87	.066	.0245	.009
P-231	J-99	J-101	105.303	.07	6.77	.066	.0237	.010
P-232	J-101	J-103	133.303	.14	8.58	.066	.0225	.013
P-233	J-103	J-105	147.303	.15	9.48	.066	.0220	.014
P-234	J-105	J-107	175.303	.19	11.29	.066	.0213	.017
P-235	J-107	J-109	189.303	.23	12.20	.066	.0209	.019
P-236	J-111	J-115	231.303	.35	14.93	.066	.0201	.023
P-237	J-115	J-119	273.303	.46	17.67	.066	.0195	.027
P-238	J-119	J-121	287.303	.72	18.60	.066	.0193	.028
P-239	J-121	J-123	301.303	.54	19.54	.065	.0192	.030
P-24	J-399	J-493	71.000	.25	8.21	.062	.0245	.013
P-240	J-123	J-125	315.303	.55	20.48	.065	.0190	.031
P-241	J-125	J-127	329.303	.58	21.42	.065	.0189	.033
P-242	J-127	J-129	357.303	.68	23.28	.065	.0186	.035
P-243	J-129	J-131	371.303	.87	24.25	.065	.0185	.037
P-244	J-131	J-134	414.303	.83	27.12	.065	.0182	.041
P-245	J-134	J-136	429.303	.77	28.16	.065	.0181	.043
P-246	J-136	J-141	459.303	1.10	30.21	.065	.0179	.046
P-247	J-141	J-143	474.303	1.26	31.29	.064	.0178	.048
P-248	J-143	J-145	489.303	1.11	32.39	.064	.0177	.049
P-249	J-145	J-146	-510.697	1.53	33.79	.064	.0176	.051
P-25	J-401	J-402	71.000	.17	8.23	.062	.0245	.013
P-250	J-146	J-14	-496.697	1.25	32.74	.064	.0176	.050
P-251	J-14	J-151	-468.697	1.56	30.77	.065	.0178	.047
P-252	J-151	J-155	-440.697	1.07	28.83	.065	.0180	.044
P-253	J-181	J-171	-2575.070	.23	22.48	.063	.0152	.034
P-254	J-150	J-148	14.000	.01	1.56	.065	.0373	.002
P-255	J-155	J-18	-426.697	1.11	27.83	.065	.0181	.042
P-256	J-18	J-20	-14.000	.01	1.54	.065	.0373	.002
P-257	J-193	J-164	3205.070	.42	28.08	.063	.0147	.043
P-258	J-156	J-158	-384.697	.31	16.10	.065	.0189	.025
P-259	J-154	J-152	14.000	.01	1.55	.065	.0373	.002
P-26	J-404	J-403	-71.000	.16	8.27	.062	.0245	.013
P-260	J-158	J-160	-370.697	.34	15.50	.065	.0191	.024
P-261	J-62	J-8	-28.000	.04	3.05	.066	.0308	.005
P-262	J-70	J-68	28.000	.04	3.05	.066	.0308	.005
P-263	J-17	J-40	-14.000	.01	1.54	.065	.0373	.002
P-264	J-118	J-116	14.000	.01	1.53	.066	.0373	.002
P-265	J-140	J-137	15.000	.01	1.67	.065	.0366	.003
P-266	J-37	J-38	-286.697	.48	18.56	.066	.0193	.028
P-267	J-74	J-75	-14.000	.01	1.53	.066	.0373	.002
P-268	J-87	J-88	-14.000	.01	1.52	.066	.0373	.002
P-269	J-109	J-110	203.303	.26	13.11	.066	.0206	.020
P-27	J-406	J-407	71.000	.06	8.20	.062	.0245	.012
P-270	J-110	J-111	217.303	.29	14.02	.066	.0204	.021
P-271	J-132	J-133	-14.000	.01	1.55	.065	.0373	.002
P-272	J-197	J-24	-2240.977	.26	19.66	.063	.0156	.030
P-273	J-199	J-26	-2380.977	.29	20.92	.062	.0154	.032
P-274	J-199	J-215	2450.977	.28	21.55	.062	.0154	.033
P-275	J-203	J-201	-2309.032	.27	20.34	.062	.0155	.031
P-276	J-201	J-30	-2239.032	.27	19.71	.062	.0156	.030
P-277	J-203	J-205	2379.032	.30	20.97	.062	.0154	.032
P-278	J-207	J-1	-2519.032	.34	22.25	.062	.0153	.034
P-279	J-1	J-205	-2449.032	.31	21.61	.062	.0154	.033
P-28	J-11	J-15	3343.618	.58	29.74	.062	.0146	.045
P-280	J-162	J-173	-1365.070	.58	21.04	.063	.0163	.032

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P-281	J-354	J-429	71.000	.14	8.22	.062	.0245	.013
P-282	J-356	J-359	71.000	.15	8.24	.062	.0245	.013
P-283	J-162	J-163	-140.000	.27	15.91	.063	.0213	.024
P-284	J-190	J-187	210.000	.51	24.06	.063	.0197	.037
P-285	J-28	J-163	70.000	.11	7.95	.063	.0246	.012
P-286	J-254	J-257	-1123.000	.95	34.36	.064	.0162	.052
P-287	J-264	J-265	-140.000	.54	15.72	.064	.0213	.024
P-288	J-257	J-259	-1053.000	1.10	32.13	.064	.0163	.049
P-289	J-259	J-263	-843.000	.70	25.65	.064	.0169	.039
P-29	J-408	J-409	71.000	.09	8.31	.062	.0245	.013
P-290	J-263	J-267	-633.000	.38	19.23	.064	.0177	.029
P-291	J-253	J-276	-1018.930	.28	15.71	.063	.0171	.024
P-292	J-276	J-165	-140.000	.19	15.91	.063	.0213	.024
P-293	J-165	J-277	-70.000	.10	7.95	.063	.0246	.012
P-294	J-276	J-278	-878.930	.24	13.54	.063	.0176	.021
P-295	J-278	J-168	-210.000	.42	23.84	.063	.0197	.036
P-296	J-168	J-166	-70.000	.11	7.94	.063	.0246	.012
P-297	J-278	J-281	-668.930	.21	10.30	.063	.0185	.016
P-298	J-281	J-170	-210.000	.40	23.83	.063	.0197	.036
P-299	J-329	J-335	787.947	.02	6.96	.062	.0189	.011
P-3	J-210	J-209	-3203.618	.53	28.38	.062	.0147	.043
P-30	J-411	J-410	-71.000	.05	8.33	.061	.0245	.013
P-300	J-360	J-331	71.000	.16	8.22	.062	.0245	.013
P-301	J-281	J-48	-458.930	.05	7.06	.063	.0200	.011
P-302	J-45	J-43	-421.000	.32	18.11	.064	.0186	.028
P-303	J-48	J-173	665.070	.14	10.24	.063	.0185	.016
P-304	J-191	J-190	140.000	.48	16.01	.063	.0213	.024
P-305	J-174	J-173	700.000	.30	21.46	.063	.0174	.033
P-306	J-362	J-363	71.000	.16	8.24	.062	.0245	.013
P-307	J-176	J-174	350.000	.08	10.72	.063	.0198	.016
P-308	J-176	J-299	-70.000	.02	2.14	.063	.0285	.003
P-309	J-364	J-495	71.000	.13	8.21	.062	.0245	.013
P-31	J-341	J-475	70.000	.17	8.04	.063	.0246	.012
P-310	J-194	J-193	210.000	.34	24.09	.063	.0197	.037
P-311	J-195	J-194	140.000	.48	16.04	.063	.0213	.024
P-312	J-184	J-371	-284.000	.60	19.55	.062	.0194	.030
P-313	J-368	J-273	71.000	.15	8.21	.062	.0245	.013
P-314	J-241	J-245	70.000	.09	8.11	.062	.0246	.012
P-315	J-370	J-496	71.000	.14	8.26	.062	.0245	.013
P-316	J-372	J-387	71.000	.15	8.23	.062	.0245	.013
P-317	J-374	J-375	71.000	.14	8.25	.062	.0245	.013
P-318	J-265	J-266	-70.000	.11	7.85	.064	.0246	.012
P-319	J-256	J-272	-283.000	.51	18.75	.064	.0194	.029
P-32	J-90	J-139	3481.576	1.17	30.75	.062	.0145	.047
P-320	J-267	J-256	-563.000	.30	17.09	.064	.0181	.026
P-321	J-412	J-413	71.000	.14	7.93	.064	.0245	.012
P-322	J-279	J-168	140.000	.38	15.87	.063	.0213	.024
P-323	J-377	J-419	71.000	.15	8.18	.062	.0245	.012
P-324	J-379	J-386	71.000	.22	8.24	.062	.0245	.013
P-325	J-381	J-420	71.000	.15	8.22	.062	.0245	.013
P-326	J-383	J-243	-4273.190	.64	38.15	.061	.0141	.058
P-327	J-384	J-426	71.000	.15	8.21	.062	.0245	.013
P-328	J-5	J-236	3808.288	1.53	33.96	.062	.0144	.052
P-329	J-36	J-411	-5345.990	1.80	48.05	.061	.0137	.073
P-33	J-32	J-291	70.000	.18	7.83	.064	.0246	.012
P-330	J-367	J-404	70.000	.13	8.15	.062	.0246	.012
P-331	J-52	J-489	-212.000	1.14	24.54	.062	.0197	.037
P-332	J-224	J-313	425.000	.68	18.60	.062	.0186	.028
P-333	J-244	J-284	212.000	.21	14.03	.064	.0205	.021
P-334	J-413	J-112	283.000	1.34	31.68	.064	.0188	.048
P-335	J-365	J-184	4707.990	1.57	41.87	.062	.0139	.064
P-336	J-184	J-409	5203.990	.78	46.44	.062	.0138	.071

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P-337	J-409	J-411	5274.990	1.21	47.21	.061	.0137	.072
P-338	J-237	J-15	-3413.618	.59	30.41	.062	.0146	.046
P-339	J-501	R-1	5306.090	3.09	48.03	.061	.0137	.073
P-34	J-179	J-89	70.000	.15	7.89	.064	.0246	.012
P-340	J-236	J-93	5862.448	2.66	52.64	.061	.0135	.080
P-341	J-175	J-407	2741.040	.87	24.12	.062	.0151	.037
P-342	J-501	J-36	1006.862	.03	9.06	.061	.0180	.014
P-343	J-93	R-1	5436.437	3.10	49.21	.061	.0137	.075
P-344	J-36	J-4	1142.750	.04	10.29	.061	.0176	.016
P-345	J-5	J-383	3667.913	1.41	32.70	.062	.0144	.050
P-346	J-352	J-21	284.000	.56	19.50	.062	.0194	.030
P-347	J-5	J-21	-3889.212	.54	34.59	.062	.0143	.053
P-348	J-96	J-385	-71.000	.15	8.25	.062	.0245	.013
P-349	J-21	J-96	-3392.213	.39	30.12	.062	.0146	.046
P-35	J-93	J-501	426.011	.01	3.83	.061	.0215	.006
P-350	J-5	J-355	-3586.988	1.26	31.86	.062	.0145	.049
P-351	J-355	J-391	-3160.988	1.29	27.97	.062	.0148	.043
P-352	J-391	J-333	-1947.041	.55	17.18	.062	.0160	.026
P-353	J-333	J-247	-1379.042	.28	12.15	.062	.0170	.019
P-354	J-247	J-246	-2003.579	.53	17.64	.062	.0159	.027
P-355	J-10	J-246	2347.983	.48	20.65	.062	.0155	.031
P-356	J-10	J-310	-136.053	.00	1.20	.062	.0282	.002
P-357	J-407	J-90	2812.040	.27	24.79	.062	.0150	.038
P-358	J-212	J-175	785.947	.03	6.91	.062	.0189	.011
P-359	J-212	J-300	-71.000	.08	8.18	.062	.0245	.012
P-36	J-52	J-361	544.587	.01	4.82	.062	.0204	.007
P-360	J-233	J-188	-70.000	.05	8.06	.062	.0246	.012
P-361	J-310	J-233	5.947	.00	.05	.062	.0376	.000
P-362	J-233	J-212	501.947	.02	4.41	.062	.0207	.007
P-363	J-302	J-233	426.000	1.18	28.92	.063	.0181	.044
P-364	J-306	J-323	-284.000	.33	19.32	.062	.0194	.029
P-365	J-323	J-312	-71.000	.16	8.18	.062	.0245	.012
P-366	J-308	J-306	284.000	.35	19.32	.062	.0194	.029
P-367	J-306	J-246	-344.404	.01	3.03	.062	.0225	.005
P-368	J-235	J-306	-1054.404	.07	9.28	.062	.0178	.014
P-369	J-248	J-451	-213.000	1.59	24.53	.062	.0197	.037
P-37	J-35	J-33	342.697	.25	14.31	.065	.0193	.022
P-370	J-235	J-248	1409.404	.11	12.40	.062	.0169	.019
P-371	J-315	J-319	1334.537	.10	11.76	.062	.0171	.018
P-372	J-275	J-251	290.947	.01	2.57	.062	.0234	.004
P-373	J-248	J-453	1906.404	.20	16.79	.062	.0160	.026
P-374	J-274	J-458	928.622	.07	8.19	.062	.0183	.012
P-375	J-331	J-391	1213.947	.06	10.72	.062	.0174	.016
P-376	J-365	J-369	-355.000	1.00	24.32	.062	.0186	.037
P-377	J-315	J-3	-979.537	.03	8.63	.062	.0181	.013
P-378	J-319	J-325	1547.537	.16	13.64	.062	.0166	.021
P-379	J-325	J-249	1689.538	.16	14.90	.062	.0164	.023
P-38	J-164	J-468	1034.093	.07	9.06	.063	.0179	.014
P-380	J-249	J-316	-71.000	.15	8.21	.062	.0245	.013
P-381	J-339	J-337	-71.000	.15	8.17	.063	.0245	.012
P-382	J-317	J-339	-213.000	1.19	24.57	.062	.0197	.037
P-383	J-304	J-317	284.000	.21	19.36	.062	.0194	.030
P-384	J-317	J-333	568.000	.24	17.73	.062	.0181	.027
P-385	J-251	J-435	361.947	.01	3.19	.062	.0223	.005
P-386	J-335	J-331	929.947	.03	8.21	.062	.0183	.013
P-387	J-335	J-358	-71.000	.14	8.22	.062	.0245	.013
P-388	J-359	J-357	-71.000	.14	8.24	.062	.0245	.013
P-389	J-363	J-359	284.000	.24	19.46	.062	.0194	.030
P-39	J-178	J-89	70.000	.09	7.89	.064	.0246	.012
P-390	J-359	J-355	426.000	.26	18.80	.062	.0186	.029
P-391	J-348	J-96	3037.213	.66	26.93	.062	.0148	.041
P-392	J-352	J-342	-71.000	.14	8.25	.062	.0245	.013

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P-393	J-373	J-243	4202.190	.59	37.45	.062	.0142	.057
P-394	J-375	J-380	284.000	.52	19.49	.062	.0194	.030
P-395	J-380	J-373	497.000	.92	34.19	.062	.0176	.052
P-396	J-350	J-378	-3492.191	.41	31.02	.062	.0145	.047
P-397	J-274	J-421	2569.191	.29	22.68	.062	.0152	.035
P-398	J-382	J-346	-2782.191	.44	24.61	.062	.0151	.038
P-399	J-378	J-415	-3066.191	.48	27.20	.062	.0148	.041
P-4	J-7	J-11	70.000	.07	8.15	.062	.0246	.012
P-40	J-180	J-286	70.000	.15	7.81	.065	.0246	.012
P-400	J-274	J-459	-1307.408	.09	11.53	.062	.0171	.018
P-401	J-369	J-273	-142.000	.54	16.45	.062	.0212	.025
P-402	J-371	J-366	-71.000	.15	8.27	.062	.0245	.013
P-403	J-404	J-184	212.000	.82	24.73	.062	.0197	.038
P-404	J-400	J-402	516.413	.02	4.57	.062	.0206	.007
P-405	J-402	J-398	658.413	.02	5.82	.062	.0196	.009
P-406	J-398	J-139	871.413	.03	7.71	.062	.0185	.012
P-407	J-361	J-207	-2589.032	.30	22.89	.062	.0152	.035
P-408	J-94	J-232	-70.000	.18	8.18	.062	.0246	.012
P-409	J-216	J-313	282.000	.38	19.18	.062	.0194	.029
P-41	J-185	J-467	70.000	.14	7.84	.064	.0246	.012
P-410	J-390	J-480	71.000	.19	8.15	.063	.0245	.012
P-411	J-238	J-405	-1129.944	.07	9.94	.062	.0176	.015
P-412	J-222	J-482	-212.000	1.19	24.43	.062	.0197	.037
P-413	J-222	J-484	1692.944	.17	14.90	.062	.0163	.023
P-414	J-217	J-90	1834.945	.28	16.17	.062	.0161	.025
P-415	J-214	J-470	-1317.093	.07	11.55	.063	.0171	.018
P-416	J-395	J-393	1671.093	.15	14.67	.063	.0164	.022
P-417	J-214	J-472	1458.093	.14	12.79	.063	.0168	.020
P-418	J-393	J-175	1955.093	.17	17.18	.062	.0159	.026
P-419	J-89	J-285	140.000	.24	15.79	.064	.0213	.024
P-42	J-189	J-49	70.000	.17	7.80	.065	.0246	.012
P-420	J-386	J-380	142.000	.61	16.51	.062	.0212	.025
P-421	J-387	J-375	142.000	.63	16.49	.062	.0212	.025
P-422	J-388	J-350	213.000	1.06	24.78	.062	.0197	.038
P-423	J-414	J-388	142.000	.55	16.48	.062	.0212	.025
P-424	J-415	J-382	-2995.191	.47	26.53	.062	.0149	.040
P-425	J-416	J-378	355.000	.95	24.34	.062	.0186	.037
P-426	J-417	J-416	284.000	.58	19.43	.062	.0194	.030
P-427	J-418	J-417	213.000	1.16	24.64	.062	.0197	.038
P-428	J-419	J-418	142.000	.53	16.38	.062	.0212	.025
P-429	J-420	J-382	142.000	.59	16.46	.062	.0212	.025
P-43	J-396	J-405	71.000	.08	8.19	.062	.0245	.012
P-430	J-421	J-346	2640.191	.35	23.33	.062	.0152	.036
P-431	J-422	J-352	142.000	.57	16.49	.062	.0212	.025
P-432	J-423	J-21	213.000	1.15	24.76	.062	.0197	.038
P-433	J-424	J-423	142.000	.57	16.47	.062	.0212	.025
P-434	J-425	J-96	213.000	1.18	24.74	.062	.0197	.038
P-435	J-426	J-425	142.000	.55	16.45	.062	.0212	.025
P-436	J-427	J-348	142.000	.69	16.47	.062	.0212	.025
P-437	J-348	J-428	-2824.213	.41	25.00	.062	.0150	.038
P-438	J-428	J-344	-2753.213	.38	24.34	.062	.0151	.037
P-439	J-429	J-363	142.000	.50	16.47	.062	.0212	.025
P-44	J-213	J-471	70.000	.17	8.04	.063	.0246	.012
P-440	J-430	J-498	142.000	.51	16.37	.062	.0212	.025
P-441	J-431	J-329	213.000	1.47	24.61	.062	.0197	.037
P-442	J-432	J-431	142.000	.71	16.35	.062	.0212	.025
P-443	J-433	J-329	574.947	.02	5.08	.062	.0201	.008
P-444	J-434	J-433	503.947	.02	4.45	.062	.0207	.007
P-445	J-435	J-434	432.947	.01	3.82	.062	.0214	.006
P-446	J-436	J-304	142.000	.56	16.38	.062	.0212	.025
P-447	J-437	J-3	213.000	1.23	24.57	.062	.0197	.037
P-448	J-438	J-437	142.000	.55	16.33	.063	.0212	.025

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P-449	J-439	J-327	-71.000	.16	8.19	.062	.0245	.012
P-45	J-215	J-313	281.944	.00	2.48	.062	.0236	.004
P-450	J-440	J-319	142.000	.57	16.40	.062	.0212	.025
P-451	J-441	J-315	284.000	.61	19.35	.062	.0194	.029
P-452	J-442	J-441	213.000	1.18	24.53	.062	.0197	.037
P-453	J-443	J-442	142.000	.51	16.31	.063	.0212	.025
P-454	J-444	J-445	142.000	.55	16.34	.063	.0212	.025
P-455	J-445	J-323	213.000	.33	24.54	.062	.0197	.037
P-456	J-446	J-306	142.000	.77	16.36	.062	.0212	.025
P-457	J-447	J-308	142.000	.85	16.34	.063	.0212	.025
P-458	J-448	J-235	284.000	.77	19.32	.062	.0194	.029
P-459	J-449	J-448	213.000	1.60	24.47	.063	.0197	.037
P-46	J-218	J-222	70.000	.16	8.07	.062	.0246	.012
P-460	J-450	J-449	142.000	.60	16.26	.063	.0212	.025
P-461	J-451	J-452	-142.000	.55	16.30	.063	.0212	.025
P-462	J-452	J-321	-71.000	.14	8.14	.063	.0245	.012
P-463	J-453	J-454	1977.404	.21	17.42	.062	.0159	.027
P-464	J-454	J-455	2048.404	.21	18.06	.062	.0158	.028
P-465	J-455	J-274	2119.404	.24	18.70	.062	.0157	.028
P-466	J-456	J-248	213.000	1.39	24.54	.062	.0197	.037
P-467	J-457	J-456	142.000	.54	16.31	.063	.0212	.025
P-468	J-458	J-275	999.622	.07	8.82	.062	.0180	.013
P-469	J-459	J-466	-1236.408	.13	10.90	.062	.0173	.017
P-47	J-220	J-481	70.000	.15	8.06	.062	.0246	.012
P-470	J-460	J-310	142.000	.40	16.35	.063	.0212	.025
P-471	J-461	J-302	284.000	.68	19.23	.063	.0194	.029
P-472	J-462	J-461	213.000	1.28	24.37	.063	.0197	.037
P-473	J-463	J-462	142.000	.58	16.20	.063	.0212	.025
P-474	J-464	J-212	213.000	1.46	24.49	.063	.0197	.037
P-475	J-465	J-464	142.000	.60	16.28	.063	.0212	.025
P-476	J-466	J-90	-1165.408	.09	10.27	.062	.0175	.016
P-477	J-467	J-244	141.000	.30	15.80	.064	.0213	.024
P-478	J-468	J-469	1105.093	.07	9.69	.063	.0177	.015
P-479	J-469	J-226	1176.093	.07	10.31	.063	.0175	.016
P-48	J-172	J-163	70.000	.12	7.95	.063	.0246	.012
P-480	J-470	J-226	-1246.093	.11	10.93	.063	.0173	.017
P-481	J-471	J-214	141.000	.35	16.21	.063	.0213	.025
P-482	J-472	J-395	1529.093	.12	13.42	.063	.0166	.020
P-483	J-473	J-393	213.000	1.21	24.49	.063	.0197	.037
P-484	J-474	J-473	142.000	.57	16.28	.063	.0212	.025
P-485	J-475	J-216	141.000	.77	16.22	.063	.0213	.025
P-486	J-476	J-216	141.000	.24	16.23	.063	.0213	.025
P-487	J-477	J-224	283.000	.22	19.22	.063	.0194	.029
P-488	J-478	J-477	212.000	1.38	24.34	.063	.0197	.037
P-489	J-479	J-478	141.000	.69	16.14	.063	.0213	.025
P-49	J-176	J-23	-280.000	.72	31.74	.063	.0188	.048
P-490	J-480	J-224	142.000	.63	16.33	.063	.0212	.025
P-491	J-481	J-238	141.000	.52	16.25	.062	.0213	.025
P-492	J-482	J-483	-141.000	.55	16.20	.063	.0213	.025
P-493	J-483	J-219	-70.000	.15	8.04	.063	.0246	.012
P-494	J-484	J-217	1763.944	.11	15.54	.062	.0162	.024
P-495	J-485	J-52	354.000	1.26	24.18	.062	.0186	.037
P-496	J-486	J-485	283.000	.65	19.28	.062	.0194	.029
P-497	J-487	J-486	212.000	1.28	24.41	.063	.0197	.037
P-498	J-488	J-487	141.000	.52	16.19	.063	.0213	.025
P-499	J-489	J-490	-141.000	.64	16.28	.062	.0213	.025
P-5	J-12	J-15	70.000	.06	8.16	.062	.0246	.012
P-50	J-44	J-45	703.000	.96	30.23	.064	.0171	.046
P-500	J-490	J-227	-70.000	.19	8.07	.062	.0246	.012
P-501	J-491	J-229	212.000	.52	24.56	.062	.0197	.037
P-502	J-492	J-491	141.000	.50	16.31	.062	.0213	.025
P-503	J-493	J-400	142.000	.63	16.45	.062	.0212	.025

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P-504	J-494	J-398	142.000	.62	16.45	.062	.0212	.025
P-505	J-495	J-369	142.000	.57	16.45	.062	.0212	.025
P-506	J-496	J-371	142.000	.57	16.54	.062	.0212	.025
P-507	J-497	J-242	3834.618	.68	34.41	.061	.0143	.052
P-508	J-344	J-275	-2611.212	.35	23.06	.062	.0152	.035
P-509	J-498	J-331	213.000	1.23	24.62	.062	.0197	.038
P-51	J-267	J-268	-70.000	.03	7.87	.064	.0246	.012
P-510	R-1	J-4	-5047.368	3.03	45.68	.061	.0138	.070
P-511	J-383	J-236	2054.160	.12	18.35	.061	.0158	.028
P-512	J-215	J-30	2169.032	.14	19.08	.062	.0157	.029
P-513	J-164	J-24	2170.977	.17	19.03	.063	.0157	.029
P-52	J-169	J-170	70.000	.11	7.93	.063	.0246	.012
P-53	J-280	J-279	70.000	.21	7.93	.064	.0246	.012
P-54	J-113	J-165	70.000	.11	7.95	.063	.0246	.012
P-55	J-49	J-413	141.000	.90	15.73	.065	.0213	.024
P-56	J-254	J-255	-70.000	.08	7.93	.063	.0246	.012
P-57	J-257	J-258	-70.000	.07	7.91	.064	.0246	.012
P-58	J-259	J-260	-210.000	.45	23.67	.064	.0197	.036
P-59	J-263	J-264	-210.000	.48	23.62	.064	.0197	.036
P-6	J-36	R-1	5210.102	3.06	47.16	.061	.0138	.072
P-60	J-272	J-112	-283.000	.20	18.73	.064	.0194	.029
P-61	J-223	J-479	70.000	.13	8.00	.063	.0246	.012
P-62	J-9	J-162	-1505.070	.88	23.24	.063	.0160	.035
P-63	J-19	J-33	-356.697	.16	10.60	.065	.0197	.016
P-64	J-225	J-488	70.000	.16	8.03	.063	.0246	.012
P-65	J-22	J-239	.000	.00	.00	.063	.0000	.000
P-66	J-228	J-492	70.000	.17	8.09	.062	.0246	.012
P-67	J-290	J-291	-140.000	.45	15.68	.064	.0213	.024
P-68	J-293	J-285	-210.000	.32	13.99	.064	.0205	.021
P-69	J-43	J-292	-350.000	.32	15.04	.064	.0193	.023
P-7	J-23	J-296	-140.000	.57	15.84	.064	.0213	.024
P-70	J-234	J-497	3763.618	.88	33.69	.061	.0144	.051
P-71	J-294	J-53	280.000	1.91	31.47	.064	.0188	.048
P-72	J-260	J-261	-140.000	.57	15.75	.064	.0213	.024
P-73	J-261	J-262	-70.000	.12	7.87	.064	.0246	.012
P-74	J-271	J-269	70.000	.10	7.83	.064	.0246	.012
P-75	J-269	J-256	210.000	1.37	23.55	.064	.0197	.036
P-76	J-94	J-234	210.000	.86	24.58	.061	.0197	.037
P-77	J-501	J-383	-5886.942	2.78	52.85	.061	.0135	.080
P-78	J-13	J-95	70.000	.09	8.07	.062	.0246	.012
P-79	J-237	J-234	3553.618	.94	31.73	.061	.0145	.048
P-8	J-202	J-201	70.000	.05	8.08	.062	.0246	.012
P-80	J-193	J-187	-2995.070	.45	26.21	.063	.0149	.040
P-81	J-269	J-270	-70.000	.12	7.83	.064	.0246	.012
P-82	J-177	J-171	70.000	.13	8.01	.063	.0246	.012
P-83	J-25	J-24	70.000	.04	8.04	.063	.0246	.012
P-84	J-198	J-197	70.000	.08	8.05	.063	.0246	.012
P-85	J-27	J-26	70.000	.08	8.06	.063	.0246	.012
P-86	J-200	J-199	70.000	.05	8.06	.062	.0246	.012
P-87	J-31	J-30	70.000	.03	8.07	.062	.0246	.012
P-88	J-240	J-242	70.000	.05	8.24	.061	.0246	.013
P-89	J-206	J-205	70.000	.10	8.09	.062	.0246	.012
P-9	J-6	J-237	140.000	.06	9.65	.062	.0223	.015
P-90	J-2	J-1	70.000	.08	8.10	.062	.0246	.012
P-91	J-208	J-207	70.000	.05	8.11	.062	.0246	.012
P-92	J-298	J-23	70.000	.13	7.92	.064	.0246	.012
P-94	J-139	J-365	4352.990	.87	38.57	.062	.0141	.059
P-95	J-44	J-287	-632.000	1.09	27.10	.064	.0174	.041
P-96	J-289	J-284	-282.000	.64	18.69	.064	.0194	.028
P-98	J-282	J-170	140.000	.61	15.86	.064	.0213	.024
P-99	J-253	J-254	-1193.000	1.17	36.61	.063	.0160	.056
R-1	R-1	R-1	-21000.000	.00	.08	.060	.0211	.000

JUNCTION NAME	NODE TITLE	DEMAND (USFU)	PRESSURE (USPU)	PRESSURE (PSIA)	PRESSURE (PSIG)	DENSITY #/CF
J-1		.00	-49.99	12.89	-1.80	.062
J-10		.00	-48.34	12.95	-1.74	.062
J-100	W28	-14.00	-27.91	13.69	-1.01	.066
J-101	W26	-14.00	-27.98	13.69	-1.01	.066
J-102	W27	-14.00	-27.96	13.69	-1.01	.066
J-103		.00	-28.11	13.68	-1.01	.066
J-104	W25	-14.00	-28.11	13.68	-1.01	.066
J-105	W23	-14.00	-28.26	13.68	-1.02	.066
J-106	W24	-14.00	-28.25	13.68	-1.02	.066
J-107		.00	-28.45	13.67	-1.03	.066
J-108	W22	-14.00	-28.45	13.67	-1.03	.066
J-109	W21	-14.00	-28.69	13.66	-1.03	.066
J-11		.00	-52.30	12.81	-1.89	.062
J-110	W19	-14.00	-28.95	13.65	-1.04	.066
J-111		.00	-29.24	13.64	-1.05	.066
J-112		.00	-38.48	13.31	-1.39	.064
J-113	77	-70.00	-43.20	13.14	-1.56	.063
J-114	W18	-14.00	-29.23	13.64	-1.05	.066
J-115		.00	-29.59	13.63	-1.07	.066
J-116	W16	-14.00	-29.57	13.63	-1.07	.066
J-117	W20	-14.00	-29.55	13.63	-1.07	.066
J-118	W17	-14.00	-29.56	13.63	-1.07	.066
J-119		.00	-30.05	13.61	-1.08	.066
J-1192		.00	-30.89	13.58	-1.11	.066
J-1193	W57	-14.00	-30.88	13.58	-1.11	.066
J-12	30	-70.00	-52.82	12.79	-1.91	.062
J-120	W15	-14.00	-30.04	13.61	-1.08	.066
J-121		.00	-30.77	13.59	-1.11	.066
J-122	W14	-14.00	-30.77	13.59	-1.11	.066
J-123		.00	-31.32	13.57	-1.13	.065
J-124	W13	-14.00	-31.31	13.57	-1.13	.065
J-125		.00	-31.87	13.55	-1.15	.065
J-126	W12	-14.00	-31.86	13.55	-1.15	.065
J-127	W11	-14.00	-32.45	13.53	-1.17	.065
J-128	W10	-14.00	-32.44	13.53	-1.17	.065
J-129		.00	-33.13	13.50	-1.20	.065
J-13	105	-70.00	-48.64	12.94	-1.76	.062
J-130	W9	-14.00	-33.13	13.50	-1.20	.065
J-131	W6	-15.00	-34.01	13.47	-1.23	.065
J-132	W7	-14.00	-33.96	13.47	-1.23	.065
J-133	W8	-14.00	-33.95	13.47	-1.22	.065
J-134		.00	-34.83	13.44	-1.26	.065
J-135	W5	-15.00	-34.83	13.44	-1.26	.065
J-136		.00	-35.60	13.41	-1.28	.065
J-137		.00	-35.59	13.41	-1.28	.065
J-138	W3	-15.00	-35.59	13.41	-1.28	.065
J-139		.00	-50.71	12.87	-1.83	.062
J-14		.00	-36.29	13.39	-1.31	.065
J-140	W4	-15.00	-35.58	13.41	-1.28	.065
J-141		.00	-36.70	13.37	-1.32	.065
J-142	W2	-15.00	-36.70	13.37	-1.32	.065
J-143		.00	-37.96	13.33	-1.37	.064
J-144	W1	-15.00	-37.95	13.33	-1.37	.064
J-145		.00	-39.07	13.29	-1.41	.064
J-146		.00	-37.54	13.34	-1.35	.064
J-147	W71	-14.00	-37.54	13.34	-1.35	.064

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J-148		.00	-36.28	13.39	-1.31	.065
J-149	W69	-14.00	-36.28	13.39	-1.31	.065
J-15		.00	-52.87	12.79	-1.91	.062
J-150	W70	-14.00	-36.27	13.39	-1.31	.065
J-151		.00	-34.73	13.44	-1.25	.065
J-152		.00	-34.73	13.44	-1.25	.065
J-153	W67	-14.00	-34.73	13.44	-1.25	.065
J-154	W68	-14.00	-34.71	13.44	-1.25	.065
J-155	W66	-14.00	-33.66	13.48	-1.21	.065
J-156		.00	-32.23	13.53	-1.16	.065
J-157	W63	-14.00	-32.22	13.53	-1.16	.065
J-158		.00	-31.91	13.54	-1.15	.065
J-159	W62	-14.00	-31.91	13.54	-1.15	.065
J-16	32	-70.00	-53.29	12.77	-1.92	.062
J-160		.00	-31.57	13.56	-1.14	.065
J-161	W61	-14.00	-31.56	13.56	-1.14	.065
J-162		.00	-43.71	13.12	-1.58	.063
J-163		.00	-43.45	13.13	-1.57	.063
J-164		.00	-47.42	12.98	-1.71	.063
J-165		.00	-43.31	13.13	-1.56	.063
J-166	81	-70.00	-42.73	13.15	-1.54	.063
J-167	117	-70.00	-47.89	12.97	-1.73	.063
J-168		.00	-42.84	13.15	-1.55	.063
J-169	82	-70.00	-42.53	13.16	-1.53	.063
J-17	W58	-14.00	-31.09	13.57	-1.12	.065
J-170		.00	-42.64	13.16	-1.54	.063
J-171		.00	-45.92	13.04	-1.66	.063
J-172	94	-70.00	-43.33	13.13	-1.56	.063
J-173		.00	-43.13	13.14	-1.56	.063
J-174		.00	-42.83	13.15	-1.55	.063
J-175		.00	-48.39	12.95	-1.75	.062
J-176		.00	-42.76	13.15	-1.54	.063
J-177	96	-70.00	-45.79	13.04	-1.65	.063
J-178	130R	-70.00	-40.51	13.23	-1.46	.064
J-179	123	-70.00	-40.45	13.24	-1.46	.064
J-18	W64	-14.00	-32.55	13.52	-1.17	.065
J-180	123R	-70.00	-36.63	13.37	-1.32	.065
J-181		.00	-46.15	13.03	-1.67	.063
J-182	1	-70.00	-45.47	13.06	-1.64	.063
J-183	1A	-70.00	-45.02	13.07	-1.62	.063
J-184		.00	-53.15	12.78	-1.92	.062
J-185	129	-70.00	-38.14	13.32	-1.38	.064
J-186	100	-70.00	-44.88	13.08	-1.62	.063
J-187		.00	-46.55	13.02	-1.68	.063
J-188	65R	-70.00	-48.29	12.95	-1.74	.062
J-189	62R	-70.00	-36.08	13.39	-1.30	.065
J-19		.00	-31.50	13.56	-1.14	.065
J-190	2	-70.00	-46.04	13.03	-1.66	.063
J-191	2A	-70.00	-45.56	13.05	-1.64	.063
J-192	2B	-70.00	-45.41	13.06	-1.64	.063
J-193		.00	-46.99	13.00	-1.70	.063
J-194	3	-70.00	-46.65	13.01	-1.68	.063
J-195	3A	-70.00	-46.17	13.03	-1.67	.063
J-196	101	-70.00	-46.01	13.04	-1.66	.063
J-197		.00	-47.85	12.97	-1.73	.063
J-198	7	-70.00	-47.77	12.97	-1.72	.063
J-199		.00	-48.41	12.95	-1.75	.062
J-2	22	-70.00	-49.91	12.89	-1.80	.062
J-20	W65	-14.00	-32.54	13.52	-1.17	.065
J-200	11	-70.00	-48.37	12.95	-1.75	.062
J-201		.00	-49.10	12.92	-1.77	.062
J-202	15	-70.00	-49.06	12.93	-1.77	.062

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J-203		.00	-49.38	12.91	-1.78	.062
J-204	18	-70.00	-49.31	12.92	-1.78	.062
J-205		.00	-49.68	12.90	-1.79	.062
J-206	19	-70.00	-49.58	12.91	-1.79	.062
J-207		.00	-50.33	12.88	-1.82	.062
J-208	23	-70.00	-50.29	12.88	-1.81	.062
J-209	26	-70.00	-50.94	12.86	-1.84	.062
J-21		.00	-52.17	12.81	-1.88	.062
J-210		.00	-51.47	12.84	-1.86	.062
J-211	27	-70.00	-51.43	12.84	-1.86	.062
J-212		.00	-48.36	12.95	-1.75	.062
J-213	132	-70.00	-47.29	12.99	-1.71	.063
J-214		.00	-47.81	12.97	-1.73	.063
J-215		.00	-48.70	12.94	-1.76	.062
J-216		.00	-48.32	12.95	-1.74	.062
J-217		.00	-49.26	12.92	-1.78	.062
J-218	58R	-70.00	-48.81	12.93	-1.76	.062
J-219	52R	-70.00	-47.09	13.00	-1.70	.063
J-22		.00	-44.46	13.09	-1.60	.063
J-220	124	-70.00	-48.21	12.96	-1.74	.063
J-221	9R	-70.00	-47.52	12.98	-1.71	.063
J-222	125	-70.00	-48.98	12.93	-1.77	.062
J-223	T5R	-70.00	-45.60	13.05	-1.65	.063
J-224		.00	-48.02	12.96	-1.73	.063
J-225	48R	-70.00	-46.76	13.01	-1.69	.063
J-226		.00	-47.63	12.98	-1.72	.063
J-227	124	-70.00	-48.65	12.94	-1.76	.062
J-228	T7R	-70.00	-49.43	12.91	-1.78	.062
J-229		.00	-50.62	12.87	-1.83	.062
J-23	91	-70.00	-42.04	13.18	-1.52	.064
J-230	T9	-70.00	-53.36	12.77	-1.93	.062
J-231	17R	-70.00	-48.74	12.94	-1.76	.062
J-232	34	-70.00	-53.35	12.77	-1.93	.062
J-233		.00	-48.34	12.95	-1.74	.062
J-234		.00	-54.40	12.73	-1.96	.061
J-235	W	-71.00	-48.89	12.93	-1.76	.062
J-236		.00	-54.24	12.74	-1.96	.061
J-237		.00	-53.46	12.77	-1.93	.062
J-238		.00	-48.88	12.93	-1.76	.062
J-239	EDI	.00	-44.46	13.09	-1.60	.063
J-24		.00	-47.59	12.98	-1.72	.063
J-240	37R	-70.00	-55.90	12.68	-2.02	.061
J-241	109	-70.00	-50.54	12.87	-1.82	.062
J-242		.00	-55.96	12.68	-2.02	.061
J-243		.00	-53.49	12.77	-1.93	.062
J-244		.00	-38.59	13.30	-1.39	.064
J-245		.00	-50.62	12.87	-1.83	.062
J-246		.00	-48.82	12.93	-1.76	.062
J-247		.00	-49.34	12.92	-1.78	.062
J-248	W	-71.00	-49.00	12.93	-1.77	.062
J-249	W	-71.00	-49.81	12.90	-1.80	.062
J-25	6	-70.00	-47.55	12.98	-1.72	.063
J-250	W	-71.00	-47.02	13.00	-1.70	.063
J-251	W	-71.00	-50.00	12.89	-1.80	.062
J-252	W	-71.00	-46.16	13.03	-1.67	.063
J-253		.00	-43.79	13.12	-1.58	.063
J-254		.00	-42.62	13.16	-1.54	.063
J-255	76	-70.00	-42.55	13.16	-1.54	.063
J-256	68	-70.00	-39.19	13.28	-1.41	.064
J-257		.00	-41.67	13.19	-1.50	.064
J-258	74	-70.00	-41.61	13.19	-1.50	.064
J-259		.00	-40.57	13.23	-1.46	.064

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J-26		.00	-48.12	12.96	-1.74	.063
J-260	73	-70.00	-40.12	13.25	-1.45	.064
J-261	166	-70.00	-39.55	13.27	-1.43	.064
J-262	T1	-70.00	-39.43	13.27	-1.42	.064
J-263		.00	-39.87	13.26	-1.44	.064
J-264	71	-70.00	-39.40	13.27	-1.42	.064
J-265	165	-70.00	-38.86	13.29	-1.40	.064
J-266	T2	-70.00	-38.74	13.30	-1.40	.064
J-267		.00	-39.49	13.27	-1.42	.064
J-268	70	-70.00	-39.45	13.27	-1.42	.064
J-269	164	-70.00	-37.82	13.33	-1.36	.064
J-27	10	-70.00	-48.04	12.96	-1.73	.063
J-270	T3	-70.00	-37.70	13.34	-1.36	.064
J-271	T4	-70.00	-37.72	13.34	-1.36	.064
J-272		.00	-38.68	13.30	-1.40	.064
J-273	W	-71.00	-50.03	12.89	-1.81	.062
J-274	W	-71.00	-49.86	12.90	-1.80	.062
J-275	W	-71.00	-49.99	12.89	-1.80	.062
J-276		.00	-43.51	13.13	-1.57	.063
J-277	78	-70.00	-43.21	13.14	-1.56	.063
J-278		.00	-43.26	13.14	-1.56	.063
J-279	79	-70.00	-42.47	13.16	-1.53	.064
J-28	93	-70.00	-43.33	13.13	-1.56	.063
J-280	142	-70.00	-42.26	13.17	-1.52	.064
J-281		.00	-43.05	13.14	-1.55	.063
J-282	83R	-70.00	-42.03	13.18	-1.52	.064
J-283	143	-70.00	-41.92	13.18	-1.51	.064
J-284	140	-70.00	-38.80	13.30	-1.40	.064
J-285	122	-70.00	-40.84	13.22	-1.47	.064
J-286	90C	-70.00	-36.78	13.37	-1.33	.065
J-287		.00	-40.28	13.24	-1.45	.064
J-288	144	-70.00	-40.10	13.25	-1.45	.064
J-289	141	-70.00	-39.44	13.27	-1.42	.064
J-29		.00	-45.52	13.05	-1.64	.063
J-290	141A	-70.00	-38.42	13.31	-1.39	.064
J-291	145	-70.00	-37.97	13.33	-1.37	.064
J-292	121	-70.00	-41.70	13.19	-1.50	.064
J-293	121A	-70.00	-41.16	13.21	-1.49	.064
J-294	90A	-70.00	-38.35	13.31	-1.38	.064
J-295	90B	-70.00	-37.21	13.35	-1.34	.064
J-296	120	-70.00	-41.47	13.20	-1.50	.064
J-297	122A	-70.00	-41.33	13.20	-1.49	.064
J-298	91A	-70.00	-41.91	13.18	-1.51	.064
J-299	5R	-70.00	-42.74	13.15	-1.54	.063
J-3		.00	-49.36	12.91	-1.78	.062
J-30		.00	-48.84	12.93	-1.76	.062
J-300	W	-71.00	-48.28	12.95	-1.74	.062
J-301	W	-71.00	-44.49	13.09	-1.61	.063
J-302	W	-71.00	-47.16	12.99	-1.70	.063
J-303	W	-71.00	-45.73	13.05	-1.65	.063
J-304	W	-71.00	-49.18	12.92	-1.77	.062
J-305	W	-71.00	-47.47	12.98	-1.71	.063
J-306		.00	-48.82	12.93	-1.76	.062
J-307	W	-71.00	-48.31	12.95	-1.74	.062
J-308	W	-71.00	-48.47	12.95	-1.75	.062
J-309	W	-71.00	-47.76	12.97	-1.72	.063
J-31	14	-70.00	-48.81	12.93	-1.76	.062
J-310		.00	-48.34	12.95	-1.74	.062
J-311	W	-71.00	-47.90	12.97	-1.73	.063
J-312	W	-71.00	-48.33	12.95	-1.74	.062
J-313		.00	-48.70	12.94	-1.76	.062
J-314	W	-71.00	-46.93	13.00	-1.69	.063

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J-315	W	-71.00	-49.39	12.91	-1.78	.062
J-316	W	-71.00	-49.65	12.90	-1.79	.062
J-317		.00	-49.38	12.91	-1.78	.062
J-318	W	-71.00	-48.77	12.94	-1.76	.062
J-319	W	-71.00	-49.49	12.91	-1.79	.062
J-32	147	-70.00	-37.79	13.33	-1.36	.064
J-320	W	-71.00	-46.89	13.00	-1.69	.063
J-321	W	-71.00	-46.73	13.01	-1.69	.063
J-322	W	-71.00	-47.44	12.98	-1.71	.063
J-323		.00	-48.49	12.95	-1.75	.062
J-324	W	-71.00	-49.43	12.91	-1.78	.062
J-325	W	-71.00	-49.65	12.90	-1.79	.062
J-326	W	-71.00	-47.36	12.99	-1.71	.063
J-327	W	-71.00	-48.62	12.94	-1.75	.062
J-328	W	-71.00	-47.72	12.97	-1.72	.063
J-329		.00	-50.05	12.89	-1.81	.062
J-33		.00	-31.35	13.57	-1.13	.065
J-330	W	-71.00	-48.21	12.96	-1.74	.063
J-331		.00	-50.10	12.89	-1.81	.062
J-332	W	-71.00	-48.46	12.95	-1.75	.062
J-333		.00	-49.62	12.91	-1.79	.062
J-334	W	-71.00	-49.02	12.93	-1.77	.062
J-335	W	-71.00	-50.08	12.89	-1.81	.062
J-336	W	-71.00	-49.22	12.92	-1.78	.062
J-337	W	-71.00	-48.04	12.96	-1.73	.063
J-338	W	-71.00	-48.02	12.96	-1.73	.063
J-339	W	-71.00	-48.19	12.96	-1.74	.063
J-34	W60	-14.00	-31.34	13.57	-1.13	.065
J-340	W	-71.00	-50.29	12.88	-1.81	.062
J-341	118	-70.00	-47.38	12.99	-1.71	.063
J-342	W	-71.00	-51.47	12.84	-1.86	.062
J-343	W	-71.00	-50.21	12.88	-1.81	.062
J-344	W	-71.00	-50.34	12.88	-1.82	.062
J-345	W	-71.00	-50.36	12.88	-1.82	.062
J-346	W	-71.00	-50.50	12.87	-1.82	.062
J-347	W	-71.00	-50.29	12.88	-1.81	.062
J-348	W	-71.00	-51.13	12.85	-1.85	.062
J-349	W	-71.00	-50.54	12.87	-1.82	.062
J-35		.00	-31.09	13.57	-1.12	.065
J-350		.00	-52.29	12.81	-1.89	.062
J-351	W	-71.00	-50.88	12.86	-1.84	.062
J-352	W	-71.00	-51.61	12.83	-1.86	.062
J-353	W	-71.00	-53.40	12.77	-1.93	.062
J-354	W	-71.00	-50.33	12.88	-1.82	.062
J-355		.00	-51.46	12.84	-1.86	.062
J-356	W	-71.00	-51.05	12.85	-1.84	.062
J-357	W	-71.00	-51.06	12.85	-1.84	.062
J-358	W	-71.00	-49.94	12.89	-1.80	.062
J-359		.00	-51.20	12.85	-1.85	.062
J-36		.00	-56.94	12.64	-2.05	.061
J-360	W	-71.00	-49.95	12.89	-1.80	.062
J-361		.00	-50.64	12.87	-1.83	.062
J-362	W	-71.00	-50.80	12.86	-1.83	.062
J-363	W	-71.00	-50.97	12.86	-1.84	.062
J-364	W	-71.00	-49.87	12.90	-1.80	.062
J-365		.00	-51.58	12.83	-1.86	.062
J-366	W	-71.00	-52.40	12.80	-1.89	.062
J-367	138	-70.00	-52.19	12.81	-1.88	.062
J-368	W	-71.00	-49.88	12.90	-1.80	.062
J-369	W	-71.00	-50.58	12.87	-1.83	.062
J-37	W56	-14.00	-30.68	13.59	-1.11	.066
J-370	W	-71.00	-51.84	12.83	-1.87	.062

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J-371	W	-71.00	-52.55	12.80	-1.90	.062
J-372	W	-71.00	-50.68	12.87	-1.83	.062
J-373		.00	-52.90	12.79	-1.91	.062
J-374	W	-71.00	-51.31	12.84	-1.85	.062
J-375	W	-71.00	-51.45	12.84	-1.86	.062
J-376	139	-71.00	-38.47	13.31	-1.39	.064
J-377	W	-71.00	-48.52	12.95	-1.75	.062
J-378	W	-71.00	-51.89	12.82	-1.87	.062
J-379	W	-71.00	-51.15	12.85	-1.85	.062
J-38		.00	-30.20	13.61	-1.09	.066
J-380	W	-71.00	-51.98	12.82	-1.88	.062
J-381	W	-71.00	-50.20	12.88	-1.81	.062
J-382	W	-71.00	-50.94	12.86	-1.84	.062
J-383		.00	-54.12	12.74	-1.95	.061
J-384	W	-71.00	-49.90	12.90	-1.80	.062
J-385	W	-71.00	-51.63	12.83	-1.86	.062
J-386	W	-71.00	-51.37	12.84	-1.85	.062
J-387	W	-71.00	-50.83	12.86	-1.83	.062
J-388	W	-71.00	-51.24	12.85	-1.85	.062
J-389	137	-71.00	-49.13	12.92	-1.77	.062
J-39	W55	-14.00	-30.20	13.61	-1.09	.066
J-390	114	-71.00	-47.21	12.99	-1.70	.063
J-391		.00	-50.17	12.89	-1.81	.062
J-392	150	-71.00	-46.29	13.03	-1.67	.063
J-393	151	-71.00	-48.22	12.96	-1.74	.063
J-394	57R	-71.00	-47.91	12.97	-1.73	.063
J-395	147	-71.00	-48.07	12.96	-1.73	.063
J-396	116	-71.00	-48.72	12.94	-1.76	.062
J-397	139	-71.00	-49.89	12.90	-1.80	.062
J-398	43R	-71.00	-50.68	12.87	-1.83	.062
J-399	136	-71.00	-49.76	12.90	-1.80	.062
J-4		.00	-56.97	12.64	-2.06	.061
J-40	W59	-14.00	-31.07	13.58	-1.12	.065
J-400	T8R	-71.00	-50.64	12.87	-1.83	.062
J-401	135	-71.00	-50.48	12.87	-1.82	.062
J-402	134	-71.00	-50.65	12.87	-1.83	.062
J-403	T10R	-71.00	-52.17	12.81	-1.88	.062
J-404	40R	-71.00	-52.33	12.81	-1.89	.062
J-405		.00	-48.81	12.93	-1.76	.062
J-406	51R	-71.00	-49.21	12.92	-1.78	.062
J-407		.00	-49.27	12.92	-1.78	.062
J-408	39R	-71.00	-53.85	12.75	-1.94	.062
J-409		.00	-53.93	12.75	-1.95	.062
J-41		.00	-29.78	13.62	-1.07	.066
J-410	38R	-71.00	-55.08	12.71	-1.99	.061
J-411		.00	-55.14	12.71	-1.99	.061
J-412	167R	-71.00	-37.00	13.36	-1.33	.064
J-413	163	-71.00	-37.14	13.36	-1.34	.064
J-414	W	-71.00	-50.69	12.87	-1.83	.062
J-415	W	-71.00	-51.41	12.84	-1.86	.062
J-416	W	-71.00	-50.94	12.86	-1.84	.062
J-417	W	-71.00	-50.36	12.88	-1.82	.062
J-418	W	-71.00	-49.20	12.92	-1.78	.062
J-419	W	-71.00	-48.67	12.94	-1.76	.062
J-42	W54	-14.00	-29.78	13.62	-1.07	.066
J-420	W	-71.00	-50.36	12.88	-1.82	.062
J-421	W	-71.00	-50.15	12.89	-1.81	.062
J-422	W	-71.00	-51.04	12.85	-1.84	.062
J-423	W	-71.00	-51.02	12.85	-1.84	.062
J-424	W	-71.00	-50.45	12.88	-1.82	.062
J-425	W	-71.00	-50.61	12.87	-1.83	.062
J-426	W	-71.00	-50.06	12.89	-1.81	.062

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J-427	W	-71.00	-50.44	12.88	-1.82	.062
J-428	W	-71.00	-50.72	12.87	-1.83	.062
J-429	W	-71.00	-50.46	12.87	-1.82	.062
J-43	87	-71.00	-42.02	13.18	-1.52	.064
J-430	W	-71.00	-48.36	12.95	-1.75	.062
J-431	W	-71.00	-48.58	12.94	-1.75	.062
J-432	W	-71.00	-47.87	12.97	-1.73	.063
J-433	W	-71.00	-50.04	12.89	-1.81	.062
J-434	W	-71.00	-50.02	12.89	-1.80	.062
J-435	W	-71.00	-50.01	12.89	-1.80	.062
J-436	W	-71.00	-48.62	12.94	-1.75	.062
J-437	W	-71.00	-48.13	12.96	-1.74	.063
J-438	W	-71.00	-47.57	12.98	-1.72	.063
J-439	W	-71.00	-48.78	12.94	-1.76	.062
J-44	85	-71.00	-41.38	13.20	-1.49	.064
J-440	W	-71.00	-48.92	12.93	-1.77	.062
J-441	W	-71.00	-48.78	12.94	-1.76	.062
J-442	W	-71.00	-47.61	12.98	-1.72	.063
J-443	W	-71.00	-47.10	13.00	-1.70	.063
J-444	W	-71.00	-47.60	12.98	-1.72	.063
J-445	W	-71.00	-48.16	12.96	-1.74	.063
J-446	W	-71.00	-48.05	12.96	-1.73	.063
J-447	W	-71.00	-47.62	12.98	-1.72	.063
J-448	W	-71.00	-48.12	12.96	-1.74	.063
J-449	W	-71.00	-46.52	13.02	-1.68	.063
J-45		.00	-42.34	13.17	-1.53	.064
J-450	W	-71.00	-45.93	13.04	-1.66	.063
J-451	W	-71.00	-47.41	12.99	-1.71	.063
J-452	W	-71.00	-46.87	13.00	-1.69	.063
J-453	W	-71.00	-49.20	12.92	-1.78	.062
J-454	W	-71.00	-49.41	12.91	-1.78	.062
J-455	W	-71.00	-49.62	12.91	-1.79	.062
J-456	W	-71.00	-47.61	12.98	-1.72	.063
J-457	W	-71.00	-47.07	13.00	-1.70	.063
J-458	W	-71.00	-49.92	12.89	-1.80	.062
J-459	W	-71.00	-49.76	12.90	-1.80	.062
J-46		.00	-29.38	13.64	-1.06	.066
J-460	W	-71.00	-47.93	12.97	-1.73	.063
J-461	W	-71.00	-46.48	13.02	-1.68	.063
J-462	W	-71.00	-45.21	13.06	-1.63	.063
J-463	W	-71.00	-44.62	13.09	-1.61	.063
J-464	W	-71.00	-46.90	13.00	-1.69	.063
J-465	W	-71.00	-46.31	13.03	-1.67	.063
J-466	W	-71.00	-49.63	12.91	-1.79	.062
J-467	126	-71.00	-38.28	13.31	-1.38	.064
J-468	102	-71.00	-47.49	12.98	-1.71	.063
J-469	119	-71.00	-47.56	12.98	-1.72	.063
J-47	W53	-14.00	-29.38	13.64	-1.06	.066
J-470	63R	-71.00	-47.74	12.97	-1.72	.063
J-471	62	-71.00	-47.46	12.98	-1.71	.063
J-472	131	-71.00	-47.95	12.97	-1.73	.063
J-473	148	-71.00	-47.01	13.00	-1.70	.063
J-474	149	-71.00	-46.44	13.02	-1.68	.063
J-475	103	-71.00	-47.54	12.98	-1.72	.063
J-476	104	-71.00	-48.08	12.96	-1.73	.063
J-477	106	-71.00	-47.80	12.97	-1.73	.063
J-478	115	-71.00	-46.43	13.02	-1.68	.063
J-479	127	-71.00	-45.74	13.05	-1.65	.063
J-48		.00	-42.99	13.14	-1.55	.063
J-480	107	-71.00	-47.40	12.99	-1.71	.063
J-481	13R	-71.00	-48.36	12.95	-1.75	.062
J-482	53R	-71.00	-47.79	12.97	-1.72	.063

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J-483	126	-71.00	-47.24	12.99	-1.70	.063
J-484	128	-71.00	-49.15	12.92	-1.77	.062
J-485	108	-71.00	-49.36	12.91	-1.78	.062
J-486	113	-71.00	-48.72	12.94	-1.76	.062
J-487	126	-71.00	-47.44	12.98	-1.71	.063
J-488	T6R	-71.00	-46.92	13.00	-1.69	.063
J-489	110	-71.00	-49.48	12.91	-1.79	.062
J-49	146R	-71.00	-36.25	13.39	-1.31	.065
J-490	111	-71.00	-48.85	12.93	-1.76	.062
J-491	112	-71.00	-50.10	12.89	-1.81	.062
J-492	125	-71.00	-49.60	12.91	-1.79	.062
J-493	133	-71.00	-50.01	12.89	-1.80	.062
J-494	47R	-71.00	-50.06	12.89	-1.81	.062
J-495	W	-71.00	-50.01	12.89	-1.80	.062
J-496	W	-71.00	-51.98	12.82	-1.88	.062
J-497	36R	-71.00	-55.28	12.70	-1.99	.061
J-498	W	-71.00	-48.87	12.93	-1.76	.062
J-499	L1 Flare	.00	-31.50	13.56	-1.14	.065
J-5		.00	-52.72	12.79	-1.90	.062
J-50		.00	-29.02	13.65	-1.05	.066
J-501		.00	-56.91	12.64	-2.05	.061
J-51	W52	-14.00	-29.02	13.65	-1.05	.066
J-52		.00	-50.62	12.87	-1.83	.062
J-53	90	-70.00	-40.27	13.24	-1.45	.064
J-54		.00	-28.73	13.66	-1.04	.066
J-55	W51	-14.00	-28.73	13.66	-1.04	.066
J-56		.00	-28.47	13.67	-1.03	.066
J-57	W50	-14.00	-28.47	13.67	-1.03	.066
J-58		.00	-28.26	13.68	-1.02	.066
J-59		.00	-28.25	13.68	-1.02	.066
J-6	31	-70.00	-53.40	12.77	-1.93	.062
J-60	W48	-14.00	-28.25	13.68	-1.02	.066
J-61	W49	-14.00	-28.24	13.68	-1.02	.066
J-62	W45	-14.00	-28.10	13.68	-1.01	.066
J-63	W46	-14.00	-28.06	13.68	-1.01	.066
J-64	W47	-14.00	-28.05	13.68	-1.01	.066
J-65		.00	-27.98	13.69	-1.01	.066
J-66	W44	-14.00	-27.98	13.69	-1.01	.066
J-67		.00	-27.88	13.69	-1.01	.066
J-68		.00	-27.86	13.69	-1.00	.066
J-69	W41	-14.00	-27.86	13.69	-1.00	.066
J-7	29	-70.00	-52.23	12.81	-1.88	.062
J-70		.00	-27.82	13.69	-1.00	.066
J-71	W42	-14.00	-27.82	13.69	-1.00	.066
J-72	W43	-14.00	-27.81	13.69	-1.00	.066
J-73		.00	-27.84	13.69	-1.00	.066
J-74	W39	-14.00	-27.82	13.69	-1.00	.066
J-75	W40	-14.00	-27.82	13.69	-1.00	.066
J-76		.00	-27.81	13.69	-1.00	.066
J-77	W38	-14.00	-27.80	13.69	-1.00	.066
J-78		.00	-27.80	13.69	-1.00	.066
J-79	W37	-14.00	-27.79	13.69	-1.00	.066
J-8		.00	-28.06	13.68	-1.01	.066
J-80		.00	-27.79	13.69	-1.00	.066
J-81	W36	-14.00	-27.79	13.69	-1.00	.066
J-82		.00	-27.79	13.69	-1.00	.066
J-83	W35	-14.00	-27.79	13.69	-1.00	.066
J-84		.00	-27.79	13.69	-1.00	.066
J-85	W34	-14.00	-27.79	13.69	-1.00	.066
J-86		.00	-27.80	13.69	-1.00	.066
J-87	W32	-14.00	-27.78	13.69	-1.00	.066
J-88	W33	-14.00	-27.78	13.69	-1.00	.066

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J-89		.00	-40.60	13.23	-1.46	.064
J-9		.00	-44.59	13.09	-1.61	.063
J-90		.00	-49.54	12.91	-1.79	.062
J-91		.00	-27.82	13.69	-1.00	.066
J-92	W31	-14.00	-27.81	13.69	-1.00	.066
J-93		.00	-56.90	12.64	-2.05	.061
J-94	35R	-70.00	-53.54	12.76	-1.93	.062
J-95		.00	-48.74	12.94	-1.76	.062
J-96	W	-71.00	-51.79	12.83	-1.87	.062
J-97	W29	-14.00	-27.85	13.69	-1.00	.066
J-98	W30	-14.00	-27.83	13.69	-1.00	.066
J-99		.00	-27.91	13.69	-1.01	.066
R-1	FLARE COMPOUND	.00	-60.00	12.53	-2.17	.060

* This designates the use of default density in a low pressure region

THE NET SYSTEM DEMAND (USFU) = -21000.000

SUMMARY OF INFLOWS(+) .AND. OUTFLOWS(-) :

NAME	FLOW (USFU)	FPN TITLE
R-1	-21000.0	R-1

MAXIMUM MACH NUMBER = .05 IN LINE NO. P-77

SUMMARY OF MINIMUM .AND. MAXIMUM VELOCITIES (FT/S)

	MINIMUM		MAXIMUM
P-361	.05	P-77	52.85
R-1	.08	P-340	52.64
P- 96	.19	P-343	49.21
P-225	.43	P-329	48.05
P-226	.47	P-339	48.03
P- 93	.81	P-337	47.21
P-356	1.20	P-6	47.16
P-224	1.33	P-336	46.44
P-227	1.37	P-510	45.68
P-268	1.52	P-335	41.87

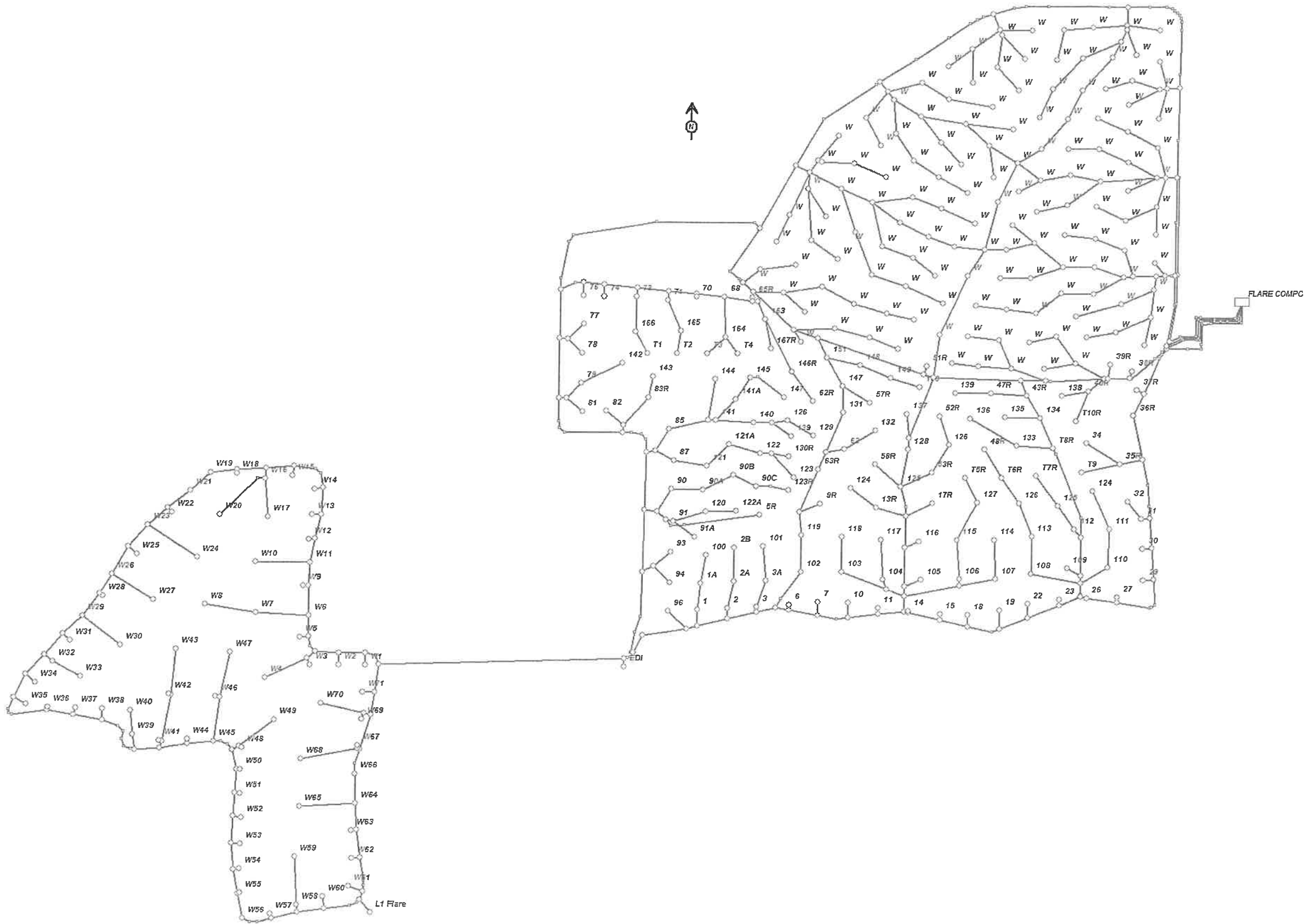
SUMMARY OF MINIMUM .AND. MAXIMUM LOSS/1000. (PSI)

	MINIMUM		MAXIMUM
R-1	.00	P-17	.41
P-361	.00	P-334	.27
P- 96	.00	P-49	.27
P-225	.00	P-71	.27
P- 93	.00	P-14	.27
P-226	.00	P-249	.22
P-356	.00	P-395	.22
P-45	.00	P-250	.21
P-372	.00	P-248	.20
P- 97	.00	P-247	.19

SUMMARY OF MINIMUM .AND. MAXIMUM PRESSURES (USPU)

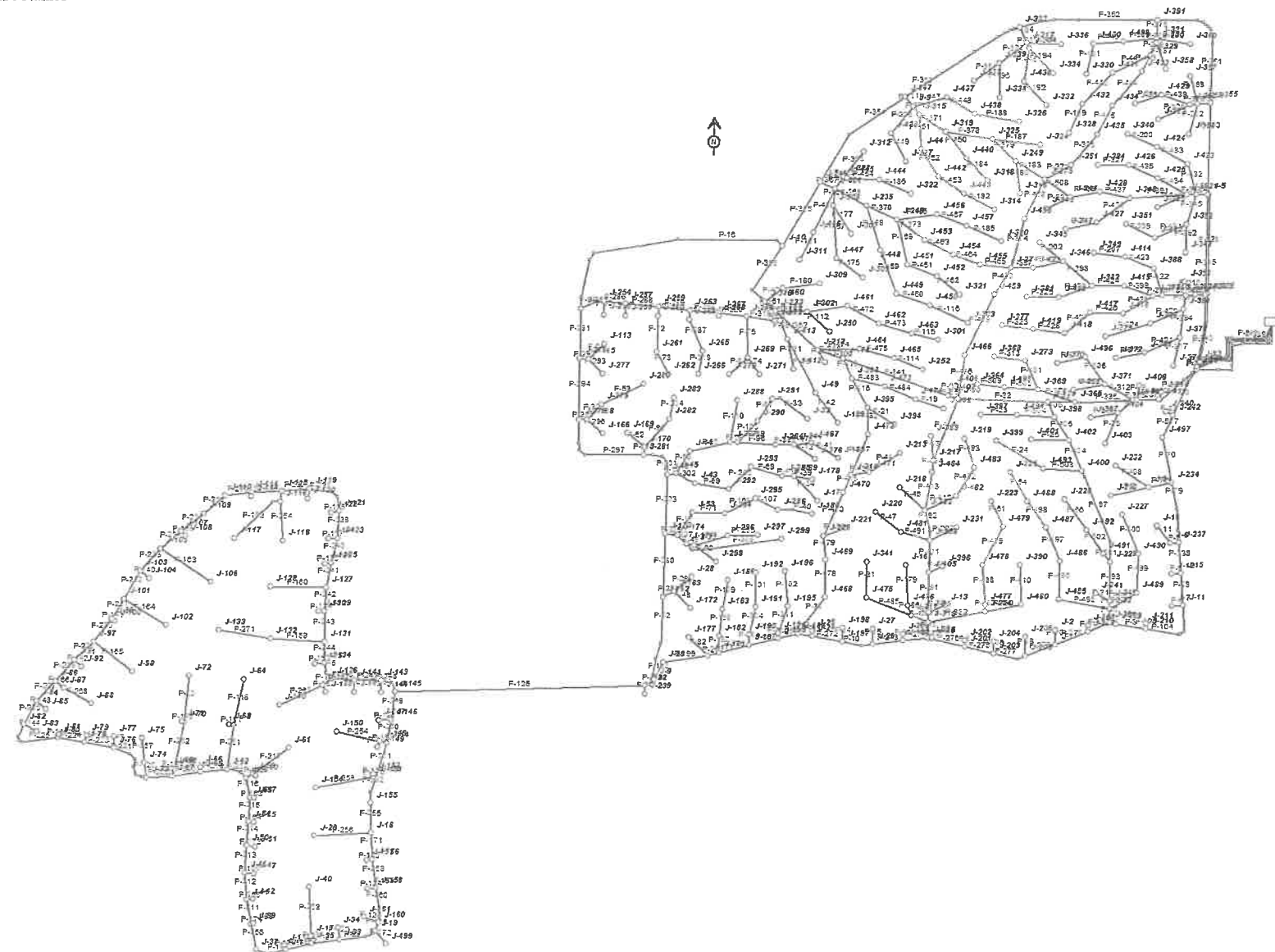
	MINIMUM		MAXIMUM
R-1	-60.00	J-88	-27.78
J-4	-56.97	J-87	-27.78
J-36	-56.94	J-83	-27.79
J-501	-56.91	J-85	-27.79
J-93	-56.90	J-81	-27.79
J-242	-55.96	J-82	-27.79
J-240	-55.90	J-80	-27.79
J-497	-55.28	J-84	-27.79
J-411	-55.14	J-79	-27.79
J-410	-55.08	J-78	-27.80

***** END OF KYGAS SIMULATION *****



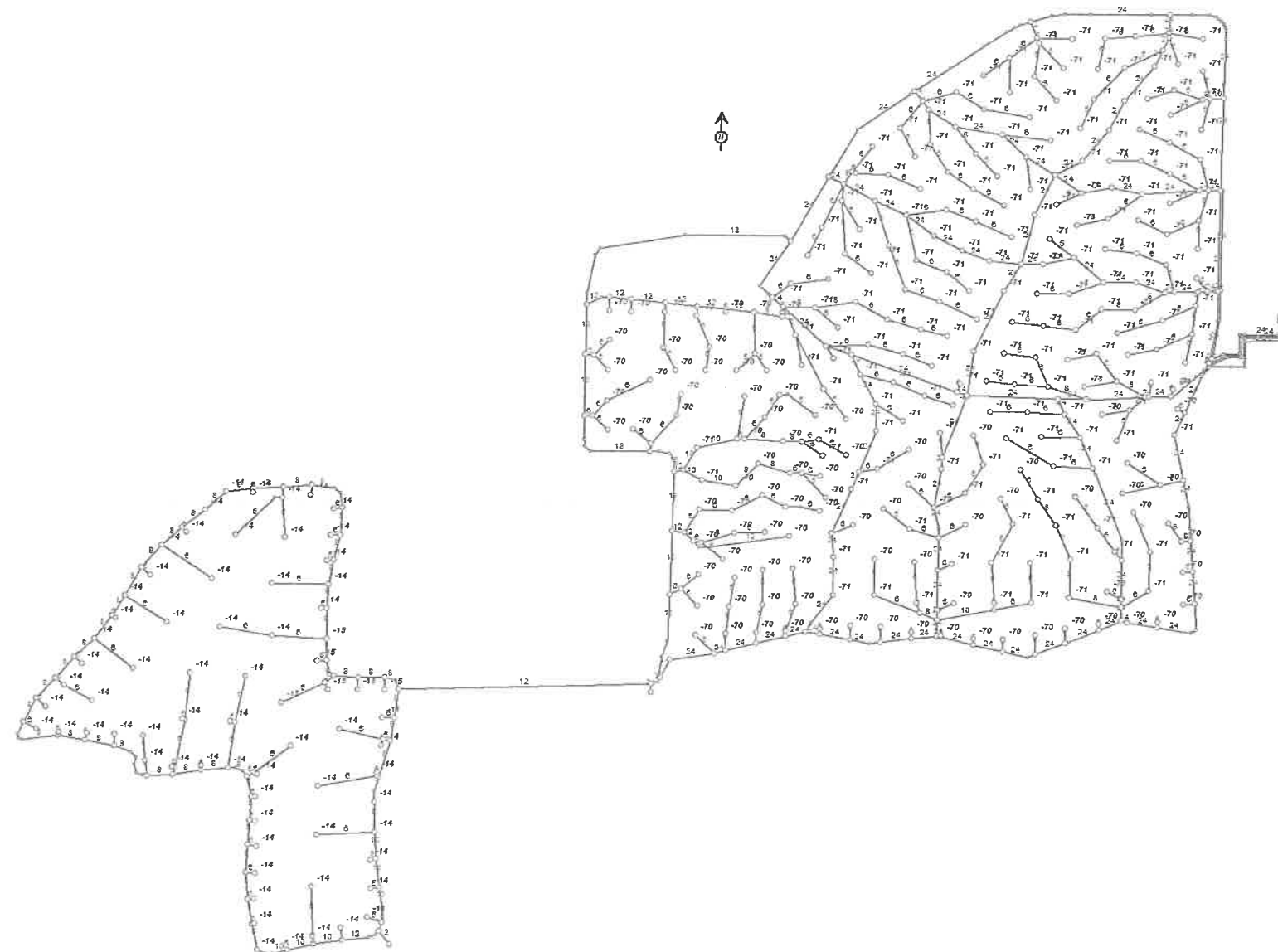
Lorain County Landfill
Landfill Gas Collection and Control System
Junction and Pipe Names

KYG-40



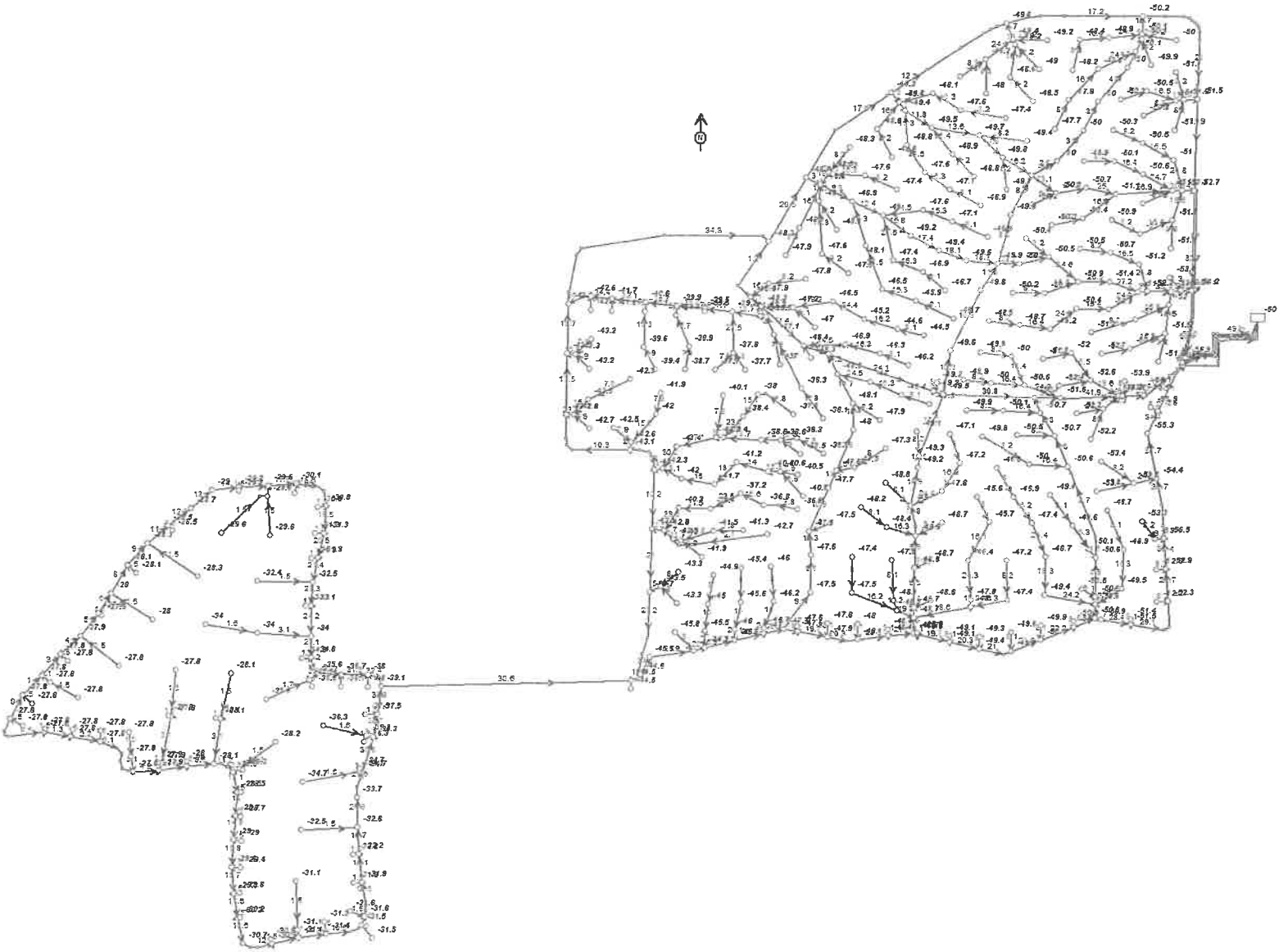
Lorain County Landfill
Landfill Gas Collection and Control System
Junction LFG Demand (scfm) and Pipe Diameter Size (in.) Information

KYG-41



Lorain County Landfill
Landfill Gas Collection and Control System
Junction Available Vacuum (in. w.c.) and Pipe Flow Velocity (fps) Information

KYG-42



ATTACHMENT 3.2
LORAIN II HEADER SYSTEM
KY-GAS ANALYSIS - EXISTING WELLFIELD

KYGAS HEADLOSS CALCULATIONS

KYGAS was developed by Dr. Don J. Wood and Dr. James E. Funk at the University of Kentucky. The program was modeled after KYPIPE, which models water distribution systems. KYGAS is used to determine head losses, system pressures, and velocities in piping systems controlled under vacuum. KYGAS operates under the assumptions that all flow in the piping system is steady, one-dimensional, isothermal flow for an ideal gas. The program uses the Darcy-Weisbach equation for head losses related to incompressible flow and the Ideal Gas Law for pressure-temperature-density relationships.

KYGAS has several useful options to develop a LFG system. The program allows the user to model any type of piping system material or configuration to coincide with field conditions. The program includes tabular and graphic interfaces for the input of information regarding the system. Multiple blower locations may be used in the program to simulate actual field conditions. In addition, blower performance curves may be entered into the program for comparison to operational and actual field conditions. KYGAS is capable of running multiple scenarios for any piping configuration including looped header systems. LFG flow units and pressure values at the wells are user specified for comparison to values obtained in the field.

The following parameters are required for operation of KYGAS.

- Pipe inside diameter
- Pipe length
- Minor loss coefficient
- Roughness within the pipe
- LFG flow rate into the system at each well or node
- LFG operating temperature (120°F)
- Specific gravity of the LFG (1.036)
- Ratio of specific heats (1.303)
- Absolute viscosity of LFG (2.82×10^{-7} lb*sec/ft²)

The design process begins with the development of the LFG flow rates for use in the program. The LFG flow is determined from the USEPA LandGEM LFG model. The LFG model is developed based on site specific information relating to waste inflow,



composition, landfill capacity, and site life. The second step involves evaluating the design of the LFG system. Based on the conceptual design and a general understanding of the planned phasing of the landfill, the total LFG flow for a landfill is divided into various amounts to simulate varied flow rates at the wellheads over the life of the site.

As mentioned before, KYGAS allows the user to input information in either a tabular or graphical method. The graphical method is called KYCAD. KYCAD allows the user to input the piping network to scale in an AutoCAD format. The user constructs the system in the computer by drawing the system as it will appear in the field, and then adjusts the necessary pipe lengths and locations of wells (nodes) as required. Site-specific conditions are considered when laying out a system. No elevations are used for the various nodes in this analysis. It is assumed that all LFG flow will proceed through the system regardless of node elevations.

The system was evaluated in the as-built configuration and the results have been compared to typical final design criteria.

The design criteria for the header system are (from the GCCS Design Plan and previous Evaluations):

<i>Maximum Con-Current Velocity</i>	<i>55 fps</i>
<i>Maximum Counter-Current Velocity</i>	<i>35 fps</i>
<i>Maximum Pressure Drop</i>	<i>1" w.c. per 100 feet of pipe</i> <i>(0.36 psig per 1000 feet of pipe)</i>
<i>Minimum Available Vacuum</i>	<i>20" w.c.</i>

These values are consistent with typical industry design practices.

The results of the KYGAS analysis indicate a total system pressure drop of approximately 13" w.c. Please refer to the attached KYGAS output files. This should occur at Node 620. The maximum pressure drop in the pipe system is 0.28 psig/1000 ft (Pipe P-100), the maximum con-current velocity is 40.72 fps (Pipe 371), and the maximum counter-current flow in the pipe system is 19.93 fps (Pipe P-207). The minimum vacuum availability is approximately 46" w.c. As all values are at or within allowable operational ranges, the design of the constructed system is appropriate for the design flow rates.

The flow used for the KYGAS analysis is 8,800 standard cubic feet per minute (scfm). This value is approximately 110% of the current extraction rate of 8,000 scfm. The flare facility on site has been assigned vacuum of 60" w.c. This matches the level of recent operating vacuum application recorded at the site.



Lorain II Landfill
Existing Landfill Gas Collection and Control System
KYGas Report Output

KYG 2012 -3

*** GAS2010 Version 2.0 ***
GAS DISTRIBUTION NETWORK ANALYSIS
COPYRIGHT 2010 - DON J. WOOD, SRINI LINGIREDDY
LEXINGTON, KY
Updated March 2010

INPUT DATA FILE NAME FOR THIS SIMULATION = x:\projects\lorain\100068~1\AUGUST~
1\PHASEI~1.KYP\phase_ii.DAT
OUTPUT DATA FILE NAME FOR THIS SIMULATION = x:\projects\lorain\100068~1\AUGUST~
1\PHASEI~1.KYP\phase_ii.OT2

DATE FOR THIS COMPUTER RUN : 8-06-2012
START TIME FOR THIS COMPUTER RUN : 15:59:32:95

SUMMARY OF DISTRIBUTION SYSTEM CHARACTERISTICS:

NUMBER OF PIPES = 397
NUMBER OF JUNCTION NODES = 388

UNITS SPECIFIED = ENGLISH

PROPERTIES OF THE GAS FOR THIS ANALYSIS ARE:

OPERATING TEMPERATURE = 120.000 DEGREES FAHRENHEIT
REFERENCE DENSITY (@ STD. PRESSURE) = .71E-01 POUNDS/CUBIC FOOT
GAS MOLECULAR WEIGHT = 30.010
GAS SPECIFIC GRAVITY = 1.036
RATIO OF SPECIFIC HEATS = 1.303
GAS CONSTANT = 51.489
ABSOLUTE VISCOSITY = .282E-06 POUND SECONDS/SQUARE FOOT

USER SPECIFIED FLOW UNITS (USFU) = SCF / MIN.
USER SPECIFIED PRESSURE UNITS (USPU) = INCHES OF WATER (GAUGE)

----- SUMMARY OF PIPE NETWORK GEOMETRIC AND OPERATING DATA -----

PIPE NAME	NODE #1	NODE #2	LENGTH (FT.)	DIAM. (IN.)	ROUGHNESS (MILLIFEET)	SUM-M FACT.	PUMP ID	ELEVATION CHANGE
1	1	J-64	30.0	5.8	.100	1.8	0	.0
5	9	234	313.0	5.8	.100	1.8	0	.0
7	13	14	21.0	5.8	.100	1.8	0	.0
9	17	24	262.0	7.6	.100	1.8	0	.0
10	19	182	309.0	5.8	.100	1.8	0	.0
11	21	22	19.0	5.8	.100	1.8	0	.0
12	23	24	19.0	5.8	.100	1.8	0	.0
13	25	26	21.0	5.8	.100	1.8	0	.0
15	29	739	63.0	5.8	.100	1.8	0	.0
19	38	126	67.0	5.8	.100	1.8	0	.0
34	67	69	309.0	15.8	.100	1.8	0	.0
35	69	70	130.0	5.8	.100	1.8	0	.0
36	71	72	136.0	5.8	.100	1.8	0	.0
37	74	J-64	168.0	5.8	.100	1.8	0	.0
38	75	76	200.0	15.8	.100	1.8	0	.0
41	80	81	14.0	5.8	.100	1.8	0	.0
42	82	83	18.0	5.8	.100	1.8	0	.0
44	86	87	68.0	5.8	.100	1.8	0	.0
45	88	89	97.0	5.8	.100	1.8	0	.0
49	96	97	197.0	5.8	.100	1.8	0	.0
55	98	J-2	88.0	11.2	.100	1.8	0	.0
58	106	J-58	48.0	7.6	.100	1.8	0	.0

Lorain II Landfill

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Existing Landfill Gas Collection and Control System

KYGas Report Output

60	111	112	88.0	5.8	.100	1.8	0	.0
61	113	388	122.0	5.8	.100	1.8	0	.0
65	121	122	175.0	5.8	.100	1.8	0	.0
67	123	J-37	294.0	5.8	.100	1.8	0	.0
68	126	739	221.0	5.8	.100	1.8	0	.0
69	128	129	179.0	5.8	.100	1.8	0	.0
71	129	131	41.0	5.8	.100	1.8	0	.0
72	128	132	48.0	5.8	.100	1.8	0	.0
75	118	390	202.0	5.8	.100	1.8	0	.0
76	136	613	204.0	5.8	.100	1.8	0	.0
77	136	719	154.0	5.8	.100	1.8	0	.0
78	139	136	42.0	5.8	.100	1.8	0	.0
79	140	223	667.0	11.2	.100	1.8	0	.0
80	142	153	279.0	21.0	.100	1.8	0	.0
83	147	169	231.0	21.0	.100	1.8	0	.0
87	152	153	170.0	5.8	.100	1.8	0	.0
88	154	155	109.0	5.8	.100	1.8	0	.0
89	156	157	71.0	5.8	.100	1.8	0	.0
90	80	158	33.0	5.8	.100	1.8	0	.0
91	159	160	37.0	5.8	.100	1.8	0	.0
92	161	162	89.0	5.8	.100	1.8	0	.0
93	163	164	100.0	5.8	.100	1.8	0	.0
94	165	166	51.0	5.8	.100	1.8	0	.0
96	90	169	43.0	5.8	.100	1.8	0	.0
97	170	171	129.0	5.8	.100	1.8	0	.0
98	172	173	106.0	5.8	.100	1.8	0	.0
101	176	177	213.0	5.8	.100	1.8	0	.0
102	178	176	220.0	5.8	.100	1.8	0	.0
103	179	739	228.0	5.8	.100	1.8	0	.0
104	180	154	174.0	5.8	.100	1.8	0	.0
105	156	181	183.0	5.8	.100	1.8	0	.0
106	182	80	184.0	5.8	.100	1.8	0	.0
107	183	184	132.0	5.8	.100	1.8	0	.0
109	186	J-15	142.0	5.8	.100	1.8	0	.0
110	468	558	195.0	5.8	.100	1.8	0	.0
112	718	184	173.0	7.6	.100	1.8	0	.0
114	129	368	258.0	5.8	.100	1.8	0	.0
115	181	515	240.0	5.8	.100	1.8	0	.0
117	121	197	193.0	5.8	.100	1.8	0	.0
118	198	179	210.0	5.8	.100	1.8	0	.0
120	94	200	49.0	5.8	.100	1.8	0	.0
121	201	202	79.0	5.8	.100	1.8	0	.0
122	178	203	166.0	5.8	.100	1.8	0	.0
126	207	180	160.0	5.8	.100	1.8	0	.0
127	123	500	338.0	5.8	.100	1.8	0	.0
129	145	158	127.0	21.0	.100	1.8	0	.0
132	212	J-61	51.0	5.8	.100	1.8	0	.0
133	214	J-114	569.0	15.8	.100	1.8	0	.0
135	109	J-57	51.0	5.8	.100	1.8	0	.0
137	100	J-56	64.0	7.6	.100	1.8	0	.0
139	J-73	J-114	81.0	7.6	.100	1.8	0	.0
141	16	223	46.0	5.8	.100	1.8	0	.0
143	226	227	140.0	15.8	.100	1.8	0	.0
144	96	228	60.0	5.8	.100	1.8	0	.0
145	229	J-10	265.0	15.8	.100	1.8	0	.0
146	231	J-28	234.0	5.8	.100	1.8	0	.0
148	232	J-68	272.0	5.8	.100	1.8	0	.0
150	237	238	387.0	5.8	.100	1.8	0	.0
151	170	J-51	205.0	5.8	.100	1.8	0	.0
152	234	J-101	192.0	15.8	.100	1.8	0	.0
153	241	242	174.0	5.8	.100	1.8	0	.0
154	243	129	63.0	5.8	.100	1.8	0	.0
155	244	245	323.0	5.8	.100	1.8	0	.0
157	231	374	387.0	5.8	.100	1.8	0	.0
159	250	J-101	231.0	5.8	.100	1.8	0	.0
161	375	75	407.0	5.8	.100	1.8	0	.0
162	256	J-99	315.0	5.8	.100	1.8	0	.0
167	252	75	15.0	15.8	.100	1.8	0	.0
171	265	22	141.0	15.8	.100	1.8	0	.0
172	77	268	51.0	15.8	.100	1.8	0	.0
173	267	268	88.0	5.8	.100	1.8	0	.0

Lorain II Landfill

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Existing Landfill Gas Collection and Control System

KYGas Report Output

174	266	270	101.0	15.8	.100	1.8	0	.0
175	270	271	31.0	5.8	.100	1.8	0	.0
177	273	17	270.0	7.6	.100	1.8	0	.0
179	274	348	244.0	5.8	.100	1.8	0	.0
180	J-47	273	130.0	15.8	.100	1.8	0	.0
192	293	J-73	133.0	5.8	.100	1.8	0	.0
193	294	J-73	183.0	5.8	.100	1.8	0	.0
194	296	132	30.0	5.8	.100	1.8	0	.0
195	297	298	23.0	5.8	.100	1.8	0	.0
196	300	J-91	27.0	5.8	.100	1.8	0	.0
200	J-85	314	6.0	5.8	.100	1.8	0	.0
201	306	307	161.0	5.8	.100	1.8	0	.0
203	J-33	314	153.0	11.2	.100	1.8	0	.0
205	312	313	30.0	5.8	.100	1.8	0	.0
208	317	132	49.0	5.8	.100	1.8	0	.0
209	177	J-2	181.0	5.8	.100	1.8	0	.0
211	306	226	56.0	5.8	.100	1.8	0	.0
212	R-1	J-8	302.0	21.0	.100	1.8	0	.0
213	322	323	40.0	5.8	.100	1.8	0	.0
215	324	J-45	43.0	5.8	.100	1.8	0	.0
216	326	J-7	111.0	5.8	.100	1.8	0	.0
217	328	J-32	226.0	5.8	.100	1.8	0	.0
218	329	464	294.0	5.8	.100	1.8	0	.0
219	331	329	152.0	5.8	.100	1.8	0	.0
228	215	J-209	1382.0	15.8	.100	1.8	0	.0
231	348	589	43.0	5.8	.100	1.8	0	.0
232	350	351	24.0	5.8	.100	1.8	0	.0
233	232	J-79	161.0	7.6	.100	1.8	0	.0
241	362	250	181.0	5.8	.100	1.8	0	.0
243	365	84	247.0	5.8	.100	1.8	0	.0
244	121	367	51.0	5.8	.100	1.8	0	.0
246	177	369	45.0	5.8	.100	1.8	0	.0
247	176	370	66.0	5.8	.100	1.8	0	.0
249	203	371	45.0	5.8	.100	1.8	0	.0
250	124	372	61.0	5.8	.100	1.8	0	.0
251	179	373	38.0	5.8	.100	1.8	0	.0
255	377	J-105	233.0	5.8	.100	1.8	0	.0
257	379	J-46	177.0	5.8	.100	1.8	0	.0
263	389	J-92	53.0	5.8	.100	1.8	0	.0
265	139	391	49.0	5.8	.100	1.8	0	.0
277	411	J-39	192.0	5.8	.100	1.8	0	.0
278	412	J-137	151.0	5.8	.100	1.8	0	.0
279	421	441	141.0	15.8	.100	1.8	0	.0
280	416	417	55.0	5.8	.100	1.8	0	.0
281	418	419	44.0	5.8	.100	1.8	0	.0
282	421	J-138	25.0	5.8	.100	1.8	0	.0
283	418	J-127	153.0	5.8	.100	1.8	0	.0
285	425	426	93.0	5.8	.100	1.8	0	.0
295	413	441	56.0	5.8	.100	1.8	0	.0
296	442	J-414	113.0	15.8	.100	1.8	0	.0
297	423	J-246	259.0	21.0	.100	1.8	0	.0
298	444	445	251.0	5.8	.100	1.8	0	.0
299	445	446	249.0	5.8	.100	1.8	0	.0
300	447	446	241.0	5.8	.100	1.8	0	.0
301	444	448	250.0	5.8	.100	1.8	0	.0
302	448	449	240.0	5.8	.100	1.8	0	.0
304	439	423	86.0	5.8	.100	1.8	0	.0
306	449	J-116	44.0	3.9	.100	1.8	0	.0
307	735	344	696.0	21.0	.100	3.6	0	.0
308	448	315	126.0	5.8	.100	1.8	0	.0
309	444	86	153.0	5.8	.100	1.8	0	.0
310	445	454	91.0	5.8	.100	1.8	0	.0
311	446	455	126.0	5.8	.100	1.8	0	.0
314	442	426	112.0	21.0	.100	1.8	0	.0
318	461	J-3	116.0	5.8	.100	1.8	0	.0
319	463	464	74.0	11.2	.100	1.8	0	.0
324	468	J-55	16.0	5.8	.100	1.8	0	.0
337	494	J-58	141.0	5.8	.100	1.8	0	.0
338	495	J-54	281.0	5.8	.100	1.8	0	.0
340	497	498	22.0	5.8	.100	1.8	0	.0
341	499	118	26.0	5.8	.100	1.8	0	.0

Lorain II Landfill

KYG 2012 -6

Existing Landfill Gas Collection and Control System

KYGas Report Output

343	501	183	20.0	5.8	.100	1.8	0	.0
346	505	506	48.0	5.8	.100	1.8	0	.0
347	507	267	158.0	5.8	.100	1.8	0	.0
348	508	J-43	287.0	5.8	.100	1.8	0	.0
349	510	612	35.0	5.8	.100	1.8	0	.0
350	307	J-42	94.0	5.8	.100	1.8	0	.0
354	516	231	20.0	5.8	.100	1.8	0	.0
356	518	519	16.0	5.8	.100	1.8	0	.0
357	26	520	21.0	5.8	.100	1.8	0	.0
358	24	J-108	21.0	5.8	.100	1.8	0	.0
359	22	J-18	20.0	5.8	.100	1.8	0	.0
360	J-246	545	151.0	21.0	.100	1.8	0	.0
361	524	525	319.0	5.8	.100	1.8	0	.0
362	526	527	65.0	5.8	.100	1.8	0	.0
363	528	244	116.0	7.6	.100	1.8	0	.0
371	R-1	J-36	263.0	21.0	.100	1.8	0	.0
374	545	596	293.0	11.2	.100	1.8	0	.0
379	197	555	21.0	5.8	.100	1.8	0	.0
380	556	J-61	156.0	5.8	.100	1.8	0	.0
384	562	J-53	26.0	5.8	.100	1.8	0	.0
385	180	563	20.0	5.8	.100	1.8	0	.0
388	86	14	20.0	5.8	.100	1.8	0	.0
404	596	597	4.0	5.8	.100	1.8	0	.0
405	598	599	65.0	5.8	.100	1.8	0	.0
408	601	603	46.0	5.8	.100	1.8	0	.0
409	604	J-31	67.0	5.8	.100	1.8	0	.0
410	606	J-144	49.0	5.8	.100	1.8	0	.0
420	620	122	20.0	5.8	.100	1.8	0	.0
424	511	J-5	138.0	5.8	.100	1.8	0	.0
426	J-32	228	317.0	15.8	.100	1.8	0	.0
450	673	J-125	6.0	5.8	.100	1.8	0	.0
456	679	683	28.0	5.8	.100	1.8	0	.0
457	684	J-130	64.0	5.8	.100	1.8	0	.0
459	688	689	12.0	5.8	.100	1.8	0	.0
461	691	692	264.0	5.8	.100	1.8	0	.0
464	410	694	214.0	5.8	.100	1.8	0	.0
466	697	J-105	68.0	5.8	.100	1.8	0	.0
468	700	J-107	41.0	5.8	.100	1.8	0	.0
470	702	252	20.0	5.8	.100	1.8	0	.0
471	703	244	32.0	5.8	.100	1.8	0	.0
472	J-49	518	41.0	7.6	.100	1.8	0	.0
482	718	139	229.0	7.6	.100	1.8	0	.0
491	734	735	68.0	5.8	.100	1.8	0	.0
495	344	84	302.0	11.2	.100	1.8	0	.0
499	230	743	20.0	5.8	.100	1.8	0	.0
500	214	142	159.0	21.0	.100	1.8	0	.0
501	744	167	23.0	5.8	.100	1.8	0	.0
502	250	745	20.0	5.8	.100	1.8	0	.0
503	746	329	47.0	5.8	.100	1.8	0	.0
504	747	748	18.0	5.8	.100	1.8	0	.0
505	442	749	128.0	21.0	.100	1.8	0	.0
P-100	J-37	J-56	149.0	5.8	.100	1.8	0	.0
P-108	261	183	185.0	5.8	.100	1.8	0	.0
P-111	557	J-57	158.0	5.8	.100	1.8	0	.0
P-113	184	193	29.0	7.6	.100	1.8	0	.0
P-116	J-10	230	273.0	15.8	.100	1.8	0	.0
P-119	506	200	192.0	21.0	.100	1.8	0	.0
P-123	560	J-37	18.0	5.8	.100	1.8	0	.0
P-124	124	197	252.0	5.8	.100	1.8	0	.0
P-125	J-54	364	38.0	5.8	.100	1.8	0	.0
P-128	147	166	173.0	21.0	.100	1.8	0	.0
P-130	J-209	344	426.0	21.0	.100	1.8	0	.0
P-131	212	J-62	326.0	15.8	.100	1.8	0	.0
P-134	106	109	625.0	15.8	.100	1.8	0	.0
P-136	109	212	392.0	15.8	.100	1.8	0	.0
P-138	J-91	718	50.0	11.2	.100	1.8	0	.0
P-14	J-68	517	20.0	5.8	.100	1.8	0	.0
P-140	527	J-102	304.0	15.8	.100	1.8	0	.0
P-142	J-41	228	224.0	15.8	.100	1.8	0	.0
P-147	155	157	205.0	21.0	.100	1.8	0	.0
P-149	J-28	232	272.0	7.6	.100	1.8	0	.0

Lorain II Landfill

KYG 2012 -7

Existing Landfill Gas Collection and Control System

KYGas Report Output

P-156	J-44	601	208.0	5.8	.100	1.8	0	.0
P-158	J-50	J-63	135.0	5.8	.100	1.8	0	.0
P-16	J-32	J-148	216.0	15.8	.100	1.8	0	.0
P-160	J-93	411	425.0	21.0	.100	1.8	0	.0
P-163	273	274	2.0	15.8	.100	1.8	0	.0
P-164	524	315	297.0	5.8	.100	1.8	0	.0
P-165	261	J-99	53.0	5.8	.100	1.8	0	.0
P-166	J-101	252	284.0	15.8	.100	1.8	0	.0
P-168	J-93	76	34.0	21.0	.100	1.8	0	.0
P-169	735	76	897.0	21.0	.100	1.8	0	.0
P-17	447	J-32	156.0	5.8	.100	1.8	0	.0
P-170	J-104	J-105	151.0	5.8	.100	1.8	0	.0
P-176	274	270	95.0	15.8	.100	1.8	0	.0
P-178	348	350	310.0	5.8	.100	1.8	0	.0
P-18	J-8	225	149.0	21.0	.100	1.8	0	.0
P-181	J-41	J-246	216.0	15.8	.100	1.8	0	.0
P-182	J-127	434	152.0	5.8	.100	1.8	0	.0
P-183	599	67	209.0	21.0	.100	1.8	0	.0
P-184	J-33	J-150	54.0	11.2	.100	1.8	0	.0
P-185	67	410	192.0	21.0	.100	1.8	0	.0
P-186	227	510	312.0	11.2	.100	1.8	0	.0
P-187	J-42	511	147.0	5.8	.100	1.8	0	.0
P-188	512	J-42	19.0	5.8	.100	1.8	0	.0
P-189	511	6	47.0	5.8	.100	1.8	0	.0
P-190	225	J-4	122.0	21.0	.100	1.8	0	.0
P-191	458	463	101.0	11.2	.100	1.8	0	.0
P-197	J-7	353	166.0	21.0	.100	1.8	0	.0
P-198	J-36	J-246	153.0	21.0	.100	1.8	0	.0
P-199	353	464	80.0	5.8	.100	1.8	0	.0
P-2	J-3	J-4	280.0	5.8	.100	1.8	0	.0
P-20	545	599	266.0	21.0	.100	1.8	0	.0
P-202	J-103	313	153.0	11.2	.100	1.8	0	.0
P-204	157	158	195.0	21.0	.100	1.8	0	.0
P-206	J-116	J-115	156.0	5.8	.100	1.8	0	.0
P-207	J-46	J-143	377.0	21.0	.100	1.8	0	.0
P-21	J-44	J-34	73.0	5.8	.100	1.8	0	.0
P-210	98	J-114	398.0	15.8	.100	1.8	0	.0
P-214	323	199	187.0	21.0	.100	1.8	0	.0
P-22	J-43	315	251.0	5.8	.100	1.8	0	.0
P-220	11	J-46	37.0	5.8	.100	1.8	0	.0
P-221	J-46	748	191.0	21.0	.100	1.8	0	.0
P-222	J-12	199	9.0	21.0	.100	1.8	0	.0
P-223	78	J-12	18.0	5.8	.100	1.8	0	.0
P-224	173	174	219.0	21.0	.100	1.8	0	.0
P-225	174	J-47	131.0	21.0	.100	1.8	0	.0
P-226	J-47	151	18.0	21.0	.100	1.8	0	.0
P-227	200	J-12	209.0	21.0	.100	1.8	0	.0
P-229	26	J-51	259.0	5.8	.100	1.8	0	.0
P-23	J-39	701	18.0	5.8	.100	1.8	0	.0
P-230	J-79	237	123.0	15.8	.100	1.8	0	.0
P-234	J-52	J-51	21.0	5.8	.100	1.8	0	.0
P-235	237	744	34.0	15.8	.100	1.8	0	.0
P-236	160	162	199.0	21.0	.100	1.8	0	.0
P-237	J-79	236	260.0	15.8	.100	1.8	0	.0
P-238	236	242	231.0	15.8	.100	1.8	0	.0
P-239	J-63	J-64	214.0	5.8	.100	1.8	0	.0
P-24	J-39	260	214.0	5.8	.100	1.8	0	.0
P-240	242	234	5.0	15.8	.100	1.8	0	.0
P-242	J-62	111	162.0	11.2	.100	1.8	0	.0
P-245	410	J-146	450.0	21.0	.100	1.8	0	.0
P-248	J-15	J-20	76.0	5.8	.100	1.8	0	.0
P-25	353	J-45	33.0	21.0	.100	1.8	0	.0
P-252	J-20	313	204.0	11.2	.100	1.8	0	.0
P-253	J-107	24	221.0	7.6	.100	1.8	0	.0
P-254	309	J-116	15.0	5.8	.100	1.8	0	.0
P-256	J-115	J-103	42.0	11.2	.100	1.8	0	.0
P-258	J-85	376	422.0	5.8	.100	1.8	0	.0
P-259	J-60	113	216.0	11.2	.100	1.8	0	.0
P-26	236	518	100.0	7.6	.100	1.8	0	.0
P-260	213	J-61	154.0	5.8	.100	1.8	0	.0
P-261	J-92	117	189.0	11.2	.100	1.8	0	.0

Lorain II Landfill

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Existing Landfill Gas Collection and Control System

KYGas Report Output

P-262	498	J-60	55.0	11.2	.100	1.8	0	.0
P-264	J-104	J-107	199.0	5.8	.100	1.8	0	.0
P-266	J-59	498	186.0	5.8	.100	1.8	0	.0
P-267	J-65	J-59	50.0	5.8	.100	1.8	0	.0
P-268	J-66	J-65	20.0	5.8	.100	1.8	0	.0
P-269	134	J-65	165.0	5.8	.100	1.8	0	.0
P-27	215	J-62	159.0	15.8	.100	1.8	0	.0
P-270	266	22	155.0	15.8	.100	1.8	0	.0
P-271	265	268	55.0	15.8	.100	1.8	0	.0
P-272	77	69	355.0	15.8	.100	1.8	0	.0
P-273	J-110	J-45	294.0	21.0	.100	1.8	0	.0
P-274	J-95	J-110	28.0	5.8	.100	1.8	0	.0
P-275	35	J-110	34.0	5.8	.100	1.8	0	.0
P-276	J-125	J-120	201.0	11.2	.100	1.8	0	.0
P-28	J-2	317	82.0	11.2	.100	1.8	0	.0
P-284	423	426	157.0	21.0	.100	1.8	0	.0
P-286	J-137	413	101.0	5.8	.100	1.8	0	.0
P-287	J-138	J-135	153.0	5.8	.100	1.8	0	.0
P-288	J-135	433	147.0	5.8	.100	1.8	0	.0
P-289	608	J-144	370.0	5.8	.100	1.8	0	.0
P-29	141	223	338.0	11.2	.100	1.8	0	.0
P-290	J-144	86	122.0	5.8	.100	1.8	0	.0
P-291	314	J-115	8.0	11.2	.100	1.8	0	.0
P-292	732	261	480.0	5.8	.100	1.8	0	.0
P-293	229	160	73.0	21.0	.100	1.8	0	.0
P-294	441	687	158.0	11.2	.100	1.8	0	.0
P-3	J-4	J-40	47.0	5.8	.100	1.8	0	.0
P-30	140	317	49.0	11.2	.100	1.8	0	.0
P-303	J-120	674	100.0	11.2	.100	1.8	0	.0
P-305	J-119	J-120	11.0	5.8	.100	1.8	0	.0
P-31	J-53	296	151.0	5.8	.100	1.8	0	.0
P-312	675	J-125	8.0	5.8	.100	1.8	0	.0
P-313	J-44	692	15.0	5.8	.100	1.8	0	.0
P-315	162	83	122.0	21.0	.100	1.8	0	.0
P-316	166	164	198.0	21.0	.100	1.8	0	.0
P-317	J-130	685	147.0	5.8	.100	1.8	0	.0
P-32	J-49	J-63	261.0	5.8	.100	1.8	0	.0
P-320	689	687	14.0	11.2	.100	1.8	0	.0
P-321	689	J-133	150.0	11.2	.100	1.8	0	.0
P-322	690	J-133	148.0	11.2	.100	1.8	0	.0
P-323	164	83	77.0	21.0	.100	1.8	0	.0
P-325	J-143	J-110	21.0	21.0	.100	1.8	0	.0
P-326	J-146	411	193.0	21.0	.100	1.8	0	.0
P-327	J-148	226	177.0	15.8	.100	1.8	0	.0
P-328	455	J-148	20.0	5.8	.100	1.8	0	.0
P-329	J-150	510	186.0	11.2	.100	1.8	0	.0
P-33	71	J-49	3.0	5.8	.100	1.8	0	.0
P-330	315	J-150	14.0	5.8	.100	1.8	0	.0
P-331	225	J-246	18.0	21.0	.100	1.8	0	.0
P-344	692	328	29.0	5.8	.100	1.8	0	.0
P-375	J-34	604	110.0	11.2	.100	1.8	0	.0
P-39	J-68	27	21.0	5.8	.100	1.8	0	.0
P-390	604	596	150.0	11.2	.100	1.8	0	.0
P-4	J-7	J-4	168.0	21.0	.100	1.8	0	.0
P-40	149	171	54.0	21.0	.100	1.8	0	.0
P-401	595	J-41	114.0	5.8	.100	1.8	0	.0
P-43	88	84	42.0	11.2	.100	1.8	0	.0
P-46	169	202	194.0	21.0	.100	1.8	0	.0
P-47	174	J-48	62.0	5.8	.100	1.8	0	.0
P-48	275	350	273.0	5.8	.100	1.8	0	.0
P-480	674	683	94.0	11.2	.100	1.8	0	.0
P-486	J-414	417	48.0	15.8	.100	1.8	0	.0
P-50	100	98	377.0	15.8	.100	1.8	0	.0
P-506	417	419	141.0	15.8	.100	1.8	0	.0
P-507	419	421	154.0	15.8	.100	1.8	0	.0
P-508	687	684	176.0	11.2	.100	1.8	0	.0
P-509	684	683	357.0	11.2	.100	1.8	0	.0
P-51	J-30	198	43.0	5.8	.100	1.8	0	.0
P-52	J-56	126	122.0	5.8	.100	1.8	0	.0
P-53	528	230	187.0	15.8	.100	1.8	0	.0
P-54	528	527	230.0	15.8	.100	1.8	0	.0

Lorain II Landfill
Existing Landfill Gas Collection and Control System
KYGas Report Output

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P-56	J-91	J-92	182.0	11.2	.100	1.8	0	.0
P-57	J-58	468	219.0	5.8	.100	1.8	0	.0
P-59	J-57	J-54	173.0	5.8	.100	1.8	0	.0
P-6	748	323	207.0	21.0	.100	1.8	0	.0
P-62	J-60	117	209.0	11.2	.100	1.8	0	.0
P-63	297	117	37.0	5.8	.100	1.8	0	.0
P-64	111	113	139.0	11.2	.100	1.8	0	.0
P-66	123	197	48.0	5.8	.100	1.8	0	.0
P-70	J-55	469	164.0	5.8	.100	1.8	0	.0
P-73	100	106	254.0	15.8	.100	1.8	0	.0
P-74	118	297	240.0	5.8	.100	1.8	0	.0
P-8	J-20	88	212.0	11.2	.100	1.8	0	.0
P-81	153	155	74.0	21.0	.100	1.8	0	.0
P-82	229	145	14.0	21.0	.100	1.8	0	.0
P-84	202	149	160.0	21.0	.100	1.8	0	.0
P-85	151	506	52.0	21.0	.100	1.8	0	.0
P-86	171	173	198.0	21.0	.100	1.8	0	.0
P-95	J-79	352	116.0	5.8	.100	1.8	0	.0
P-99	744	147	5.0	15.8	.100	1.8	0	.0

JUNCTION NAME	NODE TITLE	DEMAND (USFU)	FPN PRESSURE
1	EW-127R2	-46.00	
6	EW-154R2	-47.00	
9	EW-17R3	-47.00	
11	EW-31R	-47.00	
13		.00	
14		.00	
16	EW-5R2	-47.00	
17	EW-108R	-47.00	
19	EW-101R2	-47.00	
21	EW-112R	-47.00	
22		.00	
23	EW-113R	-47.00	
24		.00	
25	EW-114R	-47.00	
26		.00	
27	EW-117R	-47.00	
29	EW-121R	-47.00	
35	EW-35R2	-47.00	
38	EW-87R2	-47.00	
67		.00	
69		.00	
70	EW-133	-47.00	
71	EW-116R	-46.00	
72	EW-168	-46.00	
74	TEW-5R2	-46.00	
75		.00	
76		.00	
77		.00	
78		.00	
80		.00	
81	EW-3	-47.00	
82		.00	
83		.00	
84		.00	
86		.00	
87		.00	
88		.00	
89	EW-64	-47.00	
90	EW-15	-47.00	
94	EW-27	-47.00	
96		.00	
97		.00	
98		.00	
100		.00	
106		.00	
109		.00	
111		.00	

Lorain II Landfill
Existing Landfill Gas Collection and Control System
KYGas Report Output

KYG 2012 -10

112	EW-76	-47.00
113		.00
117		.00
118		.00
121		.00
122		.00
123		.00
124		.00
126		.00
128		.00
129		.00
131		.00
132		.00
134	TEW-1R	-47.00
136		.00
139		.00
140		.00
141		.00
142		.00
145		.00
147		.00
149		.00
151		.00
152	EW-96	-47.00
153		.00
154	EW-1	-47.00
155		.00
156	EW-2	-47.00
157		.00
158		.00
159	EW-6	-47.00
160		.00
161	EW-7	-47.00
162		.00
163	EW-10	-47.00
164		.00
165	EW-11	-47.00
166		.00
167	EW-14	-47.00
169		.00
170	EW-19	-47.00
171		.00
172	EW-22R	-47.00
173		.00
174		.00
176		.00
177		.00
178	EW-90B	-47.00
179		.00
180		.00
181	EW-2A	-47.00
182	EW-3A	-47.00
183		.00
184		.00
186	EW-162	-47.00
193		.00
197		.00
198		.00
199		.00
200		.00
201	EW-18	-47.00
202		.00
203		.00
207	EW-100R	-47.00
212		.00
213	EW-77	-47.00
214		.00
215		.00
223		.00
225		.00
226		.00

Lorain II Landfill
Existing Landfill Gas Collection and Control System
KYGas Report Output

KYG 2012 -11

227		.00
228		.00
229		.00
230	EW-119	-47.00
231	EW-118	-47.00
232		.00
234		.00
236		.00
237		.00
238	EW-106	-47.00
241	EW-13R	-47.00
242		.00
243	EW-120RS	-47.00
244		.00
245	EW-63	-47.00
250		.00
252		.00
256	EW-147R	-47.00
260	EW-53R	-47.00
261		.00
265		.00
266		.00
267	125R	-47.00
268		.00
270		.00
271	EW-109	-47.00
273		.00
274		.00
275	EW-124R	-47.00
293	EW-93R	-47.00
294	EW-94R	-47.00
296	EW-91R	-47.00
297		.00
298	EW-71R	-47.00
300	EW-68R	-47.00
306	EW-46	-47.00
307		.00
309		.00
312	EW-59	-47.00
313		.00
314		.00
315	EW-54R	-47.00
317		.00
322	EW-29	-47.00
323		.00
324	EW-36R	-47.00
326	EW-37R	-47.00
328	EW-138R	-47.00
329		.00
331	TEW-9R	-47.00
344		.00
348		.00
350		.00
351	EW-111	-47.00
352	EW-105	-47.00
353		.00
362	EW-63R	-47.00
364	EW-79R	-47.00
365	EW-65R	-47.00
367	EW-228	-47.00
368	EW-227	-47.00
369	EW-90R	-47.00
370	EW-224	-47.00
371	EW-122R	-47.00
372	EW-140R	-47.00
373	EW-226	-47.00
374	EW-128R	-47.00
375	EW-57R2	-47.00
376	EW-58R	-47.00
377	EW-48R	-47.00
379	EW-32R	-47.00

Lorain II Landfill
Existing Landfill Gas Collection and Control System
KYGas Report Output

KYG 2012 -12

388	EW-74R	-47.00
389	EW-70R	-47.00
390	TEW-2R	-47.00
391	EW-164R	-47.00
410		.00
411		.00
412	EW-304	-47.00
413		.00
416	EW-309	-47.00
417		.00
418	EW-310	-47.00
419		.00
421		.00
423		.00
425	EW-305	-47.00
426		.00
433	EW-303	-47.00
434	EW-302	-47.00
439	EW-301	-47.00
441	EW-312	-47.00
442		.00
444	H9	-47.00
445	H8	-47.00
446	H7	-47.00
447	H6	-47.00
448	H10	-47.00
449	H11	-47.00
454		.00
455	EW-45R	-47.00
458		.00
461	H4	-47.00
463		.00
464		.00
468		.00
469	EW-148	-47.00
494	EW-82R	-47.00
495	EW-142R	-47.00
497	EW-73R	-47.00
498		.00
499	EW-165R	-47.00
500	EW-144R	-47.00
501	EW-163R	-47.00
505	EW-28R	-47.00
506		.00
507	TEW-7R2	-47.00
508	EW-152	-47.00
510		.00
511		.00
512	EW-47R	-47.00
515	EW-2BR	-47.00
516	EW-118S	-47.00
517	EW-117S	-47.00
518		.00
519	EW-116S	-47.00
520	EW-114S	-47.00
524	EW-51R	-47.00
525	EW-153	-47.00
526	EW-150	-47.00
527		.00
528		.00
545		.00
555	EW-141R	-47.00
556	EW-78R	-47.00
557	EW-81R	-47.00
558	EW-143R	-48.00
560	EW-85R	-48.00
562	EW-91AR	-48.00
563	EW-1A	-48.00
589	EW-110R	-48.00
595	EW-38R	-48.00
596		.00

Lorain II Landfill
Existing Landfill Gas Collection and Control System
KYGas Report Output

KYG 2012 -13

597	EW-39R	-48.00
598	EW-159	-48.00
599		.00
601		.00
603	EW-40R2	-48.00
604		.00
606		.00
608		.00
612		.00
613	TEW-3R	-48.00
620	EW-145R2	-48.00
673		.00
674		.00
675	H-14	-48.00
679	H12	-48.00
683		.00
684		.00
685	EW-315	-48.00
687		.00
688	EW-316	-48.00
689		.00
690	EW-313	-48.00
691	EW-43R2	-48.00
692		.00
694	EW-160	-48.00
697	EW-161	-48.00
700	EW-126R	-48.00
701	EW-129R	-48.00
702		.00
703	EW-9R2	-48.00
718		.00
719	TEW-4R	-48.00
732	EW-62R2	-48.00
734	EW-146R	-48.00
735		.00
739		.00
743	EW-119S	-48.00
744		.00
745	EW-58R2	-48.00
746	EW-34R2	-48.00
747	EW-29	-48.00
748		.00
749		.00
J-10	EW-102	-48.00
J-101	EW-135	-48.00
J-102	EW-149	-48.00
J-103		.00
J-104	TEW-6R	-48.00
J-105		.00
J-107		.00
J-108	EW-113S	-48.00
J-110		.00
J-114		.00
J-115		.00
J-116		.00
J-119	H13	-48.00
J-12		.00
J-120		.00
J-125		.00
J-127	EW-306	-48.00
J-130	EW-317	-48.00
J-133	EW-314	-48.00
J-135	EW-307	-48.00
J-137	EW-308	-48.00
J-138	EW-311	-48.00
J-143		.00
J-144		.00
J-146		.00
J-148		.00
J-15	EW-60	-48.00
J-150		.00

Lorain II Landfill
Existing Landfill Gas Collection and Control System
KYGas Report Output

KYG 2012 -14

J-18	EW-112S	-48.00	
J-2		.00	
J-20		.00	
J-209		.00	
J-246		.00	
J-28	EW-103	-48.00	
J-3	H3	-48.00	
J-30	EW-122R	-48.00	
J-31	EW-41	-48.00	
J-32	EW-42	-48.00	
J-33		.00	
J-34		.00	
J-36		.00	
J-37		.00	
J-39		.00	
J-4	H2	-48.00	
J-40	H1	-48.00	
J-41		.00	
J-414		.00	
J-42		.00	
J-43	EW-151	-48.00	
J-44		.00	
J-45		.00	
J-46		.00	
J-47		.00	
J-48	EW-23	-48.00	
J-49		.00	
J-5	EW-158R	-48.00	
J-50	EW-115R	-48.00	
J-51		.00	
J-52	EW-107R	-48.00	
J-53		.00	
J-54		.00	
J-55	EW-83R	-48.00	
J-56		.00	
J-57		.00	
J-58		.00	
J-59		.00	
J-60		.00	
J-61		.00	
J-62		.00	
J-63	EW-115R	-48.00	
J-64		.00	
J-65		.00	
J-66	EW-166R	-48.00	
J-68		.00	
J-7		.00	
J-73		.00	
J-79		.00	
J-8		.00	
J-85	EW-55	-48.00	
J-91		.00	
J-92		.00	
J-93	EW-52R2	-48.00	
J-95	EW-155R	-48.00	
J-99	EW-167	-48.00	
R-1		.00	-60.00

===== RESULTS FOR THIS SIMULATION FOLLOW =====

Solution was obtained in 20 trials
Flow Accuracy = .3951E-04[< .500E-02]
RV Accuracy = .0000E+00[< .100E-02]

Lorain II Landfill
Existing Landfill Gas Collection and Control System
KYGas Report Output

KYG 2012 -15

PIPE NO.	NODE #1	NODE #2	FLOW (USFU)	LOSS (USPU)	VELOCITY (FT/S)	DENSITY (#/CF)	FRICTION FACTOR	AREA RATIO
1	1	J-64	46.000	.02	5.34	.062	.0271	.008
5	9	234	47.000	.11	5.49	.062	.0270	.008
7	13	14	.000	.00	.00	.061	.0000	.000
9	17	24	-286.000	.71	19.72	.062	.0194	.030
10	19	182	47.000	.11	5.47	.062	.0270	.008
11	21	22	47.000	.02	5.51	.061	.0270	.008
12	23	24	47.000	.02	5.48	.062	.0270	.008
13	25	26	47.000	.02	5.47	.062	.0270	.008
15	29	739	47.000	.03	5.43	.062	.0270	.008
19	38	126	47.000	.03	5.44	.062	.0270	.008
34	67	69	-1040.350	.29	16.59	.061	.0171	.025
35	69	70	-47.000	.05	5.52	.061	.0270	.008
36	71	72	-46.000	.05	5.36	.062	.0271	.008
37	74	J-64	46.000	.06	5.34	.062	.0271	.008
38	75	76	1049.888	.22	16.67	.061	.0170	.025
41	80	81	-47.000	.01	5.47	.062	.0270	.008
42	82	83	.000	.00	.00	.062	.0000	.000
44	86	87	.000	.00	.00	.061	.0000	.000
45	88	89	-47.000	.04	5.50	.062	.0270	.008
49	96	97	.000	.00	.00	.061	.0000	.000
55	98	J-2	-424.000	.12	13.30	.062	.0191	.020
58	106	J-58	-190.000	.11	13.02	.062	.0209	.020
60	111	112	-47.000	.04	5.45	.062	.0270	.008
61	113	388	-47.000	.05	5.45	.062	.0270	.008
65	121	122	-48.000	.07	5.50	.063	.0269	.008
67	123	J-37	236.000	1.87	27.18	.062	.0194	.041
68	126	739	-142.000	.58	16.42	.062	.0212	.025
69	128	129	-94.000	.23	10.90	.062	.0231	.017
71	129	131	.000	.00	.00	.062	.0000	.000
72	128	132	94.000	.09	10.90	.062	.0231	.017
75	118	390	-47.000	.07	5.43	.062	.0270	.008
76	136	613	-48.000	.08	5.54	.062	.0269	.008
77	136	719	-48.000	.06	5.54	.062	.0269	.008
78	139	136	-96.000	.09	11.08	.062	.0230	.017
79	140	223	-47.000	.01	1.47	.062	.0317	.002
80	142	153	862.447	.05	7.66	.062	.0185	.012
83	147	169	1839.558	.19	16.39	.062	.0161	.025
87	152	153	47.000	.06	5.47	.062	.0270	.008
88	154	155	142.000	.33	16.52	.062	.0212	.025
89	156	157	141.000	.24	16.41	.062	.0213	.025
90	80	158	141.000	.16	16.42	.062	.0213	.025
91	159	160	47.000	.02	5.48	.062	.0270	.008
92	161	162	47.000	.04	5.48	.062	.0270	.008
93	163	164	47.000	.04	5.48	.062	.0270	.008
94	165	166	47.000	.03	5.48	.062	.0270	.008
96	90	169	47.000	.02	5.49	.062	.0270	.008
97	170	171	189.000	.64	22.09	.062	.0201	.034
98	172	173	47.000	.04	5.50	.061	.0270	.008
101	176	177	141.000	.55	16.33	.062	.0213	.025
102	178	176	94.000	.27	10.87	.062	.0231	.017
103	179	739	95.000	.28	10.97	.062	.0230	.017
104	180	154	95.000	.23	11.04	.062	.0230	.017
105	156	181	-94.000	.23	10.93	.062	.0231	.017
106	182	80	94.000	.23	10.94	.062	.0231	.017
107	183	184	190.000	.65	21.92	.062	.0201	.033
109	186	J-15	47.000	.05	5.50	.062	.0270	.008
110	468	558	-48.000	.07	5.56	.062	.0269	.008
112	718	184	-190.000	.24	12.95	.062	.0209	.020
114	129	368	-47.000	.09	5.45	.062	.0270	.008
115	181	515	-47.000	.08	5.46	.062	.0270	.008
117	121	197	95.000	.24	10.90	.063	.0230	.017
118	198	179	48.000	.08	5.54	.062	.0269	.008
120	94	200	47.000	.03	5.52	.061	.0270	.008
121	201	202	47.000	.03	5.49	.062	.0270	.008
122	178	203	-47.000	.06	5.43	.062	.0270	.008

Lorain II Landfill
Existing Landfill Gas Collection and Control System
KYGas Report Output

KYG 2012 -16

126	207	180	47.000	.06	5.46	.062	.0270	.008
127	123	500	-47.000	.11	5.40	.063	.0270	.008
129	145	158	-1333.447	.08	11.85	.062	.0171	.018
132	212	J-61	-94.000	.09	10.92	.062	.0231	.017
133	214	J-114	-862.447	.32	13.60	.062	.0177	.021
135	109	J-57	-141.000	.20	16.38	.062	.0213	.025
137	100	J-56	-473.000	.70	32.41	.062	.0178	.049
139	J-73	J-114	94.000	.04	6.45	.062	.0243	.010
141	16	223	47.000	.02	5.46	.062	.0270	.008
143	226	227	-769.994	.10	12.30	.061	.0180	.019
144	96	228	.000	.00	.00	.061	.0000	.000
145	229	J-10	-333.000	.03	5.26	.062	.0214	.008
146	231	J-28	141.000	.60	16.41	.062	.0213	.025
148	232	J-68	-94.000	.33	10.96	.062	.0231	.017
150	237	238	-47.000	.13	5.49	.062	.0270	.008
151	170	J-51	-142.000	.55	16.57	.062	.0212	.025
152	234	J-101	859.888	.15	13.63	.062	.0177	.021
153	241	242	47.000	.06	5.49	.062	.0270	.008
154	243	129	47.000	.03	5.45	.062	.0270	.008
155	244	245	-47.000	.11	5.47	.062	.0270	.008
157	231	374	-47.000	.13	5.46	.062	.0270	.008
159	250	J-101	95.000	.29	11.10	.062	.0230	.017
161	375	75	47.000	.14	5.50	.062	.0270	.008
162	256	J-99	47.000	.11	5.41	.063	.0270	.008
167	252	75	1002.888	.09	15.91	.062	.0172	.024
171	265	22	-899.350	.14	14.31	.061	.0175	.022
172	77	268	-993.350	.11	15.82	.061	.0172	.024
173	267	268	94.000	.13	11.04	.061	.0231	.017
174	266	270	-804.350	.10	12.79	.061	.0179	.019
175	270	271	-47.000	.02	5.51	.061	.0270	.008
177	273	17	-333.000	.96	23.01	.061	.0188	.035
179	274	348	-142.000	.64	16.63	.061	.0212	.025
180	J-47	273	282.350	.01	4.49	.061	.0221	.007
192	293	J-73	47.000	.05	5.46	.062	.0270	.008
193	294	J-73	47.000	.07	5.46	.062	.0270	.008
194	296	132	95.000	.07	11.02	.062	.0230	.017
195	297	298	-47.000	.02	5.43	.062	.0270	.008
196	300	J-91	47.000	.02	5.43	.062	.0270	.008
200	J-85	314	95.000	.05	11.13	.061	.0230	.017
201	306	307	-142.000	.45	16.70	.061	.0212	.025
203	J-33	314	-519.511	.24	16.45	.061	.0184	.025
205	312	313	47.000	.02	5.50	.061	.0270	.008
208	317	132	-189.000	.34	21.94	.062	.0201	.033
209	177	J-2	188.000	.82	21.81	.062	.0201	.033
211	306	226	189.000	.37	22.25	.061	.0201	.034
212	R-1	J-8	-4312.220	1.17	39.12	.061	.0141	.060
213	322	323	47.000	.02	5.52	.061	.0270	.008
215	324	J-45	47.000	.02	5.55	.061	.0270	.008
216	326	J-7	47.000	.04	5.55	.061	.0270	.008
217	328	J-32	-10.668	.01	1.26	.061	.0405	.002
218	329	464	95.000	.36	11.21	.061	.0230	.017
219	331	329	47.000	.06	5.54	.061	.0270	.008
228	215	J-209	1357.553	1.61	21.47	.062	.0163	.033
231	348	589	-48.000	.02	5.62	.061	.0269	.009
232	350	351	-47.000	.02	5.49	.062	.0270	.008
233	232	J-79	283.000	.47	19.49	.062	.0194	.030
241	362	250	47.000	.07	5.49	.062	.0270	.008
243	365	84	47.000	.09	5.50	.062	.0270	.008
244	121	367	-47.000	.03	5.39	.063	.0270	.008
246	177	369	-47.000	.02	5.45	.062	.0270	.008
247	176	370	-47.000	.03	5.44	.062	.0270	.008
249	203	371	-47.000	.02	5.43	.062	.0270	.008
250	124	372	-47.000	.03	5.39	.063	.0270	.008
251	179	373	-47.000	.02	5.43	.062	.0270	.008
255	377	J-105	47.000	.08	5.47	.062	.0270	.008
257	379	J-46	47.000	.07	5.53	.061	.0270	.008
263	389	J-92	47.000	.03	5.43	.062	.0270	.008
265	139	391	-47.000	.02	5.43	.062	.0270	.008
277	411	J-39	-95.000	.25	11.14	.061	.0230	.017
278	412	J-137	47.000	.06	5.55	.061	.0270	.008
279	421	441	-526.000	.05	8.43	.061	.0194	.013

Lorain II Landfill
Existing Landfill Gas Collection and Control System
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280	416	417	47.000	.03	5.56	.061	.0270	.008
281	418	419	142.000	.19	16.78	.061	.0212	.026
282	421	J-138	-143.000	.15	16.89	.061	.0212	.026
283	418	J-127	-95.000	.21	11.22	.061	.0230	.017
285	425	426	47.000	.04	5.56	.061	.0270	.008
295	413	441	95.000	.10	11.22	.061	.0230	.017
296	442	J-414	-858.000	.11	13.76	.061	.0177	.021
297	423	J-246	952.000	.06	8.59	.061	.0182	.013
298	444	445	121.868	.49	14.30	.061	.0219	.022
299	445	446	168.868	.89	19.85	.061	.0205	.030
300	447	446	-94.581	.30	11.14	.061	.0230	.017
301	444	448	-74.868	.20	8.77	.061	.0242	.013
302	448	449	-42.350	.07	4.96	.061	.0277	.008
304	439	423	47.000	.04	5.56	.061	.0270	.008
306	449	J-116	4.650	.00	1.19	.061	.0468	.002
307	735	344	-1173.691	.21	10.47	.062	.0175	.016
308	448	315	14.482	.01	1.70	.061	.0369	.003
309	444	86	.000	.00	.00	.061	.0000	.000
310	445	454	.000	.00	.00	.061	.0000	.000
311	446	455	121.287	.28	14.28	.061	.0219	.022
314	442	426	858.000	.03	7.74	.061	.0186	.012
318	461	J-3	47.000	.05	5.55	.061	.0270	.008
319	463	464	.000	.00	.00	.061	.0000	.000
324	468	J-55	-95.000	.06	11.01	.062	.0230	.017
337	494	J-58	47.000	.05	5.46	.062	.0270	.008
338	495	J-54	47.000	.10	5.45	.062	.0270	.008
340	497	498	47.000	.02	5.44	.062	.0270	.008
341	499	118	47.000	.02	5.43	.062	.0270	.008
343	501	183	47.000	.02	5.41	.062	.0270	.008
346	505	506	47.000	.02	5.51	.061	.0270	.008
347	507	267	47.000	.06	5.52	.061	.0270	.008
348	508	J-43	47.000	.10	5.50	.061	.0270	.008
349	510	612	.000	.00	.00	.061	.0000	.000
350	307	J-42	-142.000	.30	16.68	.061	.0212	.025
354	516	231	47.000	.02	5.47	.062	.0270	.008
356	518	519	-47.000	.01	5.48	.062	.0270	.008
357	26	520	-47.000	.02	5.47	.062	.0270	.008
358	24	J-108	-48.000	.02	5.60	.062	.0269	.009
359	22	J-18	-48.000	.02	5.63	.061	.0269	.009
360	J-246	545	-3800.598	.65	34.29	.061	.0144	.052
361	524	525	-47.000	.11	5.50	.062	.0270	.008
362	526	527	47.000	.03	5.47	.062	.0270	.008
363	528	244	-95.000	.05	6.53	.062	.0242	.010
371	R-1	J-36	-4487.780	1.17	40.72	.061	.0140	.062
374	545	596	-249.668	.10	7.96	.061	.0212	.012
379	197	555	-47.000	.02	5.39	.063	.0270	.008
380	556	J-61	47.000	.06	5.46	.062	.0270	.008
384	562	J-53	48.000	.02	5.57	.062	.0269	.008
385	180	563	-48.000	.02	5.58	.062	.0269	.009
388	86	14	.000	.00	.00	.061	.0000	.000
404	596	597	-48.000	.01	5.67	.061	.0269	.009
405	598	599	48.000	.03	5.66	.061	.0269	.009
408	601	603	-48.000	.03	5.66	.061	.0269	.009
409	604	J-31	-48.000	.03	5.67	.061	.0269	.009
410	606	J-144	.000	.00	.00	.061	.0000	.000
420	620	122	48.000	.02	5.50	.063	.0269	.008
424	511	J-5	-48.000	.06	5.63	.061	.0269	.009
426	J-32	228	1306.194	.46	20.91	.061	.0164	.032
450	673	J-125	.000	.00	.00	.061	.0000	.000
456	679	683	48.000	.02	5.67	.061	.0269	.009
457	684	J-130	-96.000	.11	11.33	.061	.0230	.017
459	688	689	48.000	.01	5.67	.061	.0269	.009
461	691	692	48.000	.10	5.66	.061	.0269	.009
464	410	694	-48.000	.08	5.64	.061	.0269	.009
466	697	J-105	48.000	.03	5.58	.062	.0269	.009
468	700	J-107	48.000	.02	5.60	.062	.0269	.009
470	702	252	.000	.00	.00	.062	.0000	.000
471	703	244	48.000	.02	5.59	.062	.0269	.009
472	J-49	518	280.000	.21	19.27	.062	.0194	.029
482	718	139	-143.000	.17	9.74	.062	.0222	.015
491	734	735	48.000	.03	5.62	.062	.0269	.009

Lorain II Landfill
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495	344	84	183.862	.06	5.81	.062	.0227	.009
499	230	743	-48.000	.02	5.59	.062	.0269	.009
500	214	142	862.447	.04	7.66	.062	.0185	.012
501	744	167	-47.000	.02	5.49	.062	.0270	.008
502	250	745	-48.000	.02	5.61	.062	.0269	.009
503	746	329	48.000	.03	5.66	.061	.0269	.009
504	747	748	48.000	.02	5.65	.061	.0269	.009
505	442	749	.000	.00	.00	.061	.0000	.000
P-100	J-37	J-56	284.000	1.52	32.87	.062	.0188	.050
P-108	261	183	143.000	.50	16.47	.063	.0212	.025
P-111	557	J-57	47.000	.06	5.46	.062	.0270	.008
P-113	184	193	.000	.00	.00	.062	.0000	.000
P-116	J-10	230	-285.000	.02	4.50	.062	.0221	.007
P-119	506	200	1982.208	.20	17.74	.061	.0159	.027
P-123	560	J-37	48.000	.02	5.54	.062	.0269	.008
P-124	124	197	47.000	.09	5.39	.063	.0270	.008
P-125	J-54	364	-47.000	.02	5.45	.062	.0270	.008
P-128	147	166	-1854.446	.17	16.51	.062	.0161	.025
P-130	J-209	344	1357.553	.16	12.11	.062	.0170	.018
P-131	212	J-62	553.553	.09	8.73	.062	.0192	.013
P-134	106	109	318.553	.06	5.02	.062	.0216	.008
P-136	109	212	459.553	.08	7.24	.062	.0200	.011
P-138	J-91	718	-333.000	.06	10.39	.062	.0200	.016
P-14	J-68	517	-47.000	.02	5.48	.062	.0270	.008
P-140	527	J-102	-48.000	.00	.76	.062	.0347	.001
P-142	J-41	228	-1306.194	.37	20.93	.061	.0164	.032
P-147	155	157	1051.447	.06	9.34	.062	.0178	.014
P-149	J-28	232	189.000	.34	13.00	.062	.0209	.020
P-156	J-44	601	-48.000	.08	5.66	.061	.0269	.009
P-158	J-50	J-63	48.000	.05	5.58	.062	.0269	.009
P-16	J-32	J-148	-1127.281	.27	18.02	.061	.0168	.027
P-160	J-93	411	2319.580	.44	20.74	.061	.0155	.032
P-163	273	274	615.350	.03	9.78	.061	.0188	.015
P-164	524	315	94.000	.36	11.01	.061	.0231	.017
P-165	261	J-99	-95.000	.10	10.93	.063	.0230	.017
P-166	J-101	252	1002.888	.26	15.90	.062	.0172	.024
P-168	J-93	76	-2271.580	.16	20.30	.061	.0156	.031
P-169	735	76	1221.692	.23	10.91	.061	.0173	.017
P-17	447	J-32	141.581	.44	16.69	.061	.0212	.025
P-170	J-104	J-105	-95.000	.20	11.06	.062	.0230	.017
P-176	274	270	757.350	.08	12.04	.061	.0181	.018
P-178	348	350	-94.000	.37	10.99	.062	.0231	.017
P-18	J-8	225	-4312.220	.83	39.01	.061	.0141	.059
P-181	J-41	J-246	1354.194	.39	21.72	.061	.0163	.033
P-182	J-127	434	-47.000	.06	5.55	.061	.0270	.008
P-183	599	67	-3502.929	.64	31.48	.061	.0145	.048
P-184	J-33	J-150	519.511	.14	16.45	.061	.0184	.025
P-185	67	410	-2462.580	.31	22.10	.061	.0153	.034
P-186	227	510	-769.994	.83	24.47	.061	.0172	.037
P-187	J-42	511	-95.000	.20	11.15	.061	.0230	.017
P-188	512	J-42	47.000	.02	5.52	.061	.0270	.008
P-189	511	6	-47.000	.02	5.51	.061	.0270	.008
P-190	225	J-4	-2693.208	.31	24.31	.061	.0151	.037
P-191	458	463	.000	.00	.00	.061	.0000	.000
P-197	J-7	353	-2455.208	.29	22.12	.061	.0154	.034
P-198	J-36	J-246	-4487.780	.91	40.60	.061	.0140	.062
P-199	353	464	-95.000	.13	11.21	.061	.0230	.017
P-2	J-3	J-4	95.000	.35	11.23	.061	.0230	.017
P-20	545	599	-3550.929	.75	31.98	.061	.0145	.049
P-202	J-103	313	-419.862	.16	13.28	.061	.0191	.020
P-204	157	158	1192.447	.08	10.59	.062	.0174	.016
P-206	J-116	J-115	4.650	.00	.54	.061	.0060	.001
P-207	J-46	J-143	2218.208	.37	19.93	.061	.0156	.030
P-21	J-44	J-34	153.668	.30	18.14	.061	.0209	.028
P-210	98	J-114	768.447	.20	12.11	.062	.0180	.018
P-214	323	199	-2029.208	.21	18.19	.061	.0158	.028
P-22	J-43	315	95.000	.31	11.12	.061	.0230	.017
P-220	11	J-46	47.000	.02	5.53	.061	.0270	.008
P-221	J-46	748	-2124.208	.23	19.07	.061	.0157	.029
P-222	J-12	199	2029.208	.11	18.18	.061	.0158	.028
P-223	78	J-12	.000	.00	.00	.061	.0000	.000

Lorain II Landfill

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Existing Landfill Gas Collection and Control System

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P-224	173	174	2169.558	.26	19.38	.061	.0157	.030
P-225	174	J-47	2217.558	.21	19.83	.061	.0156	.030
P-226	J-47	151	1935.208	.11	17.31	.061	.0160	.026
P-227	200	J-12	2029.208	.22	18.18	.061	.0158	.028
P-229	26	J-51	94.000	.31	10.96	.062	.0231	.017
P-23	J-39	701	-48.000	.02	5.63	.061	.0269	.009
P-230	J-79	237	-108.888	.00	1.72	.062	.0278	.003
P-234	J-52	J-51	48.000	.02	5.60	.062	.0269	.009
P-235	237	744	-61.888	.00	.98	.062	.0323	.001
P-236	160	162	1713.446	.16	15.23	.062	.0163	.023
P-237	J-79	236	438.888	.05	6.95	.062	.0201	.011
P-238	236	242	765.888	.13	12.13	.062	.0180	.018
P-239	J-63	J-64	-92.000	.26	10.69	.062	.0232	.016
P-24	J-39	260	-47.000	.08	5.51	.061	.0270	.008
P-240	242	234	812.888	.06	12.88	.062	.0178	.020
P-242	J-62	111	-804.000	.56	25.23	.062	.0170	.038
P-245	410	J-146	-2414.580	.49	21.64	.061	.0154	.033
P-248	J-15	J-20	95.000	.12	11.11	.062	.0230	.017
P-25	353	J-45	-2360.208	.17	21.25	.061	.0155	.032
P-252	J-20	313	372.862	.16	11.79	.061	.0196	.018
P-253	J-107	24	191.000	.29	13.15	.062	.0209	.020
P-254	309	J-116	.000	.00	.00	.061	.0000	.000
P-256	J-115	J-103	-419.862	.09	13.28	.061	.0191	.020
P-258	J-85	376	-47.000	.14	5.50	.061	.0270	.008
P-259	J-60	113	710.000	.54	22.22	.062	.0174	.034
P-26	236	518	-327.000	.45	22.53	.062	.0189	.034
P-260	213	J-61	47.000	.06	5.46	.062	.0270	.008
P-261	J-92	117	427.000	.19	13.33	.062	.0191	.020
P-262	498	J-60	142.000	.01	4.44	.062	.0240	.007
P-264	J-104	J-107	143.000	.54	16.66	.062	.0212	.025
P-266	J-59	498	95.000	.24	10.99	.062	.0230	.017
P-267	J-65	J-59	95.000	.09	10.99	.062	.0230	.017
P-268	J-66	J-65	48.000	.02	5.55	.062	.0269	.008
P-269	134	J-65	47.000	.06	5.43	.062	.0270	.008
P-27	215	J-62	-1357.553	.32	21.41	.062	.0163	.033
P-270	266	22	804.350	.12	12.80	.061	.0179	.020
P-271	265	268	899.350	.10	14.32	.061	.0175	.022
P-272	77	69	993.350	.30	15.83	.061	.0172	.024
P-273	J-110	J-45	2313.208	.35	20.81	.061	.0155	.032
P-274	J-95	J-110	48.000	.02	5.66	.061	.0269	.009
P-275	35	J-110	47.000	.02	5.54	.061	.0270	.008
P-276	J-125	J-120	48.000	.00	1.53	.061	.0315	.002
P-28	J-2	317	-236.000	.04	7.40	.062	.0215	.011
P-284	423	426	-905.000	.04	8.17	.061	.0184	.012
P-286	J-137	413	95.000	.15	11.22	.061	.0230	.017
P-287	J-138	J-135	-95.000	.21	11.22	.061	.0230	.017
P-288	J-135	433	-47.000	.06	5.55	.061	.0270	.008
P-289	608	J-144	.000	.00	.00	.061	.0000	.000
P-29	141	223	.000	.00	.00	.062	.0000	.000
P-290	J-144	86	.000	.00	.00	.061	.0000	.000
P-291	314	J-115	-424.511	.07	13.43	.061	.0191	.020
P-292	732	261	48.000	.16	5.52	.063	.0269	.008
P-293	229	160	1666.446	.10	14.81	.062	.0164	.023
P-294	441	687	-384.000	.14	12.25	.061	.0195	.019
P-3	J-4	J-40	-48.000	.03	5.68	.061	.0269	.009
P-30	140	317	47.000	.00	1.47	.062	.0317	.002
P-303	J-120	674	96.000	.01	3.06	.061	.0264	.005
P-305	J-119	J-120	48.000	.01	5.67	.061	.0269	.009
P-31	J-53	296	48.000	.06	5.57	.062	.0269	.008
P-312	675	J-125	48.000	.01	5.67	.061	.0269	.009
P-313	J-44	692	-105.668	.07	12.46	.061	.0225	.019
P-315	162	83	1760.446	.13	15.66	.062	.0162	.024
P-316	166	164	-1807.446	.17	16.09	.062	.0162	.025
P-317	J-130	685	-48.000	.06	5.66	.061	.0269	.009
P-32	J-49	J-63	-188.000	1.12	21.88	.062	.0201	.033
P-320	689	687	144.000	.01	4.59	.061	.0239	.007
P-321	689	J-133	-96.000	.01	3.06	.061	.0264	.005
P-322	690	J-133	48.000	.00	1.53	.061	.0315	.002
P-323	164	83	-1760.446	.11	15.66	.062	.0162	.024
P-325	J-143	J-110	2218.208	.14	19.95	.061	.0156	.030
P-326	J-146	411	-2414.580	.30	21.61	.061	.0154	.033



CORNERSTONE
Environmental Group, LLC

Lorain II Landfill
Existing Landfill Gas Collection and Control System
KYGas Report Output

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P-327	J-148	226	-958.994	.18	15.32	.061	.0173	.023
P-328	455	J-148	168.287	.19	19.83	.061	.0205	.030
P-329	J-150	510	769.994	.57	24.42	.061	.0172	.037
P-33	71	J-49	92.000	.04	10.72	.062	.0232	.016
P-330	315	J-150	250.482	.37	29.37	.061	.0192	.045
P-331	225	J-246	-1619.012	.08	14.62	.061	.0165	.022
P-344	692	328	-57.668	.03	6.80	.061	.0257	.010
P-375	J-34	604	153.668	.02	4.90	.061	.0236	.007
P-39	J-68	27	-47.000	.02	5.48	.062	.0270	.008
P-390	604	596	201.668	.04	6.43	.061	.0222	.010
P-4	J-7	J-4	2502.208	.30	22.57	.061	.0153	.034
P-40	149	171	1933.558	.13	17.25	.062	.0160	.026
P-401	595	J-41	48.000	.05	5.67	.061	.0269	.009
P-43	88	84	-230.862	.03	7.29	.062	.0216	.011
P-46	169	202	1886.558	.19	16.82	.062	.0160	.026
P-47	174	J-48	-48.000	.03	5.62	.061	.0269	.009
P-48	275	350	47.000	.09	5.49	.062	.0270	.008
P-480	674	683	96.000	.01	3.06	.061	.0264	.005
P-486	J-414	417	-858.000	.08	13.76	.061	.0177	.021
P-50	100	98	344.447	.04	5.43	.062	.0212	.008
P-506	417	419	-811.000	.11	13.00	.061	.0179	.020
P-507	419	421	-669.000	.08	10.72	.061	.0185	.016
P-508	687	684	-240.000	.06	7.65	.061	.0214	.012
P-509	684	683	-144.000	.04	4.59	.061	.0239	.007
P-51	J-30	198	48.000	.02	5.54	.062	.0269	.008
P-52	J-56	126	-189.000	.61	21.90	.062	.0201	.033
P-53	528	230	190.000	.01	3.00	.062	.0242	.005
P-54	528	527	-95.000	.00	1.50	.062	.0288	.002
P-56	J-91	J-92	380.000	.15	11.86	.062	.0195	.018
P-57	J-58	468	-143.000	.58	16.60	.062	.0212	.025
P-59	J-57	J-54	-94.000	.22	10.91	.062	.0231	.017
P-6	748	323	-2076.208	.23	18.63	.061	.0158	.028
P-62	J-60	117	-568.000	.34	17.75	.062	.0181	.027
P-63	297	117	141.000	.17	16.30	.062	.0213	.025
P-64	111	113	-757.000	.46	23.72	.062	.0172	.036
P-66	123	197	-189.000	.34	21.70	.063	.0201	.033
P-70	J-55	469	-47.000	.06	5.45	.062	.0270	.008
P-73	100	106	128.553	.01	2.03	.062	.0266	.003
P-74	118	297	94.000	.29	10.86	.062	.0231	.017
P-8	J-20	88	-277.862	.09	8.78	.062	.0208	.013
P-81	153	155	909.447	.03	8.07	.062	.0183	.012
P-82	229	145	-1333.447	.05	11.85	.062	.0171	.018
P-84	202	149	1933.558	.18	17.25	.062	.0160	.026
P-85	151	506	1935.208	.13	17.31	.061	.0160	.026
P-86	171	173	2122.558	.24	18.95	.061	.0157	.029
P-95	J-79	352	-47.000	.05	5.49	.062	.0270	.008
P-99	744	147	-14.888	.00	.24	.062	.0502	.000
R-1	R-1	R-1	-8799.999	.00	.04	.060	.0260	.000

JUNCTION	NODE	DEMAND	PRESSURE	PRESSURE	PRESSURE	DENSITY
NAME	TITLE	(USFU)	(USPU)	(PSIA)	(PSIG)	#/CF
1	EW-127R2	-46.00	-51.21	12.85	-1.85	.062
6	EW-154R2	-47.00	-54.91	12.71	-1.98	.061
9	EW-17R3	-47.00	-53.35	12.77	-1.93	.062
11	EW-31R	-47.00	-56.04	12.67	-2.02	.061
13		.00	-54.58	12.73	-1.97	.061
14		.00	-54.58	12.73	-1.97	.061
16	EW-5R2	-47.00	-51.26	12.85	-1.85	.062
17	EW-108R	-47.00	-53.66	12.76	-1.94	.062
19	EW-101R2	-47.00	-51.73	12.83	-1.87	.062
21	EW-112R	-47.00	-54.93	12.71	-1.98	.061
22		.00	-54.95	12.71	-1.98	.061
23	EW-113R	-47.00	-52.94	12.79	-1.91	.062
24		.00	-52.95	12.79	-1.91	.062
25	EW-114R	-47.00	-52.37	12.81	-1.89	.062
26		.00	-52.39	12.81	-1.89	.062

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27	EW-117R	-47.00	-52.39	12.81	-1.89	.062
29	EW-121R	-47.00	-49.49	12.91	-1.79	.062
35	EW-35R2	-47.00	-56.56	12.65	-2.04	.061
38	EW-87R2	-47.00	-50.06	12.89	-1.81	.062
67		.00	-55.88	12.68	-2.02	.061
69		.00	-55.59	12.69	-2.01	.061
70	EW-133	-47.00	-55.54	12.69	-2.00	.061
71	EW-116R	-46.00	-52.56	12.80	-1.90	.062
72	EW-168	-46.00	-52.51	12.80	-1.90	.062
74	TEW-5R2	-46.00	-51.17	12.85	-1.85	.062
75		.00	-53.95	12.75	-1.95	.062
76		.00	-54.18	12.74	-1.96	.061
77		.00	-55.29	12.70	-2.00	.061
78		.00	-55.27	12.70	-1.99	.061
80		.00	-52.07	12.82	-1.88	.062
81	EW-3	-47.00	-52.06	12.82	-1.88	.062
82		.00	-52.75	12.79	-1.90	.062
83		.00	-52.75	12.79	-1.90	.062
84		.00	-53.79	12.75	-1.94	.062
86		.00	-54.58	12.73	-1.97	.061
87		.00	-54.58	12.73	-1.97	.061
88		.00	-53.82	12.75	-1.94	.062
89	EW-64	-47.00	-53.78	12.76	-1.94	.062
90	EW-15	-47.00	-53.38	12.77	-1.93	.062
94	EW-27	-47.00	-55.02	12.71	-1.99	.061
96		.00	-57.17	12.63	-2.06	.061
97		.00	-57.17	12.63	-2.06	.061
98		.00	-51.45	12.84	-1.86	.062
100		.00	-51.41	12.84	-1.86	.062
106		.00	-51.41	12.84	-1.86	.062
109		.00	-51.47	12.84	-1.86	.062
111		.00	-51.08	12.85	-1.84	.062
112	EW-76	-47.00	-51.04	12.85	-1.84	.062
113		.00	-50.62	12.87	-1.83	.062
117		.00	-49.74	12.90	-1.79	.062
118		.00	-49.28	12.92	-1.78	.062
121		.00	-46.73	13.01	-1.69	.063
122		.00	-46.66	13.01	-1.68	.063
123		.00	-47.31	12.99	-1.71	.063
124		.00	-46.89	13.00	-1.69	.063
126		.00	-50.09	12.89	-1.81	.062
128		.00	-50.86	12.86	-1.84	.062
129		.00	-50.64	12.87	-1.83	.062
131		.00	-50.64	12.87	-1.83	.062
132		.00	-50.95	12.86	-1.84	.062
134	TEW-1R	-47.00	-49.68	12.90	-1.79	.062
136		.00	-49.09	12.92	-1.77	.062
139		.00	-49.17	12.92	-1.77	.062
140		.00	-51.29	12.84	-1.85	.062
141		.00	-51.29	12.85	-1.85	.062
142		.00	-52.01	12.82	-1.88	.062
145		.00	-52.31	12.81	-1.89	.062
147		.00	-53.21	12.78	-1.92	.062
149		.00	-53.77	12.76	-1.94	.062
151		.00	-54.71	12.72	-1.97	.061
152	EW-96	-47.00	-52.00	12.82	-1.88	.062
153		.00	-52.06	12.82	-1.88	.062
154	EW-1	-47.00	-51.76	12.83	-1.87	.062
155		.00	-52.09	12.82	-1.88	.062
156	EW-2	-47.00	-51.91	12.82	-1.87	.062
157		.00	-52.16	12.81	-1.88	.062
158		.00	-52.23	12.81	-1.88	.062
159	EW-6	-47.00	-52.44	12.80	-1.89	.062
160		.00	-52.46	12.80	-1.89	.062
161	EW-7	-47.00	-52.58	12.80	-1.90	.062
162		.00	-52.62	12.80	-1.90	.062
163	EW-10	-47.00	-52.82	12.79	-1.91	.062
164		.00	-52.87	12.79	-1.91	.062
165	EW-11	-47.00	-53.01	12.78	-1.91	.062
166		.00	-53.04	12.78	-1.91	.062
167	EW-14	-47.00	-53.19	12.78	-1.92	.062

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169		.00	-53.40	12.77	-1.93	.062
170	EW-19	-47.00	-53.25	12.77	-1.92	.062
171		.00	-53.89	12.75	-1.94	.062
172	EW-22R	-47.00	-54.09	12.74	-1.95	.061
173		.00	-54.13	12.74	-1.95	.061
174		.00	-54.39	12.73	-1.96	.061
176		.00	-49.96	12.89	-1.80	.062
177		.00	-50.51	12.87	-1.82	.062
178	EW-90B	-47.00	-49.69	12.90	-1.79	.062
179		.00	-49.23	12.92	-1.78	.062
180		.00	-51.53	12.84	-1.86	.062
181	EW-2A	-47.00	-51.68	12.83	-1.86	.062
182	EW-3A	-47.00	-51.84	12.83	-1.87	.062
183		.00	-48.46	12.95	-1.75	.062
184		.00	-49.11	12.92	-1.77	.062
186	EW-162	-47.00	-53.73	12.76	-1.94	.062
193		.00	-49.11	12.92	-1.77	.062
197		.00	-46.97	13.00	-1.70	.063
198		.00	-49.16	12.92	-1.77	.062
199		.00	-55.38	12.70	-2.00	.061
200		.00	-55.04	12.71	-1.99	.061
201	EW-18	-47.00	-53.56	12.76	-1.93	.062
202		.00	-53.59	12.76	-1.93	.062
203		.00	-49.63	12.91	-1.79	.062
207	EW-100R	-47.00	-51.47	12.84	-1.86	.062
212		.00	-51.55	12.84	-1.86	.062
213	EW-77	-47.00	-51.39	12.84	-1.85	.062
214		.00	-51.97	12.82	-1.88	.062
215		.00	-51.96	12.82	-1.88	.062
223		.00	-51.29	12.85	-1.85	.062
225		.00	-58.00	12.60	-2.09	.061
226		.00	-56.26	12.67	-2.03	.061
227		.00	-56.16	12.67	-2.03	.061
228		.00	-57.17	12.63	-2.06	.061
229		.00	-52.36	12.81	-1.89	.062
230	EW-119	-47.00	-52.31	12.81	-1.89	.062
231	EW-118	-47.00	-51.80	12.83	-1.87	.062
232		.00	-52.74	12.79	-1.90	.062
234		.00	-53.46	12.77	-1.93	.062
236		.00	-53.26	12.77	-1.92	.062
237		.00	-53.21	12.78	-1.92	.062
238	EW-106	-47.00	-53.08	12.78	-1.92	.062
241	EW-13R	-47.00	-53.33	12.77	-1.92	.062
242		.00	-53.40	12.77	-1.93	.062
243	EW-120RS	-47.00	-50.61	12.87	-1.83	.062
244		.00	-52.25	12.81	-1.89	.062
245	EW-63	-47.00	-52.14	12.81	-1.88	.062
250		.00	-53.31	12.77	-1.92	.062
252		.00	-53.86	12.75	-1.94	.062
256	EW-147R	-47.00	-47.75	12.97	-1.72	.063
260	EW-53R	-47.00	-54.45	12.73	-1.97	.061
261		.00	-47.96	12.97	-1.73	.063
265		.00	-55.08	12.71	-1.99	.061
266		.00	-54.83	12.72	-1.98	.061
267	125R	-47.00	-55.05	12.71	-1.99	.061
268		.00	-55.18	12.70	-1.99	.061
270		.00	-54.73	12.72	-1.98	.061
271	EW-109	-47.00	-54.71	12.72	-1.97	.061
273		.00	-54.62	12.72	-1.97	.061
274		.00	-54.65	12.72	-1.97	.061
275	EW-124R	-47.00	-53.55	12.76	-1.93	.062
293	EW-93R	-47.00	-51.56	12.84	-1.86	.062
294	EW-94R	-47.00	-51.55	12.84	-1.86	.062
296	EW-91R	-47.00	-50.88	12.86	-1.84	.062
297		.00	-49.57	12.91	-1.79	.062
298	EW-71R	-47.00	-49.55	12.91	-1.79	.062
300	EW-68R	-47.00	-49.39	12.91	-1.78	.062
306	EW-46	-47.00	-55.89	12.68	-2.02	.061
307		.00	-55.43	12.70	-2.00	.061
309		.00	-54.31	12.74	-1.96	.061
312	EW-59	-47.00	-54.05	12.75	-1.95	.061

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313		.00	-54.06	12.74	-1.95	.061
314		.00	-54.38	12.73	-1.96	.061
315	EW-54R	-47.00	-54.39	12.73	-1.96	.061
317		.00	-51.30	12.84	-1.85	.062
322	EW-29	-47.00	-55.57	12.69	-2.01	.061
323		.00	-55.59	12.69	-2.01	.061
324	EW-36R	-47.00	-56.90	12.64	-2.05	.061
326	EW-37R	-47.00	-57.34	12.63	-2.07	.061
328	EW-138R	-47.00	-56.71	12.65	-2.05	.061
329		.00	-56.61	12.65	-2.04	.061
331	TEW-9R	-47.00	-56.55	12.66	-2.04	.061
344		.00	-53.73	12.76	-1.94	.062
348		.00	-54.02	12.75	-1.95	.061
350		.00	-53.65	12.76	-1.94	.062
351	EW-111	-47.00	-53.63	12.76	-1.94	.062
352	EW-105	-47.00	-53.17	12.78	-1.92	.062
353		.00	-57.10	12.64	-2.06	.061
362	EW-63R	-47.00	-53.25	12.77	-1.92	.062
364	EW-79R	-47.00	-51.03	12.85	-1.84	.062
365	EW-65R	-47.00	-53.70	12.76	-1.94	.062
367	EW-228	-47.00	-46.70	13.01	-1.69	.063
368	EW-227	-47.00	-50.55	12.87	-1.82	.062
369	EW-90R	-47.00	-50.49	12.87	-1.82	.062
370	EW-224	-47.00	-49.93	12.89	-1.80	.062
371	EW-122R	-47.00	-49.60	12.91	-1.79	.062
372	EW-140R	-47.00	-46.86	13.01	-1.69	.063
373	EW-226	-47.00	-49.21	12.92	-1.78	.062
374	EW-128R	-47.00	-51.67	12.83	-1.86	.062
375	EW-57R2	-47.00	-53.82	12.75	-1.94	.062
376	EW-58R	-47.00	-54.19	12.74	-1.96	.061
377	EW-48R	-47.00	-51.84	12.83	-1.87	.062
379	EW-32R	-47.00	-55.99	12.68	-2.02	.061
388	EW-74R	-47.00	-50.57	12.87	-1.83	.062
389	EW-70R	-47.00	-49.53	12.91	-1.79	.062
390	TEW-2R	-47.00	-49.21	12.92	-1.78	.062
391	EW-164R	-47.00	-49.15	12.92	-1.77	.062
410		.00	-55.57	12.69	-2.01	.061
411		.00	-54.78	12.72	-1.98	.061
412	EW-304	-47.00	-57.03	12.64	-2.06	.061
413		.00	-57.24	12.63	-2.07	.061
416	EW-309	-47.00	-57.56	12.62	-2.08	.061
417		.00	-57.59	12.62	-2.08	.061
418	EW-310	-47.00	-57.28	12.63	-2.07	.061
419		.00	-57.47	12.62	-2.07	.061
421		.00	-57.39	12.62	-2.07	.061
423		.00	-57.86	12.61	-2.09	.061
425	EW-305	-47.00	-57.78	12.61	-2.09	.061
426		.00	-57.82	12.61	-2.09	.061
433	EW-303	-47.00	-56.97	12.64	-2.06	.061
434	EW-302	-47.00	-57.02	12.64	-2.06	.061
439	EW-301	-47.00	-57.82	12.61	-2.09	.061
441	EW-312	-47.00	-57.34	12.63	-2.07	.061
442		.00	-57.79	12.61	-2.09	.061
444	H9	-47.00	-54.58	12.73	-1.97	.061
445	H8	-47.00	-55.07	12.71	-1.99	.061
446	H7	-47.00	-55.97	12.68	-2.02	.061
447	H6	-47.00	-56.27	12.67	-2.03	.061
448	H10	-47.00	-54.38	12.73	-1.96	.061
449	H11	-47.00	-54.31	12.74	-1.96	.061
454		.00	-55.07	12.71	-1.99	.061
455	EW-45R	-47.00	-56.25	12.67	-2.03	.061
458		.00	-56.97	12.64	-2.06	.061
461	H4	-47.00	-57.30	12.63	-2.07	.061
463		.00	-56.97	12.64	-2.06	.061
464		.00	-56.97	12.64	-2.06	.061
468		.00	-50.73	12.87	-1.83	.062
469	EW-148	-47.00	-50.61	12.87	-1.83	.062
494	EW-82R	-47.00	-51.25	12.85	-1.85	.062
495	EW-142R	-47.00	-50.95	12.86	-1.84	.062
497	EW-73R	-47.00	-50.06	12.89	-1.81	.062
498		.00	-50.07	12.89	-1.81	.062

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499	EW-165R	-47.00	-49.26	12.92	-1.78	.062
500	EW-144R	-47.00	-47.19	12.99	-1.70	.063
501	EW-163R	-47.00	-48.44	12.95	-1.75	.062
505	EW-28R	-47.00	-54.81	12.72	-1.98	.061
506		.00	-54.84	12.72	-1.98	.061
507	TEW-7R2	-47.00	-54.99	12.71	-1.98	.061
508	EW-152	-47.00	-53.97	12.75	-1.95	.062
510		.00	-55.33	12.70	-2.00	.061
511		.00	-54.93	12.71	-1.98	.061
512	EW-47R	-47.00	-55.12	12.71	-1.99	.061
515	EW-2BR	-47.00	-51.59	12.83	-1.86	.062
516	EW-118S	-47.00	-51.78	12.83	-1.87	.062
517	EW-117S	-47.00	-52.39	12.81	-1.89	.062
518		.00	-52.81	12.79	-1.91	.062
519	EW-116S	-47.00	-52.80	12.79	-1.91	.062
520	EW-114S	-47.00	-52.37	12.81	-1.89	.062
524	EW-51R	-47.00	-54.03	12.75	-1.95	.061
525	EW-153	-47.00	-53.92	12.75	-1.95	.062
526	EW-150	-47.00	-52.27	12.81	-1.89	.062
527		.00	-52.30	12.81	-1.89	.062
528		.00	-52.30	12.81	-1.89	.062
545		.00	-57.27	12.63	-2.07	.061
555	EW-141R	-47.00	-46.96	13.00	-1.69	.063
556	EW-78R	-47.00	-51.39	12.84	-1.85	.062
557	EW-81R	-47.00	-51.21	12.85	-1.85	.062
558	EW-143R	-48.00	-50.65	12.87	-1.83	.062
560	EW-85R	-48.00	-49.17	12.92	-1.77	.062
562	EW-91AR	-48.00	-50.80	12.86	-1.83	.062
563	EW-1A	-48.00	-51.52	12.84	-1.86	.062
589	EW-110R	-48.00	-53.99	12.75	-1.95	.062
595	EW-38R	-48.00	-57.49	12.62	-2.07	.061
596		.00	-57.17	12.63	-2.06	.061
597	EW-39R	-48.00	-57.16	12.63	-2.06	.061
598	EW-159	-48.00	-56.49	12.66	-2.04	.061
599		.00	-56.52	12.66	-2.04	.061
601		.00	-56.74	12.65	-2.05	.061
603	EW-40R2	-48.00	-56.71	12.65	-2.05	.061
604		.00	-57.13	12.63	-2.06	.061
606		.00	-54.58	12.73	-1.97	.061
608		.00	-54.58	12.73	-1.97	.061
612		.00	-55.33	12.70	-2.00	.061
613	TEW-3R	-48.00	-49.01	12.93	-1.77	.062
620	EW-145R2	-48.00	-46.65	13.01	-1.68	.063
673		.00	-57.08	12.64	-2.06	.061
674		.00	-57.09	12.64	-2.06	.061
675	H-14	-48.00	-57.06	12.64	-2.06	.061
679	H12	-48.00	-57.08	12.64	-2.06	.061
683		.00	-57.09	12.64	-2.06	.061
684		.00	-57.14	12.63	-2.06	.061
685	EW-315	-48.00	-56.97	12.64	-2.06	.061
687		.00	-57.20	12.63	-2.06	.061
688	EW-316	-48.00	-57.18	12.63	-2.06	.061
689		.00	-57.19	12.63	-2.06	.061
690	EW-313	-48.00	-57.18	12.63	-2.06	.061
691	EW-43R2	-48.00	-56.65	12.65	-2.04	.061
692		.00	-56.74	12.65	-2.05	.061
694	EW-160	-48.00	-55.49	12.69	-2.00	.061
697	EW-161	-48.00	-51.88	12.82	-1.87	.062
700	EW-126R	-48.00	-52.64	12.80	-1.90	.062
701	EW-129R	-48.00	-54.51	12.73	-1.97	.061
702		.00	-53.86	12.75	-1.94	.062
703	EW-9R2	-48.00	-52.23	12.81	-1.88	.062
718		.00	-49.35	12.92	-1.78	.062
719	TEW-4R	-48.00	-49.03	12.93	-1.77	.062
732	EW-62R2	-48.00	-47.80	12.97	-1.72	.063
734	EW-146R	-48.00	-53.91	12.75	-1.95	.062
735		.00	-53.95	12.75	-1.95	.062
739		.00	-49.52	12.91	-1.79	.062
743	EW-119S	-48.00	-52.29	12.81	-1.89	.062
744		.00	-53.21	12.78	-1.92	.062
745	EW-58R2	-48.00	-53.30	12.77	-1.92	.062

Lorain II Landfill
Existing Landfill Gas Collection and Control System
KYGas Report Output

KYG 2012 -25

746	EW-34R2	-48.00	-56.58	12.65	-2.04	.061
747	EW-29	-48.00	-55.81	12.68	-2.01	.061
748		.00	-55.82	12.68	-2.01	.061
749		.00	-57.79	12.61	-2.09	.061
J-10	EW-102	-48.00	-52.33	12.81	-1.89	.062
J-101	EW-135	-48.00	-53.61	12.76	-1.93	.062
J-102	EW-149	-48.00	-52.29	12.81	-1.89	.062
J-103		.00	-54.23	12.74	-1.96	.061
J-104	TEW-6R	-48.00	-52.12	12.82	-1.88	.062
J-105		.00	-51.92	12.82	-1.87	.062
J-107		.00	-52.66	12.80	-1.90	.062
J-108	EW-113S	-48.00	-52.93	12.79	-1.91	.062
J-110		.00	-56.58	12.65	-2.04	.061
J-114		.00	-51.65	12.83	-1.86	.062
J-115		.00	-54.31	12.74	-1.96	.061
J-116		.00	-54.31	12.74	-1.96	.061
J-119	H13	-48.00	-57.07	12.64	-2.06	.061
J-12		.00	-55.27	12.70	-1.99	.061
J-120		.00	-57.08	12.64	-2.06	.061
J-125		.00	-57.08	12.64	-2.06	.061
J-127	EW-306	-48.00	-57.07	12.64	-2.06	.061
J-130	EW-317	-48.00	-57.02	12.64	-2.06	.061
J-133	EW-314	-48.00	-57.18	12.63	-2.06	.061
J-135	EW-307	-48.00	-57.03	12.64	-2.06	.061
J-137	EW-308	-48.00	-57.09	12.64	-2.06	.061
J-138	EW-311	-48.00	-57.24	12.63	-2.07	.061
J-143		.00	-56.43	12.66	-2.04	.061
J-144		.00	-54.58	12.73	-1.97	.061
J-146		.00	-55.08	12.71	-1.99	.061
J-148		.00	-56.44	12.66	-2.04	.061
J-15	EW-60	-48.00	-53.79	12.75	-1.94	.062
J-150		.00	-54.76	12.72	-1.98	.061
J-18	EW-112S	-48.00	-54.93	12.71	-1.98	.061
J-2		.00	-51.33	12.84	-1.85	.062
J-20		.00	-53.91	12.75	-1.95	.062
J-209		.00	-53.57	12.76	-1.93	.062
J-246		.00	-57.92	12.61	-2.09	.061
J-28	EW-103	-48.00	-52.40	12.81	-1.89	.062
J-3	H3	-48.00	-57.34	12.63	-2.07	.061
J-30	EW-122R	-48.00	-49.13	12.92	-1.77	.062
J-31	EW-41	-48.00	-57.10	12.64	-2.06	.061
J-32	EW-42	-48.00	-56.71	12.65	-2.05	.061
J-33		.00	-54.62	12.72	-1.97	.061
J-34		.00	-57.11	12.63	-2.06	.061
J-36		.00	-58.83	12.57	-2.12	.061
J-37		.00	-49.18	12.92	-1.77	.062
J-39		.00	-54.53	12.73	-1.97	.061
J-4	H2	-48.00	-57.69	12.61	-2.08	.061
J-40	H1	-48.00	-57.66	12.61	-2.08	.061
J-41		.00	-57.54	12.62	-2.08	.061
J-414		.00	-57.67	12.61	-2.08	.061
J-42		.00	-55.13	12.71	-1.99	.061
J-43	EW-151	-48.00	-54.07	12.74	-1.95	.061
J-44		.00	-56.81	12.65	-2.05	.061
J-45		.00	-56.92	12.64	-2.05	.061
J-46		.00	-56.06	12.67	-2.02	.061
J-47		.00	-54.60	12.73	-1.97	.061
J-48	EW-23	-48.00	-54.36	12.73	-1.96	.061
J-49		.00	-52.60	12.80	-1.90	.062
J-5	EW-158R	-48.00	-54.88	12.72	-1.98	.061
J-50	EW-115R	-48.00	-51.43	12.84	-1.86	.062
J-51		.00	-52.70	12.79	-1.90	.062
J-52	EW-107R	-48.00	-52.69	12.79	-1.90	.062
J-53		.00	-50.82	12.86	-1.83	.062
J-54		.00	-51.05	12.85	-1.84	.062
J-55	EW-83R	-48.00	-50.67	12.87	-1.83	.062
J-56		.00	-50.71	12.87	-1.83	.062
J-57		.00	-51.27	12.85	-1.85	.062
J-58		.00	-51.31	12.84	-1.85	.062
J-59		.00	-49.83	12.90	-1.80	.062
J-60		.00	-50.08	12.89	-1.81	.062

Lorain II Landfill
Existing Landfill Gas Collection and Control System
KYGas Report Output

KYG 2012 -26

J-61		.00	-51.45	12.84	-1.86	.062
J-62		.00	-51.64	12.83	-1.86	.062
J-63	EW-115R	-48.00	-51.48	12.84	-1.86	.062
J-64		.00	-51.23	12.85	-1.85	.062
J-65		.00	-49.74	12.90	-1.79	.062
J-66	EW-166R	-48.00	-49.72	12.90	-1.79	.062
J-68		.00	-52.41	12.80	-1.89	.062
J-7		.00	-57.39	12.62	-2.07	.061
J-73		.00	-51.61	12.83	-1.86	.062
J-79		.00	-53.21	12.78	-1.92	.062
J-8		.00	-58.83	12.57	-2.12	.061
J-85	EW-55	-48.00	-54.33	12.74	-1.96	.061
J-91		.00	-49.41	12.91	-1.78	.062
J-92		.00	-49.55	12.91	-1.79	.062
J-93	EW-52R2	-48.00	-54.34	12.74	-1.96	.061
J-95	EW-155R	-48.00	-56.56	12.65	-2.04	.061
J-99	EW-167	-48.00	-47.86	12.97	-1.73	.063
R-1		.00	-60.00	12.53	-2.17	.060

* This designates the use of default density in a low pressure region

Lorain II Landfill
Existing Landfill Gas Collection and Control System
KYGas Report Output

KYG 2012 -27

THE NET SYSTEM DEMAND (USFU) = -8800.000

SUMMARY OF INFLOWS(+) AND.OUTFLOWS(-) :

NAME	FLOW (USFU)	FPN TITLE
R-1	-8800.0	R-1

MAXIMUM MACH NUMBER = .04 IN LINE NO. 371

SUMMARY OF MINIMUM.AND.MAXIMUM VELOCITIES (FT/S)

MINIMUM		MAXIMUM	
R-1	.04	371	40.72
P-99	.24	P-198	40.60
P-206	.54	212	39.12
P-140	.76	P-18	39.01
P-235	.98	360	34.29
306	1.19	P-100	32.87
217	1.26	137	32.41
79	1.47	P-20	31.98
P-30	1.47	P-183	31.48
P-54	1.50	P-330	29.37

SUMMARY OF MINIMUM.AND.MAXIMUM LOSS/1000. (PSI)

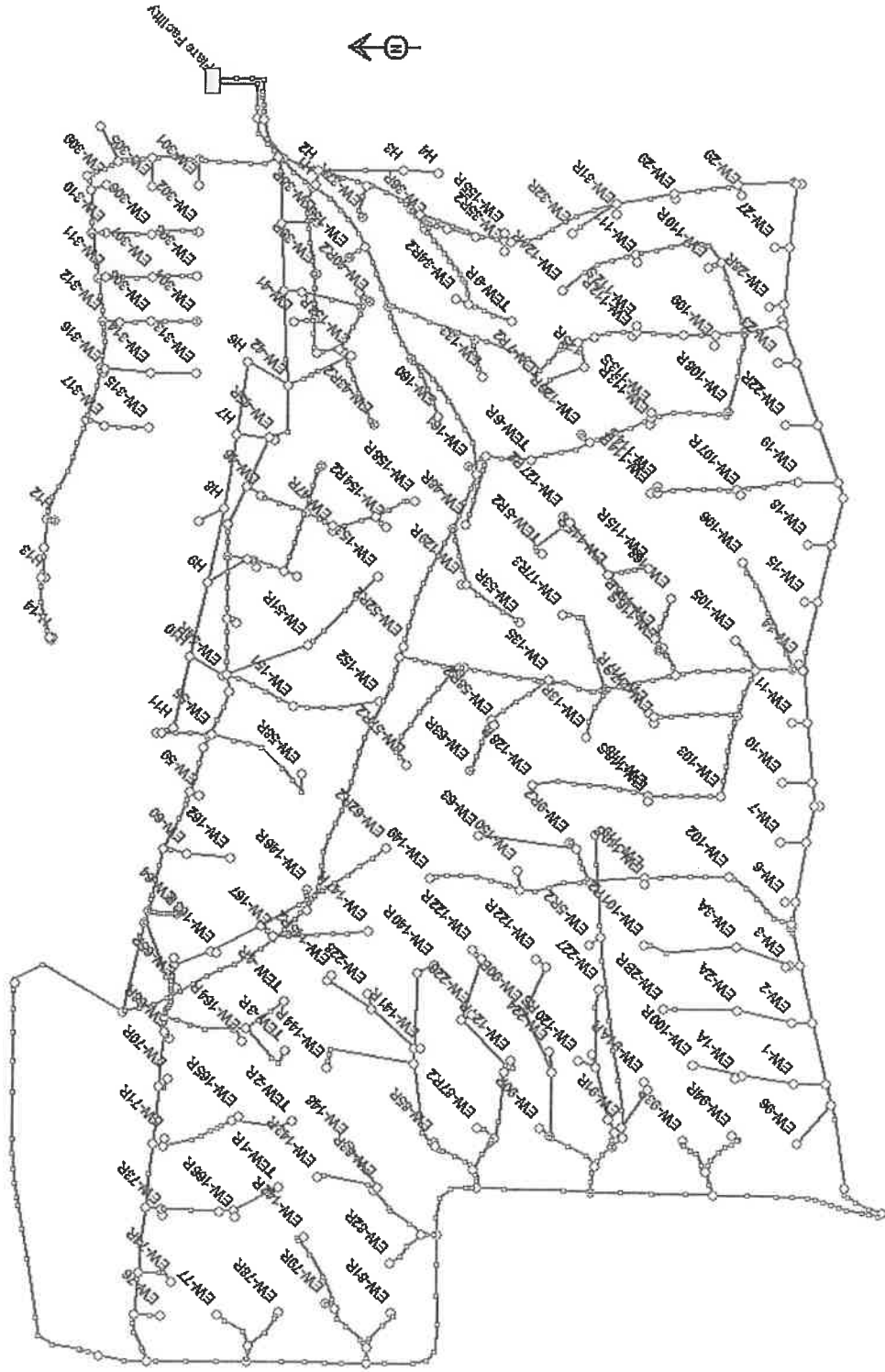
MINIMUM		MAXIMUM	
R-1	.00	P-100	.28
P-99	.00	P-330	.23
P-206	.00	67	.20
P-140	.00	137	.20
P-235	.00	211	.14
P-54	.00	97	.14
P-230	.00	107	.13
79	.00	208	.13
P-30	.00	P-52	.13
P-276	.00	P-32	.13

SUMMARY OF MINIMUM.AND.MAXIMUM PRESSURES (USPU)

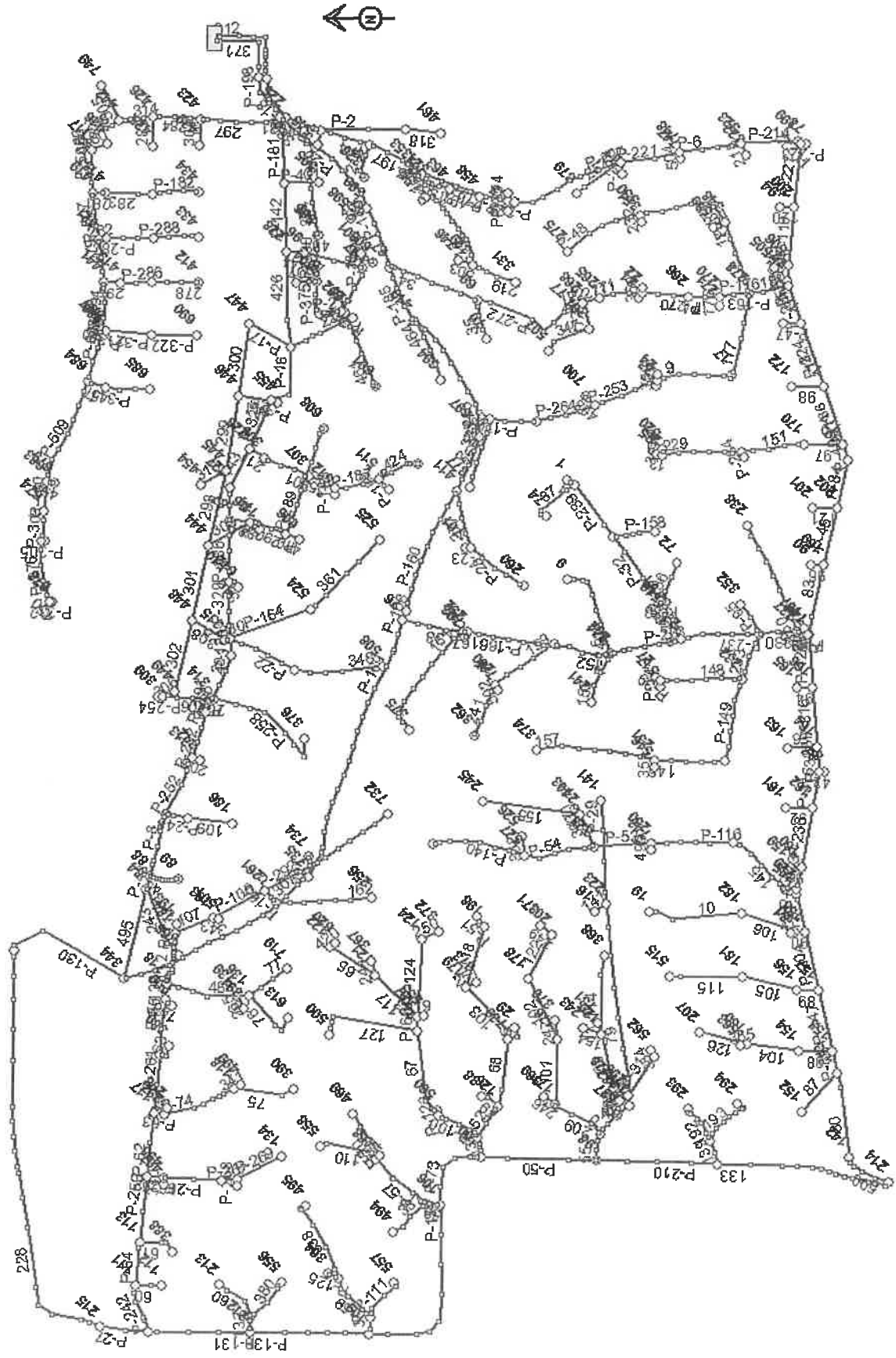
MINIMUM		MAXIMUM	
R-1	-60.00	620	-46.65
J-36	-58.83	122	-46.66
J-8	-58.83	367	-46.70
225	-58.00	121	-46.73
J-246	-57.92	372	-46.86
423	-57.86	124	-46.89
439	-57.82	555	-46.96
426	-57.82	197	-46.97
442	-57.79	500	-47.19
425	-57.78	123	-47.31

***** END OF KYGAS SIMULATION *****

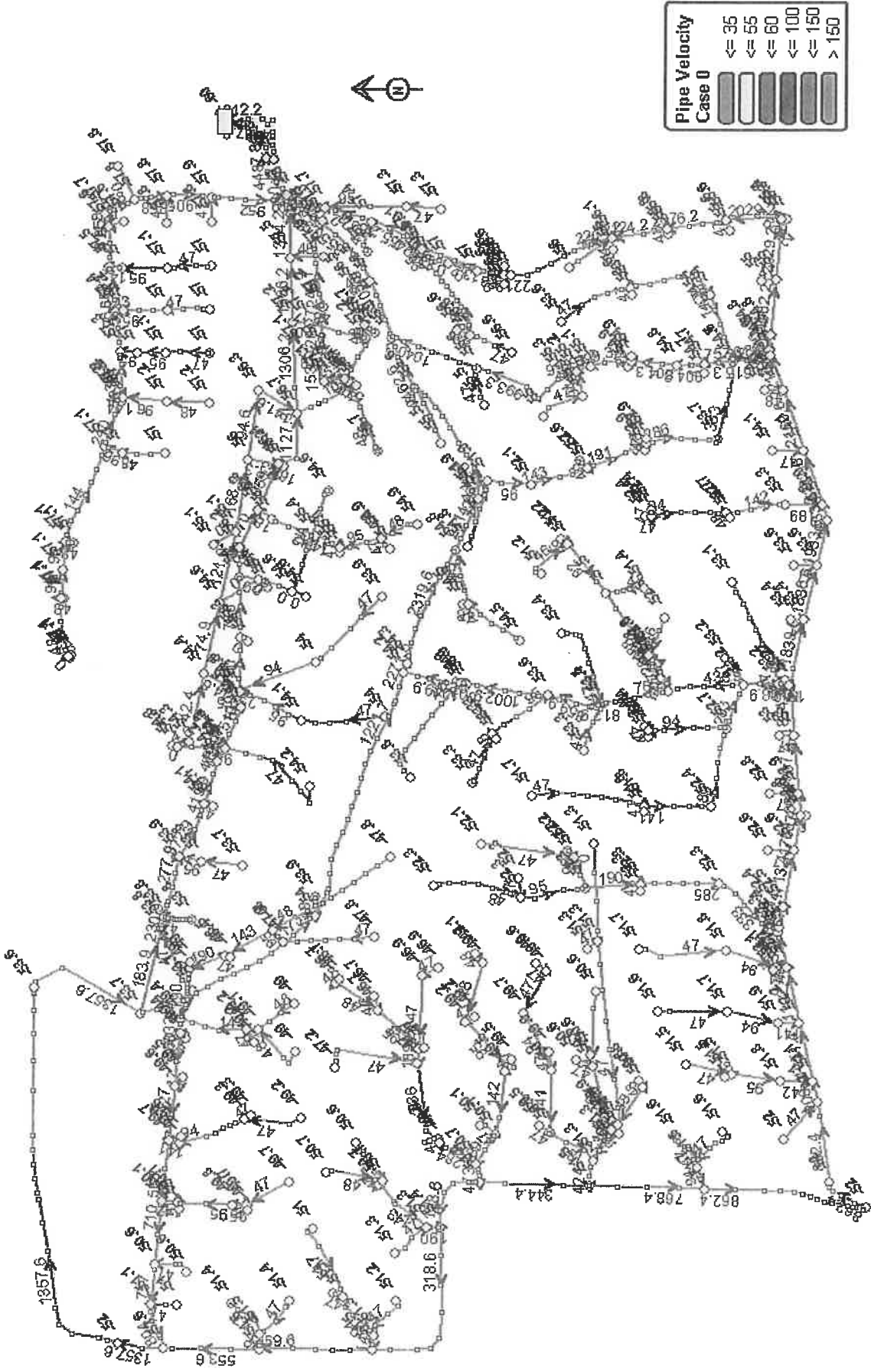
Lorain II Landfill
Existing Landfill Gas Collection and Control System
Site Plan



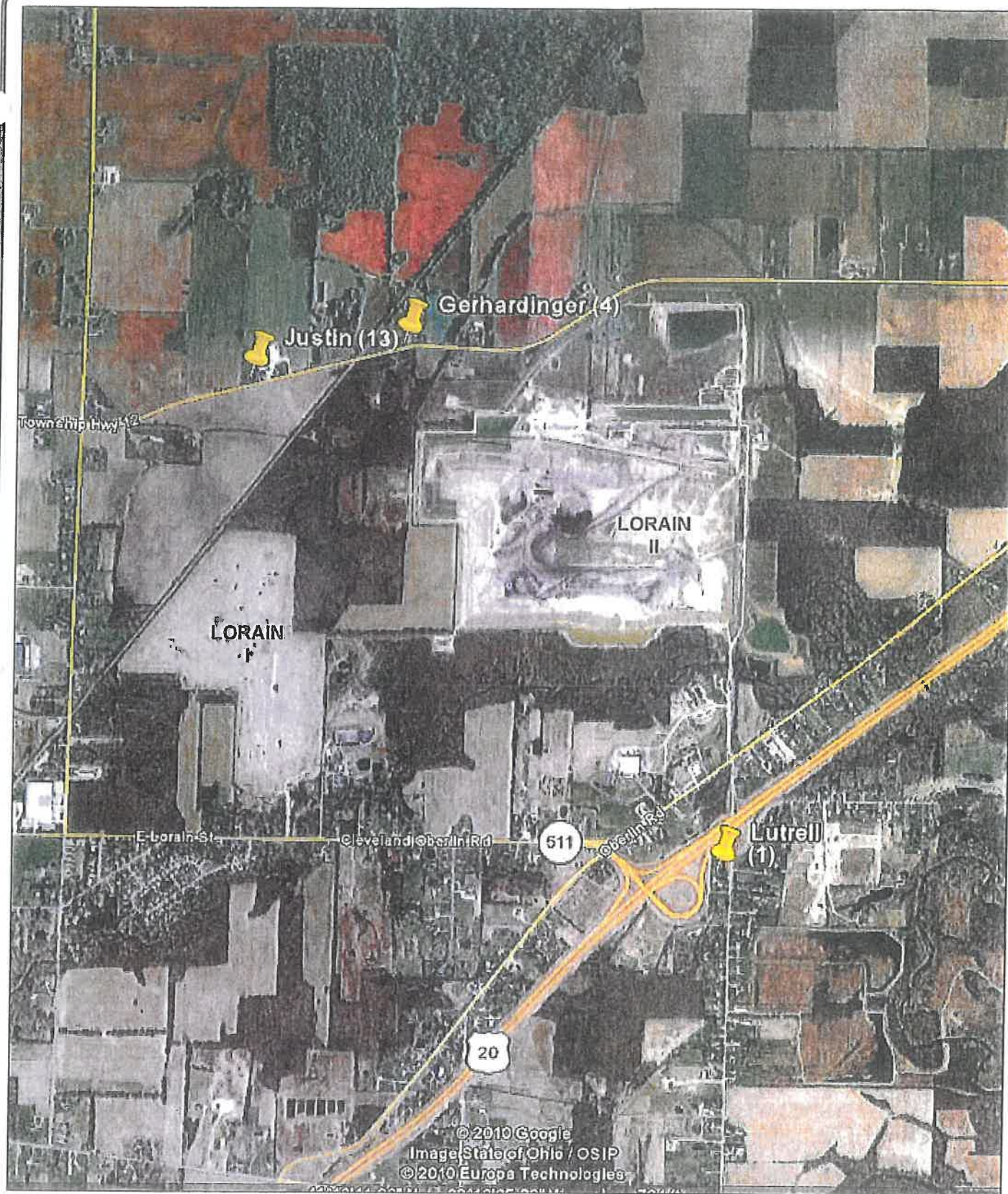
Lorain II Landfill
Existing Landfill Gas Collection and Control System
Junction and Pipe Names



Lorain II Landfill
Existing Landfill Gas Collection and Control System
Junction Available Vacuum (in. w.c.) and Pipe Flow Velocity (fps) Information



ATTACHMENT 4
ODOR COMPLAINT LOG



This drawing represents intellectual property of Cornerstone Environmental Group, LLC. Any modification to the original by other than Cornerstone Environmental Group, LLC personnel violates its original purpose and as such is rendered void. Cornerstone Environmental Group, LLC will not be held liable for any changes made to this document without express written consent of the originator.

LORAIN COUNTY LANDFILL

**2010 ODOR COMPLAINTS
ORIGINATION MAP**

Odor Log - 2010
Site Name: Lorain County II Landfill
Division No.: F08
EM: Chris Jaquet
Designated RO(s) to Maintain Log: Jeff Kraus

Date Complainant Called	Time Complainant Called	Date Odor Detected	Time Odor Detected	Name of Complainant	Address of Complainant	Summary of Complaint	Request Return Call? (Y/N)	Type of Odor Detected			Returned Call (Date)	Location of Odor	Wind Speed (mph)	Wind Direction	Barometric Pressure	Ave. GCCS Flow (SCFM) for Day of Complaint	Average Methane Concentration	Normalized Gas Flow (scfm at 50% CH4)	Tons of MSW Received	Comments
								MSW	Sludge/Special Waste	Gas										
1/7/2010	9:50PM			John Piwinski		Twp. Trustee Received complaint from Gerhardinger of strong odors coming from NW corner of Landfill. Checked himself and agreed.				x		N & NW	7	S	29.97	7,297			3745	Rick Kostelnick checked next morning and found nothing at that time.
1/7/2010	10:30 PM			Sue Gerhardinger	44276 Butternut Ridge Road	Strong Methane all day. So bad tonight she had a headache and eyes burning				x		NW	7	S	29.97					Rick Kostelnick checked next morning and found nothing at that time.
1/23/2010	6:09 AM			John Piwinski		Strong odor coming from north side of Landfill just west of bike path past Gerhardinger farm				x		N	5	ESE	30.02	7,800		152		Rick Kostelnick Checked once he arrived in morning and did not confirm anything at that time.
1/23/2010	7:30 AM			Pat Justin	44604 Butternut Ridge Road	Strong odor from Landfill				x		NW	5	ESE	30.02	7,800				Investigated by Rich Heier Monday Morning
2/22/2010	11:29 AM			Pat Justin	44604 Butternut Ridge Road	Strong Chemical Odor from landfill			x			NW	10	WSW	29.68	7,537		4,338		Rick Kostelnick called Mr. Justin at 12:10 to verify odors coming from landfill were from a load dumped by Chemtron and is off spec GoJo soap.
3/9/2010	5:26 PM			Pat Justin	44604 Butternut Ridge Road	Strong odor from Landfill				x		NW	2	SSE	30	7,400		3747		Rick Kostelnick was at Mr. Justin's home with in 10 minutes. No odors found and confirmed with Mr. Justin. Mr. Justin also stated odors are getting better overall.
3/10/2010	8:43 AM			Rick Justin	44604 Butternut Ridge Road	Strong odor from Landfill				x		NW	5	SSE	29.84	7,283			3,962	Rick Kostelnick and Chris Jaquet were at Justin's home at 9:15 AM and no odors verified. Employee of Mr. Justin verified no odors present at that time.
3/11/2010	6:20 AM			Pat Justin	44604 Butternut Ridge Road	Strong odor from Landfill	Y			x		NW	5	SE	29.81	7,536		3,926		Rich Heier performed odor patrol at 6:10 AM and no odors present. Justin's followed him during inspection. Due to this odor patrol was performed again at 6:50 AM, no odors detected.
3/11/2010	9:37 AM			Rick Justin	44604 Butternut Ridge Road	Left message wanting call	Y					NW	5	SE	29.81	7,536		3,926		
3/11/2010	9:46 AM			Rick Justin	44604 Butternut Ridge Road	Abusive call demanding call back and response was taking too long.	Y									7,536				10:00am Rich Heier "I leave to check out complaint....while at location five along Butternut Ridge Road Rick Justin stopped to ask me why no one has returned his calls yet, informed me that I was supposed to check odors at his house (he had been waiting from 6:00am to 7:00am for me to come past) and that odors were horrendous this morning especially by Fred Swanson's house. I told Rick Justin that Mr. Kostelnick was busy preparing for a meeting..... and that I was up and down the road twice today and had smelled nothing at any of the locations...he disagreed. Mr. Justin then informed me that it was brought up in the last township meeting that I would be stopping at his house to check for odors per Mr. Kostelnick and Dave Kidder. He was going to have the minutes pulled. He also said that there were still odors that I could not smell. I told him that I was not going to argue with him. Rick Justin then made the comment that Fred would never say anything about the odors because he has a signed contract with us." 10:45 Rich Heier returns to landfill and picks up Dan Brotherton to verify odor findings. Both confirm no odors present.
3/11/2010	11:27 AM			Patty Brubaker		Justin's were at twp. Hall complaining that responses were taking too long from landfill	Y					NW	5	SE	29.81	7,536		3,926		Rick Kostelnick in meeting at Hauling Company. Dan Brotherton returned her call.

Notes:
1. Average Methane Concentration and Normalized LFG Flow Columns Added July 2010.

Odor Log - 2010
Site Name: Lorain County II Landfill
Division No.: F08
EM: Chris Jaquet
Designated RO(s) to Maintain Log: Jeff Kraus

Date Complainant Called	Time Complainant Called	Date Odor Detected	Time Odor Detected	Name of Complainant	Address of Complainant	Summary of Complaint	Request Return Call? (Y/N)	Type of Odor Detected			Returned Call (Date)	Location of Odor	Wind Speed (mph)	Wind Direction	Barometric Pressure	Ave. GCCS Flow (SCFM) for Day of Complaint	Average Methane Concentration	Normalized Gas Flow (scfm at 50% CH4)	Tons of MSW Received	Comments
								MSW	Sludge/Special Waste	Gas										
3/12/2010	12:29 AM			Clarissa Gereby	e-mail	Phone message from unnamed resident that on 3/10 at 7:15PM there were strong methane odors throughout evening and garbage odors during the day.						NW	9	SE	29.71	7,784			4,175	Rick's reply to e-mail "I just got off the Phone with Rick Justin 1 hour ago and he did not mention any odors when asked if there were any recent odors. We have been investigating odor complaints from him over the last 2 days and have not confirmed any once we arrived at his location.
3/16/2010	6:25 AM			Rick Justin	44604 Butternut Ridge Road	Requested Call, did not state problem	Y					NW	6	NNW	30.14	7,788			4,319	Rick Kostelnick called Mr. Justin at 8:40 AM. No odor complaint, he claimed Rich Heier did not stop at Gerhardingers. It was verified with Rich that he did patrol the location and does not have to stop. Mr. Justin hung up.
3/16/2010	8:49 AM															7,788				Rich Heier - "6:05am began odor inspection along Butternut Ridge Road. Started at location 3 then drove west to Oberlin Road with windows down. Turned around at Oberlin Road and traveled east stopping at locations 5, 4 & 8. While at location 8 which is across from Fred Swanson's a white pickup drove by and pulled into the old orchard parking lot. When I left location 8 the pickup truck pulled out and followed me back to the landfill entrance. I did not stop at location 3 again because I figured it was Rick Justin and I did not want to get into an argument with him. Last time we talked he said he smelled odors and I said that I did not. (No odors were detected along Butternut Ridge Road). 6:35 AM went into the office to check the complaint phone. There was one message from Rick Justin for Rick Kostelnick to call him. Figuring that he had called about odors again I asked Dan Brotherton to ride along to verify my findings. Again, No odors present."
4/14/2010	6:30 AM			Pat Justin	44604 Butternut Ridge Road	Smells Smoke			x			NW	5	SE	30.47	8,544			4,602	Small Fire put out with additional cover and wells in area isolated per SOP
4/21/2010	8:30 PM			Clarissa Gereby	e-mail	Strong odor from landfill				x		NW	3	NNW	29.82	8,400			4,249	Didn't receive complaint until morning of 22nd. At that time no odor was detected during the morning odor patrol
4/23/2010	6:45 AM			Pat Justin	44604 Butternut Ridge Road	Strong odor from landfill				x		NW	2	ENE	29.97	7,899			3,822	Rich Heier performed the odor patrol at 6:10 and no odors were present. Rick Kostelnick checked at 6:20 and no odors were present.
4/24/2010	10:00 AM, noon, 11:30 PM			Pat Justin	44604 Butternut Ridge Road	Strong odor from landfill				x		NW	7	ESE	29.82	8,308			225	Complaint was e-mailed, no phone message received. Personnel is on site every Saturday and could have checked to verify odors had the complaint been called in.
4/29/2010	9:00 PM	4/29/2010	9:00 PM	Rick Justin	44604 Butternut Ridge Road	Strong odor from landfill				x	4/29/2010	NW	3.3	S/SE	29.77	7068				
4/29	9:05 PM	4/29/2010	9:05 PM	Sue Gerhardinger	44276 Butternut Ridge Road	Strong odor from landfill				x	4/29/2010	NW	3.3	S/SE	29.77	7068				Lorain 1 landfill flare was down for service for two days, Thursday and Friday but that would not effect the flare and power plant on Lorain II. , Miller Bros. was working on the NE side-slope riser yesterday and will be completing that work today, which
5/5/2010	2:15 PM	5/5/2010	2:15 PM	Dennis Luttrell	13184 Hale Road	Strong odor					5/5/2010	S	12.7	NE	29.68			0		Returned phone call and notified Dennis about the work we're doing. Invited him to facility.

Notes:
1. Average Methane Concentration and Normalized LFG Flow Columns Added July 2010.

ATTACHMENT 5
DIRECTOR'S CONDITIONAL APPROVAL
JUNE 28, 2007



State of Ohio Environmental Protection Agency

STREET ADDRESS:

Lazarus Government Center
50 W. Town St., Suite 700
Columbus, Ohio 43215

TELE: (614) 644-3020 FAX: (614) 644-3184
www.epa.state.oh.us

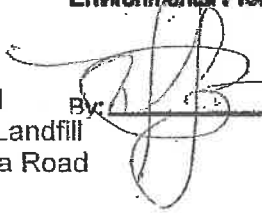
MAILING ADDRESS:

P.O. Box 1049
Columbus, OH 43216-1049

June 28, 2007

I certify this to be a true and accurate copy of the
official documents as filed in the records of the Ohio
Environmental Protection Agency.

Ms. Elena Goodhall
BFI-Lorain County Landfill
43502 Oberlin-Elyria Road
Oberlin, OH 44074

By: 

Date: 6/28/07

CERTIFIED MAIL

OHIO E.P.A.
JUN 28 2007
RECEIVED DIRECTOR'S JOURNAL

RE: Extension of the Director's approval for an environmentally beneficial project determination involving the installation of a temporary landfill flare at the BFI-Lorain County Landfill

Dear Ms Goodhall:

On May 4, 2007, BFI requested a one-year extension to the June 14, 2006 director's approval of an environmentally beneficial project involving the installation of a temporary flare for the control of landfill gas emissions at the BFI-Lorain County Landfill in Lorain County. The environmentally beneficial determination was made in accordance with Ohio Administrative Code (OAC) rule 3745-31-01(PPP)(1)(a)(vi). The 2006 approval allowed for the temporary flare to operate for one year from the date of initial startup, which was on July 4, 2006. This letter conditionally approves an extension to that 2006 approval until July 4, 2008.

Pursuant to OAC rule 3745-31-01(PPP)(1)(a)(vi), the director may determine that a pollution control or prevention project is environmentally beneficial and does not constitute a "modification" of the air contaminant source. In evaluating whether to grant this request, the proposed project may not:

- Cause or contribute to a violation of a national ambient air quality standard;
- Cause or contribute to a violation of an increment per OAC rule 3745-31-11(B);
- Adversely impact a visibility limitation; and
- Be expressly prohibited under any Ohio EPA or Federal Clean Air Act permit condition or applicable requirement.

The May 2007 request indicates that all of the above conditions will be met. The letter also indicates that the temporary flare will be used to control the migration of landfill gas. Control of the gas will result in the reduction of methane, non-methane organic compounds, and hydrogen sulfide emissions, which would otherwise be released to the ambient air.

The addition of the temporary flare will bring the source-wide emissions levels of carbon monoxide (CO) above Prevention of Significant Deterioration (PSD) thresholds. The

Ted Strickland, Governor
Lee Fisher, Lieutenant Governor
Chris Korleski, Director

Ms. Elena Goodhall
BFI-Lorain County Landfill
Page 2

proposed flare will be a temporary solution. As such, the facility is requesting an exemption from permitting pursuant to OAC rule 3745-31-13(F) - Temporary Increases. BFI-Lorain County Landfill proposes that the flare will be in operation for no more than one more year. In order to be granted this exemption, two criteria must be met:

- The temporary increase in CO emissions will not impact a Class I area; and
- The temporary increase will not be in an area where an applicable increment is known to be violated.

The closest Class I areas (Shenandoah National Park, Dolly Sods Wilderness, and Otter Creek Wilderness) are all located more than 250 kilometers to the southeast from the Lorain County Landfill. In determining whether or not to perform an analysis of the impacts at these Class I areas, the facility considered the PSD application for the Energy Developments, Inc. (EDI) power plant located at the Lorain County Landfill. The emissions of criteria pollutants from this facility are much greater than the incremental increase in emissions from the installation of the temporary flare in question. Because of the distance from the Lorain County Landfill to these Class I areas, the relatively low emission rates and release heights (i.e., <50 feet) of criteria pollutants from EDI's facility, EDI did not need to perform an analysis of impacts at these Class I areas. Likewise, because of the relatively lower level of criteria pollutant emissions from the temporary flare, BFI did not perform an analysis of impacts at these Class I areas.

Finally, U.S. EPA has not established PSD increments for CO, therefore, a baseline has not been triggered and PSD increments have not been consumed. The emissions from the utility flare will be in an area where there is no applicable increment known to be violated.

Subject to the condition discussed in the following paragraph, I have determined that installation of the temporary flare at the BFI-Lorain County Landfill is environmentally beneficial pursuant to OAC rule 3745-31-01(PPP)(1)(a)(vi), and that the planned temporary use of the flare meets the temporary increase exemption pursuant to OAC rule 3745-31-13(F), and as proposed, does not require an air pollution PTI.

It is my understanding that the installation of the temporary flare was to allow BFI time to develop a permanent solution to the landfill's flare capacity deficiencies. My finding a year ago, and today, is based on the understanding that the flare will in fact be temporary, that BFI is aggressively pursuing a permanent solution, and that an air PTI is not required for the temporary solution, as detailed above. On April 5, 2007, BFI submitted a permit-to-install (PTI) request (number 02-22570) for the installation of additional flare capacity to control landfill gas on a permanent basis. This PTI application was preceded by a meeting on November 9, 2006, where details of what Ohio EPA would require in a technically complete PTI application were discussed with representatives of BFI and Cornerstone Environmental Group (BFI's consultant). On June 6, 2007, Ohio EPA returned the PTI application because it was technically

Ms. Elena Goodhall
BFI-Lorain County Landfill
Page 3

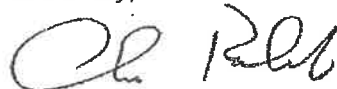
incomplete. Given that the facility has had sufficient time to prepare a PTI application that was technically complete but has not done so, this extension of one year is conditioned upon BFI submitting in the next four months (by November 4, 2007), a technically complete PTI application for expansion to the landfill's gas collection and control system. This PTI application shall detail the interim gas control measures to be undertaken between the expiration of this approval and the installation of the permanent enclosed flare. In addition, BFI shall expeditiously respond to any follow-up requests for information Ohio EPA needs to process the PTI application. If I find these conditions have not been met, this determination and extension will be terminated.

You are hereby notified that this action of the Director is final and may be appealed to the Environmental Review Appeals Commission pursuant to Section 3745.04 of the Ohio Revised Code. The appeal must be in writing and set forth the action complained of and the grounds upon which the appeal is based. The appeal must be filed with the Commission within thirty (30) days after notice of the Director's action. The appeal must be accompanied by a filing fee of \$70.00 which the Commission, in its discretion, may reduce if by affidavit you demonstrate that payment of the full amount of the fee would cause extreme hardship. Notice of the filing of the appeal shall be filed with the Director within three (3) days of filing with the Commission. Ohio EPA requests that a copy of the appeal be served upon the Ohio Attorney General's Office, Environmental Enforcement Section. An appeal may be filed with the Environmental Review Appeals Commission at the following address:

Environmental Review Appeals Commission
309 South Fourth Street, Room 222
Columbus, OH 43215

If you have any questions regarding this letter, please contact Joe Loucek of the Division of Air Pollution Control at the Northeast District Office at (330) 963-1258, or Dave Morehart of the Division of Air Pollution Control at Central Office at (614) 644-3601.

Sincerely,



Chris Korleski
Director

CK/JL/mt

cc: Joe Loucek, Ohio EPA, DAPC, NEDO
Jennifer Kurko, Ohio EPA, DAPC, NEDO
Dave Morehart, Ohio EPA, DAPC, CO
Terri Smith (2), Ohio EPA, DAPC, CO

Ms. Elena Goodhall
BFI-Lorain County Landfill
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Ms. Elena Goodhall
BFI-Lorain County Landfill
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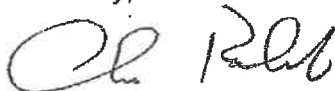
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Sincerely,



Chris Korleski
Director

CK/JL/mt

cc: Joe Loucek, Ohio EPA, DAPC, NEDO
Jennifer Kurko, Ohio EPA, DAPC, NEDO
Dave Morehart, Ohio EPA, DAPC, CO
Terri Smith (2), Ohio EPA, DAPC, CO

ATTACHMENT 6
DATA NORMALIZATION EXAMPLE

COMPUTATION SHEET

PROJECT TITLE: Typical Calculation PROJECT NO: _____
DESCRIPTION: LFG Data Normalization SHEET: 1
Calculation Template OF: 3
PREPARED BY: TAB DATE: _____ CHECKED BY: _____ DATE: _____

Purpose: Normalize data to a common standard, typically 50% CH₄ by volume or a thermal basis, to provide an accurate comparison of data sets. Comparing extraction rates (volumetric rates) at differing methane contents does not provide an accurate evaluation of changing conditions. Data needs to be converted to a uniform standard for an accurate comparison.

Given: LFG extracted from the wellfield at a rate of 4000 scfm and a methane content of 60% CH₄.

Calculation Methodology:

1. Convert to Thermal Rate

Thermal Rate = (xxxx scfm) * (yy% CH₄) * (1,014 BTU/cf) *{Note: HV_{CH4} = 1,014 BTU/cf}*

Thermal Rate = 2,433,600 BTU/min

2. Normalize - i.e. convert to "standard" methane content for comparison

Normalized Rate = $\frac{\text{Thermal Rate}}{(50\% \text{ CH}_4) * (1,014 \text{ BTU/cf})}$

Normalized Rate = 4800 scfm *{Note: @ 50%CH₄}*

Alternate Calculation:

Normalized Rate * 50% CH₄ = Measured Rate * Measured CH₄ Content

Normalized Rate = $\frac{\text{Measured Rate} * \text{Measured CH}_4 \text{ Content}}{50\% \text{ CH}_4}$

Normalized Rate = 4800 scfm *{Note: @ 50%CH₄}*

COMPUTATION SHEET

PROJECT TITLE: Typical Calculation PROJECT NO: _____
DESCRIPTION: LFG Data Normalization SHEET: 2
Example Calculation OF: 3
PREPARED BY: TAB DATE: _____ CHECKED BY: _____ DATE: _____

Purpose: Normalize data to a common standard, typically 50% CH₄ by volume or a thermal basis, to provide an accurate comparison of data sets. Comparing extraction rates (volumetric rates) at differing methane contents does not provide an accurate evaluation of changing conditions. Data needs to be converted to a uniform standard for an accurate comparison.

Given: LFG extracted from the wellfield at a rate of 1,000 scfm and a methane content of 60% CH₄ by volume.

Calculation Methodology:

1. Convert to Thermal Rate

$$\text{Thermal Rate} = (1,000 \text{ scfm}) * (60\% \text{ CH}_4) * (1,014 \text{ BTU/cf}) \quad \{\text{Note: } HV_{\text{CH}_4} = 1,014 \text{ BTU/cf}\}$$

$$\text{Thermal Rate} = \underline{\underline{608,400 \text{ BTU/min}}}$$

2. Normalize - i.e. convert to "standard" methane content for comparison

$$\text{Normalized Rate} = \frac{(608,400 \text{ BTU/min})}{(50\% \text{ CH}_4) * (1,014 \text{ BTU/cf})}$$

$$\text{Normalized Rate} = \underline{\underline{1200 \text{ scfm}}}$$

Alternate Calculation:

$$\text{Normalized Rate} * 50\% \text{ CH}_4 = \text{Measured Rate} * \text{Measured CH}_4 \text{ Content}$$

$$\text{Normalized Rate} = \frac{\text{Measured Rate} * \text{Measured CH}_4 \text{ Content}}{50\% \text{ CH}_4}$$

$$\text{Normalized Rate} = \underline{\underline{1200 \text{ scfm}}}$$

Summary: *On a thermal basis, 1,000 scfm @ 60% CH₄ is equivalent to 1,200 scfm @ 50% CH₄.*

COMPUTATION SHEET

PROJECT TITLE: Typical Calculation

PROJECT NO: _____

DESCRIPTION: LFG Data Normalization

SHEET: 3

Nomograph

OF: 3

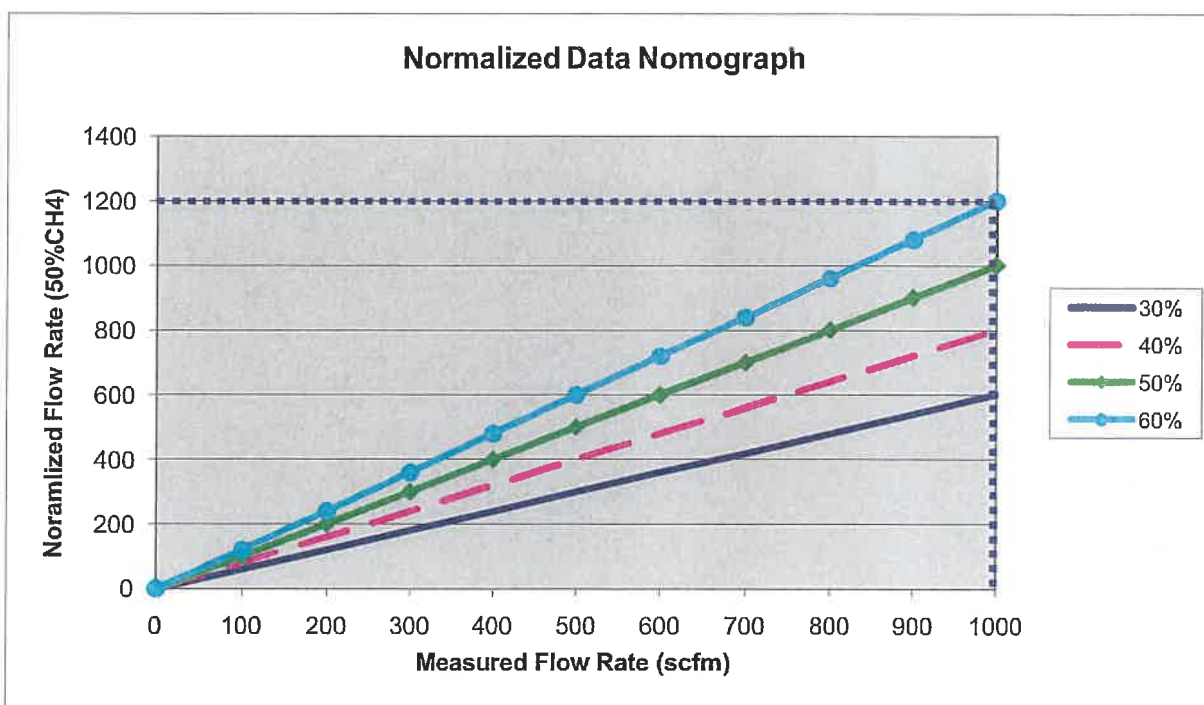
PREPARED BY: TAB

DATE: _____

CHECKED BY: _____

DATE: _____

Data can also be normalized graphically, utilizing a nomograph such as the one shown below. The measured flow rate (X-axis) can be translated to the normalized rate (Y-axis) via the measured methane content of the gas stream.



ATTACHMENT 7
OEPA WASTE RECEIPT RECORDS

Table 8. Tons of Solid Waste Accepted by Ohio Landfills in 1998

SWMD Name	Tons of Solid Waste Disposed			
	In-district	Out-of-district	Out-of-State	Total
*** Lake County SWMD				
County: LAKE				
LAKE COUNTY SOLID WASTE FACILITY LF				
43 -00 -07	184,863	13,832	0	198,696
Totals for SWMD:	184,863	13,832	0	198,696
*** Lawrence-Scioto Joint SWMD				
County: LAWRENCE				
NO SOLID WASTE LANDFILLS IN LAWRENCE				
44 -00 -00	0	0	0	0
County: SCIOTO				
NO SOLID WASTE LANDFILLS IN SCIOTO				
73 -00 -00	0	0	0	0
Totals for SWMD:	0	0	0	0
*** Logan County SWMD				
County: LOGAN				
LWS LOGAN CO.(CHEROKEE RUN) LANDFILL				
46 -00 -01	42,519	296,179	1,300	339,999
Totals for SWMD:	42,519	296,179	1,300	339,999
*** Lorain County SWMD				
County: LORAIN				
BFI (LORAIN COUNTY) LANDFILL				
47 -00 -16	285,453	326,397	0	611,850
OHIO EDISON EDGEWATER PLANT LANDFILL				
47 -00 -14	0	0	0	0
Totals for SWMD:	285,453	326,397	0	611,850
*** Lucas County SWMD				
County: LUCAS				
ENVIROSAFE SERVICES HW & INDUSTRIAL LF				
48 -00 -01	80	216	5,131	5,428
HOFFMAN ROAD SANITARY LANDFILL				
48 -01 -06	200,688	0	0	200,688
Totals for SWMD:	200,769	216	5,131	206,117
*** Mahoning County SWMD				
County: MAHONING				
AWS MAHONING LANDFILL				
50 -00 -06	66,051	74,103	60,519	200,674
BFI CARBON LIMESTONE LANDFILL				
50 -00 -04	213,242	343,541	731,207	1,287,992

Table 12.

**1998 Landfill Disposal by Type of Waste Stream, and
Solid Waste Management District**

Tons of Solid Waste Disposed						Totals	
Solid Waste Management District (SWMD)	Asbestos	General	Industrial	Exempt	Other		
Lake County SWMD							
In-district:	0	184,863	0	0	0	184,863	
Out-of-district:	0	13,321	510	0	0	13,832	
Out-of-state:	0	0	0	0	0	0	
Totals for SWMD:	0	198,185	510	0	0	198,696	
Lawrence-Scioto Joint SWMD							
In-district:	0	0	0	0	0	0	
Out-of-district:	0	0	0	0	0	0	
Out-of-state:	0	0	0	0	0	0	
Totals for SWMD:	0	0	0	0	0	0	
Logan County SWMD							
In-district:	0	36,150	4,787	1,581	0	42,519	
Out-of-district:	0	239,398	20,454	16,325	0	296,179	
Out-of-state:	0	585	714	0	0	1,300	
Totals for SWMD:	0	296,135	25,956	17,906	0	339,999	
Lorain County SWMD							
In-district:	0	238,476	13,624	33,353	0	285,453	
Out-of-district:	0	273,352	38,160	14,885	0	326,397	
Out-of-state:	0	0	0	0	0	0	
Totals for SWMD:	0	511,828	51,784	48,238	0	611,850	
Lucas County SWMD							
In-district:	0	200,688	80	0	0	200,769	
Out-of-district:	0	0	216	0	0	216	
Out-of-state:	0	0	5,131	0	0	5,131	
Totals for SWMD:	0	200,688	5,428	0	0	206,117	
Mahoning County SWMD							
In-district:	0	237,941	47,309	4,136	0	289,387	
Out-of-district:	0	430,529	129,699	8,818	0	569,047	
Out-of-state:	0	694,259	92,739	4,742	0	791,740	
Totals for SWMD:	0	1,362,729	269,748	17,697	0	1,650,175	

Table 8. Tons of Solid Waste Accepted by Ohio Landfills in 1999

SWMD Name	Tons of Solid Waste Disposed			
	In-district	Out-of-district	Out-of-State	Total
*** Lake County SWMD				
County: LAKE				
LAKE COUNTY SOLID WASTE FACILITY LF				
43 -00 -07	202,821	10,958	0	213,780
Totals for SWMD:	202,821	10,958	0	213,780
*** Lawrence-Scioto Joint SWMD				
County: LAWRENCE				
NO SOLID WASTE LANDFILLS IN LAWRENCE				
44 -00 -00	0	0	0	0
County: SCIOTO				
NO SOLID WASTE LANDFILLS IN SCIOTO				
73 -00 -00	0	0	0	0
Totals for SWMD:	0	0	0	0
*** Logan County SWMD				
County: LOGAN				
LWS LOGAN CO.(CHEROKEE RUN) LANDFILL				
46 -00 -01	45,705	305,675	1,511	352,892
Totals for SWMD:	45,705	305,675	1,511	352,892
*** Lorain County SWMD				
County: LORAIN				
BFI (LORAIN COUNTY) LANDFILL				
47 -00 -16	284,228	383,726	0	667,955
Totals for SWMD:	284,228	383,726	0	667,955
*** Lucas County SWMD				
County: LUCAS				
ENVIROSAFE SERVICES HW & INDUSTRIAL LF				
48 -00 -01	0	3,046	37,434	40,481
HOFFMAN ROAD SANITARY LANDFILL				
48 -01 -06	197,782	0	0	197,782
Totals for SWMD:	197,782	3,046	37,434	238,263
*** Mahoning County SWMD				
County: MAHONING				
AWS MAHONING LANDFILL				
50 -00 -06	54,011	96,127	107,336	257,474
BFI CARBON LIMESTONE LANDFILL				
50 -00 -04	203,585	420,037	744,713	1,368,335
CENTRAL WASTES, INC. LANDFILL				
50 -00 -08	23,632	118,075	11,632	153,339

Table 12.

**1999 Landfill Disposal by Type of Waste Stream, and
Solid Waste Management District**

Solid Waste Management District (SWMD)		Tons of Solid Waste Disposed				Totals	
		Asbestos	General	Industrial	Exempt	Other	
<i>Lake County SWMD</i>							
In-district:		0	202,821	0	0	0	202,821
Out-of-district:		0	10,958	0	0	0	10,958
Out-of-state:		0	0	0	0	0	0
Totals for SWMD:		0	213,780	0	0	0	213,780
<i>Lawrence-Scioto Joint SWMD</i>							
In-district:		0	0	0	0	0	0
Out-of-district:		0	0	0	0	0	0
Out-of-state:		0	0	0	0	0	0
Totals for SWMD:		0	0	0	0	0	0
<i>Logan County SWMD</i>							
In-district:		0	36,405	6,748	2,551	0	45,705
Out-of-district:		0	260,877	43,444	1,353	0	305,675
Out-of-state:		0	0	1,511	0	0	1,511
Totals for SWMD:		0	297,283	51,704	3,904	0	352,892
<i>Lorain County SWMD</i>							
In-district:		0	241,282	16,322	26,623	0	284,228
Out-of-district:		0	328,725	43,190	11,811	0	383,726
Out-of-state:		0	0	0	0	0	0
Totals for SWMD:		0	570,008	59,512	38,434	0	667,955
<i>Lucas County SWMD</i>							
In-district:		0	197,782	0	0	0	197,782
Out-of-district:		0	0	3,046	0	0	3,046
Out-of-state:		0	0	37,434	0	0	37,434
Totals for SWMD:		0	197,782	40,481	0	0	238,263
<i>Mahoning County SWMD</i>							
In-district:		0	268,505	12,560	105	57	281,228
Out-of-district:		0	563,123	62,294	8,821	0	634,239
Out-of-state:		0	734,550	128,975	155	0	863,681
Totals for SWMD:		0	1,566,180	203,830	9,081	57	1,779,149

Table 7. Tons of Solid Waste Accepted by Ohio Landfills in 2000

SWMD Name	Tons of Solid Waste Disposed			Total
	In-district	Out-of-district	Out-of-State	
Totals for SWMD:	206,080	8,292	0	214,372
*** Lawrence-Scioto Joint SWMD				
County: LAWRENCE				
NO SOLID WASTE LANDFILLS IN LAWRENCE				
44 -00 -00	0	0	0	0
County: SCIOTO				
NO SOLID WASTE LANDFILLS IN SCIOTO				
73 -00 -00	0	0	0	0
Totals for SWMD:	0	0	0	0
*** Logan County SWMD				
County: LOGAN				
LWS LOGAN CO.(CHEROKEE RUN) LANDFILL				
46 -00 -01	44,903	331,777	704	377,385
Totals for SWMD:	44,903	331,777	704	377,385
*** Lorain County SWMD				
County: LORAIN				
BFI (LORAIN COUNTY) LANDFILL				
47 -00 -16	302,871	391,640	0	694,511
Totals for SWMD:	302,871	391,640	0	694,511
*** Lucas County SWMD				
County: LUCAS				
ENVIROSAFE SERVICES HW & INDUSTRIAL LF				
48 -00 -01	53	3,167	9,820	13,041
HOFFMAN ROAD SANITARY LANDFILL				
48 -01 -06	195,713	0	0	195,713
Totals for SWMD:	195,767	3,167	9,820	208,754
*** Mahoning County SWMD				
County: MAHONING				
AWS MAHONING LANDFILL				
50 -00 -06	102,418	100,884	114,432	317,735
BFI CARBON LIMESTONE LANDFILL				
50 -00 -04	154,706	448,338	773,128	1,376,173
CENTRAL WASTES, INC. LANDFILL				
50 -00 -08	29,737	141,892	11,632	183,262
Totals for SWMD:	286,862	691,114	899,193	1,877,170
*** Medina County SWMD				
County: MEDINA				

Table 11.

**2000 Landfill Disposal by Type of Waste Stream, and
Solid Waste Management District**

Solid Waste Management District (SWMD)	Tons of Solid Waste Disposed				Totals
	Asbestos	General	Industrial	Exempt	
Lake County SWMD					
In-district:	0	206,080	0	0	206,080
Out-of-district:	0	8,292	0	0	8,292
Out-of-state:	0	0	0	0	0
Totals for SWMD:	0	214,372	0	0	214,372
Lawrence-Scioto Joint SWMD					
In-district:	0	0	0	0	0
Out-of-district:	0	0	0	0	0
Out-of-state:	0	0	0	0	0
Totals for SWMD:	0	0	0	0	0
Logan County SWMD					
In-district:	0	36,934	5,167	2,800	44,903
Out-of-district:	0	259,431	68,260	4,085	331,777
Out-of-state:	0	0	704	0	704
Totals for SWMD:	0	296,365	74,133	6,885	377,385
Lorain County SWMD					
In-district:	0	260,363	18,950	23,557	302,871
Out-of-district:	0	311,628	61,707	18,304	391,640
Out-of-state:	0	0	0	0	0
Totals for SWMD:	0	571,991	80,658	41,862	694,511
Lucas County SWMD					
In-district:	0	195,713	53	0	195,767
Out-of-district:	0	0	3,167	0	3,167
Out-of-state:	0	0	9,820	0	9,820
Totals for SWMD:	0	195,713	13,041	0	208,754
Mahoning County SWMD					
In-district:	0	247,335	32,875	6,586	286,862
Out-of-district:	0	584,998	97,550	8,563	691,114
Out-of-state:	45,549	694,129	157,605	1,909	899,193
Totals for SWMD:	45,549	1,526,463	288,031	17,059	1,877,170

Table 7.

Tons of Solid Waste Accepted by Ohio Landfills in 2001

SWMD Name	Tons of Waste Disposed			Total
	In-district	Out-of-District	Out-of-State	
Hamilton County SWMD				
County: <i>Hamilton</i>				
18465 Bond Road Landfill	21.74	3.71	11.46	36.91
33318 Rumpke Sanitary Landfill Inc	884,941.40	837,560.62	156,640.49	1,879,142.51
Totals for SWMD:	884,963.14	837,564.33	156,651.95	1,879,179.42
Hancock County SWMD				
County: <i>Hancock</i>				
21465 Hancock County Sanitary Landfill	65,522.69	20,519.83	0.00	86,042.52
Totals for SWMD:	65,522.69	20,519.83	0.00	86,042.52
Henry County SWMD				
County: <i>Henry</i>				
22065 Henry County Landfill	15,477.56	8,330.76	0.00	23,808.32
Totals for SWMD:	15,477.56	8,330.76	0.00	23,808.32
Holmes County SWMD				
County: <i>Holmes</i>				
22641 Holmes County Landfill	6,276.25	4,730.38	0.00	11,006.63
Totals for SWMD:	6,276.25	4,730.38	0.00	11,006.63
Lake County SWMD				
County: <i>Lake</i>				
24397 Lake County Solid Waste Facility	204,730.63	8,604.66	0.00	213,335.29
Totals for SWMD:	204,730.63	8,604.66	0.00	213,335.29
Logan County SWMD				
County: <i>Logan</i>				
139513 Cherokee Run Landfill	43,765.94	296,249.62	115.94	340,131.50
Totals for SWMD:	43,765.94	296,249.62	115.94	340,131.50
Lorain County SWMD				
County: <i>Lorain</i>				
26024 Browning-Ferris Industries of Ohio Lorain County LF	321,996.05	483,710.45	0.00	805,706.50
Totals for SWMD:	321,996.05	483,710.45	0.00	805,706.50
Lucas County SWMD				
County: <i>Lucas</i>				
27057 Hoffman Road Sanitary Landfill	189,904.18	0.00	0.00	189,904.18
27256 Envirosafe Services of Ohio Inc	2,202.59	3,093.76	11,177.14	16,473.49
Totals for SWMD:	192,106.77	3,093.76	11,177.14	206,377.67
Mahoning County SWMD				
County: <i>Mahoning</i>				
28809 Central Waste Inc	27,599.98	114,770.25	1,076.06	143,446.29
29084 Mahoning Landfill Inc	98,072.64	94,215.41	111,605.28	303,893.33
28726 BFI Carbon Limestone Sanitary Landfill	164,107.58	415,724.55	830,652.64	1,410,484.77
Totals for SWMD:	289,780.20	624,710.21	943,333.98	1,857,824.39

Table 12. 2001 Landfill Disposal by Type of Waste Stream, and Solid Waste Management District

SWMD/Facility Name	Tons of Waste Disposed					Total
	Asbestos	General	Industrial	Exempt	Other	
Lake County SWMD						
In-district:	0.00	204,730.63	0.00	0.00	0.00	204,730.63
Out-of-district:	0.00	8,604.66	0.00	0.00	0.00	8,604.66
Total for SWMD:	0.00	213,335.29	0.00	0.00	0.00	213,335.29
Logan County SWMD						
In-district:	0.00	34,671.22	4,038.99	5,055.73	0.00	43,765.94
Out-of-district:	0.00	251,388.02	37,023.05	7,838.55	0.00	296,249.62
Out-of-state:	0.00	0.00	115.94	0.00	0.00	115.94
Total for SWMD:	0.00	286,059.24	41,177.98	12,894.28	0.00	340,131.50
Lorain County SWMD						
In-district:	0.00	271,870.01	16,276.52	33,849.52	0.00	321,996.05
Out-of-district:	0.00	364,479.45	106,319.23	12,911.77	0.00	483,710.45
Total for SWMD:	0.00	636,349.46	122,595.75	46,761.29	0.00	805,706.50
Lucas County SWMD						
In-district:	0.00	191,917.58	184.92	4.27	0.00	192,106.77
Out-of-district:	0.00	382.59	2,639.57	71.60	0.00	3,093.76
Out-of-state:	14.33	1,672.09	9,490.72	0.00	0.00	11,177.14
Total for SWMD:	14.33	193,972.26	12,315.21	75.87	0.00	206,377.67
Mahoning County SWMD						
In-district:	0.00	242,759.28	41,265.08	5,714.08	41.76	289,780.20
Out-of-district:	0.00	549,210.34	73,880.15	1,619.72	0.00	624,710.21
Out-of-state:	0.00	792,561.84	143,453.55	7,318.59	0.00	943,333.98
Total for SWMD:	0.00	1,584,531.46	258,598.78	14,652.39	41.76	1,857,824.39
Mercer County SWMD						
In-district:	0.00	20,866.23	277.72	6,963.03	0.00	28,106.98
Out-of-district:	0.00	47,930.58	5,642.70	3,502.07	0.00	57,075.35
Out-of-state:	0.00	1,214.99	3,591.74	8,026.00	0.00	12,832.73
Total for SWMD:	0.00	70,011.80	9,512.16	18,491.10	0.00	98,015.06

Table 7.

Tons of Solid Waste Accepted by Ohio Landfills in 2002

SWMD Name	Tons of Waste Disposed			
	In-district	Out-of-District	Out-of-State	Total
Hancock County SWMD				
County: <i>Hancock</i>				
21465 Hancock County Sanitary Landfill	72,031.13	25,405.44	0.00	97,436.57
Totals for SWMD:	72,031.13	25,405.44	0.00	97,436.57
Henry County SWMD				
County: <i>Henry</i>				
22065 Henry County Landfill	16,338.47	4,943.52	0.00	21,281.99
Totals for SWMD:	16,338.47	4,943.52	0.00	21,281.99
Holmes County SWMD				
County: <i>Holmes</i>				
22641 Holmes County Landfill	19,630.91	22,529.65	0.00	42,160.56
Totals for SWMD:	19,630.91	22,529.65	0.00	42,160.56
Lake County SWMD				
County: <i>Lake</i>				
24397 Lake County Solid Waste Facility	195,735.15	6,587.03	0.00	202,322.18
Totals for SWMD:	195,735.15	6,587.03	0.00	202,322.18
Logan County SWMD				
County: <i>Logan</i>				
139513 Cherokee Run Landfill	38,362.19	310,142.20	0.00	348,504.39
Totals for SWMD:	38,362.19	310,142.20	0.00	348,504.39
Lorain County SWMD				
County: <i>Lorain</i>				
26024 Browning-Ferris Industries of Ohio Lorain County LF	358,137.05	556,026.81	0.00	914,163.86
Totals for SWMD:	358,137.05	556,026.81	0.00	914,163.86
Lucas County SWMD				
County: <i>Lucas</i>				
27057 Hoffman Road Sanitary Landfill	187,966.86	0.00	0.00	187,966.86
27256 Envirosafe Services of Ohio Inc	17.17	1,118.37	8,456.81	9,592.35
Totals for SWMD:	187,984.03	1,118.37	8,456.81	197,559.21
Mahoning County SWMD				
County: <i>Mahoning</i>				
28809 Central Waste Inc	9,969.81	85,306.48	120,146.41	215,422.70
29084 Mahoning Landfill Inc	109,683.16	58,510.33	98,091.42	266,284.91
28726 BFI Carbon Limestone Sanitary Landfill	176,741.55	418,343.15	923,627.06	1,518,711.76
Totals for SWMD:	296,394.52	562,159.96	1,141,864.89	2,000,419.37
Mercer County SWMD				
County: <i>Mercer</i>				
140649 Celina Sanitary Landfill	32,648.03	56,218.86	12,123.98	100,990.87
Totals for SWMD:	32,648.03	56,218.86	12,123.98	100,990.87

Table 12. 2002 Landfill Disposal by Type of Waste Stream, and Solid Waste Management District

SWMD/Facility Name	Tons of Waste Disposed					Total
	Asbestos	General	Industrial	Exempt	Other	
Logan County SWMD						
In-district:	0.00	32,854.04	1,271.21	4,236.94	0.00	38,362.19
Out-of-district:	0.00	259,725.71	36,889.34	13,527.15	0.00	310,142.20
Total for SWMD:	0.00	292,579.75	38,160.55	17,764.09	0.00	348,504.39
Lorain County SWMD						
In-district:	0.00	286,320.99	32,586.03	39,230.03	0.00	358,137.05
Out-of-district:	0.00	440,916.31	100,583.59	14,526.91	0.00	556,026.81
Total for SWMD:	0.00	727,237.30	133,169.62	53,756.94	0.00	914,163.86
Lucas County SWMD						
In-district:	0.00	187,966.86	17.17	0.00	0.00	187,984.03
Out-of-district:	0.00	0.00	1,118.37	0.00	0.00	1,118.37
Out-of-state:	0.00	0.00	8,456.81	0.00	0.00	8,456.81
Total for SWMD:	0.00	187,966.86	9,592.35	0.00	0.00	197,559.21
Mahoning County SWMD						
In-district:	0.00	235,107.46	59,428.79	1,807.31	50.96	296,394.52
Out-of-district:	0.00	441,763.96	78,352.86	42,008.11	35.03	562,159.96
Out-of-state:	0.00	853,822.61	241,346.26	46,696.02	0.00	1,141,864.89
Total for SWMD:	0.00	1,530,694.03	379,127.91	90,511.44	85.99	2,000,419.37
Mercer County SWMD						
In-district:	0.00	17,941.16	3,596.85	11,110.02	0.00	32,648.03
Out-of-district:	0.00	35,823.56	4,764.28	7,639.96	7,991.06	56,218.86
Out-of-state:	0.00	47.08	2,389.61	9,687.29	0.00	12,123.98
Total for SWMD:	0.00	53,811.80	10,750.74	28,437.27	7,991.06	100,990.87
Montgomery County SWMD						
In-district:	999.52	486,198.43	47,927.36	34,147.83	0.00	569,273.14
Out-of-district:	24,210.22	214,170.91	24,885.72	12,459.84	0.00	275,726.69
Total for SWMD:	25,209.74	700,369.34	72,813.08	46,607.67	0.00	844,999.83

Table 7.

Tons of Solid Waste Accepted by Ohio Landfills in 2003

SWMD Name	Tons of Waste Disposed			Total
	In-district	Out-of-District	Out-of-State	
Hancock County SWMD				
County: <i>Hancock</i>				
21465 Hancock County Sanitary Landfill	75,593.71	30,247.27	0.00	105,840.98
Totals for SWMD:	75,593.71	30,247.27	0.00	105,840.98
Henry County SWMD				
County: <i>Henry</i>				
22065 Henry County Landfill	19,673.92	6,331.21	0.00	26,005.13
Totals for SWMD:	19,673.92	6,331.21	0.00	26,005.13
Holmes County SWMD				
County: <i>Holmes</i>				
22641 Holmes County Landfill	29,456.90	13,071.09	6,269.40	48,797.39
Totals for SWMD:	29,456.90	13,071.09	6,269.40	48,797.39
Lake County SWMD				
County: <i>Lake</i>				
24397 Lake County Solid Waste Facility	203,323.88	5,508.23	0.00	208,832.11
Totals for SWMD:	203,323.88	5,508.23	0.00	208,832.11
Logan County SWMD				
County: <i>Logan</i>				
139513 Cherokee Run Landfill	44,942.83	371,566.49	20.47	416,529.79
Totals for SWMD:	44,942.83	371,566.49	20.47	416,529.79
Lorain County SWMD				
County: <i>Lorain</i>				
26024 Browning-Ferris Industries of Ohio Lorain County LF	394,760.44	581,839.41	0.00	976,599.85
Totals for SWMD:	394,760.44	581,839.41	0.00	976,599.85
Lucas County SWMD				
County: <i>Lucas</i>				
27057 Hoffman Road Sanitary Landfill	179,560.12	0.00	0.00	179,560.12
27256 EnviroSAFE Services of Ohio Inc	81.20	144.70	2,034.96	2,260.86
Totals for SWMD:	179,641.32	144.70	2,034.96	181,820.98
Mahoning County SWMD				
County: <i>Mahoning</i>				
28726 BFI Carbon Limestone Sanitary Landfill	174,904.23	305,723.48	1,021,004.49	1,501,632.20
28809 Central Waste Inc	10,590.96	105,365.48	70,556.19	186,512.63
29084 Mahoning Landfill Inc	139,686.54	92,872.78	100,401.98	332,961.30
Totals for SWMD:	325,181.73	503,961.74	1,191,962.66	2,021,106.13
Mercer County SWMD				
County: <i>Mercer</i>				
140649 Celina Sanitary Landfill	26,339.00	58,620.00	5,740.00	90,699.00
Totals for SWMD:	26,339.00	58,620.00	5,740.00	90,699.00

Table 7.1
Types of Solid Waste Accepted by Ohio Landfills in 2003

SWMD Name	Tons of Waste Disposed (Tons)				
	Asbestos	General	Industrial	Exempt	Other
Logan County SWMD					
County: <i>Logan</i>					
139513 Cherokee Run Landfill	0.00	336,810.55	64,520.95	15,198.29	0.00
Totals for SWMD:	0.00	336,810.55	64,520.95	15,198.29	0.00
Lorain County SWMD					
County: <i>Lorain</i>					
26024 Browning-Ferris Industries of Ohio Lorain County LF	0.00	782,703.53	126,630.49	67,265.83	0.00
Totals for SWMD:	0.00	782,703.53	126,630.49	67,265.83	0.00
Lucas County SWMD					
County: <i>Lucas</i>					
27057 Hoffman Road Sanitary Landfill	0.00	179,560.12	0.00	0.00	0.00
27256 Envirosafe Services of Ohio Inc	0.00	0.00	1,513.80	0.00	747.06
Totals for SWMD:	0.00	179,560.12	1,513.80	0.00	747.06
Mahoning County SWMD					
County: <i>Mahoning</i>					
28726 BFI Carbon Limestone Sanitary Landfill	0.00	1,127,983.53	347,156.79	26,491.88	0.00
28809 Central Waste Inc	0.00	155,818.30	28,660.47	1,964.02	69.84
29084 Mahoning Landfill Inc	0.00	277,896.06	49,468.37	5,596.87	0.00
Totals for SWMD:	0.00	1,561,697.89	425,285.63	34,052.77	69.84
Mercer County SWMD					
County: <i>Mercer</i>					
140649 Celina Sanitary Landfill	16,639.00	37,596.00	12,900.00	10,409.00	13,155.00
Totals for SWMD:	16,639.00	37,596.00	12,900.00	10,409.00	13,155.00
Montgomery County SWMD					
County: <i>Montgomery</i>					
32719 Stony Hollow Landfill Inc	1,747.41	556,683.27	74,982.30	64,376.78	0.00
148712 Fraser Papers Inc Landfill	0.00	0.00	0.00	0.00	0.00
Totals for SWMD:	1,747.41	556,683.27	74,982.30	64,376.78	0.00

Table 7. Tons of Solid Waste Accepted at Ohio's Landfills 2004

SWMDID/FACID	Facility	In-District	Out-of-District	Out-of-State	Total Of Total
22641	Holmes County Landfill	44,012.49	26,100.45	8,675.67	78,788.61
Totals for SWMD:		44,012.49	26,100.45	8,675.67	78,788.61
Lake County SWMD					
24397	Lake County Solid Waste Facility (Landfill)	195,747.01	8,241.92	0.00	203,988.93
Totals for SWMD:		195,747.01	8,241.92	0.00	203,988.93
Logan County SWMD					
139513	Cherokee Run Landfill	34,289.40	550,423.49	1,659.27	586,372.16
Totals for SWMD:		34,289.40	550,423.49	1,659.27	586,372.16
Lorain County SWMD					
26024	BFI of Ohio Lorain County Landfill	372,067.11	699,391.14	0.00	1,071,458.25
Totals for SWMD:		372,067.11	699,391.14	0.00	1,071,458.25
Lucas County SWMD					
27256	Envirosafe HW & Ind Landfill	10.91	144.08	667.23	822.22
27057	Hoffman Road Sanitary Landfill	190,279.64	0.00	0.00	190,279.64
Totals for SWMD:		190,290.55	144.08	667.23	822.22
Mahoning County SWMD					
29084	WM Mahoning Landfill, Inc.	142,937.61	91,970.27	93,662.64	328,570.52
28809	Central Waste, Inc. Landfill	4,887.46	70,010.70	5,308.79	80,206.95
28726	BFI Carbon Limestone Sanitary Landfill	198,323.44	324,301.44	971,186.13	1,493,811.01
Totals for SWMD:		346,148.51	486,282.41	1,070,157.56	328,570.52
Mercer County SWMD					
140649	Celina Sanitary Landfill	14,852.58	49,200.15	574.00	64,626.73
Totals for SWMD:		14,852.58	49,200.15	574.00	64,626.73
Montgomery County SWMD					
32719	Stony Hollow Rec. & Disposal Facility	255,732.18	315,417.09	0.00	571,149.27
Totals for SWMD:		255,732.18	315,417.09	0.00	571,149.27
Ottawa-Sandusky-Seneca Joint SWMD					
52732	Brush Wellman Inc. Landfill	2,025.00	0.00	0.00	2,025.00
33916	Graymont Dolime Ohio Inc. Landfill	9,008.30	0.00	0.00	9,008.30
37706	Sunny Farms LF	94,645.14	12,010.71	296,965.33	403,621.18

Table 7.1
Types of Solid Waste Accepted at Ohio Landfills in 2004

SWMDname	FacType	ASBESTOS	GENERAL	INDUSTRIAL	EXEMPT	OTHER	Total
County: <i>HENRY</i>							
22065 Henry County Landfill	MSWLF	0.00	12,780.54	10,259.30	3,639.26	2,492.72	29,171.82
Total for SWMD:		0.00	12,780.54	10,259.30	3,639.26	2,492.72	29,171.82
Holmes County SWMD							
County: <i>HOLMES</i>							
22641 Holmes County Landfill	MSWLF	0.00	45,962.66	0.00	32,825.95	0.00	78,788.61
Total for SWMD:		0.00	45,962.66	0.00	32,825.95	0.00	78,788.61
Lake County SWMD							
County: <i>LAKE</i>							
24397 Lake County Solid Waste Facility (Landfill)	MSWLF	0.00	203,988.93	0.00	0.00	0.00	203,988.93
Total for SWMD:		0.00	203,988.93	0.00	0.00	0.00	203,988.93
Logan County SWMD							
County: <i>LOGAN</i>							
139513 Cherokee Run Landfill	MSWLF	0.00	514,483.56	65,901.57	5,987.03	0.00	586,372.16
Total for SWMD:		0.00	514,483.56	65,901.57	5,987.03	0.00	586,372.16
Lorain County SWMD							
County: <i>LORAIN</i>							
26024 BFI of Ohio Lorain County Landfill	MSWLF	0.00	836,741.55	160,572.60	74,144.10	0.00	1,071,458.25
Total for SWMD:		0.00	836,741.55	160,572.60	74,144.10	0.00	1,071,458.25
Lucas County SWMD							
County: <i>LUCAS</i>							
27256 Envirosafe HW & Ind Landfill	ENVIRO	21.87	0.00	800.35	0.00	0.00	822.22
27057 Hoffman Road Sanitary Landfill	MSWLF	0.00	190,279.64	0.00	0.00	0.00	190,279.64
Total for SWMD:		21.87	190,279.64	800.35	0.00	0.00	191,101.86
Mahoning County SWMD							

Table 7. Tons of Solid Waste Accepted at Ohio's Landfills for 2005

SWMDID/FACID	Facility	In-District	Out-of-District	Out-of-State	Total Of Total
Holmes County SWMD					
22641	Holmes County Landfill	43,495.66	32,343.71	3,501.56	79,340.93
Totals for SWMD:		43,495.66	32,343.71	3,501.56	79,340.93
Lake County SWMD					
24397	Lake County Solid Waste Facility (Landfill)	201,685.99	8,666.35	0.00	210,352.34
Totals for SWMD:		201,685.99	8,666.35	0.00	210,352.34
Logan County SWMD					
139513	Cherokee Run Landfill	39,532.60	539,502.99	48.04	579,083.63
Totals for SWMD:		39,532.60	539,502.99	48.04	579,083.63
Lorain County SWMD					
26024	BFI of Ohio Lorain County Landfill	432,166.07	696,240.93	0.00	1,128,407.00
Totals for SWMD:		432,166.07	696,240.93	0.00	1,128,407.00
Lucas County SWMD					
27057	Hoffman Road Sanitary Landfill	186,107.99	0.00	0.00	186,107.99
27256	Envirosafe HW & Ind Landfill	313.44	646.85	1,699.00	2,659.29
Totals for SWMD:		186,421.43	646.85	1,699.00	188,767.28
Mahoning County SWMD					
29084	WM Mahoning Landfill, Inc.	146,736.47	101,720.62	85,962.34	334,419.43
28726	BFI Carbon Limestone Sanitary Landfill	197,507.06	335,234.39	983,586.75	1,516,328.20
28809	Central Waste, Inc. Landfill	244.75	2,874.64	0.00	3,119.39
Totals for SWMD:		344,488.28	439,829.65	1,069,549.09	1,853,867.02
Mercer County SWMD					
140649	Celina Sanitary Landfill	26,422.81	61,675.89	57.92	88,156.62
Totals for SWMD:		26,422.81	61,675.89	57.92	88,156.62
Montgomery County SWMD					
32719	Stony Hollow Rec. & Disposal Facility	256,276.07	335,623.77	0.00	591,899.84
Totals for SWMD:		256,276.07	335,623.77	0.00	591,899.84
Ottawa-Sandusky-Seneca Joint SWMD					
33837	BFI Ottawa County Landfill	115,397.51	135,168.53	263,893.51	514,459.55
52732	Brush Wellman Inc. Landfill	1,508.00	0.00	0.00	1,508.00
37706	Sunny Farms LF	63,627.95	5,992.05	581,280.09	650,900.09

Table 7.1
Types of Solid Waste Accepted at Ohio Landfills in 2005

SWMDname	FacType	ASBESTOS	GENERAL	INDUSTRIAL	EXEMPT	CDD	OTHER	Total
Total for SWMD		0.00	48,204.17	0.00	21,956.26	9,180.50	0.00	79,340.93
Lake County SWMD								
County: LAKE								
24397 Lake County Solid Waste Facility (Landfill)	MSWLF	0.00	210,352.34	0.00	0.00	0.00	0.00	210,352.34
Total for SWMD		0.00	210,352.34	0.00	0.00	0.00	0.00	210,352.34
Logan County SWMD								
County: LOGAN								
139513 Cherokee Run Landfill	MSWLF	0.00	503,581.25	50,912.05	24,254.97	335.36	0.00	579,083.63
Total for SWMD		0.00	503,581.25	50,912.05	24,254.97	335.36	0.00	579,083.63
Lorain County SWMD								
County: LORAIN								
26024 BFI of Ohio Lorain County Landfill	MSWLF	0.00	753,577.00	269,465.60	0.00	105,364.40	0.00	1,128,407.00
Total for SWMD		0.00	753,577.00	269,465.60	0.00	105,364.40	0.00	1,128,407.00
Lucas County SWMD								
County: LUCAS								
27057 Hoffman Road Sanitary Landfill	MSWLF	0.00	185,027.05	0.00	0.00	1,080.94	0.00	186,107.99
27256 EnviroSafe HW & Ind Landfill	ENVIRO	0.52	0.00	2,658.77	0.00	0.00	0.00	2,659.29
Total for SWMD		0.52	185,027.05	2,658.77	0.00	1,080.94	0.00	188,767.28
Mahoning County SWMD								
County: MAHONING								
29084 WM Mahoning Landfill, Inc.	MSWLF	0.00	265,005.50	63,174.62	0.00	6,239.31	0.00	334,419.43
28726 BFI Carbon Limestone Sanitary Landfill	MSWLF	0.00	1,118,708.90	297,237.82	56,921.81	43,459.67	0.00	1,516,328.20

MSWLF = Municipal Landfill, INCL = Captive Industrial, INL = Industrial, RW1L = Residual Class I, RW2L = Residual Class II, RW3L = Residual Class III, RW4L = Residual Class IV, STMFL = Scrap Tire Monofill/Monocell

Table 7. Tons of Solid Waste Accepted at Ohio's Landfills 2006

SWMDID/FACID	Facility		In-District	Out-of-District	Out-of-State	Total Of Total
Hancock County SWMD						
21465	Hancock County Sanitary Landfill	DH	84,422.41	42,611.98	0.00	127,034.39
Totals for SWMD:			84,422.41	42,611.98	0.00	127,034.39
Henry County SWMD						
22065	Henry County Landfill	DH	20,662.78	6,525.48	0.00	27,188.26
Totals for SWMD:			20,662.78	6,525.48	0.00	27,188.26
Holmes County SWMD						
22641	Holmes County Landfill	DH	43,004.04	28,346.99	429.91	71,780.94
Totals for SWMD:			43,004.04	28,346.99	429.91	71,780.94
Lake County SWMD						
24397	Lake County Solid Waste Facility (Landfill)	DH	208,591.39	8,265.94	0.00	216,857.33
Totals for SWMD:			208,591.39	8,265.94	0.00	216,857.33
Logan County SWMD						
139513	Cherokee Run Landfill	TW	0.00	400,555.06	0.00	400,555.06
139513	Cherokee Run Landfill	DH	39,157.01	130,819.43	0.00	169,976.44
Totals for SWMD:			39,157.01	531,374.49	0.00	570,531.50
Lorain County SWMD						
26024	BFI of Ohio Lorain County Landfill	TW	2,718.81	311,030.10	0.00	313,748.91
26024	BFI of Ohio Lorain County Landfill	DH	502,152.61	409,030.28	0.00	911,182.89
Totals for SWMD:			504,871.42	720,060.38	0.00	1,224,931.80
Lucas County SWMD						
27256	Envirosafe HW & Ind Landfill	DH	93.80	1,199.67	2,545.10	3,838.57
27057	Hoffman Road Sanitary Landfill	DH	186,279.73	0.00	0.00	186,279.73
Totals for SWMD:			186,373.53	1,199.67	2,545.10	190,118.30
Mahoning County SWMD						
28726	BFI Carbon Limestone Sanitary Landfill	TW	0.00	157,727.07	770,316.52	928,043.59
29084	WM Mahoning Landfill, Inc.	TW	4,993.81	16,173.70	322.43	21,489.94
28726	BFI Carbon Limestone Sanitary Landfill	DH	190,912.52	173,186.85	261,725.11	625,824.48
29084	WM Mahoning Landfill, Inc.	DH	141,479.36	72,418.06	76,658.86	290,556.28
28809	Central Waste, Inc. Landfill	DH	0.00	1.07	0.00	1.07
Totals for SWMD:			337,385.69	419,506.75	1,109,022.92	1,865,915.36

Table 7.1 Types of Solid Waste Accepted at Ohio Landfills in 2006

SWMDname	FacType	ASBESTOS	GENERAL	INDUSTRIAL	EXEMPT	CDD	OTHER	Total
21465 Hancock County Sanitary Landfill	MSWLF	0.00	97,083.88	13,348.54	472.31	16,129.66	0.00	127,034.39
Total for SWMD		0.00	97,083.88	13,348.54	472.31	16,129.66	0.00	127,034.39
Heary County SWMD								
County: HENRY								
22065 Heary County Landfill	MSWLF	0.00	10,747.73	11,068.78	0.00	3,453.41	1,918.34	27,188.26
Total for SWMD		0.00	10,747.73	11,068.78	0.00	3,453.41	1,918.34	27,188.26
Holmes County SWMD								
County: HOLMES								
22641 Holmes County Landfill	MSWLF	0.00	41,638.11	0.00	18,898.08	11,244.75	0.00	71,780.94
Total for SWMD		0.00	41,638.11	0.00	18,898.08	11,244.75	0.00	71,780.94
Lake County SWMD								
County: LAKE								
24397 Lake County Solid Waste Facility (Landfill)	MSWLF	0.00	216,857.33	0.00	0.00	0.00	0.00	216,857.33
Total for SWMD		0.00	216,857.33	0.00	0.00	0.00	0.00	216,857.33
Logan County SWMD								
County: LOGAN								
139513 Cherokee Run Landfill	MSWLF	0.00	491,627.71	38,090.09	27,747.07	12,985.10	81.53	570,531.50
Total for SWMD		0.00	491,627.71	38,090.09	27,747.07	12,985.10	81.53	570,531.50
Lorain County SWMD								
County: LORAIN								
26024 BFI of Ohio Lorain County Landfill	MSWLF	0.00	779,190.31	266,642.23	122,595.15	56,504.11	0.00	1,224,931.80
Total for SWMD		0.00	779,190.31	266,642.23	122,595.15	56,504.11	0.00	1,224,931.80
Lucas County SWMD								
County: LUCAS								
27057 Hoffman Road Sanitary Landfill	MSWLF	0.00	185,363.45	0.00	0.00	916.28	0.00	186,279.73
27256 EnviroSAFE HW & Ind Landfill	ENVIRO	2.67	0.00	3,835.90	0.00	0.00	0.00	3,838.57

Draft

Table 7. Tons of Solid Waste Accepted at Ohio Landfills in 2008

SWMD/Facility			In-District	Out-of-District	Out-of-State	Total
42096	Severstal Warren Inc	DH	112,032.00	0.00	0.00	112,032.00
Total for SWMD			112,032.00	0.00	0.00	112,032.00
Hamilton County SWMD						
33318	Rumpke Sanitary Landfill, Inc.	TW	0.00	339,423.35	8,943.94	348,367.29
33318	Rumpke Sanitary Landfill, Inc.	DH	896,477.91	827,110.79	102,703.81	1,826,292.51
18465	Bond Road Landfill	DH	0.00	0.00	25.59	25.59
Total for SWMD			896,477.91	1,166,534.14	111,673.34	2,174,685.39
Hancock County SWMD						
21465	Hancock County Sanitary Landfill	DH	96,701.58	40,244.12	0.00	136,945.70
Total for SWMD			96,701.58	40,244.12	0.00	136,945.70
Henry County SWMD						
22065	Henry County Landfill	DH	18,502.64	1,603.96	0.00	20,106.60
Total for SWMD			18,502.64	1,603.96	0.00	20,106.60
Holmes County SWMD						
22641	Holmes County Landfill	DH	32,693.15	8,858.40	0.00	41,551.55
Total for SWMD			32,693.15	8,858.40	0.00	41,551.55
Lake County SWMD						
24397	Lake County Solid Waste Facility (Landfill)	DH	184,924.99	7,300.31	0.00	192,225.30
Total for SWMD			184,924.99	7,300.31	0.00	192,225.30
Logan County SWMD						
139513	Cherokee Run Landfill	DH	37,125.18	108,012.41	0.00	145,137.59
139513	Cherokee Run Landfill	TW	0.00	257,007.64	0.00	257,007.64
Total for SWMD			37,125.18	365,020.05	0.00	402,145.23
Lorain County SWMD						
26024	BFI of Ohio Lorain County Landfill	DH	513,625.90	397,768.00	0.00	911,393.90
26024	BFI of Ohio Lorain County Landfill	TW	708.73	229,836.05	0.00	230,544.78
Total for SWMD			514,334.63	627,604.05	0.00	1,141,938.68
Lucas County SWMD						
27057	Hoffman Road Sanitary Landfill	DH	153,512.52	0.00	0.00	153,512.52
Total for SWMD			153,512.52	0.00	0.00	153,512.52
Mahoning County SWMD						

Draft

Table 7.1
Types of Solid Waste Accepted at Ohio Landfills in 2008

SWMD	Facility Type	ASBESTOS	GENERAL	INDUSTRIAL	EXEMPT	CDD	OTHER	Total
Total for SWMD		0.00	107,714.57	12,652.53	300.27	16,278.33	0.00	136,945.70
Henry County SWMD								
County: HENRY								
22065 Henry County Landfill	MSWLF	0.00	7,120.45	9,316.89	0.00	2,878.82	790.44	20,106.60
Total for SWMD		0.00	7,120.45	9,316.89	0.00	2,878.82	790.44	20,106.60
Holmes County SWMD								
County: HOLMES								
22641 Holmes County Landfill	MSWLF	0.00	18,748.17	16,331.88	0.00	6,471.50	0.00	41,551.55
Total for SWMD		0.00	18,748.17	16,331.88	0.00	6,471.50	0.00	41,551.55
Lake County SWMD								
County: LAKE								
24397 Lake County Solid Waste Facility (Landfill)	MSWLF	0.00	192,225.30	0.00	0.00	0.00	0.00	192,225.30
Total for SWMD		0.00	192,225.30	0.00	0.00	0.00	0.00	192,225.30
Logan County SWMD								
County: LOGAN								
139513 Cherokee Run Landfill	MSWLF	0.00	333,312.85	38,319.93	17,343.23	13,169.22	0.00	402,145.23
Total for SWMD		0.00	333,312.85	38,319.93	17,343.23	13,169.22	0.00	402,145.23
Lorain County SWMD								
County: LORAIN								
26024 BFI of Ohio Lorain County Landfill	MSWLF	0.00	782,953.10	144,272.23	174,970.59	39,742.76	0.00	1,141,938.68
Total for SWMD		0.00	782,953.10	144,272.23	174,970.59	39,742.76	0.00	1,141,938.68

MSWLF = Municipal Solid Waste, INCL = Captive Industrial, INL = Industrial, RW1L = Residual Class I, RW2L = Residual Class II, RW3L = Residual Class III, RW4L = Residual Class IV

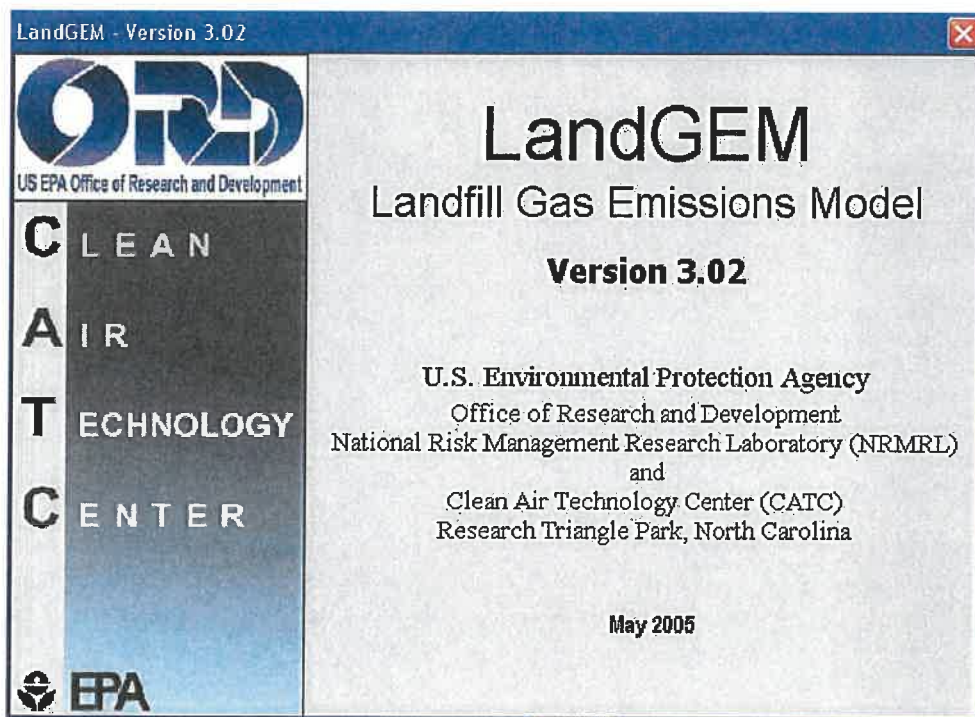
ATTACHMENT 8
USEPA LANDGEM VERSION 3.02 USER'S GUIDE



United States
Environmental Protection
Agency

EPA-600/R-05/047
May 2005

Landfill Gas Emissions Model (LandGEM) Version 3.02 User's Guide



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Landfill Gas Emissions Model (LandGEM) Version 3.02 User's Guide

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Abstract

The Landfill Gas Emissions Model (LandGEM) is an automated estimation tool with a Microsoft Excel interface that can be used to estimate emission rates for total landfill gas, methane, carbon dioxide, nonmethane organic compounds, and individual air pollutants from municipal solid waste landfills. This guide provides step-by-step guidance for using this software application, as well as an appendix containing background information on the technical basis of LandGEM. LandGEM can use either site-specific data to estimate emissions or default parameters if no site-specific data are available. The model contains two sets of default parameters, CAA defaults and inventory defaults. The CAA defaults are based on federal regulations for MSW landfills laid out by the Clean Air Act (CAA) and can be used for determining whether a landfill is subject to the control requirements of these regulations. The inventory defaults are based on emission factors in EPA's *Compilation of Air Pollutant Emission Factors (AP-42)* and can be used to generate emission estimates for use in emission inventories and air permits in the absence of site-specific test data.

Foreword

The U.S. Environmental Protection Agency (EPA) is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory (NRMRL) is the Agency's center for investigation of technological and management approaches for preventing and reducing risks from pollution that threaten human health and the environment. The focus of the Laboratory's research program is on methods and their cost-effectiveness for prevention and control of pollution to air, land, water, and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites, sediments and ground water; prevention and control of indoor air pollution; and restoration of ecosystems. NRMRL collaborates with both public and private sector partners to foster technologies that reduce the cost of compliance and to anticipate emerging problems. NRMRL's research provides solutions to environmental problems by: developing and promoting technologies that protect and improve the environment; advancing scientific and engineering information to support regulatory and policy decisions; and providing the technical support and information transfer to ensure implementation of environmental regulations and strategies at the national, state, and community levels.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development to assist the user community and to link researchers with their clients.

Sally Gutierrez, Acting Director
National Risk Management Research Laboratory

EPA Review Notice

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Introduction

This document provides step-by-step guidance for using the Landfill Gas Emissions Model (LandGEM), a software application with a Microsoft Excel interface that estimates air pollutants and other gases from municipal solid waste (MSW) landfills. Using this document, you will learn how to

- Enter landfill-specific data,
- Choose between site-specific and default model parameters,
- Estimate emission rates, and
- View and print tabular and graphical results.

Overview of How LandGEM Works

LandGEM is an automated tool for estimating emission rates for total landfill gas, methane, carbon dioxide, nonmethane organic compounds (NMOCs), and individual air pollutants from MSW landfills. Landfill owners and operators can use LandGEM to determine if a landfill is subject to the control requirements of the federal New Source Performance Standards (NSPS) for new MSW landfills (40 CFR 60 Subpart WWW), the federal Emission Guidelines (EG) for existing MSW landfills (40 CFR Subpart Cc), or the National Emission Standards for Hazardous Air Pollutants (NESHAP) for MSW landfills (40 CFR Subpart AAAAA).

LandGEM can use either site-specific data to estimate emissions or default parameters if no site-specific data are available. LandGEM contains two sets of default parameters.

CAA Defaults—The CAA defaults are based on requirements for MSW landfills laid out by the Clean Air Act (CAA), including the NSPS/EG and NESHAP. This set of default parameters yields conservative emission estimates and can be used for determining whether a landfill is subject to the control requirements of the NSPS/EG or NESHAP.

Inventory Defaults—With the exception of wet landfill defaults, the inventory defaults are based on emission factors in the U.S. Environmental Protection

Agency's (EPA's) *Compilation of Air Pollutant Emission Factors (AP-42)*. This set of defaults yields average emissions and can be used to generate emission estimates for use in emission inventories and air permits in the absence of site-specific test data.

The default parameters in Version 3.02 of LandGEM represent values specified by NSPS/EG and NESHAP for determining applicability of CAA requirements. Also included are values specified in AP-42 for developing national and state emission inventories. The AP-42 values are being updated with new information that has been collected by EPA from more recent field tests. In addition, research is underway to obtain data for developing emission factors for wet/bioreactor landfills where leachate and other liquids are added to accelerate waste decomposition.

Section 1.

Understanding LandGEM

LandGEM is based on a first-order decomposition rate equation for quantifying emissions from the decomposition of landfilled waste in MSW landfills. The software provides a relatively simple approach to estimating landfill gas emissions. Model defaults are based on empirical data from U.S. landfills. Field test data can also be used in place of model defaults when available. Further guidance on EPA test methods, CAA regulations, and other guidance regarding landfill gas emissions and control technology requirements can be found at <http://www.epa.gov/ttnatw01/landfill/landflpg.html>.

LandGEM is considered a screening tool—the better the input data, the better the estimates. Often, there are limitations with the available data regarding waste quantity and composition, variation in design and operating practices over time, and changes occurring over time that impact the emissions potential. Changes to landfill operation, such as operating under wet conditions through leachate recirculation or other liquid additions, will result in generating more gas at a faster rate. Defaults for estimating emissions for this type of operation are being developed to include in LandGEM along with defaults for conventional landfills (no leachate or liquid additions) for developing emission inventories and determining CAA applicability. Refer to the Web site identified above for future updates to LandGEM.

Appendix A provides further background information regarding the technical basis of LandGEM and how it relates to landfill emissions, methane, carbon dioxide, NMOCs, and air pollutants.

1.1 Spreadsheet Design

LandGEM consists of nine worksheets within a Microsoft Excel spreadsheet. The worksheet names and their functions are listed in Table 1.

Table 1. Worksheet Names and Functions in LandGEM

Worksheet Name	Function
INTRO	Contains an overview of the model and important notes about using LandGEM
USER INPUTS	Allows users to provide landfill characteristics, determine model parameters, select up to four gases or pollutants (total landfill gas, methane, carbon dioxide, NMOCs, and 46 air pollutants), and enter waste acceptance rates
POLLUTANTS	Allows users to edit air pollutant concentrations and molecular weights for existing pollutants and add up to 10 new pollutants
INPUT REVIEW	Allows users to review and print model inputs
METHANE	Calculates methane emission estimates using the first-order decomposition rate equation
RESULTS	Shows tabular emission estimates for up to four gases/pollutants (selected in the USER INPUTS worksheet) in megagrams per year, cubic meters per year, and user's choice of a third unit of measure (average cubic feet per minute, cubic feet per year, or short tons per year)
GRAPHS	Shows graphical emission estimates for up to four gases/pollutants (selected in the USER INPUTS worksheet) in megagrams per year, cubic meters per year, and user's choice of a third unit of measure (selected in the RESULTS worksheet)
INVENTORY	Displays tabular emission estimates for all gases/pollutants for a single year specified by users
REPORT	Allows users to review and print model inputs and outputs in a summary report

1.2 First-Order Decomposition Rate Equation

LandGEM uses the following first-order decomposition rate equation to estimate annual emissions over a time period that you specify. The model parameters k and L_o used by this decomposition equation are described further in Section 3.0.

$$Q_{CH_4} = \sum_{i=1}^n \sum_{j=0.1}^1 k L_o \left(\frac{M_i}{10} \right) e^{-k t_{i,j}}$$

where

Q_{CH_4} = annual methane generation in the year of the calculation ($m^3/year$)

$i = 1$ year time increment

n = (year of the calculation) - (initial year of waste acceptance)

$j = 0.1$ year time increment

k = methane generation rate ($year^{-1}$)

L_o = potential methane generation capacity (m^3/Mg)

M_i = mass of waste accepted in the i^{th} year (Mg)

t_{ij} = age of the j^{th} section of waste mass M_i accepted in the i^{th} year (decimal years, e.g., 3.2 years)

1.3 Software Requirements

LandGEM requires Microsoft Excel 97 or a more recent version of Excel. Earlier versions of Excel are unable to properly run the model because macros are embedded in the software.

Enable Macros—You **must** select *Enable Macros* when prompted (immediately after opening the file) to allow the LandGEM software to use macros embedded in the file. LandGEM has been carefully screened and is free of any viruses.

Macro Security—If you are using Microsoft Excel 2000 or Excel 2002 (within the Microsoft Office XP software package), you must set your *Macro Security Level* to *Medium* prior to opening the software to allow the *Enable Macros* option to be selected. If your *Macro Security Level* is set to *High* when the model is opened, then the warning message shown in Image 1 will appear, and the embedded macros needed to run LandGEM properly will be disabled. You can adjust the *Macro Security Level* in Excel by selecting *Macro...Security* from the *Tools* menu and clicking on the *Medium* radio button. Although LandGEM can operate with the *Macro Security Level* set to *Low*, this setting is not recommended by Microsoft.

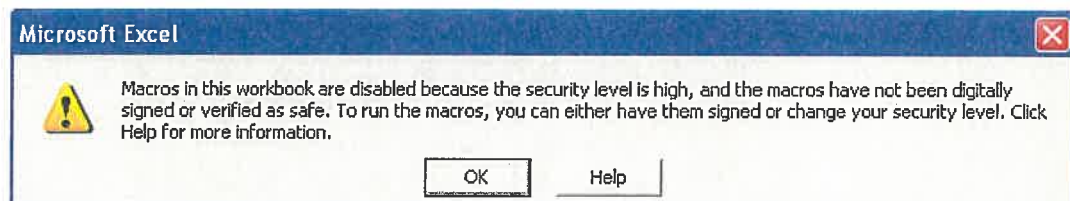


Image 1. Macro Security Warning Message.

Memory Requirements—You should have a minimum of 64 megabytes of random access memory (RAM). In addition, you will need a minimum of 2 megabytes of free space on your hard drive to accommodate the LandGEM software.

Read Only Feature—LandGEM has been specified as a *Read Only* file. You save a copy of LandGEM under a new file name when running each landfill scenario. The *Read Only* restriction is intended to protect the original file from being inadvertently over-written. If necessary, you can remove this restriction by changing the file properties via a file management program (e.g., Windows Explorer).

Password Protection Feature—To avoid user modifications from occurring within the model, all of the worksheets contained in LandGEM and the Microsoft Excel workbook itself have been password protected.

Screen Resolution—The optimum screen resolution for viewing LandGEM is 1024 by 768 pixels. To change the screen resolution, you can open the *Control Panel* from the *Start* menu, open the *Display* folder, select the *Settings* tab at the top of the window, and adjust the *Screen resolution* or *Screen area* option (depending on your version of Windows) accordingly.

1.4 Significant Differences Between Model Versions

LandGEM Version 3.02 replaces Versions 2.01 and 3.01. Significant differences between Versions 2.01 and 3.02 of LandGEM include:

- Version 3.02 uses a revised first-order decomposition rate equation that improves the accuracy of emission estimates over time, especially for landfills being modeled using higher methane generation rate (k) values. The equation used in Version 2.01 integrates emissions over each year, whereas the revised equation in Version 3.02 integrates emissions over a 0.1 year time increment. This revision is considered an improvement over the previous calculation methodology. This new equation in Version 3.02 results in slightly lower emission estimates than previous versions for typical k values. For example, Version 3.02 emission estimates are 2% lower for a k of 0.05 year⁻¹ (CAA Conventional) and 1% lower for a k of 0.02 year⁻¹ (CAA Arid Area). Version 3.02 estimates significantly lower emissions for higher k values—for example, 25% lower for a k of 0.7 year⁻¹ (Inventory Wet).

- Version 3.02 allows users to model emissions of total landfill gas, which can be calibrated using a user-specified methane content other than 50 percent. In Version 2.01, users cannot estimate total landfill gas emissions directly and must calculate total landfill gas off-line using methane emission estimates.
- Version 2.01 uses metric units of measure exclusively, whereas Version 3.02 allows users to choose between several English (e.g., short tons, cubic feet) and metric (e.g., megagrams, cubic meters) units of measure for model inputs and outputs.
- Version 2.01 reports emissions for 200 years past closure year of the landfill, whereas Version 3.02 reports emissions for 140 years total.
- Version 2.01 does not allow waste to be accepted in the closure year. To provide users with more flexibility when entering inputs, Version 3.02 was changed to allow waste to be accepted in the closure year.
- Version 2.01 contains AP-42 default values and air pollutant concentrations and molecular weights that were current as of September 1997 (Supplement C of the 5th Edition). Version 3.02 contains revised AP-42 default values (within the inventory defaults), air pollutant concentrations, and molecular weights that are current as of November 1998 (Supplement E of the 5th Edition).
- Version 3.02 incorporates inventory default k and L_o values for wet landfills (such as bioreactors).
- Version 3.02 replaces Version 3.01 by correcting an error when $\text{av ft}^3/\text{min}$ or ft^3/year is selected as the user-specified unit in the RESULTS worksheet.

1.5 Differences Between the Model and AP-42

Significant differences between Version 3.02 of LandGEM and EPA's *Compilation of Air Pollutant Emission Factors (AP-42)* include:

- The inventory default values for NMOC concentration and several air pollutant concentrations used in Version 3.02 of LandGEM differ slightly from those in the November 1998 version (Supplement E of the 5th Edition) of AP-42. These minor differences are due to rounding of the concentration values to more accurately reflect their relative uncertainty. These rounding differences are expected to be rectified in

an upcoming revision of AP-42 for MSW landfills because the uncertainty of the values within the current version of AP-42 do not accurately correspond with the inherent uncertainty of the NMOC and air pollutant concentrations.

- Due to a revision in the first-order decomposition rate equation used in Version 3.02 of LandGEM (Section 1.4), the methane generation equation (Equation 1) within AP-42 no longer matches the equation used by LandGEM. Differences between the two calculation methodologies are expected to be rectified in an upcoming revision of AP-42 for MSW landfills.

Section 2.

Providing Landfill Characteristics

Enter data on the USER INPUTS worksheet that relate to the identity and size of the landfill being modeled.

- Landfill name or identifier,
- Landfill open year,
- Landfill closure year,
- Option to have model calculate closure year, and
- Waste design capacity.

Image 2 shows these inputs as they appear on the USER INPUTS worksheet. To clear all of the landfill characteristic inputs, gas/pollutant selections (see Section 4.0), and waste acceptance rate data (see Section 5.0), click on *Clear ALL Non-Parameter Inputs/Selections* in the USER INPUTS worksheet. These inputs will then return to their defaults.

USER INPUTS		Landfill Name or Identifier:
1: PROVIDE LANDFILL CHARACTERISTICS		Clear ALL Non-Parameter Inputs/Selections
Landfill Open Year		
Landfill Closure Year		
Have Model Calculate Closure Year?	☒ Yes ☐ No	
Waste Design Capacity	megagrams ▾	

Image 2. Landfill Characteristics Inputs.

2.1 Landfill Name or Identifier

Use the *Landfill Name or Identifier* to enter a landfill's name and scenario information (for example, "Landfill A - Closed Cells" or "Landfill A - Leachate Recirculation Cells"). You can also enter information about the landfill as it relates to the types of model parameters chosen (for example, "Landfill B - NSPS/EG Conventional k Value" or "Landfill B - User-specified k = 0.06"). Model parameters are discussed further in Section 3.0. The *Landfill Name or Identifier* entry box is limited to 50 characters.

The *Landfill Name or Identifier* you enter on the USER INPUTS worksheet is shown in the same location on other worksheets within LandGEM. You are not required to enter information into the *Landfill Name or Identifier* entry box. The *Landfill Name or Identifier* entry box is not affected by the *Clear ALL Non-Parameter Inputs/Selections* button.

2.2 Landfill Open Year

Landfill Open Year is a required input and represents the year that the landfill began accepting waste. The open year should be in a four-digit year format (e.g., 2004).

2.3 Landfill Closure Year

Landfill Closure Year represents either of the following in LandGEM:

- Final year the landfill accepted waste, or
- Year the landfill is expected to reach *Waste Design Capacity*.

LandGEM uses the closure year of the landfill to determine the final year the landfill has accepted or is planning to accept waste. The “permitted” closure year of the landfill does not always represent the same year the landfill ceases to accept waste.

Landfill Closure Year is not a required input. However, if *Landfill Closure Year* is unknown, then you **must** select *Yes* for the *Have Model Calculate Closure Year?* option, AND you **must** enter *Waste Design Capacity*. If you enter a closure year, but still select *Yes* for the option to have the model calculate closure year, then the model will disregard the closure year you entered and automatically calculate closure year for you.

The model limits the number of years for entering *Waste Acceptance Rates* to 80 years (see Section 5.0 for further discussion about *Waste Acceptance Rates*). If the *Landfill Closure Year* entered is greater than 80 years from the *Landfill Open Year* entered (i.e., over 80 years of waste acceptance), then the model will disregard the *Landfill Closure Year* entered and will assign the 80th year past the *Landfill Open Year* as the final year of waste acceptance (or the closure year) used by the model to estimate emissions. For example, if you enter a *Landfill Open Year* of 1940, a *Landfill Closure Year* of 2030, and *Waste Acceptance Rates* for 1940-2004, then the model will only allow *Waste Acceptance Rates* to be entered for 2005 to 2019 and will calculate emissions as though the landfill closed in 2019. See Section 2.6 for instructions on estimating total emissions properly for scenarios where landfills accept waste beyond the waste acceptance limit of 80 years.

2.4 Have Model Calculate Closure Year?

If *Landfill Closure Year* is unknown, select *Yes* for the option to have the model calculate closure year. The default option is *No*. You **must** enter the *Waste Design Capacity* if you want the model to calculate closure year for you. *Waste Design Capacity* is discussed further in Section 2.5.

If you allow LandGEM to determine the closure year, it does so based on *Landfill Open Year*, *Waste Design Capacity*, and *Waste Acceptance Rates* you entered. Essentially, LandGEM calculates the closure year by summing the *Waste Acceptance Rates* entered, subtracting this “waste-in-place” amount from the *Waste Design Capacity* entered, and then dividing by the final (or most recent) acceptance rate entered. The model assumes that your final waste acceptance rate entered will continue to be the annual amount of waste accepted until closure of the landfill or until there are 80 years of waste acceptance, whichever scenario comes first (see Section 5.0 for further discussion about *Waste Acceptance Rates*).

Example 1 illustrates how the model calculates the closure year if it is unknown.

Example 1. Scenario for Unknown *Landfill Closure Year*

Landfill open year = 1970

Landfill closure year = ?

Have model calculate closure year? = Yes

Waste design capacity = 5,000,000 short tons

Waste acceptance rate from 1970 to 1990 = 100,000 short tons/year

Waste acceptance rate from 1991 to 2000 = 200,000 short tons/year

$$\text{Calculated landfill closure year} = \left[\frac{(\text{Waste design capacity} - \sum (\text{Waste acceptance rates}))}{\text{Final waste acceptance rate in 2000}} \right] + \text{Year of final waste acceptance rate}$$

$$\begin{aligned} \text{Calculated landfill closure year} &= \left[\frac{(5,000,000 \text{ short tons} - 4,100,000 \text{ short tons})}{200,000 \text{ short tons}} \right] + 2000 \\ &= 2005 \end{aligned}$$

The model limits the number of years for entering *Waste Acceptance Rates* to 80 years (see Section 5.0 for further discussion about *Waste Acceptance Rates*). If the *Waste Design Capacity* has not been reached by the 80th year of waste acceptance, then the model will assign the 80th year past the *Landfill Open Year* entered as the final year of waste acceptance (or the closure year) used by the model to estimate emissions. For example, if you allow the

model to calculate closure year and enter a *Landfill Open Year* of 1960, a *Waste Design Capacity* of 10,000,000 Mg, and *Waste Acceptance Rates* of 100,000 Mg/year for 1960–2004, then the model will calculate emissions as though the landfill closed in 2039 because that is when it will reach the 80-year limit of waste acceptance. See Section 2.6 for instructions on estimating total emissions properly for scenarios where landfills accept waste beyond the waste acceptance limit of 80 years.

2.5 Waste Design Capacity

Waste Design Capacity represents the total amount of waste that can be disposed of in the landfill, or the amount of “waste-in-place” upon closure. Enter *Waste Design Capacity* only when you select *Yes* for the *Have Model Calculate Closure Year?* option. If you enter *Waste Design Capacity* without selecting *Yes*, the model will simply disregard the capacity amount you entered.

Waste Design Capacity can be entered in metric units of megagrams or English units of short tons. (Note: One megagram is equivalent to one metric ton.) Select the units of measure using the drop-down menu. The default unit of measure for *Waste Design Capacity* is megagrams.

Landfill gas emission factors were developed using empirical data from U.S. MSW landfills. The composition of waste in the landfills reflects U.S. waste composition including MSW, inert material, and other non-hazardous waste streams. If a portion of the landfill contains primarily non-biodegradable waste (i.e., inert material), such as ash from waste combustion, this portion may be subtracted from the *Waste Design Capacity*, depending upon documentation and approval from a regulatory authority. However, this is not recommended for sites that are typical of MSW landfills, which contain a range of waste that may or may not be degradable. This is because the emission factors were developed relating total waste quantity to total quantity of landfill gas.

2.6 Landfills Accepting Waste Over 80 Years

Sections 2.3 and 2.4 explain scenarios where LandGEM will implement a waste acceptance limit of 80 years in order to estimate emissions properly. If you are modeling a landfill that either has accepted or will accept waste for over 80 years, then multiple model runs are required to calculate emissions for the entire waste acceptance lifetime of the landfill. You should associate a unique file name and *Landfill Name or Identifier* in the USER INPUTS worksheet for each model run to properly identify the order of the model runs (“Landfill X - Run 1 of 2” and “Landfill X - Run 2 of 2,” for example).

When the 80-year waste acceptance limit is exceeded, the INPUT REVIEW worksheet reports the actual landfill closure year that would be reached in absence of the 80-year limit. The additional years of waste acceptance can be modeled in a successive model run in order to capture the total emissions from the actual waste acceptance lifetime. The METHANE worksheet provides the waste-in-place amount at the end of the initial 80 years and remaining waste capacity from the final year of the initial model run if you have chosen to have model calculate closure year. These values can be used as inputs for the second model run. Once both model runs have been completed, then the emissions on the RESULTS worksheet from each run can be summed together by year for each gas/pollutant to result in total emissions for the actual waste acceptance lifetime of the landfill.

Example 2 outlines a scenario for running LandGEM multiple times in order to accurately represent the emissions for landfills accepting waste over 80 years.

Example 2. Scenario for Landfills Accepting Waste Over 80 Years

First Model Run Inputs on USER INPUTS Worksheet:

Landfill open year = 1940

Landfill closure year = ?

Have model calculate closure year? = Yes

Waste design capacity = 12,000,000 Mg

Waste acceptance rate from 1940 to 2000 = 100,000 Mg/year

Waste acceptance rate from 2001 to 2004 = 200,000 Mg/year

First Model Run Results on METHANE Worksheet:

Closure year (with 80-year limit) = 2019

Actual closure year (without limit) = 2030

Calculated waste acceptance rate from 2005 to 2019 = 200,000 Mg/year

Waste-in-place at start of next model run = 9,900,000 Mg

Capacity remaining at start of next model run = 2,100,000 Mg

Second Model Run Inputs on USER INPUTS Worksheet:

Landfill open year = 2020 [One year past closure year from the first model run]

Landfill closure year = ?

Have model calculate closure year? = Yes

Waste design capacity = 2,100,000 Mg [Capacity remaining from the first model run]

Waste acceptance rate for 2020 = 200,000 Mg/year [Calculated waste acceptance rate from the first model run]

Second Model Run Results on METHANE Worksheet:

Closure year (with 80-year limit) = Actual closure year (without limit) = 2030

Total annual emissions for each gas/pollutant = (Run 1 emissions) + (Run 2 emissions)

For example, methane emissions for 2021 = $2.586 \times 10^7 + 1.662 \times 10^6 = 2.752 \times 10^7$

Section 3.

Determining Model Parameters

LandGEM relies on several model parameters to estimate landfill emissions.

- Methane generation rate (k),
- Potential methane generation capacity (L_0),
- NMOC concentration, and
- Methane content.

Default values for the model parameter inputs on the USER INPUTS worksheet are shown in Image 3. Model parameters should be selected using consistent default options. For example, if “Inventory Conventional - 0.04” is chosen for k , then “Inventory Conventional - 100” should be selected for L_0 , and “Inventory No or Unknown Co-disposal - 600” or “Inventory Co-disposal - 2,400” should be selected for *NMOC Concentration*. When using LandGEM to determine whether a landfill is subject to the control requirements of the NSPS/EG or NESHAP, CAA defaults **must** be chosen for all four model parameters.

The image shows a screenshot of a software interface for determining model parameters. At the top right, there is a button labeled "Restore Default Model Parameters". Below this, the section is titled "2: DETERMINE MODEL PARAMETERS". There are four input fields, each with a label and a drop-down menu:

- Methane Generation Rate, k (year^{-1})**: The drop-down menu shows "CAA Conventional - 0.05".
- Potential Methane Generation Capacity, L_0 (m^3/Mg)**: The drop-down menu shows "CAA Conventional - 170".
- NMOC Concentration (ppmv as hexane)**: The drop-down menu shows "CAA - 4,000".
- Methane Content (% by volume)**: The drop-down menu shows "CAA - 50% by volume".

Image 3. Model Parameters Inputs.

You may select each of the model parameters from the drop-down menu. Alternatively, you may enter site-specific model parameter values other than the default values based on field

data or other information. Select *User-specified* for the model parameter for which you would like to enter site-specific data. A *User-specified value* entry box will appear to the right of that parameter and you can enter the site-specific value. *User-specified value* entry boxes only appear when *User-specified* is selected from the drop-down menu for a particular model parameter.

Clicking on *Restore Default Model Parameters* in the USER INPUTS worksheet resets all four of the model parameters back to their default values (shown in Image 3) and removes any user-specified values entered.

3.1 Methane Generation Rate (k)

The *Methane Generation Rate*, k , determines the rate of methane generation for the mass of waste in the landfill. The higher the value of k , the faster the methane generation rate increases and then decays over time. The value of k is primarily a function of four factors:

- Moisture content of the waste mass,
- Availability of the nutrients for microorganisms that break down the waste to form methane and carbon dioxide,
- pH of the waste mass, and
- Temperature of the waste mass.

Use EPA Method 2E to determine site-specific k values for user-specified data. The k value, as it is used in the first-order decomposition rate equation, is in units of 1/year, or year⁻¹. The five k values used by LandGEM are shown in Table 2. Arid area landfills are located in areas that receive less than 25 inches of rainfall per year. The default k value is the CAA k value for conventional landfills.

Table 2. Values for the Methane Generation Rate (k).

Default Type	Landfill Type	k Value year ⁻¹
CAA	Conventional	0.05 (default)
CAA	Arid Area	0.02
Inventory	Conventional	0.04
Inventory	Arid Area	0.02
Inventory	Wet (Bioreactor)	0.7

3.2 Potential Methane Generation Capacity (L_o)

The *Potential Methane Generation Capacity*, L_o , depends only on the type and composition of waste placed in the landfill. The higher the cellulose content of the waste, the higher the value of L_o . The default L_o values used by LandGEM are representative of MSW. The L_o value, as it is used in the first-order decomposition rate equation, is measured in metric units of cubic meters per megagram to be consistent with the CAA. The five L_o values used by LandGEM are shown in Table 3. The default L_o value is the CAA L_o value for conventional landfills.

Table 3. Values for the Potential Methane Generation Capacity (L_o).

Emission Type	Landfill Type	L_o Value - m ³ /Mg
CAA	Conventional	170 (default)
CAA	Arid Area	170
Inventory	Conventional	100
Inventory	Arid Area	100
Inventory	Wet (Bioreactor)	96

3.3 Nonmethane Organic Compound Concentration

The *NMOC Concentration* in landfill gas is a function of the types of waste in the landfill and the extent of the reactions that produce various compounds from the anaerobic decomposition of waste. *NMOC Concentration* is measured in units of parts per million by volume (ppmv) and is used by LandGEM only when NMOC emissions are being estimated. The *NMOC Concentration* for the CAA default is 4,000 ppmv as hexane. The *NMOC Concentration* for the inventory default is 600 ppmv where co-disposal of hazardous waste has either not occurred or is unknown and 2,400 ppmv where co-disposal of hazardous waste has occurred.

The default *NMOC Concentration* is the CAA value. If you use a site-specific value for NMOC concentration, then you must correct for air infiltration. EPA Method 25C is recommended for obtaining a site-specific concentration of NMOCs.

3.4 Methane Content

For LandGEM, landfill gas is assumed to be 50 percent methane and 50 percent carbon

dioxide, with additional, trace constituents of NMOCs and other air pollutants. When using LandGEM for complying with the CAA, *Methane Content* must remain fixed at 50 percent by volume (the model default value).

You may choose other methane amounts for the *Methane Content* using the *User-specified* selection if data exist to support using another concentration. However, using LandGEM at landfills that have methane content outside the range of 40 to 60 percent is not recommended. The first-order decomposition rate equation used by LandGEM to determine emissions may not be valid outside of this range.

The production of methane is determined using the first-order decomposition rate equation and is not affected by the concentration of methane. However, the concentration of methane affects the calculated production of carbon dioxide. The production of carbon dioxide (Q_{CO2}) is calculated from the production of methane (Q_{CH4}) and the methane content percentage (P_{CH4}) using the equation

$$Q_{CO2} = Q_{CH4} \times \left\{ \left[1 / (P_{CH4} / 100) \right] - 1 \right\}$$

This equation is derived as follows:

$$\begin{aligned} Q_{total} &= Q_{CH4} + Q_{CO2} \\ Q_{CH4} &= Q_{total} \times (P_{CH4} / 100) \\ Q_{CO2} &= Q_{total} - Q_{CH4} = \left[Q_{CH4} / (P_{CH4} / 100) \right] - Q_{CH4} \\ Q_{CO2} &= Q_{CH4} \times \left\{ \left[1 / (P_{CH4} / 100) \right] - 1 \right\} \end{aligned}$$

where Q_{total} is the total production of landfill gas.

Section 4. Selecting Gases/Pollutants

You can choose four gases or air pollutants to be modeled at one time. The gases and pollutants to choose from and data associated with them are shown in Table 4.

Table 4. Gas/Pollutant Default Data Used in LandGEM.

Gas/Pollutant	Concentration (ppmv)	Molecular Weight	Notes
Gases			
Total landfill gas	Not applicable	30.03	
Methane	Not applicable	16.04	
Carbon dioxide	Not applicable	44.01	
NMOCs	4,000 for CAA	86.18	
	600 for Inventory No or Unknown Co-disposal		
	2,400 for Inventory Co-disposal		
Pollutants:			
1,1,1-Trichloroethane (methyl chloroform)	0.48	133.41	A
1,1,2,2-Tetrachloroethane	1.1	167.85	A, B
1,1-Dichloroethane (ethylidene dichloride)	2.4	98.97	A, B
1,1-Dichloroethene (vinylidene chloride)	0.20	96.94	A, B
1,2-Dichloroethane (ethylene dichloride)	0.41	98.96	A, B
1,2-Dichloropropane (propylene dichloride)	0.18	112.99	A, B
2-Propanol (isopropyl alcohol)	50	60.11	B
Acetone	7.0	58.08	
Acrylonitrile	6.3	53.06	A, B
Benzene	1.9 for No or Unknown Co-disposal	78.11	A, B
	11 for Co-disposal		
Bromodichloromethane	3.1	163.83	B
Butane	5.0	58.12	B
Carbon disulfide	0.58	76.13	A, B
Carbon monoxide	140	28.01	

Table 4. Gas/Pollutant Default Data Used in LandGEM (Concluded)

Carbon tetrachloride	4.0×10^{-3}	153.84	A, B
Carbonyl sulfide	0.49	60.07	A, B
Chlorobenzene	0.25	112.56	A, B
Chlorodifluoromethane	1.3	86.47	
Chloroethane (ethyl chloride)	1.3	64.52	A, B
Chloroform	0.03	119.39	A, B
Chloromethane	1.2	50.49	B
Dichlorobenzene	0.21	147	B, C
Dichlorodifluoromethane	16	120.91	
Dichlorofluoromethane	2.6	102.92	B
Dichloromethane (methylene chloride)	14	84.94	A
Dimethyl sulfide (methyl sulfide)	7.8	62.13	B
Ethane	890	30.07	
Ethanol	27	46.08	B
Ethyl mercaptan (ethanethiol)	2.3	62.13	B
Ethylbenzene	4.6	106.16	A, B
Ethylene dibromide	1.0×10^{-3}	187.88	A, B
Fluorotrichloromethane	0.76	137.38	B
Hexane	6.6	86.18	A, B
Hydrogen sulfide	36	34.08	
Mercury (total)	2.9×10^{-4}	200.61	A
Methyl ethyl ketone	7.1	72.11	A, B
Methyl isobutyl ketone	1.9	100.16	A, B
Methyl mercaptan	2.5	48.11	B
Pentane	3.3	72.15	B
Perchloroethylene (tetrachloroethylene)	3.7	165.83	A
Propane	11	44.09	B
t-1,2-Dichloroethene	2.8	96.94	B
Toluene	39 for No or Unknown Co-disposal	92.13	A, B
	170 for Co-disposal		
Trichloroethylene (trichloroethene)	2.8	131.40	A, B
Vinyl chloride	7.3	62.50	A, B
Xylenes	12	106.16	A, B

A. Hazardous air pollutants (HAP) listed in Title III of the 1990 Clean Air Act Amendments.

B. Considered volatile organic compounds (VOC), as defined by U.S. EPA in 40 CFR 51.100(s).

C. Source tests did not indicate whether this compound was the para- or ortho- isomer. The para- isomer is a Title III-listed HAP.

Concentrations, molecular weights, and notes for NMOCs and the 46 air pollutants contained in Table 4 are from Tables 2.4-1 and 2.4-2 of AP-42 (November 1998 version). These default pollutant concentrations have already been corrected for air infiltration, as stated in AP-42. If you use a site-specific value for *NMOC Concentration*, then you must

correct for air infiltration.

As discussed in Section 3.3, the *NMOC Concentration* for the inventory default is 600 ppmv where co-disposal of hazardous waste has either not occurred or is unknown and 2,400 ppmv where co-disposal of hazardous waste has occurred. Similarly, benzene and toluene have different concentrations depending upon the co-disposal status of the landfill. Both no or unknown co-disposal and co-disposal concentrations are shown in Table 4 for these pollutants.

The molecular weight of landfill gas was estimated using a weighted average of the molecular weights for methane and carbon dioxide. The molecular weight of 30.03 represents landfill gas as 50 percent methane and 50 percent carbon dioxide. If the *Methane Content* model parameter is changed to a value other than 50 percent, then the molecular weight of total landfill gas is adjusted to represent the appropriate methane content.

Image 4 shows where you can select four gases or pollutants on the USER INPUTS worksheet. Each of the gas or pollutant entries can be selected from the drop-down menus.

3: SELECT GASES/POLLUTANTS

Gas / Pollutant #1 Default pollutant parameters are currently being used by model.

Total landfill gas

Gas / Pollutant #2

Methane

Gas / Pollutant #3

Carbon dioxide

Gas / Pollutant #4

NMOC

Edit Existing or Add New Pollutant Parameters

Restore Default Pollutant Parameters

Description/Comments:

Image 4. Gas/Pollutant Inputs.

The *Edit Existing or Add New Pollutant Parameters* button in the USER INPUTS worksheet allows you to change the default pollutant parameters, including concentrations and molecular weights, for any of the 46 air pollutants listed on the drop-down menus, as well as add new pollutants and corresponding parameters. Clicking on the *Edit Existing or Add New Pollutant Parameters* button lets you view and edit the default parameters for existing pollutants in the POLLUTANTS worksheet. The default parameters shown on the POLLUTANTS worksheet are identical to the ones in Table 4. In addition, there are entry boxes at the bottom of the POLLUTANTS worksheet where you can enter new pollutants and corresponding concentrations and molecular weights. The *Enter New Pollutant Parameters* and *Edit Existing Pollutant Parameters* buttons at the top of the POLLUTANTS worksheet help guide you through this worksheet.

The model does not allow you to edit default parameters for total landfill gas, methane, carbon dioxide, or NMOCs, nor does it allow you to change names of existing pollutants. To restore the default pollutant parameters for existing pollutants and remove any new pollutants you may have added, click on the *Restore Default Pollutant Parameters* button in the USER INPUTS worksheet. Clicking this button also returns the gas/pollutant drop-down menus in the USER INPUTS worksheet to their default selections.

In the *Description/Comments* entry box, you can enter detailed information about the landfill or the scenario you are modeling. The *Description/Comments* entry box is limited to 450 characters.

To clear all of the gas/pollutant selections (but not the pollutant parameters) and the landfill characteristics and waste acceptance rate inputs (see Section 5.0), click on *Clear ALL Non-Parameter Inputs/Selections* in the USER INPUTS worksheet. The gas/pollutant drop-down menus will return to their default selections, as shown in Image 4. The *Description/Comments* box is not affected by the *Clear ALL Non-Parameter Inputs/Selections* button.

Section 5.

Entering Waste Acceptance Data

Waste Acceptance Rates **must** be entered in the USER INPUTS worksheet for LandGEM to properly estimate emissions. Enter annual acceptance rates for each year listed in the *Waste Acceptance Rates* table from the *Landfill Open Year* to the current year or the *Landfill Closure Year*. The *Waste Acceptance Rates* table is shown in Image 5. Once you enter the *Landfill Open Year*, the year column of the *Waste Acceptance Rates* table automatically shows the years for which acceptance rate data are needed.

4: ENTER WASTE ACCEPTANCE RATES

Input Units:

Year	Input Units (Mg/year)	Calculated Units (short tons/year)
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Image 5. Waste Acceptance Rate Inputs.

You may enter *Waste Acceptance Rates* in metric units of megagrams per year or English units of short tons per year by selecting from the drop-down menu. The default unit of measure for *Waste Acceptance Rates* is megagrams per year. If you enter acceptance rates in

units of megagrams per year, then LandGEM automatically calculates and displays the acceptance rates in units of short tons per year. Likewise, if you enter acceptance rates in short tons per year, then LandGEM automatically calculates and displays acceptance rates in megagrams per year.

The model makes the assumptions outlined in Table 5. regarding data entered in the *Waste Acceptance Rates* table.

Table 5. Acceptance Rate Input Options.

If you...	Then LandGEM will...
Enter acceptance rates beyond the <i>Landfill Closure Year</i> you entered,	Ignore the acceptance rates you entered past the <i>Landfill Closure Year</i> .
Enter acceptance rates through the current year but not up to the <i>Landfill Closure Year</i> you entered,	Apply the final (or most recent) acceptance rate you entered to the years between the current year and the <i>Landfill Closure Year</i> .
Enter acceptance rates through the current year and choose to have the model calculate closure year,	Apply the final (or most recent) acceptance rate you entered to each successive year not having an acceptance rate until the waste design capacity is reached. A smaller acceptance rate may be used the last year to achieve the exact design capacity. The final year the landfill receives waste becomes the closure year.

The model limits the number of years for entering *Waste Acceptance Rates* to 80 years. See Section 2.6 for instructions on estimating total emissions properly for scenarios where landfills accept waste beyond the waste acceptance limit of 80 years.

Landfill gas emission factors were developed using empirical data from U.S. MSW landfills. The composition of waste in the landfills reflects U.S. waste composition including MSW, inert material, and other non-hazardous waste streams. For a landfill that may have a portion containing non-biodegradable waste (i.e., inert material), such as ash from waste combustion, this portion may be subtracted from the *Waste Acceptance Rates* depending on documentation and approval from a regulatory authority. However, this is not recommended for sites that are typical of MSW landfills containing a range of waste that may or may not be degradable. This is because the emission factors were developed relating total waste quantity to total quantity of landfill gas.

To clear all entries in the *Waste Acceptance Rates* table, in addition to landfill characteristics inputs and gas/pollutant selections, click on *Clear ALL Non-Parameter Inputs/Selections* in the USER INPUTS worksheet. The *Waste Acceptance Rates* table then returns to its defaults, as shown in Image 5.

Section 6.

Printing Inputs

To review your inputs as they will be used by LandGEM, go to the INPUT REVIEW worksheet. All data entered in the USER INPUTS worksheet as well as inputs determined by the model, such as calculated landfill closure year and waste acceptance rates as they are interpreted by LandGEM, appear on the INPUT REVIEW worksheet. Image 6 shows a scenario where closure year is unknown.

The screenshot shows the Microsoft Excel - LandGEM-V3.02 [Read Only] interface. The main window displays the 'INPUT REVIEW' tab, which is divided into two sections: 'LANDFILL CHARACTERISTICS' and 'MODEL PARAMETERS'. The 'LANDFILL CHARACTERISTICS' section includes fields for Landfill Open Year (1985), Landfill Closure Year (with 30-year limit) (2006), Actual Closure Year (without limit) (2006), Have Model Calculate Closure Year? (Yes), and Waste Design Capacity (5,000,000 megagrams). The 'MODEL PARAMETERS' section includes fields for Methane Generation Rate, k (0.050 year⁻¹), Potential Methane Generation Capacity, L₀ (170 m³/Mg), NMOC Concentration (4,000 ppmv as hexane), and Methano Content (50 % by volume). The 'WASTE ACCEPTANCE RATES' table shows a list of years from 1985 to 2003, with corresponding values for (Mg/year) and (short tons/year). The 'INPUT REVIEW' tab is selected, and the 'Description/Comments' field is empty.

LANDFILL CHARACTERISTICS		WASTE ACCEPTANCE RATES	
Landfill Open Year	1985	Year	(Mg/year) (short tons/year)
Landfill Closure Year (with 30-year limit)	2006	1985	181,818 200,000
Actual Closure Year (without limit)	2006	1986	181,818 200,000
Have Model Calculate Closure Year?	Yes	1987	181,818 200,000
Waste Design Capacity	5,000,000 megagrams	1988	181,818 200,000
		1989	181,818 200,000
		1990	181,818 200,000
		1991	181,818 200,000
		1992	181,818 200,000
		1993	181,818 200,000
		1994	181,818 200,000
		1995	181,818 200,000
		1996	181,818 200,000
		1997	181,818 200,000
		1998	181,818 200,000
		1999	181,818 200,000
		2000	181,818 200,000
		2001	227,273 250,000
		2002	272,727 300,000
		2003	318,182 350,000

Image 6. INPUT REVIEW Worksheet.

To print the INPUT REVIEW worksheet, select *Print...* from the *File* menu. The INPUT REVIEW worksheet is set to print on one page. However, you may adjust this, as well as other print settings, by selecting *Page Setup...* from the *File* menu.

Section 7.

Viewing and Printing Tabular Results

To view emission estimates in a tabular format, go to the RESULTS worksheet. When comparing results from LandGEM with measurements of extracted gas collected at a site, the landfill owner or operator must adjust for air infiltration prior to any comparisons. Image 7 displays the RESULTS worksheet for the scenario shown in Image 6.

Microsoft Excel - LandGEM V3.07 [Read-Only]

File Edit View Insert Format Tools Data Window LandGEM Help

Type a question for help

M4

RESULTS Landfill Name or Identifier: Example Landfill

Closure Year (with 80-year limit) = 2006
Methane = 50 % by volume

Please choose a third unit of measure to represent all of the emission rates below.
User-specified Unit: av ft³/min

Year	Waste Accepted		Waste In-Place		Total landfill gas			Methane	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(Mg/year)	(m ³ /year)
1985	181,818	200,000	0	0	0	0	0	0	0
1986	181,818	200,000	181,818	200,000	3.775E+03	3.022E+06	2.031E+02	1.008E+03	1.511E
1987	181,818	200,000	363,636	400,000	7.550E+03	6.044E+06	3.963E+02	1.907E+03	2.949E
1988	181,818	200,000	545,454	599,999	1.078E+04	8.632E+06	5.800E+02	2.880E+03	4.316E
1989	181,818	200,000	727,272	799,999	1.403E+04	1.123E+07	7.548E+02	3.744E+03	5.617E
1990	181,818	200,000	909,090	999,999	1.712E+04	1.371E+07	9.211E+02	4.573E+03	6.854E
1991	181,818	200,000	1,090,909	1,199,999	2.006E+04	1.606E+07	1.070E+03	5.358E+03	8.031E
1992	181,818	200,000	1,272,726	1,399,999	2.286E+04	1.830E+07	1.230E+03	6.105E+03	9.151E
1993	181,818	200,000	1,454,544	1,599,999	2.551E+04	2.043E+07	1.373E+03	6.815E+03	1.022E
1994	181,818	200,000	1,636,362	1,799,999	2.805E+04	2.246E+07	1.509E+03	7.491E+03	1.123E
1995	181,818	200,000	1,818,180	1,999,999	3.045E+04	2.438E+07	1.638E+03	8.134E+03	1.219E
1996	181,818	200,000	1,999,998	2,199,999	3.274E+04	2.622E+07	1.762E+03	8.746E+03	1.311E
1997	181,818	200,000	2,181,816	2,399,999	3.492E+04	2.796E+07	1.879E+03	9.327E+03	1.398E
1998	181,818	200,000	2,363,634	2,599,997	3.699E+04	2.962E+07	1.990E+03	9.901E+03	1.491E
1999	181,818	200,000	2,545,452	2,799,997	3.896E+04	3.120E+07	2.096E+03	1.041E+04	1.560E
2000	181,818	200,000	2,727,270	2,999,997	4.084E+04	3.271E+07	2.197E+03	1.091E+04	1.634E
2001	227,273	250,000	2,909,088	3,199,997	4.262E+04	3.413E+07	2.293E+03	1.138E+04	1.706E
2002	272,727	300,000	3,136,361	3,449,997	4.526E+04	3.624E+07	2.435E+03	1.209E+04	1.812E
2003	318,182	350,000	3,409,088	3,749,997	4.871E+04	3.901E+07	2.621E+03	1.301E+04	1.950E

Ready NUM

Image 7. RESULTS Worksheet.

Data on the RESULTS worksheet include

- Landfill closure year (provided on USER INPUTS worksheet or calculated),
- Methane content from USER INPUTS worksheet,
- Years of waste acceptance from open year to closure year of the landfill,
- Annual waste acceptance rates used by the model in megagrams per year and short

tons per year,

- Annual waste-in-place amounts based on acceptance rates used by the model, in megagrams and short tons,
- Annual emission estimates for the four gases/pollutants selected on the USER INPUTS worksheet in megagrams per year, cubic meters per year, and a third measurement unit that you may select from the drop-down menu. The third unit of measure options are average cubic feet per minute, cubic feet per year, and short tons per year. LandGEM uses average cubic feet per minute as the default third unit.

To print the RESULTS worksheet, select *Print...* from the *File* menu. The RESULTS worksheet is set to print on one page. However, you may adjust this as well as other print settings by selecting *Page Setup...* from the *File* menu.

Formatting of the values contained in the RESULTS worksheet is protected from user modification. To adjust the number formats of the values contained in the RESULTS worksheet, you will need to copy and paste the emission estimates into a new Microsoft Excel file by following the instructions below:

1. Highlight cells A7 to Q149 and select *Copy* from the *Edit* menu,
2. Open a new Microsoft Excel file by selecting *New... (Blank Workbook)* from the *File* menu,
3. Select *Paste Special...* from the *Edit* menu and click on the *Values* radio button in the *Paste Special* window that appears.
4. You can now change the number formats of these emission values by selecting *Cells...Number* from the *Format* menu.

It is important to note that when the *Methane Content* is assumed to be 50 percent by volume (default), then methane and carbon dioxide emission rates are identical on a volume basis (e.g., cubic meters per year, average cubic feet per minute, cubic feet per year) because carbon dioxide is also assumed to be 50 percent by volume. However, methane and carbon dioxide emission rates will differ from one another on a mass basis (e.g., megagrams per year, short tons per year) because methane and carbon dioxide have different molecular weights and, thus, different mass emissions.

Section 8.

Viewing and Printing Graphical Results

To view the emission estimates in a graphical format, go to the GRAPHS worksheet. Image 8 contains one of the three graphs generated on the GRAPHS worksheet for the scenario shown in Image 6.

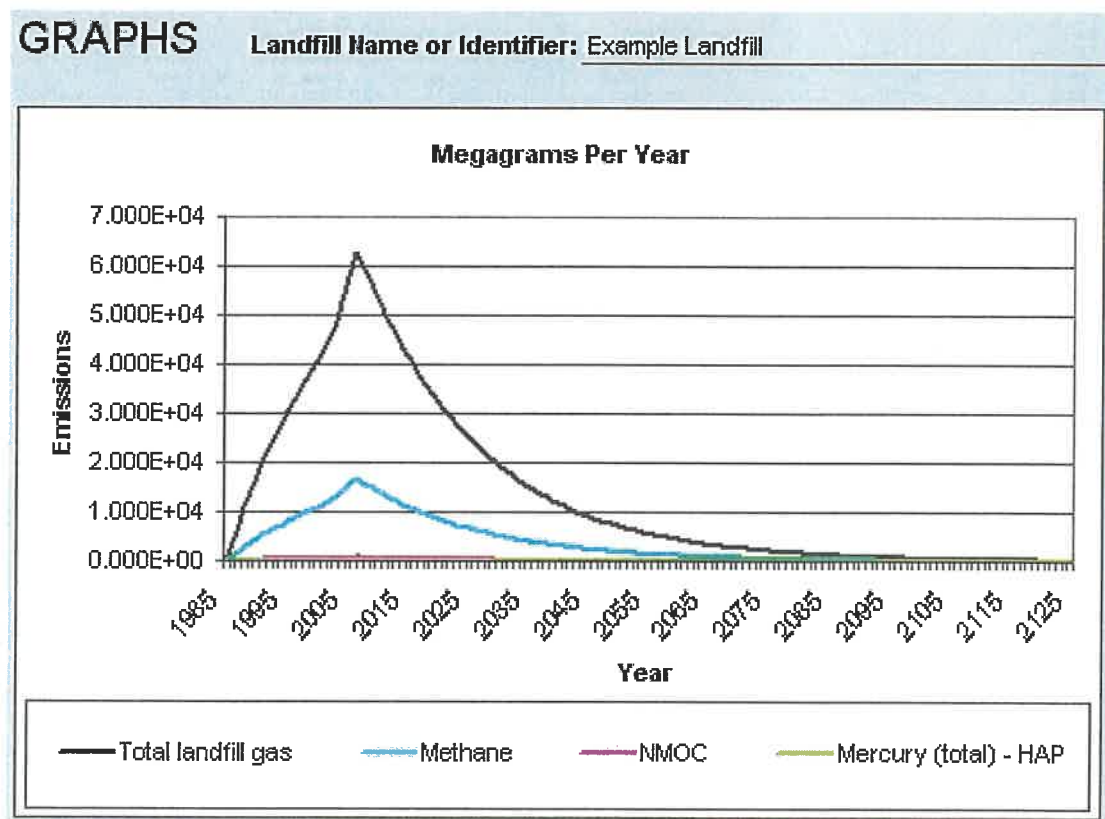


Image 8. Graphical Results in Units of Megagrams per Year.

A total of three graphs are generated for each scenario, one for each unit of measure of emissions on the RESULTS worksheet. The top two graphs are in units of megagrams per year and cubic meters per year, respectively. The third graph represents the units you

selected on the RESULTS worksheet (see Section 7.0 for further discussion), which defaults to average cubic feet per minute. The emission estimates for all four gases or pollutants are shown on each of the three graphs using a different color to represent each gas or pollutant's emissions.

To print the GRAPHS worksheet, select *Print...* from the *File* menu. The GRAPHS worksheet is set to print on one page. However, you may adjust this as well as other print settings by selecting *Page Setup...* from the *File* menu.

Editing and formatting of the graphs are protected from user modification. To create graphs that can be edited or formatted, you will need to copy and paste the emission estimates from the RESULTS worksheet or the INVENTORY worksheet into a new Microsoft Excel file by following the instructions below.

1. Highlight the cells containing the values to be graphed and select *Copy* from the *Edit* menu.
2. Open a new Microsoft Excel file by selecting *New... (Blank Workbook)* from the *File* menu.
3. Select *Paste Special...* from the *Edit* menu and click on the *Values* radio button in the *Paste Special* window that appears.
4. You can now create graphs from these emission values by selecting *Chart...* from the *Insert* menu and following the instructions in the *Chart Wizard* window.

Section 9.

Viewing and Printing Inventory Results

To view emission estimates for use in emission inventories and air permits, go to the INVENTORY worksheet. This worksheet allows you to view and print emission estimates for a particular year for all gases or pollutants in megagrams per year, cubic meters per year, average cubic feet per minute, cubic feet per year, and short tons per year. You **must** enter a valid four-digit year in the designated entry box to obtain estimates for a particular year. The inventory year entered **must** be between the year after the *Landfill Open Year* entered and 140 years past the *Landfill Open Year*. Image 9 displays the INVENTORY worksheet for the scenario shown in Image 6.

Microsoft Excel - LandGEM V3.02 [Read Only]

File Edit View Insert Format Tools Data Window LandGEM Help

100%

Type a question for help

Landfill Name or Identifier: Example Landfill

Enter year of emissions inventory: 2004

Gas / Pollutant	Emission Rate				
	(Mg/year)	(m ³ /year)	(av ft ³ /min)	(ft ³ /year)	(short tons/year)
Total landfill gas	5.294E+04	4.239E+07	2.848E+03	1.497E+09	5.824E+04
Methane	1.414E+04	2.120E+07	1.424E+03	7.488E+08	1.556E+04
Carbon dioxide	3.880E+04	2.120E+07	1.424E+03	7.488E+08	4.268E+04
NMOC	6.077E+02	1.696E+05	1.139E+01	5.988E+06	6.686E+02
1,1,1-Trichloroethane (methyl chloroform) - HAP	1.129E-01	2.035E+01	1.367E-03	7.186E+02	1.242E-01
1,1,2,2-Tetrachloroethane - HAP/VOC	3.258E-01	4.663E+01	3.133E-03	1.647E+03	3.581E-01
1,1-Dichloroethane (ethylene dichloride) - HAP/VOC	4.188E-01	1.017E+02	6.836E-03	3.593E+03	4.607E-01
1,1-Dichloroethane (vinylidene dichloride) - HAP/VOC	3.419E-02	8.479E+00	5.697E-04	2.994E+02	3.760E-02
1,2-Dichloroethane (ethylene dichloride) - HAP/VOC	7.154E-02	1.730E+01	1.160E-03	6.130E+02	7.070E-02
1,2-Dichloropropane (propylene dichloride) - HAP/VOC	3.588E-02	7.631E+00	6.127E-04	2.695E+02	3.945E-02
2-Propanol (isopropyl alcohol) - VOC	5.299E+00	2.120E+03	1.424E-01	7.488E+04	5.829E+00
Acetone	7.169E-01	2.968E+02	1.994E-02	1.048E+04	7.666E-01
Acrylonitrile - HAP/VOC	5.894E-01	2.671E+02	1.794E-02	9.432E+03	6.484E-01
Benzene - No or Unknown Co-disposal - HAP/VOC	2.617E-01	8.055E+01	5.412E-03	2.845E+03	2.879E-01
Benzene - Co-disposal - HAP/VOC	1.515E+00	4.663E+02	3.133E-02	1.647E+04	1.667E+00
Bromodichloromethane - VOC	0.955E-01	1.314E+02	0.030E-03	4.641E+03	9.051E-01
Butane - VOC	5.124E-01	2.120E+02	1.424E-02	7.488E+03	5.536E-01
Carbon disulfide - HAP/VOC	7.786E-02	2.459E+01	1.662E-03	8.683E+02	8.564E-02
Carbon monoxide	6.914E+00	5.935E+03	3.988E-01	2.096E+05	7.605E+00
Carbon tetrachloride - HAP/VOC	1.085E-03	1.696E-01	1.139E-05	6.988E+00	1.194E-03
Carbonyl sulfide - HAP/VOC	5.190E-02	2.077E+01	1.396E-03	7.396E+02	5.709E-02
Chlorobenzene - HAP/VOC	4.982E-02	1.080E+01	7.121E-04	3.743E+02	5.458E-02
Chlorodifluoromethane	1.982E-01	5.511E+01	3.703E-03	1.945E+03	2.180E-01

Ready NUM

Image 9. INVENTORY Worksheet.

To print the INVENTORY worksheet, select *Print...* from the *File* menu. The INVENTORY worksheet is set to print on one page. However, you may adjust this as well as other print settings by selecting *Page Setup...* from the *File* menu.

Formatting of the values contained in the INVENTORY worksheet is protected from user modification. To adjust the number formats of the values contained in the INVENTORY worksheet, you will need to copy and paste the emission estimates into a new Microsoft Excel file by following the instructions below:

1. Highlight cells B5 to K68 and select *Copy* from the *Edit* menu.
2. Open a new Microsoft Excel file by selecting *New... (Blank Workbook)* from the *File* menu.
3. Select *Paste Special...* from the *Edit* menu and click on the *Values* radio button in the *Paste Special* window that appears.
4. You can now change the number formats of these emission values by selecting *Cells...Number* from the *Format* menu.

Section 10.

Viewing and Printing the Summary Report

To view the summary report, go to the REPORT worksheet. Information contained in the summary report on the RESULTS worksheet includes

- A cover page showing the LandGEM title screen (pop-up introduction window that includes the model version and date), Landfill Name or Identifier and Description/Comments entered in the USER INPUTS worksheet, the current date, the first-order decomposition rate equation used to estimate emissions, and a general description of the model,
- Data contained in the INPUT REVIEW worksheet, including landfill characteristics, model parameters, gases/pollutants selected, waste acceptance rates, and yearly waste-in-place amounts,
- Emission estimates in graphical format, as shown on the GRAPHS worksheet, and
- Emission estimates in tabular format, from the RESULTS worksheet.

To print the REPORT worksheet, select *Print...* from the *File* menu. The REPORT worksheet is set to print on seven pages. However, you may adjust this as well as other print settings by selecting *Page Setup...* from the *File* menu.

Section 11.

Additional Information and References

Additional Information

For further information regarding landfill gas emissions, please access the following Web sites and documents:

- *Rules and Implementation Information for Standards of Performance for MSW Landfills.* EPA, Technology Transfer Network, Air Toxics Website:
<http://www.epa.gov/ttnatw01/landfill/landflpg.html>.
The following topics are included on this Web site:
 - Proposed and Promulgated Rules, including the NSPS/EG requirements,
 - Closely Related Rules, Policies or Program Guidance,
 - Technical Information, including Background Information Document (BID)/Response to Comments, Fact Sheets, and Risk Assessment,
 - Implementation and Enabling Documents,
 - Emission Estimation Tools, including the LandGEM software,
 - Source Identification and Location,
 - Outreach and Training Materials,
 - Permitting,
 - Compliance and Enforcement.

- *NESHAP Rule and Implementation Information for Municipal Solid Waste Landfills.* EPA, Technology Transfer Network, Air Toxics Website:
<http://www.epa.gov/ttnatw01/landfill/lnfillpg.html>.
The following topics are included on this Web site:
 - Proposed and Promulgated Rules, including the NESHAP requirements,
 - Closely Related Rules, Policies or Program Guidance,
 - Technical Information, including Background Information Document (BID)/Response to Comments, Fact Sheets, and Economic Analysis,
 - Implementation Documents,
 - Source Identification and Location,
 - Outreach and Training Materials,

- Permitting,
- Compliance and Enforcement.
- *Compilation of Air Pollutant Emission Factors (AP-42), Volume 1: Stationary Point and Area Sources, 5th ed., Chapter 2.4: Municipal Solid Waste Landfills.* EPA, Office of Air Quality Planning and Standards. Research Triangle Park, NC.
<http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s04.pdf>.
- *Use of Landfill Gas Generation Model to Estimate VOC Emissions from Landfills.* Memorandum from Y.C. McGuinn, Radian Corporation, to Susan Thorneloe, EPA. June 21, 1988. Public Docket No. A-88-09.
- *Sensitivity Analysis of Landfill Gas Generation Model.* Memorandum from Y.C. McGuinn, Radian Corporation, to Susan Thorneloe, EPA. June 21, 1988. Public Docket No. A-88-09.
- *Methodology Used to Revise the Model Inputs in the Municipal Solid Waste Landfills Input Database (Revised).* Memorandum from W.R. Pelt, Radian Corporation, to Municipal Solid Waste Landfills Docket A-88-09. April 28, 1993. Public Docket No. A-88-09.
- Methane Emissions from Landfills and Open Dumps, In *EPA Report to Congress on International Anthropogenic Methane Emissions: Estimates for 1990.* S.A. Thorneloe, M. Doorn, and M. Barlaz. EP A, Office of Policy, Planning and Evaluation. Washington, DC, 1994. EPA-230-R-93-010.
- *Landfill Gas Utilization – Options, Benefits, and Barriers, The Second United States Conference on Municipal Solid Waste Management, Arlington, VA.* S.A. Thorneloe. Published in Conference Proceedings, June 3–5, 1992.
- *Global Methane Emissions from Waste Management.* S.A. Thorneloe, M. A. Barlaz, R. Peer, L. C. Huff, L. Davis, and J. Mangino. Published in Atmospheric Methane: Sources, Sinks, and Role in Global Change, NATO ASI Series, Vol. 13, 1993.

References

EPA, 1991a. *Air Emissions from Municipal Solid Waste Landfills. Background Information for Proposed Standards and Guidelines*, EPA-450/3-90-011a (NTIS PB91-197061), U.S. Environmental Protection Agency, Research Triangle Park, NC.

EPA, 1991b. *Standards of Performance for New Stationary Sources and Guidelines for Control of Existing Sources: Municipal Solid Waste Landfills*, proposed rule. Federal Register, 56 FR 24468, May 30.

EPA, 1991c. *Regulatory Package for New Source Performance Standards and III(d) Guidelines for Municipal Solid Waste Air Emissions*, Public Docket No. A-88-09 (proposed May 1991). U.S. Environmental Protection Agency, Research Triangle Park, NC.

EPA, 1996. *Standards of Performance for New Stationary Sources and Guidelines for Control of Existing Sources: Municipal Solid Waste Landfills*, final rule. Federal Register, 61 FR 9905, March 12.

EPA, 1998. *Compilation of Air Pollutant Emission Factors, AP-42, Volume 1: Stationary Point and Area Sources*, 5th ed., Supplement E, Chapter 2.4: Municipal Solid Waste Landfills. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, November.

McGuinn, Y.C., 1988a. Memorandum. Radian Corporation, to Susan Thorneloe, EPA. *Use of Landfill Gas Generation Model to Estimate VOC Emissions from Landfills*, Public Docket No. A-88-09, June 21.

McGuinn, Y.C., 1988b. Memorandum. Radian Corporation, to Susan Thorneloe, EPA. *Sensitivity Analysis of Landfill Gas Generation Model*, Public Docket No. A-88-09, June 21.

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NARA, 1997b. Code of Federal Regulations, Part 60, Protection of the Environment, *Subpart Cc - Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills*, Office of the Federal Register, Washington, DC.

Pelt, W.R., 1993. Memorandum. Radian Corporation to Municipal Solid Waste Landfills Docket A-88-09, *Methodology Used to Revise the Model Inputs in the Municipal Solid Waste Landfills Input Database* (Revised), Public Docket No. A-88-09, April 28.

Thorneloe, S.A., A. Reisdorph, M. Laur, R. Pelt, R.L. Bass, and C. Burklin, 1999. The U.S. Environmental Protection Agency's Landfill Gas Emissions Model (LandGEM), Sardinia 99, Seventh International Waste Management and Landfill Symposium, Published in Proceedings, Volume IV, Pages 11-18, October 4-8.

Thorneloe, S.A. and J.G. Pacey, 1994. *Landfill Gas Utilization---Database of North American Projects*, Presented at the 17th Annual International Landfill Gas Symposium by the Solid Waste Association of North America, Long Beach, CA, March 22-24.

Thorneloe, S.A., M. Doorn, M. Barlaz, et al., 1994. Methane Emissions from Landfills and Open Dumps, In *EPA Report to Congress on International Anthropogenic Methane Emissions: Estimates for 1990*. EPA-230-R-93-010.

Appendix A

Technical Background

Introduction

The Landfill Gas Emissions Model (LandGEM) provides an automated estimation tool for quantifying air emissions from municipal solid waste (MSW) landfills. The model was developed by the Control Technology Center (CTC) of the U.S. Environmental Protection Agency and can be obtained by downloading from the TTNWeb (<http://www.epa.gov/ttn/catc/products.html#software>). It is also available from the National Technical Information Service (NTIS).

Air emissions from landfills come from landfill gas generated by the decomposition of waste in the landfill. Landfill gas is assumed by this model to be roughly half methane and half carbon dioxide with additional, relatively low, concentrations of other air pollutants. The following information is needed to estimate emissions from a landfill (see the Glossary of Terms at the end of Appendix A):

- The waste design capacity of the landfill,
- The amount of waste-in-place in the landfill or the annual waste acceptance rate for the landfill,
- The methane generation rate (k),
- The potential methane generation capacity (L_o),
- The concentration of total nonmethane organic compounds (NMOCs) and speciated NMOCs found in the landfill gas,
- The years the landfill has been in operation, and
- Whether the landfill has been used for disposal of hazardous waste (co-disposal).

The estimation method used by the model is a simple first-order decay equation. Because the data available for landfills (such as data on the quantity, age, and composition of the waste in the landfill) are limited, using a more sophisticated calculation method is not justified. The Landfill Gas Emissions Model estimates emissions of total landfill gas, methane, carbon dioxide (CO₂), NMOCs, and selected air pollutants. Information on the assumptions used in the model can be found in the background information document (EPA, 1991a) written to support the Standards of Performance for New Stationary Sources (NARA, 1997a) and Emission Guidelines for Control of Existing Sources (NARA, 1997b) and in the public docket (McGuinn, 1988a; McGuinn, 1988b; Pelt, 1993).

The Landfill Gas Emissions Model can be used with site-specific data for all the information needed to generate emission estimates, or it can be used with two different sets of default values. One set of default values (the CAA defaults) is for estimating emissions to determine the applicability of the Clean Air Act (CAA) regulations for MSW landfill emissions,

specifically the New Source Performance Standards (NSPS) for new MSW Landfills and the emission guidelines (EG) for existing MSW landfills. The NSPS/EG were initially proposed May 30, 1991 (EPA, 1991b), and the final rule was promulgated on March 12, 1996 (EPA, 1996).

The applicability of the NSPS/EG to a particular landfill can be determined based on emissions estimated using the CAA defaults in the model. The applicability of the NSPS/EG to a particular landfill is determined in tiers. There is, first, a size cutoff (i.e., 2.5 million tons or 2.5 million cubic meters of waste) below which landfills are not subject to the rule. After the size cutoff, the first tier of the applicability determination is to assess whether emissions of NMOCs exceed a cutoff value of 50 Mg of NMOCs/yr using LandGEM with all default values set for the CAA defaults. Landfills with emissions exceeding the cutoff value can choose to install emission controls or move to the second tier of the applicability determination, which is to test the landfill for landfill gas NMOC concentrations. If the revised NMOC concentrations result in NMOC emissions that still exceed the cutoff value, the landfill can choose to install emission controls or move to the third tier of the applicability determination, which is to perform another test to obtain a site-specific k value (the methane generation rate constant).

The CAA default values in the model provide emission estimates that would reflect the expected maximum emissions and generally would be used only for determining the applicability of the regulations to a landfill. To estimate actual emissions in the absence of site-specific data, a second set of default values (the inventory defaults) is provided in the model. The inventory default values in the model are based on emission factors from the U.S. Environmental Protection Agency's *Compilation of Air Pollutant Emission Factors*, AP-42 (EPA, 1998). The inventory default values provide emission estimates that should reflect typical landfill emissions and are the values suggested for use in developing estimates for state inventories.

The EPA fully recognizes that modeling landfill air emissions accurately is difficult due to limitations in available information for inputs to the model. However, as new landfills are constructed and operated and better information is collected, the present modeling approach can be improved. As better data become available, including longer term data on landfill air emissions, better modeling approaches are expected to evolve. For example, several firms in the landfill gas industry have models for estimating landfill emissions that are regarded as proprietary. If this information is released to the public, the EPA can use it to improve the present emission estimation approach. In addition, as data become available through the

implementation of the NSPS/EG, the new data can be used to improve the modeling calculations.

Landfill Emissions

The Landfill Gas Emissions Model estimates the emissions resulting from the biodegradation of waste in landfills. The anaerobic decomposition of waste in MSW landfills causes emissions of landfill gas. As landfill gas passes through the waste, it sweeps NMOCs and other air pollutants present in the waste to the surface. The composition of MSW landfill emissions is estimated by the model to be about 50 percent methane (CH_4) and 50 percent carbon dioxide (CO_2), with additional, trace constituents of NMOCs, although, these default percentages can easily be changed. The concentration of total and speciated NMOCs can be estimated by the model using either default or site-specific concentrations. The pollutant regulated under the NSPS/EG is MSW landfill emissions, but the surrogate for measuring MSW landfill emissions for the applicability of and compliance with the regulations is NMOCs.

The EPA has determined that emissions from MSW landfills cause, or contribute significantly to, air pollution that may reasonably be anticipated to endanger public health or welfare. Some NMOCs are known or suspected carcinogens, or cause other noncancer health effects. Public welfare concerns include the odor nuisance from the landfill gas and the potential for CH_4 migration, both on-site and off-site, which may lead to explosions or fires. The CH_4 emitted from landfills is also a concern because it is a greenhouse gas and contributes to global climate change. It has been estimated that the United States contributed 8 to 16 Tg/yr of CH_4 to the atmosphere in 1990, about 40 percent of the worldwide amount emitted from landfills and open dumps (Thorneloe and Pacey, 1994; Thorneloe et al., 1994). The environmental and welfare concerns associated with MSW landfill air emissions are documented in the preamble to the proposed NSPS/EG (EPA, 1991c).

This computer model uses a first-order decomposition rate equation and estimates annual emissions over any time period specified by the user. Total landfill gas emissions are estimated by estimating CH_4 generation and doubling it (the landfill gas is assumed to be half CH_4 and half CO_2). Methane generation is estimated using L_o , the potential CH_4 generation capacity of the waste, and k , the CH_4 generation rate constant, which accounts for how quickly the CH_4 generation rate decreases once it reaches its peak rate. The CH_4 generation rate is assumed to be at its peak upon closure of the landfill or final placement of waste at the site. The model allows the user to enter L_o and k values derived using site-specific test data collected at the landfill (site-specific data may be collected using the test

methods specified in the NSPS/EG for MSW landfills), or to use the CAA or inventory default values.

The model estimates emission rates for total landfill gas, CH₄, CO₂, NMOCs, and a list of air pollutants expected to be emitted from landfills based on test data from AP-42 (EPA, 1998).

Methane and Carbon Dioxide

The NSPS/EG require only NMOC emission estimates, but the model provides estimates of all landfill gas constituents. Landfill gas is assumed to be half CH₄ and half CO₂. The model assumes that CO₂ emissions are the same as CH₄ emissions and that landfill gas emissions are twice the CH₄ emissions. The generation of CH₄ from a landfill is a function of k , the CH₄ generation rate constant, and L_o , the CH₄ generation potential.

The CH₄ generation rate constant, k , determines the rate of CH₄ generation for each submass of waste in the landfill. The higher the value of k , the faster the CH₄ generation rate increases and then decays over time. The value of k is a function of (1) waste moisture content, (2) availability of the nutrients for methanogens, (3) pH, and (4) temperature. The k values obtained from the data collected for the NSPS/EG range from 0.003 to 0.21 (EPA, 1991a). These values were obtained from theoretical models using field test data and from actual field test measurements. If no user-specified k value is entered into LandGEM, a default value is used. The default k value used by the model is 0.05 year⁻¹ for the CAA conventional landfills option (EPA, 1991a).

The value for the potential CH₄ generation capacity of waste (L_o) depends only on the type of waste in the landfill. The higher the cellulose content of the waste, the higher the value of L_o . The values of theoretical and obtainable L_o range from 6.2 to 270 m³/Mg of waste (EPA, 1991c). If no user-specified L_o value is entered into LandGEM, a default value is used for L_o . The default L_o value used in the model is 170 m³/Mg of waste for the CAA conventional landfills option (EPA, 1991a).

Air Pollutants

Landfill gas contains low concentrations of air pollutants from the leaching and decomposition of waste. The Landfill Gas Emissions Model can estimate emissions of such air pollutants if users choose to do so. Emissions of air pollutants are based on concentrations of air pollutants in the landfill gas. The model contains default concentrations for specific air pollutant compounds. The list of air pollutants expected to be emitted with

landfill gas and the concentrations of these air pollutants were taken from test data in AP-42 (EPA, 1998). The default air pollutants included in the model are designated as a hazardous air pollutant (HAP) or a volatile organic compound (VOC) with the HAP or VOC abbreviation after their chemical names. These designations are based on EPA HAP and VOC definitions that are current as of April 2004.

Because some air pollutant concentrations in the landfill gas are slightly higher for landfills that have been used for disposal of hazardous waste than for those that have not, there is a choice in the model between “Co-disposal,” (i.e., landfills used for disposal of hazardous and non-hazardous waste), and “No or Unknown Co-disposal,” (i.e., landfills that have not been used for disposal of hazardous waste or unknown disposal of hazardous waste). For example, concentrations in the model for benzene and toluene are different for landfills with hazardous waste “Co-disposal” than for landfills with “No or Unknown Codisposal.”

Landfill sites that have hazardous waste co-disposal or Superfund sites should use the co-disposal option for estimating air pollutant emissions. In general, it is recommended that landfill owners and operators obtain actual test data for air pollutant concentrations in the landfill gas for their specific landfill.

Nonmethane Organic Compounds

The NMOC concentration in the landfill gas is a function of the types of waste in the landfill and the extent of the reactions that produce various compounds from the anaerobic decomposition of waste. To determine NMOC concentrations, NMOC data were collected from emission test reports from industry, state, and local regulatory agencies (Pelt, 1993). The NMOC concentrations from 23 landfills ranged from 240 to 14,300 ppmv. Three suggested default NMOC concentrations are used in the model: one for the CAA default option and two for the inventory default option (one for co-disposal and one for no or unknown co-disposal). For the CAA default option, the NMOC concentration as hexane is 4,000 ppmv. For the inventory default option, the NMOC concentration as hexane for co-disposal is 2,400 ppmv and is 600 ppmv for no or unknown co-disposal. The analysis of NMOC concentrations in landfill gas is documented in a memorandum (Pelt, 1993), which can be found in Public Docket No. A-88-09 and in AP-42 (EPA, 1998). Because the NMOC concentration in landfill gas varies from landfill to landfill, collection of site-specific data using EPA Method 25C will provide the most accurate estimates (EPA, 1991c).

GLOSSARY OF TERMS

Term	Definition
Co-disposal	Disposal of hazardous waste as well as other kinds of waste in a landfill.
Waste Design Capacity	The total amount of waste that can be disposed of in the landfill.
Landfill Gas	Landfill gas is a product of biodegradation of waste in landfills and consists of primarily CH ₄ and CO ₂ , with trace amounts of NMOCs and air pollutants.
Methane Generation Rate (k)	k is a constant that determines the rate of landfill gas generation. The first-order decomposition rate assumes that k values before and after peak landfill gas generation are the same. k is a function of moisture content in the landfill waste, availability of nutrients for methanogens, pH, and temperature.
Nonmethane Organic Compounds (NMOCs)	NMOCs are specified in this program as the fraction of landfill gas containing nonmethane organic compounds, expressed as hexane. NMOCs include air pollutants and VOCs. NMOC concentration can be measured using guidance provided by EPA Method 25C.
Potential Methane Generation Capacity (L_o)	L_o is a constant that represents the potential capacity of a landfill to generate CH ₄ (a primary constituent of landfill gas). L_o depends on the amount of cellulose in the waste.
Air Pollutants	Compounds found in landfill gas or emitted with landfill gas, some of which are listed as air pollutants under section 112 of the Clean Air Act (CAA). A total of 46 air pollutants emitted from landfills are included in the model.
Landfill Closure Year	The year in which the landfill ceases, or is expected to cease, accepting waste.

TECHNICAL REPORT DATA		
(Please read Instructions on the reverse before completing)		
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15. SUPPLEMENTARY NOTES The EPA Project Officer is Susan A. Thorneloe, mail drop E305-02, phone (919) 541-2709, e-mail Thorneloe.Susan@epamail.epa.gov		
16. ABSTRACT The Landfill Gas Emissions Model (LandGEM) is an automated estimation tool with a Microsoft Excel interface that can be used to estimate emission rates for total landfill gas, methane, carbon dioxide, nonmethane organic compounds, and individual air pollutants from municipal solid waste landfills. This guide provides step-by-step guidance for using this software application, as well as an appendix containing background information on the technical basis of LandGEM. LandGEM can use either site-specific data to estimate emissions or default parameters if no site-specific data are available. The model contains two sets of default parameters, CAA defaults and inventory defaults. The CAA defaults are based on federal regulations for MSW landfills laid out by the Clean Air Act (CAA) and can be used for determining whether a landfill is subject to the control requirements of these regulations. The inventory defaults are based on emission factors in EPA's <i>Compilation of Air Pollutant Emission Factors (AP-42)</i> and can be used to generate emission estimates for use in emission inventories and air permits in the absence of site-specific test data.		
17. KEY WORDS AND DOCUMENT ANALYSIS		
a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Landfills Mathematical Models Computer Simulation Methane Carbon Dioxide Emission	Pollution Control Stationary Sources	13B 13C 12A 14B 07C 07B 14G
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ATTACHMENT 9
VERTICAL WELL CONSTRUCTION SCHEDULE

**Lorain County Landfill I and II
Landfill Gas Collection System
Vertical Well Schedule**

Well ID		STATUS	COORDINATES		ELEVATIONS		DEPTHS			
			North	East	Existing	Base	Refuse	Bore	Solid	Perf.
EW-1	Lorain I	EXISTING	595,507	2,054,791	815.9	761.9	54.0	39.0	19.0	21.5
EW-2	Lorain I	EXISTING	595,507	2,054,616	818.6	766.6	52.0	37.0	19.0	19.0
EW-3	Lorain I	EXISTING	595,506	2,054,428	821.1	757.1	64.0	49.0	19.0	28.5
EW-4	Lorain I	EXISTING	595,421	2,054,132	823.7	768.7	55.0	40.0	20.5	30.5
EW-5	Lorain I	EXISTING	595,686	2,054,359	818.4	767.4	51.0	36.0	19.0	18.5
EW-6	Lorain I	EXISTING	595,833	2,054,383	817.0	767.0	50.0	35.0	19.0	18.0
EW-7	Lorain I	EXISTING	595,863	2,054,058	823.2	766.2	57.0	42.0	19.0	25.0
EW-8	Lorain I	EXISTING	595,904	2,053,734	828.3	770.3	58.0	43.0	19.0	25.0
EW-9	Lorain I	EXISTING	596,029	2,054,382	818.9	769.9	49.0	34.0	19.0	16.5
EW-10	Lorain I	EXISTING	596,188	2,054,063	823.8	766.3	57.5	42.5	19.0	25.0
EW-11	Lorain I	EXISTING	596,188	2,054,397	819.4	764.9	54.5	39.5	19.0	23.5
EW-12R	Lorain I	EXISTING	596,337	2,054,416	817.3	761.3	56.0	41.0	19.0	23.5
EW-13	Lorain I	EXISTING	596,497	2,054,437	819.9	762.9	57.0	42.0	19.0	25.0
EW-14	Lorain I	EXISTING	596,669	2,054,448	816.8	763.3	53.5	38.5	19.0	21.5
EW-15	Lorain I	EXISTING	596,753	2,054,301	815.8	757.3	58.5	43.5	19.0	13.0
EW-16	Lorain I	EXISTING	596,759	2,054,127	816.3	764.3	52.0	37.0	19.0	19.5
EW-17	Lorain I	EXISTING	596,483	2,054,142	820.7	759.7	61.0	46.0	19.0	28.5
EW-18	Lorain I	EXISTING	596,770	2,053,936	819.1	768.1	51.0	36.0	19.0	18.5
EW-19	Lorain I	EXISTING	596,758	2,053,757	820.9	762.4	58.5	43.5	19.0	16.5
EW-20	Lorain I	EXISTING	596,499	2,053,826	823.7	775.7	48.0	33.0	19.0	19.0
EW-21	Lorain I	EXISTING	596,642	2,053,626	821.6	761.6	60.0	45.0	19.0	28.0
EW-22	Lorain I	EXISTING	596,511	2,053,509	822.7	765.7	57.0	42.0	19.0	24.5
EW-23	Lorain I	EXISTING	596,378	2,053,384	821.9	767.9	54.0	39.0	19.0	22.0
EW-24	Lorain I	EXISTING	596,215	2,053,678	827.7	771.2	56.5	41.5	19.0	24.5
EW-25	Lorain I	EXISTING	596,238	2,053,284	822.1	767.6	54.5	39.5	19.0	22.5
EW-26	Lorain I	EXISTING	596,093	2,053,160	822.3	772.8	49.5	34.5	19.0	17.5
EW-27	Lorain I	EXISTING	595,936	2,053,390	827.4	765.4	62.0	47.0	19.0	29.5
EW-28	Lorain I	EXISTING	595,960	2,053,060	823.1	772.6	50.5	35.5	19.0	18.5
EW-29	Lorain I	EXISTING	595,800	2,052,935	822.1	773.1	49.0	34.0	19.0	16.5
EW-30	Lorain I	EXISTING	595,634	2,053,178	826.6	766.1	60.5	45.5	19.0	28.5
EW-31	Lorain I	EXISTING	595,663	2,052,847	822.8	766.8	56.0	41.0	19.0	23.0
EW-32	Lorain I	EXISTING	595,511	2,052,723	822.4	771.4	51.0	36.0	19.0	17.5
EW-33	Lorain I	EXISTING	595,427	2,052,915	823.9	778.4	45.5	30.5	19.0	14.5
EW-34	Lorain I	EXISTING	595,385	2,052,624	820.6	765.6	55.0	40.0	19.0	22.5

**Lorain County Landfill I and II
Landfill Gas Collection System
Vertical Well Schedule**

Well ID		STATUS	COORDINATES		ELEVATIONS		DEPTHS			
			North	East	Existing	Base	Refuse	Bore	Solid	Perf.
EW-35	Lorain I	EXISTING	595,246	2,052,570	816.0	760.0	56.0	41.0	19.0	22.0
EW-36	Lorain I	EXISTING	595,225	2,052,706	820.8	766.3	54.5	39.5	19.0	20.0
EW-37	Lorain I	EXISTING	595,220	2,052,887	821.6	768.6	53.0	38.0	19.0	20.0
EW-38	Lorain I	EXISTING	595,212	2,053,063	821.7	763.2	58.5	43.5	19.0	25.0
EW-39	Lorain I	EXISTING	595,037	2,053,271	819.9	757.9	62.0	47.0	19.0	29.0
EW-40	Lorain I	EXISTING	595,204	2,053,247	822.9	767.9	55.0	40.0	19.0	19.0
EW-41	Lorain I	EXISTING	595,006	2,053,436	821.4	768.9	52.5	37.5	20.5	20.5
EW-42	Lorain I	EXISTING	595,312	2,053,502	828.1	758.6	69.5	54.5	22.5	34.0
EW-43	Lorain I	EXISTING	595,609	2,053,546	827.9	763.9	64.0	49.0	20.5	30.5
EW-44	Lorain I	EXISTING	595,017	2,053,626	821.9	769.4	52.5	37.5	20.5	19.5
EW-45	Lorain I	EXISTING	595,018	2,053,810	822.7	771.7	51.0	36.0	20.5	17.5
EW-46	Lorain I	EXISTING	595,298	2,053,808	830.7	775.7	55.0	40.0	20.5	22.0
EW-47	Lorain I	EXISTING	595,587	2,053,899	832.2	775.2	57.0	42.0	19.0	23.0
EW-48	Lorain I	EXISTING	594,963	2,053,983	821.5	765.5	56.0	41.0	20.5	23.0
EW-49	Lorain I	EXISTING	595,143	2,054,194	824.6	764.6	60.0	45.0	20.5	27.5
EW-50	Lorain I	EXISTING	594,819	2,053,973	820.5	773.5	47.0	32.0	20.5	13.0
EW-51	Lorain I	EXISTING	594,658	2,053,975	824.2	767.2	57.0	42.0	18.5	25.0
EW-52	Lorain I	EXISTING	594,500	2,053,986	821.7	764.7	57.0	42.0	20.5	24.0
EW-53	Lorain I	EXISTING	594,329	2,053,978	823.1	780.1	43.0	28.0	20.5	9.0
EW-54	Lorain I	EXISTING	594,165	2,053,975	823.1	760.1	63.0	48.0	20.5	30.5
EW-55	Lorain I	EXISTING	594,006	2,053,981	819.8	772.8	47.0	32.0	20.5	15.0
EW-56	Lorain I	EXISTING	593,854	2,053,996	816.6	771.6	45.0	30.0	20.5	12.5
EW-57	Lorain I	EXISTING	593,867	2,054,181	812.7	765.2	47.5	32.5	14.8	20.7
EW-58	Lorain I	EXISTING	593,932	2,054,347	815.5	760.5	55.0	40.0	17.3	25.7
EW-59	Lorain I	EXISTING	594,246	2,054,340	818.7	764.7	54.0	39.0	17.0	25.0
EW-60	Lorain I	EXISTING	593,966	2,054,403	821.5	771.0	50.5	35.5	15.8	22.6
EW-61R	Lorain I	EXISTING	594,053	2,054,697	817.8	760.3	57.5	42.5	18.2	27.3
EW-62	Lorain I	EXISTING	594,192	2,054,723	817.6	747.1	70.5	55.5	22.5	36.0
EW-63	Lorain I	EXISTING	594,417	2,054,709	816.5	749.5	67.0	52.0	21.3	33.7
EW-64R	Lorain I	EXISTING	594,606	2,054,710	824.9	763.4	61.5	46.5	19.5	30.0
EW-65	Lorain I	EXISTING	594,578	2,054,371	824.9	757.9	67.0	52.0	21.4	44.7
EW-66R	Lorain I	EXISTING	594,790	2,054,719	816.2	753.2	63.0	48.0	20.0	31.0
EW-67	Lorain I	EXISTING	594,977	2,054,744	814.5	758.5	56.0	41.0	17.7	26.3
EW-68	Lorain I	EXISTING	594,886	2,054,373	822.0	765.5	56.5	41.5	17.8	26.7

**Lorain County Landfill I and II
Landfill Gas Collection System
Vertical Well Schedule**

Well ID		STATUS	COORDINATES		ELEVATIONS		DEPTHS			
			North	East	Existing	Base	Refuse	Bore	Solid	Perf.
EW-69	Lorain I	EXISTING	595,151	2,054,770	811.5	755.5	56.0	41.0	17.7	26.3
EW-70	Lorain I	EXISTING	595,252	2,054,502	812.3	751.3	61.0	46.0	19.3	29.7
EW-71	Lorain I	EXISTING	595,326	2,054,776	817.0	758.5	58.5	43.5	18.5	28.0
EW-1	Lorain II	EXISTING	595,881	2,056,972	825.0	760.0	65.0	50.0	20.0	30.0
EW-1A	Lorain II	EXISTING	596,053	2,056,994	836.0	760.0	76.0	56.0	20.0	36.0
EW-2	Lorain II	EXISTING	595,891	2,057,171	825.0	760.0	65.0	50.0	20.0	30.0
EW-2A	Lorain II	EXISTING	596,069	2,057,211	841.0	760.0	81.0	61.0	20.0	41.0
EW-2B	Lorain II	EXISTING	596,289	2,057,210	881.0	758.0	123.0	100.0	20.0	80.0
EW-3	Lorain II	EXISTING	595,899	2,057,361	825.0	761.0	64.0	49.0	20.0	29.0
EW-3A	Lorain II	EXISTING	596,073	2,057,421	840.0	760.0	80.0	60.0	20.0	40.0
EW-5R	Lorain II	EXISTING	596,554	2,057,424	894.0	756.0	138.0	100.0	20.0	80.0
EW-6	Lorain II	EXISTING	595,916	2,057,570	825.0	761.0	64.0	49.0	20.0	29.0
EW-7	Lorain II	EXISTING	595,933	2,057,766	825.0	761.0	64.0	49.0	20.0	29.0
EW-9R	Lorain II	EXISTING	596,609	2,057,747	903.0	755.0	148.0	133.0	20.0	113.0
EW-10	Lorain II	EXISTING	595,929	2,057,963	825.0	762.0	63.0	48.0	20.0	28.0
EW-11	Lorain II	EXISTING	595,897	2,058,160	825.0	763.0	62.0	47.0	20.0	27.0
EW-13R	Lorain II	EXISTING	596,572	2,058,109	900.0	756.0	144.0	129.0	20.0	109.0
EW-14	Lorain II	EXISTING	595,877	2,058,354	825.0	763.0	62.0	47.0	20.0	27.0
EW-15	Lorain II	EXISTING	595,858	2,058,559	825.0	763.0	62.0	47.0	20.0	27.0
EW-17R	Lorain II	EXISTING	596,625	2,058,508	894.0	755.0	139.0	124.0	20.0	104.0
EW-18	Lorain II	EXISTING	595,851	2,058,749	825.0	763.0	62.0	47.0	20.0	27.0
EW-19	Lorain II	EXISTING	595,883	2,058,955	822.0	762.0	60.0	45.0	20.0	25.0
EW-22	Lorain II	EXISTING	595,926	2,059,143	822.0	761.0	61.0	46.0	20.0	26.0
EW-23	Lorain II	EXISTING	595,955	2,059,350	820.0	760.0	60.0	45.0	20.0	25.0
EW-26	Lorain II	EXISTING	595,966	2,059,542	822.0	759.0	63.0	48.0	20.0	28.0
EW-27	Lorain II	EXISTING	595,968	2,059,732	821.0	759.0	62.0	47.0	20.0	27.0
EW-29	Lorain II	EXISTING	596,084	2,059,894	820.0	757.0	63.0	48.0	20.0	28.0
EW-30	Lorain II	EXISTING	596,290	2,059,890	821.0	755.0	66.0	51.0	20.0	31.0
EW-31	Lorain II	EXISTING	596,488	2,059,878	825.0	753.0	72.0	57.0	20.0	37.0
EW-32R	Lorain II	EXISTING	596,626	2,059,772	843.0	752.0	91.0	76.0	20.0	56.0
EW-34R	Lorain II	PROP.	596,988	2,059,520	890.0	761.0	129.0	114.0	20.0	94.0
EW-35R	Lorain II	EXISTING	596,851	2,059,740	860.0	765.0	95.0	80.0	20.0	60.0
EW-36R	Lorain II	EXISTING	597,135	2,059,831	832.0	764.0	68.0	53.0	20.0	33.0
EW-37R	Lorain II	EXISTING	597,337	2,059,844	827.0	762.0	65.0	50.0	20.0	30.0

**Lorain County Landfill I and II
Landfill Gas Collection System
Vertical Well Schedule**

Well ID		STATUS	COORDINATES		ELEVATIONS		DEPTHS			
			North	East	Existing	Base	Refuse	Bore	Solid	Perf.
EW-38R	Lorain II	EXISTING	597,462	2,059,813	837.0	760.0	77.0	62.0	20.0	42.0
EW-39R	Lorain II	EXISTING	597,507	2,059,673	875.0	757.0	118.0	103.0	20.0	83.0
EW-40R	Lorain II	PROP.	597,326	2,059,529	890.0	758.0	132.0	117.0	20.0	97.0
EW-43R	Lorain II	PROP.	597,289	2,059,151	883.0	764.0	119.0	104.0	20.0	84.0
EW-47R	Lorain II	PROP.	597,311	2,058,889	923.0	759.0	164.0	140.0	20.0	120.0
EW-48R	Lorain II	PROP.	596,972	2,058,807	908.0	761.0	147.0	132.0	20.0	112.0
EW-51R	Lorain II	EXISTING	597,486	2,058,408	937.0	763.0	174.0	140.0	20.0	120.0
EW-52R	Lorain II	EXISTING	597,162	2,058,543	930.0	763.0	167.0	140.0	20.0	120.0
EW-53R	Lorain II	PROP.	596,792	2,058,489	912.0	780.0	132.0	117.0	20.0	97.0
EW-56R	Lorain II	EXISTING	597,506	2,057,983	886.0	762.0	124.0	109.0	20.0	89.0
EW-57R	Lorain II	EXISTING	597,163	2,058,014	928.0	764.0	164.0	140.0	20.0	120.0
EW-58R	Lorain II	PROP.	596,845	2,058,125	915.0	766.0	149.0	134.0	20.0	114.0
EW-62R	Lorain II	EXISTING	597,232	2,057,742	915.0	764.0	151.0	136.0	20.0	116.0
EW-63R	Lorain II	EXISTING	596,950	2,057,993	916.0	767.0	149.0	134.0	20.0	114.0
EW-65R	Lorain II	PROP.	597,938	2,057,276	824.0	770.0	54.0	39.0	15.0	24.0
EW-68	Lorain II	EXISTING	597,939	2,057,134	832.0	765.0	67.0	52.0	20.0	32.0
EW-70	Lorain II	EXISTING	597,933	2,056,975	828.0	764.0	64.0	49.0	20.0	29.0
EW-71	Lorain II	EXISTING	597,938	2,056,756	830.0	764.0	66.0	51.0	20.0	31.0
EW-73	Lorain II	EXISTING	597,938	2,056,552	830.0	753.0	77.0	62.0	20.0	42.0
EW-74R	Lorain II	EXISTING	597,925	2,056,305	830.0	754.0	76.0	61.0	20.0	41.0
EW-76	Lorain II	EXISTING	597,950	2,056,199	818.0	754.0	64.0	49.0	20.0	29.0
EW-77	Lorain II	EXISTING	597,766	2,056,202	820.0	755.0	65.0	50.0	20.0	30.0
EW-78	Lorain II	EXISTING	597,575	2,056,196	822.0	755.0	67.0	52.0	20.0	32.0
EW-79R	Lorain II	EXISTING	597,413	2,056,213	823.0	755.0	68.0	53.0	20.0	33.0
EW-81	Lorain II	EXISTING	597,191	2,056,198	825.0	755.0	70.0	55.0	20.0	35.0
EW-82	Lorain II	EXISTING	597,200	2,056,353	830.0	754.0	76.0	61.0	20.0	41.0
EW-83R	Lorain II	EXISTING	597,273	2,056,632	842.0	751.0	91.0	76.0	20.0	56.0
EW-85	Lorain II	EXISTING	597,056	2,056,757	817.0	749.0	68.0	53.0	20.0	33.0
EW-87R	Lorain II	EXISTING	596,896	2,056,815	826.0	747.0	79.0	64.0	20.0	44.0
EW-90R	Lorain II	EXISTING	596,715	2,056,815	828.0	752.0	76.0	61.0	20.0	41.0
EW-90A	Lorain II	EXISTING	596,673	2,057,006	871.0	754.0	117.0	97.0	20.0	77.0
EW-90B	Lorain II	EXISTING	596,770	2,057,203	888.0	782.0	106.0	86.0	20.0	66.0
EW-90C	Lorain II	EXISTING	596,694	2,057,350	896.0	754.0	142.0	100.0	20.0	80.0
EW-91	Lorain II	EXISTING	596,464	2,056,807	822.0	754.0	68.0	53.0	20.0	33.0

**Lorain County Landfill I and II
Landfill Gas Collection System
Vertical Well Schedule**

Well ID		STATUS	COORDINATES		ELEVATIONS		DEPTHS			
			North	East	Existing	Base	Refuse	Bore	Solid	Perf.
EW-91A	Lorain II	EXISTING	596,358	2,056,949	860.0	756.0	104.0	84.0	20.0	64.0
EW-93	Lorain II	EXISTING	596,264	2,056,789	827.0	756.0	71.0	56.0	20.0	36.0
EW-94	Lorain II	EXISTING	596,060	2,056,786	827.0	758.0	69.0	54.0	20.0	34.0
EW-96	Lorain II	EXISTING	595,869	2,056,775	824.0	760.0	64.0	49.0	20.0	29.0
EW-100	Lorain II	EXISTING	596,241	2,057,031	876.0	758.0	118.0	98.0	20.0	78.0
EW-101R	Lorain II	EXISTING	596,352	2,057,421	879.0	757.0	123.0	93.0	20.0	73.0
EW-102	Lorain II	EXISTING	596,133	2,057,653	855.0	759.0	96.0	81.0	20.0	61.0
EW-103	Lorain II	EXISTING	596,129	2,057,917	852.0	760.0	92.0	77.0	20.0	57.0
EW-104	Lorain II	EXISTING	596,083	2,058,188	840.0	761.0	79.0	64.0	20.0	44.0
EW-105	Lorain II	EXISTING	596,087	2,058,430	845.0	761.0	84.0	69.0	20.0	49.0
EW-106	Lorain II	EXISTING	596,084	2,058,688	840.0	760.0	80.0	65.0	20.0	45.0
EW-107	Lorain II	EXISTING	596,086	2,058,927	835.0	760.0	75.0	60.0	20.0	40.0
EW-108	Lorain II	PROP.	596,124	2,059,164	842.0	759.0	83.0	68.0	20.0	48.0
EW-109	Lorain II	PROP.	596,164	2,059,401	855.0	758.0	97.0	82.0	20.0	62.0
EW-110	Lorain II	PROP.	596,166	2,059,667	855.0	757.0	98.0	83.0	20.0	63.0
EW-111	Lorain II	PROP.	596,418	2,059,676	872.0	755.0	117.0	102.0	20.0	82.0
EW-112	Lorain II	PROP.	596,418	2,059,443	892.0	755.0	137.0	122.0	20.0	102.0
EW-113	Lorain II	PROP.	596,369	2,059,166	890.0	756.0	134.0	119.0	20.0	99.0
EW-114	Lorain II	EXISTING	596,345	2,058,918	887.0	757.0	130.0	115.0	20.0	95.0
EW-115	Lorain II	EXISTING	596,345	2,058,667	887.0	758.0	129.0	114.0	20.0	94.0
EW-116	Lorain II	EXISTING	596,338	2,058,419	887.0	758.0	129.0	114.0	20.0	94.0
EW-117	Lorain II	EXISTING	596,348	2,058,179	890.0	758.0	132.0	117.0	20.0	97.0
EW-118	Lorain II	EXISTING	596,364	2,057,918	890.0	758.0	132.0	117.0	20.0	97.0
EW-119	Lorain II	EXISTING	596,371	2,057,650	890.0	757.0	133.0	118.0	20.0	98.0
EW-120	Lorain II	EXISTING	596,529	2,057,023	863.6	753.8	109.8	76.0	20.0	56.0
EW-120R	Lorain II	EXISTING	596,589	2,057,044	883.0	753.0	130.0	115.0	20.0	95.0
EW-121	Lorain II	EXISTING	596,829	2,057,027	881.8	752.0	129.8	95.0	20.0	74.0
EW-121A	Lorain II	EXISTING	596,972	2,057,173	888.0	754.0	134.0	100.0	20.0	80.0
EW-122	Lorain II	EXISTING	596,911	2,057,375	898.0	754.0	144.0	100.0	20.0	80.0
EW-122A	Lorain II	EXISTING	596,532	2,057,219	890.0	756.0	134.0	100.0	20.0	80.0
EW-123R	Lorain II	PROP.	596,670	2,057,564	907.0	754.0	153.0	138.0	20.0	118.0
EW-124	Lorain II	PROP.	596,672	2,059,562	887.0	752.0	135.0	120.0	20.0	100.0
EW-125	Lorain II	PROP.	596,578	2,059,341	900.0	754.0	146.0	131.0	20.0	111.0
EW-126	Lorain II	PROP.	596,573	2,059,084	900.0	755.0	145.0	130.0	20.0	110.0

**Lorain County Landfill I and II
Landfill Gas Collection System
Vertical Well Schedule**

Well ID		STATUS	COORDINATES		ELEVATIONS		DEPTHS			
			North	East	Existing	Base	Refuse	Bore	Solid	Perf.
EW-127	Lorain II	PROP.	596,945	2,057,930	919.0	768.0	151.0	136.0	20.0	116.0
EW-127R	Lorain II	EXISTING	596,639	2,058,819	893.0	755.0	138.0	123.0	20.0	103.0
EW-128R	Lorain II	EXISTING	596,747	2,057,949	899.0	780.0	119.0	104.0	20.0	84.0
EW-129	Lorain II	PROP.	597,031	2,057,725	920.0	760.0	160.0	140.0	20.0	120.0
EW-130R	Lorain II	PROP.	596,894	2,057,557	912.0	756.0	156.0	140.0	20.0	120.0
EW-131	Lorain II	PROP.	597,161	2,057,906	922.0	766.0	156.0	140.0	20.0	120.0
EW-132	Lorain II	PROP.	597,070	2,058,134	925.0	764.0	161.0	140.0	20.0	120.0
EW-133	Lorain II	PROP.	596,967	2,059,062	914.0	765.0	149.0	134.0	20.0	114.0
EW-134	Lorain II	PROP.	597,149	2,059,220	905.0	765.0	140.0	125.0	20.0	105.0
EW-135	Lorain II	PROP.	597,154	2,058,980	917.0	762.0	155.0	140.0	20.0	120.0
EW-136	Lorain II	PROP.	597,145	2,058,754	927.0	760.0	167.0	140.0	20.0	120.0
EW-137	Lorain II	PROP.	597,176	2,058,328	930.0	766.0	164.0	140.0	20.0	120.0
EW-138	Lorain II	PROP.	597,298	2,059,357	900.0	761.0	139.0	124.0	20.0	104.0
EW-139	Lorain II	PROP.	597,027	2,057,578	912.0	759.0	153.0	138.0	20.0	118.0
EW-140R	Lorain II	EXISTING	597,062	2,057,352	890.0	756.6	132.2	98.0	20.0	77.0
EW-141	Lorain II	EXISTING	597,129	2,057,031	876.9	751.0	125.9	80.0	20.0	60.0
EW-141A	Lorain II	EXISTING	597,268	2,057,211	890.0	760.0	130.0	100.0	20.0	80.0
EW-142	Lorain II	EXISTING	597,506	2,056,458	885.0	753.0	132.0	117.0	20.0	97.0
EW-143	Lorain II	EXISTING	597,421	2,056,663	882.0	751.0	131.0	116.0	20.0	96.0
EW-144	Lorain II	EXISTING	597,404	2,056,956	882.7	755.2	127.5	104.0	20.0	84.0
EW-145	Lorain II	EXISTING	597,415	2,057,306	889.0	761.3	127.7	100.0	20.0	79.0
EW-145R	Lorain II	EXISTING	597,423	2,057,366	900.0	761.0	139.0	124.0	20.0	104.0
EW-146	Lorain II	EXISTING	597,479	2,057,563	888.0	765.5	122.5	93.0	20.0	72.0
EW-146R	Lorain II	PROP.	597,471	2,057,571	900.0	766.0	134.0	119.0	20.0	99.0
EW-147	Lorain II	EXISTING	597,282	2,057,463	887.0	760.0	127.0	112.0	20.0	92.0
EW-148	Lorain II	PROP.	597,495	2,058,025	920.0	761.0	159.0	140.0	20.0	120.0
EW-149	Lorain II	PROP.	597,411	2,058,229	930.0	762.0	168.0	140.0	20.0	120.0
EW-150	Lorain II	PROP.	597,351	2,058,414	937.0	765.0	172.0	140.0	20.0	120.0
EW-151	Lorain II	PROP.	597,545	2,057,810	910.0	769.0	141.0	126.0	20.0	106.0
EW-160	Lorain II	PROP.	597,070	2,059,657	880.0	761.0	119.0	104.0	20.0	84.0
EW-162	Lorain II	EXISTING	597,739	2,057,713	855.4	771.5	83.9	64.0	20.0	43.0
EW-163	Lorain II	EXISTING	597,797	2,057,400	857.2	767.7	89.5	68.0	20.0	47.0
EW-164R	Lorain II	EXISTING	597,692	2,057,097	877.0	760.0	117.0	102.0	20.0	82.0
EW-165	Lorain II	EXISTING	597,718	2,056,844	885.0	760.0	125.0	110.0	20.0	90.0

**Lorain County Landfill I and II
Landfill Gas Collection System
Vertical Well Schedule**

Well ID		STATUS	COORDINATES		ELEVATIONS		DEPTHS			
			North	East	Existing	Base	Refuse	Bore	Solid	Perf.
EW-166	Lorain II	EXISTING	597,709	2,056,546	885.0	752.0	133.0	118.0	20.0	98.0
EW-167R	Lorain II	PROP.	597,604	2,057,440	891.0	765.0	126.0	111.0	20.0	91.0
EW-168	Lorain II	PROP.	597,652	2,057,638	900.0	769.0	131.0	116.0	20.0	96.0
EW-169	Lorain II	PROP.	597,740	2,057,861	906.0	761.0	145.0	130.0	20.0	110.0
EW-170	Lorain II	PROP.	597,678	2,058,086	917.0	758.0	159.0	140.0	20.0	120.0
EW-171	Lorain II	PROP.	597,604	2,058,274	827.0	761.0	66.0	51.0	20.0	31.0
EW-172	Lorain II	PROP.	597,847	2,057,659	895.0	773.0	122.0	107.0	20.0	87.0
EW-173	Lorain II	PROP.	597,977	2,057,517	885.0	773.0	112.0	97.0	20.0	77.0
EW-174	Lorain II	PROP.	598,014	2,057,773	895.0	790.0	105.0	90.0	20.0	70.0
EW-175	Lorain II	PROP.	597,903	2,057,982	907.0	765.0	142.0	127.0	20.0	107.0
EW-176	Lorain II	PROP.	597,836	2,058,198	917.0	757.0	160.0	140.0	20.0	120.0
EW-177	Lorain II	PROP.	597,799	2,058,371	927.0	760.0	167.0	140.0	20.0	120.0
EW-179	Lorain II	PROP.	598,130	2,057,365	836.0	790.0	46.0	31.0	15.0	16.0
EW-180	Lorain II	PROP.	598,156	2,057,598	885.0	770.0	115.0	100.0	20.0	80.0
EW-181	Lorain II	PROP.	598,312	2,057,468	830.0	767.0	63.0	48.0	20.0	28.0
EW-182	Lorain II	PROP.	598,489	2,057,569	830.0	764.0	66.0	51.0	20.0	31.0
EW-183	Lorain II	PROP.	598,665	2,057,675	830.0	761.0	69.0	54.0	20.0	34.0
EW-184	Lorain II	PROP.	598,320	2,057,701	885.0	764.0	121.0	106.0	20.0	86.0
EW-185	Lorain II	PROP.	598,201	2,057,874	895.0	782.0	113.0	98.0	20.0	78.0
EW-186	Lorain II	PROP.	598,482	2,057,794	885.0	760.0	125.0	110.0	20.0	90.0
EW-187	Lorain II	PROP.	598,842	2,057,767	827.0	757.0	70.0	55.0	20.0	35.0
EW-188	Lorain II	PROP.	598,830	2,057,978	880.0	753.0	127.0	112.0	20.0	92.0
EW-189	Lorain II	PROP.	598,741	2,058,187	895.0	737.0	158.0	140.0	20.0	120.0
EW-190	Lorain II	PROP.	599,011	2,057,873	830.0	753.0	77.0	62.0	20.0	42.0
EW-191	Lorain II	PROP.	599,132	2,058,052	830.0	750.0	80.0	65.0	20.0	45.0
EW-192	Lorain II	PROP.	598,948	2,058,150	885.0	745.0	140.0	125.0	20.0	105.0
EW-193	Lorain II	PROP.	599,252	2,058,237	830.0	750.0	80.0	65.0	20.0	45.0
EW-194	Lorain II	PROP.	599,029	2,058,247	885.0	732.0	153.0	138.0	20.0	118.0
EW-195	Lorain II	PROP.	598,851	2,058,365	895.0	732.0	163.0	140.0	20.0	120.0
EW-196	Lorain II	PROP.	598,744	2,058,525	905.0	735.0	170.0	140.0	20.0	120.0
EW-197	Lorain II	PROP.	598,639	2,058,721	915.0	740.0	175.0	140.0	20.0	120.0
EW-198	Lorain II	PROP.	599,142	2,058,409	880.0	730.0	150.0	135.0	20.0	115.0
EW-199	Lorain II	PROP.	598,971	2,058,543	895.0	732.0	163.0	140.0	20.0	120.0
EW-200	Lorain II	PROP.	598,827	2,058,678	905.0	745.0	160.0	140.0	20.0	120.0

**Lorain County Landfill I and II
Landfill Gas Collection System
Vertical Well Schedule**

Well ID		STATUS	COORDINATES		ELEVATIONS		DEPTHS			
			North	East	Existing	Base	Refuse	Bore	Solid	Perf.
EW-201	Lorain II	PROP.	599,090	2,058,709	895.0	747.0	148.0	133.0	20.0	113.0
EW-202	Lorain II	PROP.	599,057	2,059,022	905.0	742.0	163.0	140.0	20.0	120.0
EW-204	Lorain II	PROP.	599,256	2,058,592	885.0	737.0	148.0	133.0	20.0	113.0
EW-203	Lorain II	PROP.	599,364	2,058,411	830.0	750.0	80.0	65.0	20.0	45.0
EW-205	Lorain II	PROP.	599,207	2,058,884	895.0	745.0	150.0	135.0	20.0	115.0
EW-206	Lorain II	PROP.	599,475	2,058,585	830.0	750.0	80.0	65.0	20.0	45.0
EW-207	Lorain II	PROP.	599,363	2,058,753	885.0	745.0	140.0	125.0	20.0	105.0
EW-208	Lorain II	PROP.	599,589	2,058,750	827.0	750.0	77.0	62.0	20.0	42.0
EW-209	Lorain II	PROP.	599,679	2,058,940	830.0	750.0	80.0	65.0	20.0	45.0
EW-210	Lorain II	PROP.	599,467	2,058,913	885.0	741.0	144.0	129.0	20.0	109.0
EW-211	Lorain II	PROP.	599,317	2,059,056	895.0	742.0	153.0	138.0	20.0	118.0
EW-212	Lorain II	PROP.	599,523	2,059,092	885.0	739.0	146.0	131.0	20.0	111.0
EW-213	Lorain II	PROP.	599,713	2,059,143	830.0	750.0	80.0	65.0	20.0	45.0
EW-214	Lorain II	PROP.	599,519	2,059,308	885.0	737.0	148.0	133.0	20.0	113.0
EW-215	Lorain II	PROP.	599,714	2,059,351	830.0	750.0	80.0	65.0	20.0	45.0
EW-216	Lorain II	PROP.	599,716	2,059,555	830.0	750.0	80.0	65.0	20.0	45.0
EW-217	Lorain II	PROP.	599,140	2,059,197	905.0	745.0	160.0	140.0	20.0	120.0
EW-218	Lorain II	PROP.	599,323	2,059,280	895.0	740.0	155.0	140.0	20.0	120.0
EW-219	Lorain II	PROP.	599,529	2,059,473	885.0	735.0	150.0	135.0	20.0	115.0
EW-220	Lorain II	PROP.	599,715	2,059,978	830.0	760.0	70.0	55.0	20.0	35.0
EW-221	Lorain II	PROP.	599,721	2,059,766	830.0	755.0	75.0	60.0	20.0	40.0
EW-222	Lorain II	PROP.	599,550	2,059,826	870.0	735.0	135.0	120.0	20.0	100.0
EW-223	Lorain II	PROP.	599,535	2,059,672	880.0	735.0	145.0	130.0	20.0	110.0
EW-224	Lorain II	EXISTING	596,681	2,057,067	875.0	753.0	122.0	107.0	20.0	87.0
EW-225	Lorain II	EXISTING	596,729	2,057,372	889.0	763.0	126.0	111.0	20.0	91.0
EW-226	Lorain II	EXISTING	596,938	2,057,205	883.0	754.0	129.0	114.0	20.0	94.0
EW-227	Lorain II	EXISTING	596,516	2,057,276	885.0	755.0	130.0	115.0	20.0	95.0
EW-228	Lorain II	EXISTING	597,279	2,057,257	886.0	759.0	127.0	112.0	20.0	92.0
EW-229	Lorain II	PROP.	599,384	2,059,800	880.0	737.0	143.0	128.0	20.0	108.0
EW-230	Lorain II	PROP.	599,324	2,059,977	830.0	750.0	80.0	65.0	20.0	45.0
EW-231	Lorain II	PROP.	599,225	2,059,779	885.0	736.0	149.0	134.0	20.0	114.0
EW-232	Lorain II	PROP.	599,132	2,059,974	830.0	750.0	80.0	65.0	20.0	45.0
EW-233	Lorain II	PROP.	599,130	2,059,581	895.0	740.0	155.0	140.0	20.0	120.0
EW-234	Lorain II	PROP.	599,047	2,059,778	885.0	735.0	150.0	135.0	20.0	115.0

**Lorain County Landfill I and II
Landfill Gas Collection System
Vertical Well Schedule**

Well ID		STATUS	COORDINATES		ELEVATIONS		DEPTHS			
			North	East	Existing	Base	Refuse	Bore	Solid	Perf.
EW-235	Lorain II	PROP.	598,941	2,059,967	830.0	750.0	80.0	65.0	20.0	45.0
EW-236	Lorain II	PROP.	598,744	2,059,965	830.0	750.0	80.0	65.0	20.0	45.0
EW-237	Lorain II	PROP.	598,848	2,059,781	882.0	732.0	150.0	135.0	20.0	115.0
EW-238	Lorain II	PROP.	598,928	2,059,587	895.0	735.0	160.0	140.0	20.0	120.0
EW-239	Lorain II	PROP.	598,928	2,059,384	905.0	737.0	168.0	140.0	20.0	120.0
EW-240	Lorain II	PROP.	598,656	2,059,780	880.0	730.0	150.0	135.0	20.0	115.0
EW-241	Lorain II	PROP.	598,719	2,059,599	895.0	732.0	163.0	140.0	20.0	120.0
EW-242	Lorain II	PROP.	598,560	2,059,381	905.0	735.0	170.0	140.0	20.0	120.0
EW-243	Lorain II	PROP.	598,514	2,059,182	915.0	735.0	180.0	140.0	20.0	120.0
EW-244	Lorain II	PROP.	598,756	2,059,400	904.0	735.0	169.0	140.0	20.0	120.0
EW-245	Lorain II	PROP.	598,722	2,059,209	915.0	735.0	180.0	140.0	20.0	120.0
EW-246	Lorain II	PROP.	598,649	2,059,059	920.0	735.0	185.0	140.0	20.0	120.0
EW-247	Lorain II	PROP.	598,263	2,059,759	885.0	730.0	155.0	140.0	20.0	120.0
EW-248	Lorain II	PROP.	598,339	2,059,568	895.0	732.0	163.0	140.0	20.0	120.0
EW-249	Lorain II	PROP.	598,363	2,059,366	905.0	735.0	170.0	140.0	20.0	120.0
EW-250	Lorain II	PROP.	598,084	2,059,757	885.0	730.0	155.0	140.0	20.0	120.0
EW-251	Lorain II	PROP.	598,149	2,059,565	895.0	730.0	165.0	140.0	20.0	120.0
EW-252	Lorain II	PROP.	598,149	2,059,357	905.0	731.0	174.0	140.0	20.0	120.0
EW-253	Lorain II	PROP.	598,308	2,059,166	915.0	735.0	180.0	140.0	20.0	120.0
EW-254	Lorain II	PROP.	598,428	2,059,022	923.0	745.0	178.0	140.0	20.0	120.0
EW-255	Lorain II	PROP.	598,581	2,058,921	922.0	737.0	185.0	140.0	20.0	120.0
EW-256	Lorain II	PROP.	598,434	2,058,770	925.0	745.0	180.0	140.0	20.0	120.0
EW-257	Lorain II	PROP.	598,535	2,058,546	915.0	740.0	175.0	140.0	20.0	120.0
EW-258	Lorain II	PROP.	598,609	2,058,356	905.0	735.0	170.0	140.0	20.0	120.0
EW-259	Lorain II	PROP.	598,575	2,058,098	895.0	755.0	140.0	125.0	20.0	105.0
EW-260	Lorain II	PROP.	598,664	2,057,895	885.0	757.0	128.0	113.0	20.0	93.0
EW-261	Lorain II	PROP.	598,446	2,058,270	907.0	754.0	153.0	138.0	20.0	118.0
EW-262	Lorain II	PROP.	598,348	2,058,460	917.0	742.0	175.0	140.0	20.0	120.0
EW-263	Lorain II	PROP.	598,284	2,058,635	927.0	752.0	175.0	140.0	20.0	120.0
EW-264	Lorain II	PROP.	598,262	2,058,838	930.0	737.0	193.0	140.0	20.0	120.0
EW-265	Lorain II	PROP.	598,090	2,058,506	925.0	775.0	150.0	135.0	20.0	115.0
EW-266	Lorain II	PROP.	598,210	2,058,362	917.0	745.0	172.0	140.0	20.0	120.0
EW-267	Lorain II	PROP.	598,281	2,058,166	907.0	745.0	162.0	140.0	20.0	120.0
EW-268	Lorain II	PROP.	598,379	2,057,988	896.0	757.0	139.0	124.0	20.0	104.0

**Lorain County Landfill I and II
Landfill Gas Collection System
Vertical Well Schedule**

Well ID		STATUS	COORDINATES		ELEVATIONS		DEPTHS			
			North	East	Existing	Base	Refuse	Bore	Solid	Perf.
EW-269	Lorain II	PROP.	598,093	2,058,095	907.0	790.0	117.0	102.0	20.0	82.0
EW-270	Lorain II	PROP.	598,020	2,058,316	920.0	770.0	150.0	135.0	20.0	115.0
EW-271	Lorain II	PROP.	597,906	2,058,562	932.0	790.0	142.0	127.0	20.0	107.0
EW-272	Lorain II	PROP.	598,093	2,058,727	935.0	765.0	170.0	140.0	20.0	120.0
EW-273	Lorain II	PROP.	598,075	2,058,939	925.0	755.0	170.0	140.0	20.0	120.0
EW-274	Lorain II	PROP.	598,075	2,059,145	915.0	745.0	170.0	140.0	20.0	120.0
EW-275	Lorain II	PROP.	597,891	2,058,783	930.0	790.0	140.0	125.0	20.0	105.0
EW-276	Lorain II	PROP.	597,869	2,058,985	920.0	780.0	140.0	125.0	20.0	105.0
EW-277	Lorain II	PROP.	597,842	2,059,185	910.0	780.0	130.0	115.0	20.0	95.0
EW-278	Lorain II	PROP.	597,974	2,059,344	905.0	765.0	140.0	125.0	20.0	105.0
EW-279	Lorain II	PROP.	597,971	2,059,556	895.0	755.0	140.0	125.0	20.0	105.0
EW-280	Lorain II	PROP.	598,262	2,058,979	925.0	735.0	190.0	140.0	20.0	120.0
EW-281	Lorain II	PROP.	598,003	2,059,951	830.0	750.0	80.0	65.0	20.0	45.0
EW-282	Lorain II	PROP.	597,905	2,059,739	885.0	765.0	120.0	105.0	20.0	85.0
EW-283	Lorain II	PROP.	597,823	2,059,443	897.0	770.0	127.0	112.0	20.0	92.0
EW-284	Lorain II	PROP.	597,820	2,059,928	832.0	780.0	52.0	37.0	15.0	22.0
EW-285	Lorain II	PROP.	597,637	2,059,892	830.0	790.0	40.0	25.0	15.0	10.0
EW-286	Lorain II	PROP.	597,720	2,059,707	880.0	785.0	95.0	80.0	20.0	60.0
EW-287	Lorain II	PROP.	597,685	2,059,513	892.0	790.0	102.0	87.0	20.0	67.0
EW-288	Lorain II	PROP.	597,510	2,059,443	895.0	757.0	138.0	123.0	20.0	103.0
EW-289	Lorain II	PROP.	597,688	2,059,317	903.0	780.0	123.0	108.0	20.0	88.0
EW-290	Lorain II	PROP.	597,649	2,059,139	910.0	760.0	150.0	135.0	20.0	115.0
EW-291	Lorain II	PROP.	597,475	2,059,241	905.0	761.0	144.0	129.0	20.0	109.0
EW-292	Lorain II	PROP.	597,479	2,059,019	915.0	759.0	156.0	140.0	20.0	120.0
EW-293	Lorain II	PROP.	597,667	2,058,936	920.0	756.0	164.0	140.0	20.0	120.0
EW-294	Lorain II	PROP.	597,692	2,058,734	930.0	755.0	175.0	140.0	20.0	120.0
EW-295	Lorain II	PROP.	597,514	2,058,627	935.0	758.0	177.0	140.0	20.0	120.0
EW-296	Lorain II	PROP.	597,695	2,058,540	935.0	758.0	177.0	140.0	20.0	120.0
EW-297	Lorain II	PROP.	598,949	2,058,863	905.0	743.0	162.0	140.0	20.0	120.0
EW-298	Lorain II	PROP.	598,744	2,058,893	915.0	740.0	175.0	140.0	20.0	120.0
EW-299	Lorain II	PROP.	598,836	2,059,049	915.0	740.0	175.0	140.0	20.0	120.0
EW-300	Lorain II	PROP.	598,550	2,059,964	830.0	750.0	80.0	65.0	20.0	45.0
EW-301	Lorain II	PROP.	598,462	2,059,765	885.0	732.0	153.0	138.0	20.0	118.0
EW-302	Lorain II	PROP.	598,547	2,059,572	895.0	732.0	163.0	140.0	20.0	120.0

**Lorain County Landfill I and II
Landfill Gas Collection System
Vertical Well Schedule**

Well ID		STATUS	COORDINATES		ELEVATIONS		DEPTHS			
			North	East	Existing	Base	Refuse	Bore	Solid	Perf.
EW-303	Lorain II	PROP.	598,366	2,059,957	830.0	750.0	80.0	65.0	20.0	45.0
EW-304	Lorain II	PROP.	598,181	2,059,956	830.0	750.0	80.0	65.0	20.0	45.0
EW-305	Lorain II	PROP.	597,492	2,058,799	925.0	756.0	169.0	140.0	20.0	120.0
EW-306	Lorain II	PROP.	596,682	2,057,964	905.0	755.0	150.0	135.0	20.0	115.0
EW-307	Lorain II	PROP.	596,697	2,058,302	905.0	760.0	145.0	130.0	20.0	110.0
EW-308	Lorain II	PROP.	596,971	2,058,609	920.0	764.0	156.0	140.0	20.0	120.0
EW-309	Lorain II	PROP.	597,311	2,058,649	935.0	760.0	175.0	140.0	20.0	120.0
EW-310	Lorain II	PROP.	597,133	2,057,550	912.0	760.0	152.0	137.0	20.0	117.0
EW-311	Lorain II	PROP.	597,283	2,057,528	907.0	762.0	145.0	130.0	20.0	110.0
EW-312	Lorain II	PROP.	599,317	2,059,473	895.0	740.0	155.0	140.0	20.0	120.0
EW-313	Lorain II	PROP.	599,127	2,059,381	905.0	745.0	160.0	140.0	20.0	120.0
EW-314	Lorain II	PROP.	598,931	2,059,212	912.0	740.0	172.0	140.0	20.0	120.0
EW-315	Lorain II	PROP.	599,508	2,059,980	830.0	760.0	70.0	55.0	20.0	35.0
EW-316	Lorain II	PROP.	599,330	2,059,630	897.0	737.0	160.0	140.0	20.0	120.0
TEW-1R	Lorain II	EXISTING	597,535	2,056,637	877.0	751.0	126.0	111.0	20.0	91.0
TEW-2R	Lorain II	EXISTING	597,527	2,056,837	878.0	757.0	121.0	106.0	20.0	86.0
TEW-3	Lorain II	EXISTING	597,569	2,057,021	890.0	758.0	132.0	117.0	20.0	97.0
TEW-4	Lorain II	EXISTING	597,569	2,057,221	892.0	763.0	129.0	114.0	20.0	94.0
TEW-5R	Lorain II	EXISTING	596,757	2,058,722	910.0	780.0	130.0	115.0	20.0	95.0
TEW-6R	Lorain II	EXISTING	596,757	2,058,956	910.0	780.0	130.0	115.0	20.0	95.0
TEW-7R	Lorain II	EXISTING	596,770	2,059,194	907.0	780.0	127.0	112.0	20.0	92.0
TEW-8R	Lorain II	EXISTING	596,953	2,059,307	902.0	765.0	137.0	122.0	20.0	102.0
TEW-9R	Lorain II	EXISTING	596,795	2,059,491	893.0	780.0	113.0	98.0	20.0	78.0
TEW-10R	Lorain II	EXISTING	597,133	2,059,451	895.0	761.0	134.0	119.0	20.0	99.0
TOTAL							33,662	7,207	26,586	

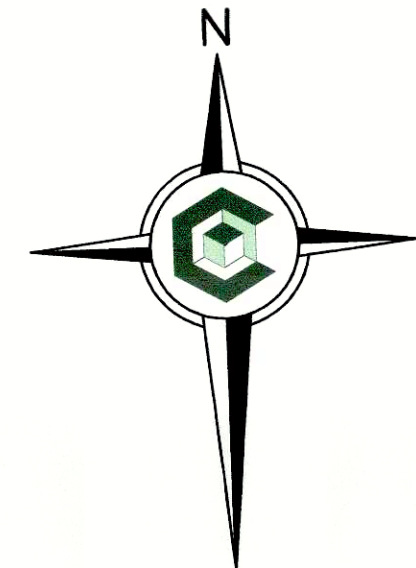
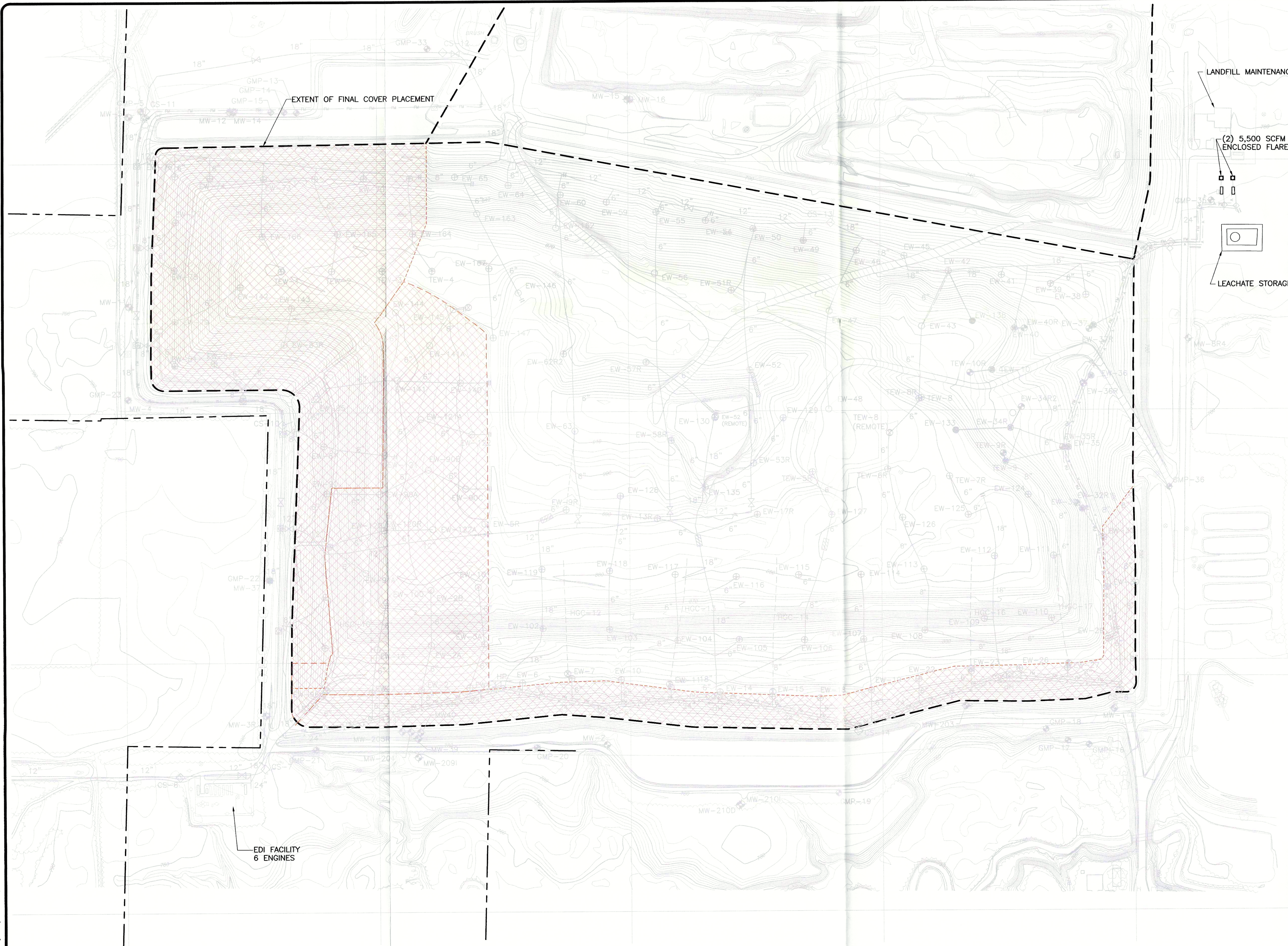
NOTES:

1. Final contours taken from final cover grading at closure.
2. Base grade elevations were taken from a drawing titled "Leachate Management System Plan", provided by CEC.
3. Proposed well coordinates based on the existing site coordinate system.
4. Additional existing Lorain II data provided by Wellert.
5. Northings, Eastings, and Final Cover elevations taken from a composite developed by CEC, Inc. Incorporative Aerial Mapping dated 10/16/98, 2/28/01 prepared by Intermap, Inc., 2/27/05 prepared by Keddal Aerial Mapping, and USGS mapping taken from the Oberlin, Ohio quadrangle dated 1969, photo revised 1979.
6. Solid pipe lengths, perforated pipe lengths, ground elevations, and bore depths for Lorain I wells provided by Air Quality Specialists, Inc. "Lorain One Gas Extraction Well Log", dated July 16, 2005.
7. Proposed extraction well data based upon Final Development grade conditions.

ATTACHMENT 10
LORAIN LANDFILL II FINAL COVER PLAN

1" = 1/2" 0" 1"

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LEGEND

- PROPERTY BOUNDARY
- EXISTING SOLID WASTE CELL BOUNDARY
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- EXISTING LANDFILL GAS HEADER
- EXISTING CONDENSATE FORCEMAIN
- EXISTING CONDENSATE FORCEMAIN
- EW-90A
- ⊕ EW-113
- △ EW-45
- ⊕ EXISTING LFG EXTRACTION WELL WITH LANDTEC WELLHEAD
- ⊕ EXISTING LFG EXTRACTION WELL
- ⊕ EXISTING COMBINATION WELL
- ⊕ EXISTING REMOTE WELLHEAD
- ⊕ EXISTING HEADER ACCESS RISER
- ⊕ EXISTING CONTROL VALVE
- ⊕ EXISTING BLIND FLANGE
- ⊕ EXISTING FLANGE CONNECTION
- ⊕ EXISTING CONDENSATE DRIPLEG
- ⊕ EXISTING CONDENSATE SUMP STATION
- ⊕ EXISTING GAS MONITORING PROBE
- ⊕ EXISTING GROUNDWATER MONITORING WELL
- NEW LANDFILL GAS LATERAL
- ABANDONED LANDFILL GAS HEADER/LATERAL
- EW-133
- ✕ EW-40
- ⊕ TEW-10R
- NEW LFG EXTRACTION WELL
- ✕ NEW LFG WELL - ABANDONMENT
- ⊕ NEW LFG EXTRACTION WELL - REDRILL

0 200 400
SCALE IN FEET

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY
1	02/24/10	DRAWN BY P.J.L. DESIGNED BY K.J.K.				
2		CHECKED BY TAB APPROVED BY TAB				

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Environmental Group, LLC.

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LORAIN COUNTY LANDFILL, LLC
LORAIN COUNTY LANDFILL
LORAIN COUNTY, OHIO

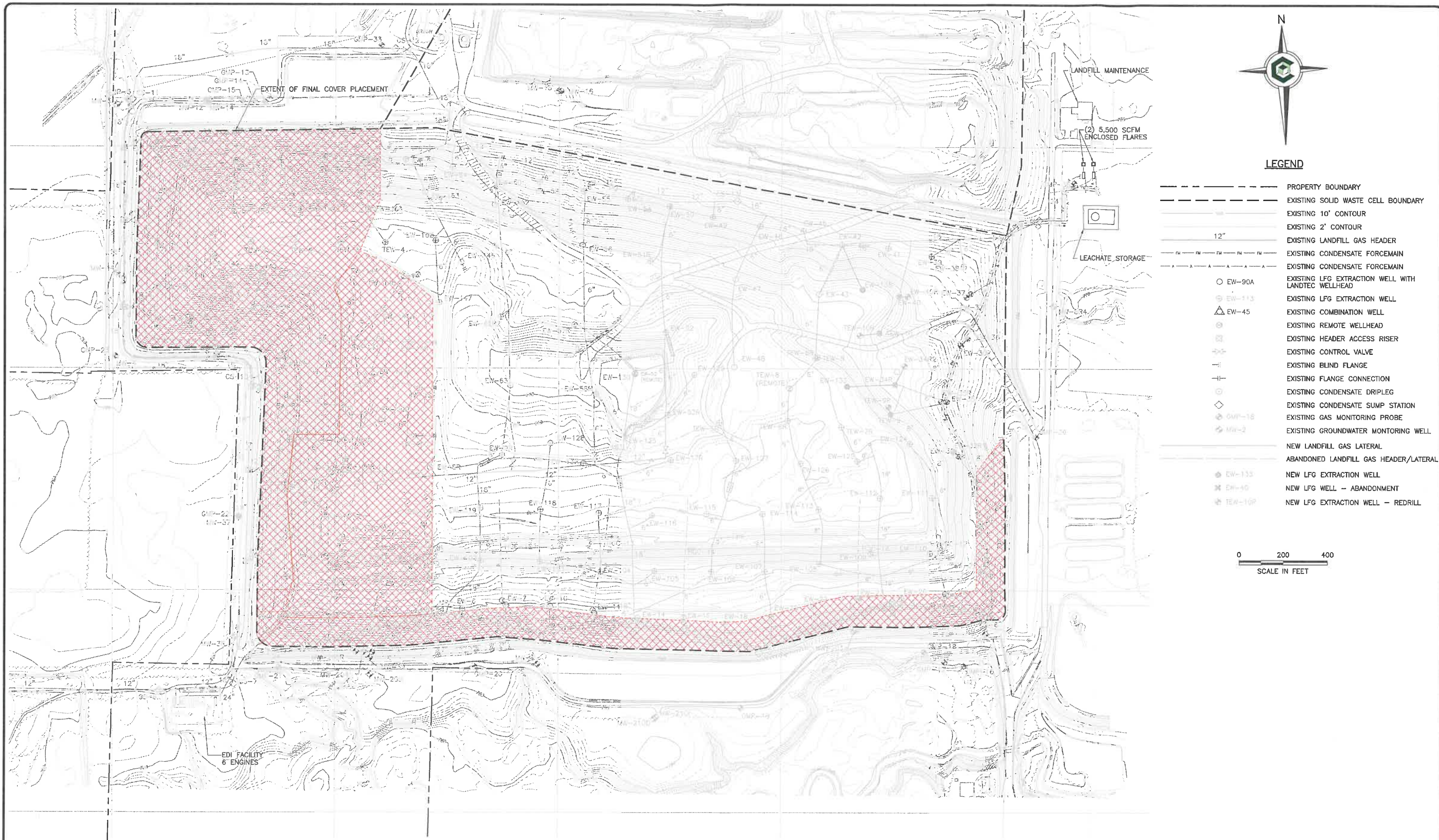
LORAIN II EXISTING FINAL COVER AREA

SHEET NO.
A-10

PROJECT NO.
100068

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LEGEND

- PROPERTY BOUNDARY
- EXISTING SOLID WASTE CELL BOUNDARY
- EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- 12" --- EXISTING LANDFILL GAS HEADER
- FM --- FM --- FM --- FM --- FM --- EXISTING CONDENSATE FORCEMAIN
- A --- A --- A --- A --- A --- EXISTING CONDENSATE FORCEMAIN
- EW-90A EXISTING LFG EXTRACTION WELL WITH LANDTEC WELLHEAD
- ⊕ EW-113 EXISTING LFG EXTRACTION WELL
- △ EW-45 EXISTING COMBINATION WELL
- ⊗ EXISTING REMOTE WELLHEAD
- ⊕ EXISTING HEADER ACCESS RISER
- ⊕ EXISTING CONTROL VALVE
- ⊕ EXISTING BLIND FLANGE
- ⊕ EXISTING FLANGE CONNECTION
- ⊕ EXISTING CONDENSATE DRIPLEG
- ◇ EXISTING CONDENSATE SUMP STATION
- ⊕ GMP-18 EXISTING GAS MONITORING PROBE
- ⊕ MW-2 EXISTING GROUNDWATER MONITORING WELL
- NEW LANDFILL GAS LATERAL
- ⊕ EW-133 ABANDONED LANDFILL GAS HEADER/LATERAL
- ⊕ EW-40 NEW LFG EXTRACTION WELL
- ⊕ TEW-10P NEW LFG WELL -- ABANDONMENT
- ⊕ TEW-10P NEW LFG EXTRACTION WELL -- REDRILL

0 200 400
SCALE IN FEET

REV	DATE	DESCRIPTION			DWN BY	DES BY	CHK BY	APP BY	
DATE OF ISSUE 02/24/10		DRAWN BY PUL DESIGNED BY KJR			CHECKED BY APPROVED BY		TAB TAB		



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LORAIN COUNTY LANDFILL, LLC
LORAIN COUNTY LANDFILL
LORAIN COUNTY, OHIO

LORAIN II EXISTING FINAL COVER AREA

SHEET NO.
A-10
PROJECT NO.
100068

ATTACHMENT 11
CONDENSATE GENERATION PROJECTION

COMPUTATION SHEET

PROJECT TITLE: Lorain Landfill GCCS Design Plan

PROJECT NO: 070170

DESCRIPTION: Landfill Gas Condensate Generation - Worst Case Conditions

SHEET: 1

OF: 1

PREPARED BY: KJK DATE: 8/27/2008

CHECKED BY: TAB DATE: 8/27/2008

Assumptions:

1. LFG temperature at the wellhead is the warmest gas.
2. LFG traveling in a buried header will try to stabilize its temperature consistent with the ground temperature.
3. Ground temp. below the frost line remains constant year round at 59 °F
4. LFG header pipe is installed below frost depth.
5. The LFG temperature (just before the blower) depends on the distance traveled in buried header pipe and the thermal conductivity of the header pipe.
6. Work at the blower compresses the LFG, but no additional condensate is generated due to the heat of compression.

Condensate Generation (gallons/day) = (Y_{wellhead} - Y_{blower inlet}) * LFG Flow * (18 / (380 * 8.35)) * 60min/hr * 24 hrs/day

Wellhead Conditions		
P (psia)	VP (psia)	Y (moles)
14.34	0.950	0.066

Blower Inlet Conditions			
	P (psia)	VP (psia)	Y (moles)
59 °F	12.90	0.217	0.017
60 °F	12.90	0.256	0.020
70 °F	12.90	0.363	0.028
80 °F	12.90	0.507	0.039
90 °F	12.90	0.699	0.054
Y(moles) = VP/P			

Temperature vs. Vapor Pressure	
LFG Temperature (°F)	Vapor Pressure (psia)
0	0.090
35	0.100
40	0.122
45	0.147
50	0.178
55	0.217
60	0.256
65	0.310
70	0.363
75	0.435
80	0.507
85	0.603
90	0.699
95	0.825
100	0.950
105	1.115
110	1.280
115	1.485
120	1.690

LFG Flow Data		
Typical Pressure at Wellhead	-10	in. w.c.
Blower Inlet Pressure	-50	in. w.c.
Typical Wellhead Temperature	100	°F
Total Site LFG Flow	20,000	scfm

Daily Condensate Generation Rates	
59 °F	8,075
60 °F	7,581
70 °F	6,225
80 °F	4,401
90 °F	1,968

Summary: Anticipated condensate generation rate will be 8,075 gallons per day under the noted conditions.



CORNERSTONE
Environmental Group, LLC

ATTACHMENT 12
2009 LANDFILL CAPACITY CALCULATION

Weaver Boos Consultants, LLC 4260 Tuller Road, Suite 202 Dublin, OH 43017 (614) 389-4132 Fax (614) 389-4135	Lorain County Landfill 2009 Annual Report Landfill Capacity Calculation Sheet	Job Number: 0120-470-10-06 Sheet No.: 1 of 1 Calculated by: PEB Date: 3/28/10 Checked by: _____ Date: _____
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1. Additional Capacity Permitted at the Facility During 2009	0	cy
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2. Remaining Capacity	
-----------------------	--

End Date of Reporting Year =	12/31/09	Date of Latest Annual Survey =	01/21/10	(survey date)
		Date of Previous Annual Survey =	12/13/08	(survey date)
		Calendar Days Between Surveys =	404	
Calendar Days Between 12/31/09 & 01/21/10 =			21	
Operating Days Between 12/31/09 & 01/21/10 =			18	
Remaining Gross Permitted Airspace (RGA) at the End of 2008 (2008 RGA) =		26,040,417	cy	(from 2008 annual rept.)
Remaining Gross Permitted Airspace as of 01/21/10 =		25,033,475	cy	(CADD Volume Analysis)
2009 Waste Receipts =		999,550.00	tons	(from facility records)
2009 Operating Days =		312	days	(from facility records)
Average Daily Waste Receipt (operating days) =		3204	tons/day	
Waste Receipts Between Surveys =		1,103,239	tons	(from facility records)
Gross Airspace Used Between Surveys =		1,250,296	cy	(CADD Volume Analysis)
Average Emplaced Compaction Ratio =		0.88	tons/cy	
		1,765	lbs/cy	
Total Waste Tons Taken Between 12/31/09 and 01/21/10 =		57,347	tons	(from facility records)
a. Remaining Gross Airspace (RGA) as of 12/31/09 =		25,098,466	cy	(using 2009 compaction ratio)
Remaining Constructed Airspace at the End of 2008 (2008 RGA) =		2,181,412		(from previous annual rept.)
Remaining Constructed Capacity as of Most Recent Survey =		3,017,690	cy	(CADD Volume Analysis)
Airspace Constructed in 2009 =		1,959,300	cy	(from facility records)
b. Remaining Constructed Capacity as of 12/31/09 =		3,082,681	cy	(calculated using 2009 compaction ratio)
Constructed Capacity Consumed in 2009 =		1,058,031	cy	
c. Projected Airspace Constructed in 2010 =		2,000,000	cy	(from facility records)

3. Remaining Life	
-------------------	--

a. Based on AMDWR	
-------------------	--

AMDWR	=	6,500	tons/day
Days Operating	=	312	days/yr
Receipts at AMDWR =		2,028,000	tons/yr
Remaining Life =	25,098,466 cy * 0.88 tons/cy /	2,028,000 tons/yr =	10.92 years

b. Based on Actual 2009 Waste Receipts	
--	--

2009 Waste Receipts =	999,550	tons/yr	
			Days Operating =
			312 days/yr
			Average Daily Tonnage =
			3,204 tons/day
Remaining Life =	25,098,466 cy * 0.88 tons/cy /	999,550 tons/yr =	22.2 years
			(calc. using 2009 receipts)

4. Remaining Tons for Waste Placement =	
---	--

	22,146,441 tons
--	-----------------

5. Gross Airspace Used During 2009 =	
--------------------------------------	--

	941,951 cy
--	------------

ATTACHMENT 13
LANDGEM MODELING BACKGROUND



State of Ohio Environmental Protection Agency

Northeast District Office

2110 East Aurora Rd.
Twinsburg, Ohio 44087

TELE: (330) 968-1200 FAX: (330) 487-0769
www.epa.state.oh.us

Ted Strickland, Governor
Lee Fisher, Lieutenant Governor
Chris Korleski, Director

March 27, 2008

Mr. Chris Jaquet
Browning-Ferris Industries, of Ohio, Inc.
43502 Oberlin-Elyria Road
Oberlin, OH 44014

Dear Mr. Jaquet:

RE: Request for additional information to process PTI application No. 02-22821

On March 14, 2008, I sent you an e-mail indicating that complications came up with the processing of Allied's permit-to-install application No. 02-22821. Upon consultation with Ohio EPA Division of Air Pollution Control (DAPC) Central Office, I was informed that while the exemption for the temporary flare is still in effect and applicable, we must now consider the emissions from the flare in determining PSD and NOx nonattainment New Source Review (NSR) applicability. After a number of conference calls with Central Office, I can now provide additional guidance on what is needed to continue processing the application.

When the emissions from the temporary flare are included with the existing permitted flares and diesel engine emissions, the facility will most likely exceed the 250 tons of CO, which will require the pending PTI application to be either a PSD or netting application. Likewise, the emissions are very close to 100 tons per year for NOx. The 100 TPY threshold for NOx is a critical number in considering nonattainment NSR. Based on the discussions and correspondence to get us to this point, I assume Allied will want to pursue a netting permit to avoid PSD and nonattainment NSR, and the guidance herein is based on this assumption.

In order to process a netting permit, the facility is required to submit a demonstration of the actual facility emissions for the past ten years, and the projected actual emissions for the next five years. In calculating the actual emissions from the engines, I will be looking for the demonstration to include copies of each engine's operating hours or fuel usage, and the use of the 0.34 lb fuel/hp-hr conversion factor, if the AP-42 fuel input emission factor is used. In calculating the actual emissions from the flares, I will be looking for the chart recorder plots for flow, and AP-42 emission factors.

I think we have adequately addressed the future emissions from both the flare and the diesel engines. In terms of the requested update, I will be looking for a reaffirmation of what Allied's projected actual emissions over the next five years, and through the life of the existing facility to be clearly and completely explicated. For purposes of netting, the

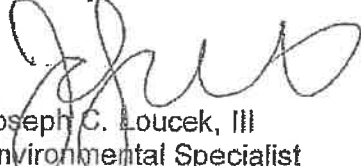
Mr. Chris Jaquet
Browning-Ferris Industries, of Ohio, Inc.
March 27, 2008
Page 2

landfill's projected actual emissions over the next five years will equal the potential to emit for the flares for the next five years without considering any gas being routed to Energy Development, Inc.'s landfill gas to energy recovery facility.

Ohio EPA understands Allied's concern with getting a PTI in time to meet the deadline for the authorization to operate the temporary flare. I have been authorized to prepare a renewal of the authorization, and I will be preparing that in conjunction with the submittal of the above requested information.

If you have any questions, please do not hesitate to contact me at (330) 963-1258.

Sincerely,



Joseph C. Loucek, III
Environmental Specialist
Division of Air Pollution Control

JCL/mt

ec: Bob Princic, Ohio EPA, DAPC, NEDO

Bilgri, Tom

From: Jerry Parker [jerry.parker@epa.state.oh.us]
Sent: Friday, March 28, 2008 6:18 PM
To: Chris Jaquet
Cc: Alvie Green; Bilgri, Tom; Clarissa Gereby; Joseph Loucek; Murat Tukul;
jsabo@loraincountyhealth.com
Subject: Re: Lorain Landfill

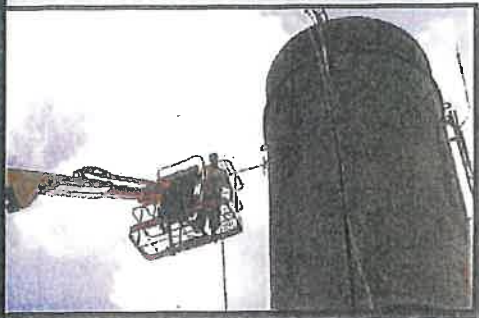
Chris,

Greetings. I hope this message finds you in good health and good spirits as well as the rest of the staff at the landfill. Prior to reviewing the revised "Design and Operational Evaluation - Landfill Gas Collection and Control System (GCCS)" for the above site which was submitted on January 4, 2008, I had a conversation with DAPC-CO to discuss the status of the air permit for the flares. Since some of the same assumptions that were based on the LandGem model were being presented in both the air permit and the GCCS, DAPC-CO has recommended to DSIWM-NEDO to wait to commence its review of the GCCS after the draft air permit has been issued. If you desire an update on the air permit, you can reach Mr. Joe Loucek at (330) 963-1258 or joseph.loucek@epa.state.oh.us. If you have any other questions and/or comments, please do not hesitate to contact me.



Enclosed Flare PTI Application

October 2007



Prepared for:
Browning Ferris Industries of Ohio, Inc.



Lorain County Landfill Facilities
43502 Oberlin-Elyria Road
Oberlin, OH 44074



39395 W. 12 Mile Road, Suite 103, Farmington Hills, MI 48331

Building lifetime relationships with our clients and employees.

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INTRODUCTION

Landfill Description

The Lorain County Facilities (LCF) is an existing solid waste disposal facility located in Oberlin, Ohio. The LCF is owned and operated by the Browning-Ferris Industries of Ohio, Inc (BFI).

The LCF consists of three separate operations: Lorain County Landfill #1, Lorain County Landfill #2, and Lorain County Resource Recovery. Lorain County Landfill #1 is a closed landfill that accepted waste from 1974-1985. Lorain County Landfill #2 is an active landfill that began accepting waste in 1985. Lorain County Landfill #2 currently accepts municipal solid waste, non-hazardous special waste and construction and demolition debris. These two landfills are considered to be one landfill according to the facility Title V Permit. The Lorain Resource Recovery facility consists of transfer operations where glass, plastic, metals, and paper are separated from each other within an enclosed building. In addition to the landfill, the LCF operates a landfill gas collection and control system including an enclosed flare at Lorain County Landfill #1 and open flares at Lorain County Landfill #2. An on-site landfill gas-to-energy plant operated by Energy Developments, Inc. (EDI) utilizes the collected landfill gas to generate electric power.

Landfill Gas Collection and Control System

Both Lorain County Landfills have collection and control equipment for landfill gas (LFG). The existing gas collection and control system (GCCS) consists of approximately 72 and 114 vertical extraction wells at Lorain County Landfill #1 and Lorain County Landfill #2, respectively. LFG is extracted from the Lorain I and Lorain II landfills via the GCCS. Currently, all extracted LFG is either destroyed via utility flares (2 - one permitted, one temporary), enclosed flare or utilized as a fuel source for the generation of electricity. The electrical generating facility is owned and operated by EDI.

Purpose of PTI Application

This PTI Application is being submitted in order to ensure that LCF has enough flare capacity to meet New Source Performance Standard obligations for at least the next five (5) years and up to the maximum, expected landfill gas generation capacity of the landfill, without considering the capacity of EDI. As stated above LCF currently utilizes 2 utility flares and an enclosed flare. The goal of this application is to replace the existing open flares with enclosed flares over the next few years. LCF is proposing to have a normalized flow limitation, assuming a 500 Btu/cf landfill gas heat content and cooresponding to the maximum, expected landfill gas generation capacity. This approach will not limit flow to each individual flare and will provide LCF with needed flexibility to manage landfill gas collection from multiple areas that have varying landfill gas generation and flow. It is expected that landfill gas generation and flow at Lorain County Landfill #1 will be decreasing steadily because it is no longer actively accepting MSW. Conversely, Lorain County Landfill #2 is active and accepting MSW, therefore, landfill gas generation will be increasing until it reaches capacity and waste acceptance ceases.

Regulatory Discussion

The Lorain County Landfill, source of the landfill gas that is proposed to be combusted in the new enclosed flares, is subject to the MSW Landfill New Source Performance Standards (NSPS) – 40 CFR 60, Subpart WWW and National Emission Standards for Hazardous Air Pollutants (NESHAP) – 40 CFR 63, Subpart AAAA, any landfill gas generated by the LCF Landfill needs to be controlled in accordance with these two regulations.

The NSPS regulatory citation of concern for the control and/or treatment of landfill gas is 40 CFR 60.752(b)(2)(iii):

(iii) Route all the collected gas to a control system that complies with the requirements in either paragraph (b)(2)(iii) (A), (B) or (C) of this section.

(A) An open flare designed and operated in accordance with §60.18;

(B) A control system designed and operated to reduce NMOC by 98 weight-percent, or, when an enclosed combustion device is used for control, to either reduce NMOC by 98 weight percent or reduce the outlet NMOC concentration to less than 20 parts per million by volume, dry basis as hexane at 3 percent oxygen. The reduction efficiency or parts per million by volume shall be established by an initial performance test to be completed no later than 180 days after the initial startup of the approved control system using the test methods specified in §60.754(d).

(1) If a boiler or process heater is used as the control device, the landfill gas stream shall be introduced into the flame zone.

(2) The control device shall be operated within the parameter ranges established during the initial or most recent performance test. The operating parameters to be monitored are specified in §60.756;

(C) Route the collected gas to a treatment system that processes the collected gas for subsequent sale or use. All emissions from any atmospheric vent from the gas treatment system shall be subject to the requirements of paragraph (b)(2)(iii) (A) or (B) of this section.

Specifically, 40 CFR 60.752(b)(2)(iii)(B) above allows for the use of an “enclosed combustion device” that reduces NMOC by 98% or NMOC concentration to 20 ppmv as hexane. The facility has selected new enclosed flares as the control devices, as well as continuing to utilize the existing LC#1 Enclosed flare to continue to meet these requirements well into the future. As discussed in further detail below, the facility is proposing to temporarily keep an existing open flare LC#2 and restrict emissions until June 2009 to ensure enough flare capacity for purposes of odor and NSPS control between new enclosed flare installations.

Permit-to-Install Application Strategy

This Permit to Install (PTI) application is intended to provide the necessary details to properly permit the proposed control devices at LCF. Upon issuance, the resulting PTI lists applicable rules and requirements pertaining to each source, along with operating requirements, emission limits, stack information and monitoring requirements within a facility.

Sources are categorized as either *major* or *minor (non-major)* for purposes of federal and state pre-construction permitting by the calculated potential emissions (in tpy) for specific compounds. Major-source thresholds vary by geographic area. The major-source threshold for the region LCF is located (Oberlin, Lorain County) is more complicated than in other places because it is located in an area that was designated non-attainment for ozone (prior to May 1996), became attainment, and now is designated non-attainment for the new 8-hour ozone and PM_{2.5} standards. Ozone is regulated by the emission of pre-cursors to its development, volatile organic compounds (VOC) and nitrogen oxides (NO_x). Lorain County is designated attainment for all other criteria pollutants (i.e. CO, SO₂, NO₂).

Therefore, a source located in Lorain County is considered major and triggers non-attainment New Source Review (NSR) if it's calculated potential NO_x or VOC emissions are at least 100 tpy. Also, if a source has emissions greater than 250 tpy for an attainment pollutant [carbon monoxide (CO), sulfur dioxide (SO_x), particulate matter (PM₁₀)], then Prevention of Significant Deterioration (PSD) permitting would apply. Table 1 - below presents a summary of the present emissions. Appendix A presents more details on the source of the emissions presented in Tables 1-4.

Table 1

Existing PTI/Permitted Emissions

Source	Capacity	PTI/Permitted Maximum POTENTIAL Emissions - Existing							NOx Factor ^a lb/mmBtu	CO Factor ^a lb/mmBtu
		Units/Fuel	PM ₁₀	SO ₂	NO ₂	CO	VOC	HAPs		
2,000 scfm Enclosed Flare - LC1 (PTI# 02-17081; dated 3/6/2003)	2,000	scfm, landfill gas	4.50	8.90	10.50	74.50	5.46	8.87	0.036	0.258
3,000 scfm Enclosed/Open Flare - LC2 (PTI# 02-17081; dated 3/6/2003)	3,000	scfm, landfill gas	6.70	13.30	15.80	143.50	5.46	35.20	0.036	0.331
Misc. Grinders, Engines, Etc. (PTI# 02-14640; dated 8/7/2001)	3016	Diesel hrs/yr, Restriction	6.28	3.35	29.40	7.03	2.36			
	5,000.00	scfm, landfill gas - Controlled by Lorain Co. LF	17.48	25.55	55.70	225.03	13.28	44.07		

As depicted above, the existing permitted emissions are below the 100 TPY and 250 TPY PSD triggering levels explained above. Therefore, LCF is a minor source.

It is important to note that LCF installed a second 3,000 scfm flare in July 2006 pursuant to a Director's environmentally beneficial exemption dated June 14, 2006 (See Appendix C).

Therefore, the temporary 3,000 scfm open flare was not considered in the current potential-to-emit because this flare was approved to operate on a temporary basis for one year. As stated in the June 14, 2006 letter,

“The addition of the temporary will bring source-wide emission levels of carbon monoxide (CO) above major modification thresholds (*i.e.*, federal Prevention of Significant Deterioration (PSD) thresholds). Because the proposed flare will be operated temporarily, it is not subject to major modification review and pursuant to OAC rule 3745-31-13(F), which applies to temporary increases of emissions from proposed major stationary source or major modifications. In order for the rule to apply to this case, two criteria must be met:

1) the temporary increase in CO emissions will not impact a Class I area (a park or wilderness area meeting OAC rule 3745-31-1 I(D)); and

2) the temporary increase will not be in an area where an applicable increment (the maximum allowable deterioration of air quality) is known to be violated.”

The temporary 3,000 scfm open flare met these criteria, therefore, should not be considered part of the potential-to-emit for the facility. Table 2 below depicts the emissions based upon this temporary exemption.

Table 2

Current Emission Units On-Site

Source	Capacity	Units/Fuel	Calculated Maximum POTENTIAL Emissions - EXISTING (TPY)						NOx Factor lb/mmBtu	CO Factor lb/mmBtu
			PM ₁₀	SO ₂	NO ₂	CO	VOC	HAPs		
2,000 scfm Enclosed Flare - LC1	2,000	scfm, landfill gas	4.52	4.40	17.34	57.82	5.19	8.75	0.06 ^a	0.20 ^a
3,000 scfm Open Flare - LC2	3,000	scfm, landfill gas	6.78	6.60	29.49	160.44	7.78	13.12	0.068 ^a	0.37 ^a
3,000 scfm Open Flare - Temporary	3,000	scfm, landfill gas	6.78	6.60	29.49	160.44	7.78	13.120	0.068 ^a	0.37 ^a
Misc. Grinders, Engines, Etc.	3016	Diesel hrs/yr, Restriction	6.28	3.35	29.40	7.03	2.36	0.00		
	8,000.00	scfm, landfill gas - Controlled by Lorain Co. LF	24.36	20.94	105.72	385.72	23.10	34.99		
		Emissions without Temporary Flare	17.59	14.35	76.23	225.29	15.32	21.87		

^a Calculated emission factor from PT# 02-17061

^b Typical emission guarantee for a new Enclosed Flare

^c AP-42 Section 13.5 - Industrial Flares; Guarantee from Open Flare Manufacturer

Conversely, minor sources, which LCF is, are *not* subject to NSR and can increase emissions (for a major modification) up to 100 tpy of VOC or 100 tpy of NO_x and 250 TPY of CO, SO_x or PM₁₀. If the increase is calculated to be above these thresholds, the source becomes major and is subject to NSR.

Proposed Permitting Strategy

LCF is a minor source for NO_x, and, is proposing an insignificant modification. This project has proposed an insignificant increase in NO_x emissions from the new enclosed flare and from other NO_x emission increases over the last 5 years. **The proposed annual limit is a facility-wide normalized flow limit of 17.325 scfm @ 50% methane**

concentration of landfill gas. This level, along with guaranteed (see Appendix A for manufacturer's guaranteed value) emission factors from a flare manufacturer for the new flare(s) and the proposed emission factors for Flare at LC1, will remain below the PSD major source threshold of 250 tpy emissions for all attainment pollutants. Also, even though the proposed facility-wide emissions of NOx will be above NSR major source thresholds of 100 tpy for NOx, the proposed increase associated with this project, 68.85 tpy, is below the major source threshold, therefore not triggering NSR requirements at this time.

Table 3

Proposed Final Permitted Emissions

Source	Capacity	Units/Fuel	Calculated/Permitted Maximum POTENTIAL Emissions - NEW (TPY)						NOx Factor lb/mmBtu	CO Factor lb/mmBtu
			PM ₁₀	SO ₂	NO _x	CO	VOC	HAPs		
NEW Enclosed Flare(s) Standard Flare-Lower EF	13,750	scfm, landfill gas	31.08	30.24	99.37	198.74	3.81	16.62	0.05	0.1
2,000 scfm Enclosed Flare - LC1 (calculated emissions)/ NO Flow Restriction	2,000	scfm, landfill gas	4.52	4.40	14.45	28.91	5.19	8.75	0.05	0.1
Misc. Grinders, Engines, Etc. (3,016 Hours/yr/each Restriction)	3016	hrs/yr	6.28	3.35	29.40	7.03	2.36	0.00		
	15,750.00	scfm, landfill gas - Controlled by Lorain Co. LF @ 550 Btu/cf	41.88	37.99	143.23	234.68	11.35	25.37		
	4,553,010.00	mmBtu/yr	1,039,500.00 scf/yr							
	17,325.00	scfm @ 550 Btu/cf								
	14,437.50	scfm @ 600 Btu/cf								

Source	Capacity	Units/Fuel	Calculated Maximum POTENTIAL Emissions INCREASES (TPY)					
			PM ₁₀	SO ₂	NO _x	CO	VOC	HAPs
NEW Enclosed Flares (Standard Flare-Lower EF); 2000 scfm-calculated emis./flow restrict.; NO 3000 scfm OPEN- LC2	22,249	scfm, landfill gas - TOTAL	24.41	12.34	87.53	9.65	-2.15	-21.36
Misc. Grinders, Engines, Etc. - 3,016 hrs/yr/each	15,750	scfm, landfill gas - Controlled by Lorain Co. LF @ 550 Btu/cf						

NOTE: Any NEW enclosed flare emissions based on reduced NOx emission factor (0.05 lb/mmBtu) and CO emission factor (0.1 lb/mmBtu)

The above calculated maximum potential emissions increases are the difference between the Potential Emissions presented in Table 3 and Table 1. At full implementation of the above permitting strategy, LCF proposes to remove the current LC2 open flare and temporary open flare and substitute with enclosed flare capacity. This replacement will occur in the following phases. The current open flare capacity is approximately 6,000 scfm (depending on landfill gas heat content). LCF proposes to initially install a 6,000 scfm enclosed flare and keep 3,000 scfm @ 550 Btu/cf landfill gas heat content of open

flare capacity until June 2009 to account for anticipated increases in landfill gas production and minimize the possibility of odor. This open flare capacity is being requested to ensure that LCF has the extra flaring capacity to ensure continued compliance with NSPS regulations and to prevent odors. Table 4 below presents the emission scenario with the use of the additional 3,000 scfm of open flare capacity and shows that emissions remain under major source levels and there are no significant increases of any pollutant.

Table 4

Proposed Interim Emission Units/Emissions – Until June 2009

Source	Capacity	Units/Fuel	Until 2009 - Calculated Maximum POTENTIAL Emissions - NEW (TPY)						NOx Factor lb/mmBtu	CO Factor lb/mmBtu
			PM ₁₀	SO ₂	NO _x	CO	VOC	HAPs		
NEW Enclosed Flare Standard Flare-Lower EF	6,000	scfm, landfill gas	13.56	13.20	43.36	86.72	1.66	7.29	0.05	0.10
2,000 scfm Enclosed Flare - LC1 (calculated emissions)/Flow Restriction	1,500	scfm, landfill gas	3.39	3.30	10.84	21.68	3.89	6.59	0.05	0.10
Misc. Grinders, Engines, Etc. (2,000 Hours/yr/each Restriction)	2,000	hrs/yr	4.16	2.22	19.50	4.66	1.56	0.00		
3,000 scfm Open Flare - LC2 (calculated emissions)	3,000	scfm, landfill gas	6.78	6.60	29.49	160.44	0.83	13.12	0.068	0.37
	867,240.00	mmBtu/yr								
	3,300.00	scfm @ 500 Btu/cf								
	2,796.51	scfm @ 590 Btu/cf								
	10,500.00	scfm, landfill gas - Controlled by Lorain Co. LF	27.90	23.09	103.18	273.51	7.96	26.93		
	3,035,340.00	mmBtu/yr								
	11,550.00	scfm @ 500 Btu/cf								
	9,625.00	scfm @ 600 Btu/cf								

Source	Capacity	Units/Fuel	Calculated Maximum POTENTIAL Emissions INCREASES (TPY)					
			PM ₁₀	SO ₂	NO _x	CO	VOC	HAPs
UNTIL 2009 - NEW 6,000 scfm enclosed flare, 2000 scfm-calculated emts. w/flow restriction, 3,000 scfm OPEN-LC2 with flow restriction	13,983	scfm, landfill gas - TOTAL	10.43	-2.55	45.82	48.48	-5.55	-19.79
Misc. Grinders, Engines, Etc. - 2,000 hrs/yr/each	10,560	scfm, landfill gas - Controlled by Lorain Co. LF						

The above calculated maximum potential emissions increases are the difference between the Potential Emissions presented in Table 4 and Table 1. Based on the proposed annual normalized flow limit, there is additional flaring capacity that LCF could install, when needed. LCF proposes to install additional flare capacity, beyond the initial enclosed flare installation whenever the facility deems it necessary based on the requirements of the MSW Landfill NSPS [40 CFR 60.759(c)] with only notification of the additional flare capacity startup to the OEPA. This start date will be the date from which the initial 180 day operation will require NSPS testing and reporting to show compliance with the NMOC emission limits in the NSPS.

Lastly, LCF proposes to install flare(s) with capacity of 11,000 scfm @ 550 Btu/cf by 2009, as described below, and install the remaining new enclosed flare capacity as needed beyond 2009. This installed capacity as of 2009 will not have emissions greater than 100 tpy of NOx. The 100 tpy NOx potential emissions levels will not be exceeded until after the next round of flare installation after 2013. (see table 5 below that presents the emissions of the interim flare capacity and prove that emissions remain less than 100 tpy up to the year 2013, at a minimum.)

Table 5

Proposed Interim Emission Units/Emissions – Until 2013

Source	Capacity	Units/Fuel	Calculated/Permitted POTENTIAL Emissions - NEW - UNTIL 2013 (TPY)						NOx Factor lb/mmBtu	CO I lb/h
			PM ₁₀	SO ₂	NO ₂	CO	VOC	HAPs		
NEW Enclosed Flare(s) Standard Flare-Lower EF	10,400	scfm, landfill gas	23.51	22.87	75.16	150.32	2.88	12.57	0.05	
2,000 scfm Enclosed Flare - LCI (calculated emissions)/NO Flow	1,500	scfm, landfill gas	3.39	3.30	10.84	21.68	3.89	6.56	0.05	
Misc. Grinders, Engines, Etc. (1,100 Hours/yr/each Restriction)	1100	hrs/yr, Restriction	2.29	1.22	12.72	2.56	0.06	0.00		
		scfm, landfill gas - Controlled by Lorain Co. LF @ 550 Btu/cf	29.19	27.39	95.72	174.57	7.63	19.13		
	11,900.00									
	3,440,052.00	mmBtu/yr								
	13,090.00	scfm @ 500 Btu/cf								
	10,908.33	scfm @ 600 Btu/cf								
			785,400.00	scf/hr						

Proposed Monitoring and Recordkeeping

In order to ensure that LCF does not exceed the proposed normalized flow limit, a proposed 12-month rolling average monitoring, and recordkeeping procedure is proposed. LCF will monitor landfill gas monthly at the inlet of each enclosed flare. The monitoring will utilize a LANDTEC GEM™ 2000 or equivalent to determine the methane concentration of the collected landfill gas. LCF proposes to apply a conversion factor of 1012 Btu/scf applied to the methane percent (%) concentration (e.g. 55% *1012 Btu/scf = 556 Btu/scf) to obtain a monthly heating value of the landfill gas. LCF monitors landfill gas flow at each of the points being monitored for methane quality, utilizing a thermal dispersion flow meter or comparable equipment. The flow data is acquired on a continuous basis, allowing LCF to document the total monthly throughput, as well as an average daily throughput, of landfill gas at each unit. The monthly landfill gas heating value will be applied to the landfill gas flow obtained from each flare to develop a monthly Btu and average flow (i.e. scfm=total flow (cubic feet) / numbers of

days in month) usage rate. In order to ensure compliance, LCF proposes to keep track of normalized flow to 500 Btu/cf on a rolling 12-month basis with the first 12-months projected utilizing and average of the previous months (actual value used for the first month) to ensure compliance during the first 12 months. LCF will develop a proposed recordkeeping and reporting template. LCF will work with OEPA to develop terms and conditions for the PTI.

Title V Operating Permit

LCF recently submitted a Title V Renewal Application for the whole facility in June 2006. The emissions, recordkeeping, and reporting requirements expected from the new enclosed flares and proposed flow limitations are different than what is currently required of the other open and enclosed flares operated by LCF. After issuance of this PTI Application, LCF will submit an updated the Title V Renewal Application incorporating the new requirements.

Calculation Methodology

The emissions presented in Table 1-4 above and in Appendix A were developed utilizing multiple sources of information. Current permitted potential-to-emit emissions were developed based on review of the latest PTIs (PTI# 02-17061; dated 3/6/2003 and PTI# 02-14640; dated 8/7/2001). Based on these PTI permitted emission values, the current site potential-to-emit are less than major sources levels for all criteria pollutants for attainment and non-attainment major new source review. As stated above, the temporary 3,000 scfm open flare is not considered towards the potential-to-emit because of the Director's exemption. The goal of the calculation methodology was to increase LCF flaring capacity to meet its NSPS goals, but also, to maintain all criteria pollutant emissions below major sources levels/major modification levels for PSD and NNSR permitting. There were three methodologies employed to restrict/limit emissions:

- 1) emission factor guarantees from flare manufacturer;
- 2) flow limitation; and
- 3) equipment operation (hours) limitation.

Based on past experience and flare manufacturer guarantees, Flare LC1 emission factors are proposed to be increased for NOx emissions and decreased for CO emissions. The emissions presented in the document "LC1 Pollutant Emissions Test Report Enclosed Flare Exhaust Lorain County Landfill #1, dated January 30, 2007 by Air Quality Specialists, Inc. showed that the proposed emission limits will allow LCF to operate the flare as originally designed. Emission factors for the new, proposed enclosed flares will be based on guarantees from flare manufacturers (see Appendix A) and will be slightly lower than those proposed for Flare LC1.

In addition to emissions from the existing and proposed flare, there are miscellaneous combustion sources that utilize diesel fuel. These miscellaneous combustion sources have a limitation of 3,106 hours/year operation on PTI# 02-14640. As part of this Application, LCF proposes a further restriction to 1,100 hours per year operation on each of these miscellaneous combustion sources until the final flaring capacity is installed after 2013 (see Table 5 above). Section 4.0 presents the EAC Form 3862 for each Miscellaneous Engine, along with the supporting calculations of emissions. Also as part of this Application, LCF proposes to retain the 3,016 hours per year operation on each of these miscellaneous combustion sources after the post 2013 installation of flaring capacity. This reverting of the hours limitation to the current level is proposed to expand and allow the use of off-site vendor combustion devices (i.e. generators, pump engines, other combustion devices) under the emissions of this restriction.

Lastly, LCF proposes a total normalized flare flow, based on 50% methane concentration in the landfill gas, rather than individual flare flow or methane content restriction. This will allow for the most flexibility for LCF and account for the varying Btu content of landfill gas.

Cornerstone has developed, and provided in Appendix E, a document which was submitted to the Ohio EPA Division of Solid and Infectious Waste entitled "Design and Operational Evaluation, Landfill Gas Collection and Control System, Lorain County Landfill, Oberlin, Ohio" (LFG Evaluation), originally submitted in March 2007, revised and resubmitted on June 8, 2007. This document provides a detailed technical evaluation

of the current and future status of the landfill gas collection and control system at BFI-Lorain.

Additionally, Cornerstone has developed a graphical presentation to illustrate the reasons why the assumptions used in the LandGEM model provides a conservative projection of total LFG production over the life of the facility. Each graph below is intended to provide graphical details to support narrative below.

Figure 1

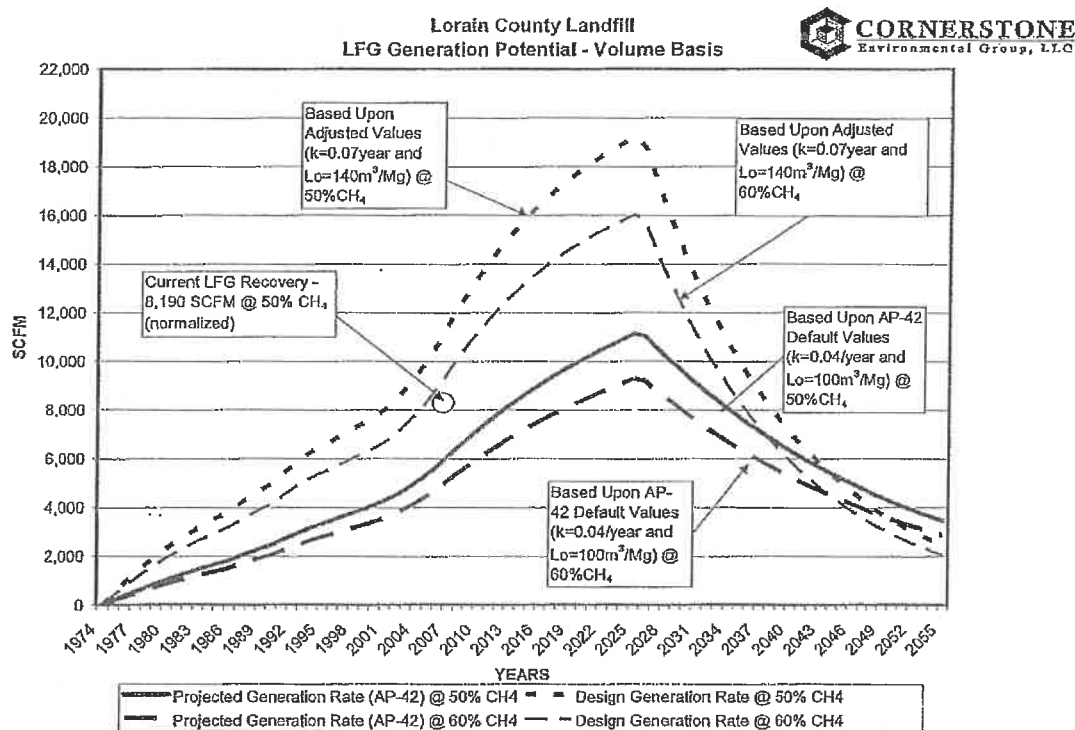


Figure 2

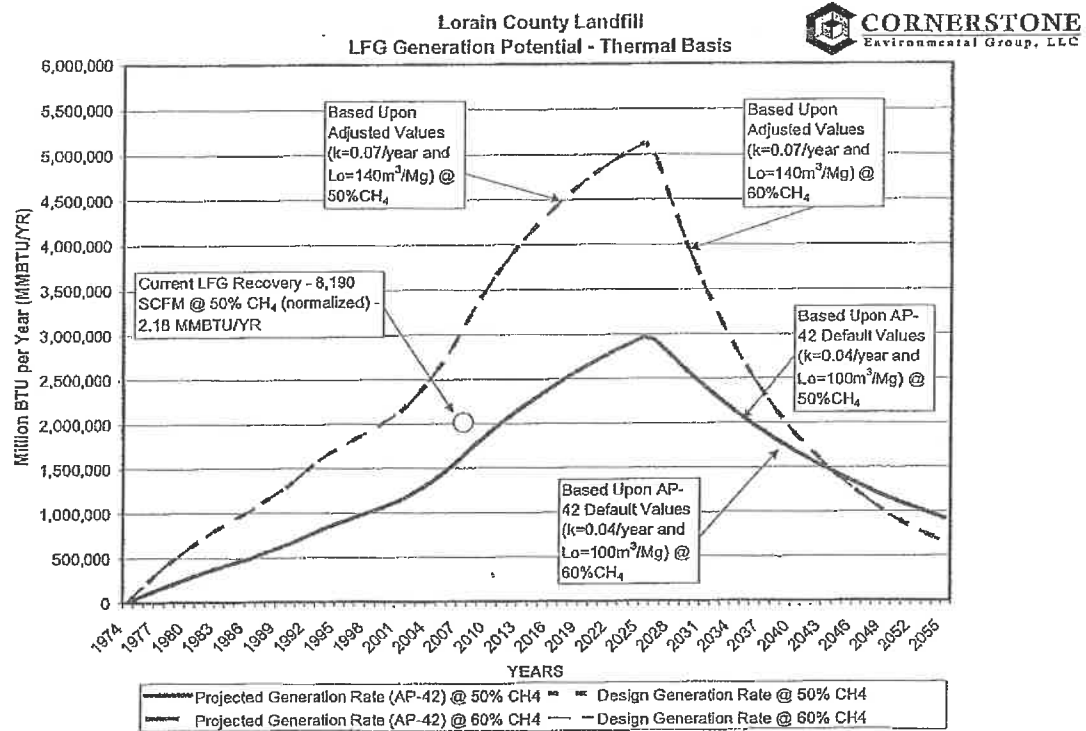


Figure 3

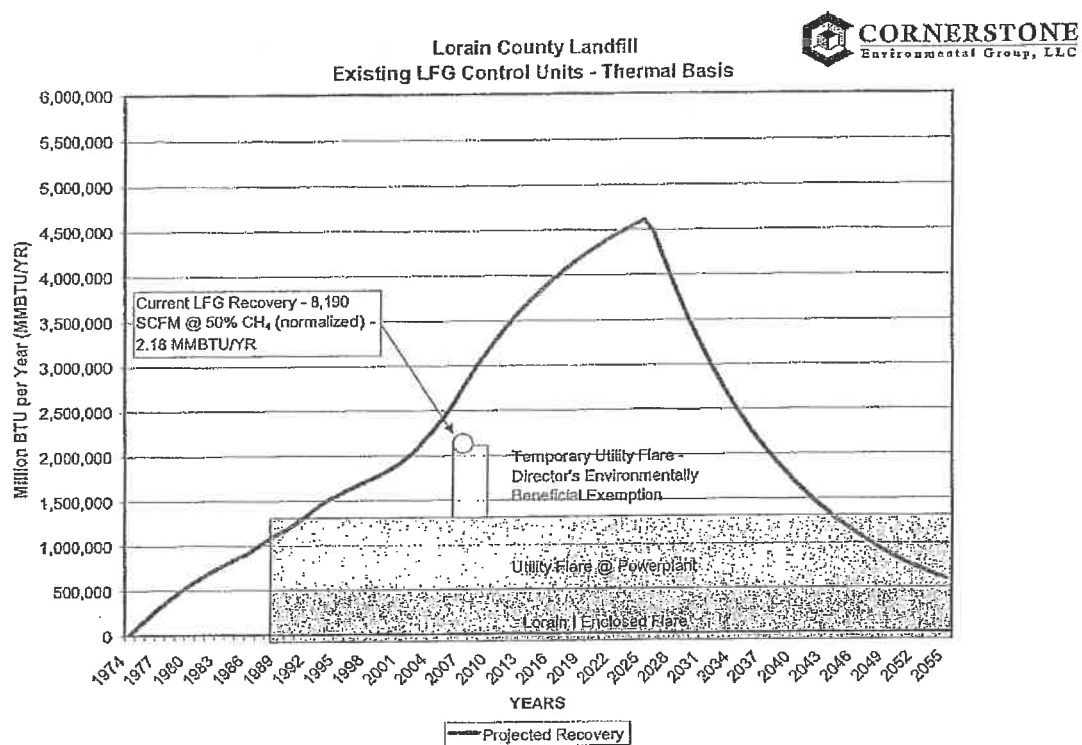
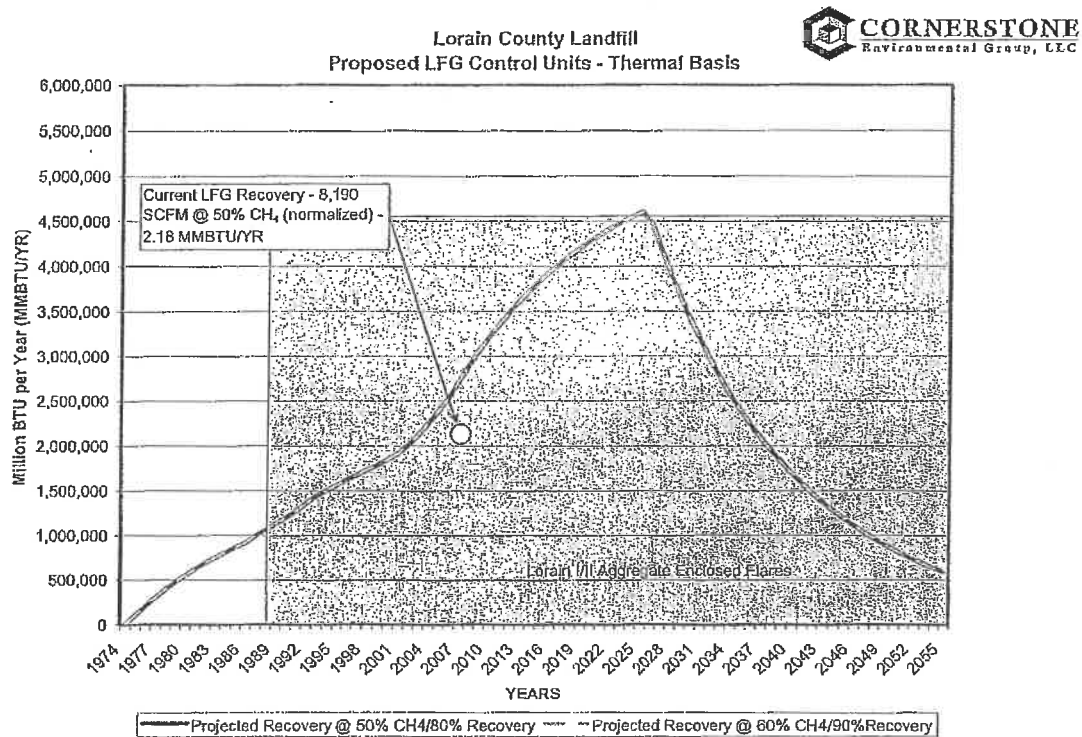


Figure 4



The EPA LandGEM Model runs, provided in Appendix B, utilized a 0.07 value for k is a more conservative value than AP-42 to insure LCF's proposed control strategy will serve the facility to the maximum projected landfill gas generation rate. As demonstrated in the above graphs and further supported in the attached LFG Analysis document (Appendix E), the use of AP-42 default value of 0.04 would only result in a lowered LFG generation rate. Therefore, it would be less conservative from a permitting and planning perspective.

The 140 for Lo value was selected to provide a more conservative approach than what AP-42 provides. As demonstrated in the above graphs and further supported in the attached LFG Analysis document, the use of AP-42 default value of 100 would only result in a lowered LFG generation rate. Therefore, it would be less conservative from a permitting and planning perspective.

The methane concentration of 50% is the standard LandGEM default value. As demonstrated in the above graph, LFG Generation Potential – Volume Basis, the use of 60% would only result in a lowered LFG generation rate. LandGEM is based upon a first-order decomposition rate equation for qualifying emissions from the decomposition of emplaced waste in a MSW landfill. This model is based upon law of conservation of mass/matter. Therefore, a higher methane concentration results in lower total landfill gas volume. Our control strategy is based on heating value of the LFG that typically has a methane concentration between 45-65%.

The overall landfill gas collection and control system at the BFI-Lorain has been designed to handle the maximum landfill gas expected to be produced by the current permitted waste volume. The landfill gas capacity proposed includes the current flare at the Lorain I area, a proposed increase in enclosed flare capacity of 13,750 scfm @ 550 Btu/cf (15,125 scfm @ 500 Btu/cf) to be “phased-in” and will be made up of more than one flare. LCF proposes to install flare(s) with capacity of 11,000 scfm @ 550 Btu/cf by 2009, as described above, and install the remaining new enclosed flare capacity as needed beyond 2009. The overall landfill gas collection and control system has been designed to be expanded to account for the increase in waste placed over the years and the corresponding landfill gas generated from the waste. Ohio EPA has approved this type of approach at other facilities by inserting terms and conditions which will ensure compliance with NSPS regulations and permit limits when the flare(s) are installed.

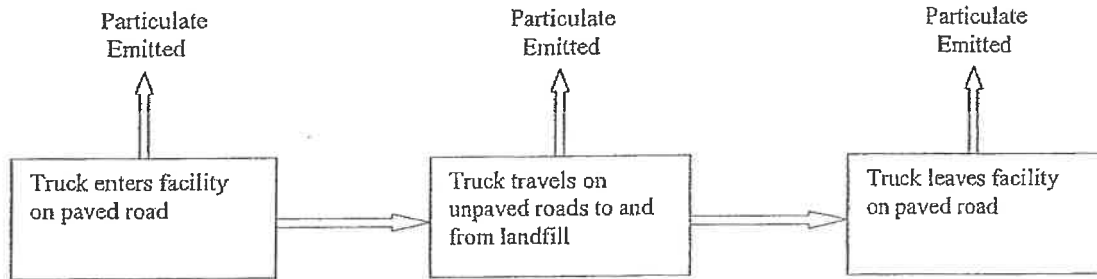
With approval of this PTI Application, and inclusion of the existing EDI facility, the combined control will be capable of handling collected landfill gas (using a collection efficiency of 80-90%) up to the highest predicted volume in year 2025. Therefore, the PTI Application has met the requirements of the NSPS by developing a landfill gas collection and control system plan that is designed to handle the maximum projected landfill gas generation/collection rate, and at the same time allows the facility to “phase-in” control components so that there are no unused and idle flares at this facility. It is important to note that Ohio EPA has routinely issued PTIs to facilities for additional control devices as it is determined to be needed over the life of the facility. However,

BFI-Lorain, because of the complexities associated with having an energy partner on site is requesting a more conservative approach.

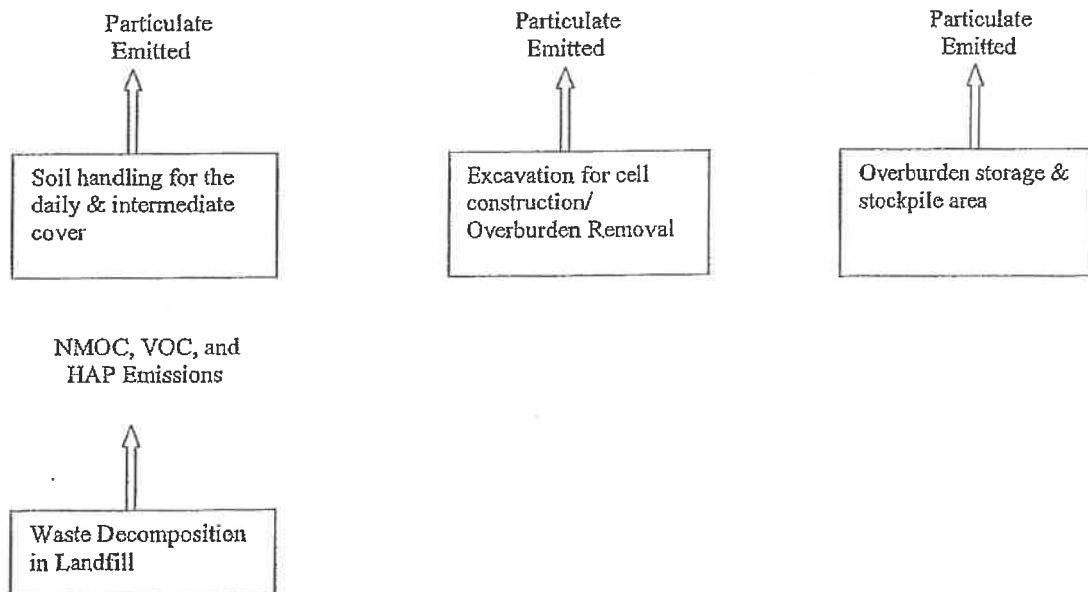
As presented in the original April 2007 PTI Application, a collection efficiency of 75% was used which is based on values and guidance presented in the US EPA AP-42 Section 2.4 – MSW Landfills. We have revised and increased the proposed landfill gas to be controlled by BFI-Lorain to 17,325 scfm at 50% methane concentration of the landfill gas. This proposed control will be enough control until the year 2025 assuming 90% collection, based on a methane content of the landfill gas at 50%.

Process Flow Diagram

Fugitive Emissions: Paved and Unpaved Roadways

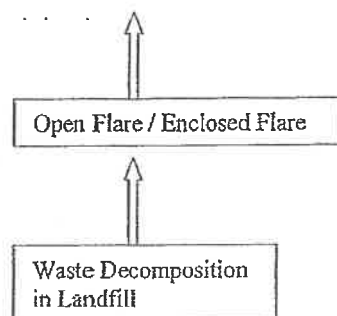


Fugitive Emissions: Landfill Operations



Stack Emissions: Gas Collection and Control System

Emissions from control equipment
(CO, NO_x, SO₂, PE, NMOC, VOC, HAPs)



ATTACHMENT 14

**RADIUS OF INFLUENCE CALCULATIONS
(APPENDIX A-2, GCCS DESIGN PLAN – UPDATED)**

ATTACHMENT 14

**RADIUS OF INFLUENCE CALCULATIONS
(APPENDIX A-2, GCCS DESIGN PLAN – UPDATED)**

APPENDIX A-2

**RADIUS OF INFLUENCE AND
WELL SPACING CALCULATIONS**

COMPUTATION SHEET

PROJECT TITLE: Lorain County Landfill GCCS PROJECT NO: 100452

DESCRIPTION: Vertical Well ROI Calculation CALC NO: _____ SHEET 1 OF 6

PREP. BY: PJL DATE: 11/15/10 CHKD BY: TAB DATE: 11/15/10

Required: Determine the radius of influence (ROI) for vertical LFG extraction wells, using both EMCON and NSPS methods for the average flow rate condition.

Purpose: The ROI is calculated in the design of an active gas extraction system to properly locate extraction wells. The location of the extraction well will dictate the well depth, once the refuse depth is known. A detail of each well can then be created with respect to total well depth, depth to slotted pipe, applied vacuum and rate of extraction.

Although horizontal collectors are not modeled directly by this analysis, the effected flow patterns developed by horizontal collectors are analogous to those created by vertical extraction wells. The net result is that vertical well spacing criteria can be translated directly to horizontal collectors in a similar environment.

Method: The following methods were used to estimate the theoretical ROI for an LFG extraction well.

A) EMCON Method (from *Methane Generation and Recovery from Landfills*, EMCON, 1982, pg. 81)

$$Q_w = \frac{k \pi R^2 t D r}{C}$$

where: Q_w = individual extraction well LFG flow rate [L/s]
 k = conversion factor (1.157×10^{-8}) [(L/s)/(mL/day)]
 R = radius of influence [m]
 t = perforated pipe length [m]
 D = in-place refuse density [kg/m³]
 r = methane production rate [mL/kg/day]
 C = fractional methane concentration [-]

1. Noting that the methane production rate (r) divided by the fractional methane concentration (C) is equal to the LFG production rate (G), and solving for the ROI yields:

$$R = \left(\frac{Q_w}{k \pi t D G} \right)^{1/2}$$

COMPUTATION SHEET

PROJECT TITLE: Lorain County Landfill GCCS PROJECT NO: 100452

DESCRIPTION: Vertical Well ROI Calculation CALC NO: _____ SHEET 2 OF 6

PREP. BY: PJL DATE: 11/15/10 CHKD BY: TAB DATE: 11/15/10

2. Converting from metric to English units yields the following conversion factors (allowing input in English units):

Q_w (from cfm to L/s):

$$\frac{1 \text{ ft}^3}{\text{min}} \times \frac{1 \text{ min}}{60 \text{ sec}} \times \frac{28.317 \text{ L}}{\text{ft}^3} = 0.47195$$

t (from ft to m):

$$1 \text{ ft} \times \frac{0.3048 \text{ m}}{\text{ft}} = 0.3048$$

D (from lb/cy to kg/m³):

$$\frac{1 \text{ lb}}{1 \text{ cy}} \times \frac{0.4536 \text{ kg}}{1 \text{ lb}} \times \frac{1 \text{ cy}}{27 \text{ ft}^3} \times \left(\frac{1 \text{ ft}}{0.3048 \text{ m}} \right)^3 = 0.5932$$

In addition, converting G from flow per volume to flow per mass equals:

G (from cfm/cy to mL/kg/day):

$$\begin{aligned} & \frac{1 \text{ ft}^3}{\text{min yd}^3} \times \left(\frac{1}{D} \times \frac{1 \text{ yd}^3}{1 \text{ lb}} \right) \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{24 \text{ hr}}{1 \text{ day}} \times \frac{28.317 \text{ L}}{\text{ft}^3} \times \frac{1 \text{ lb}}{0.4536 \text{ kg}} \times \frac{1000 \text{ mL}}{\text{L}} \\ &= \frac{89,895,238}{D} \end{aligned}$$

Therefore:

$$R = \left[\frac{0.47195 Q_w}{1.157 \times 10^{-8} \pi (0.3048 t) (0.5932 D) \left(\frac{89,895,238}{D} \times G \right)} \right]^{1/2}$$

Where: R is in meters

Q_w is in cfm

t is in feet

D is in lb/cy

G is in cfm/cy

COMPUTATION SHEET

PROJECT TITLE: Lorain County Landfill GCCS PROJECT NO: 100452

DESCRIPTION: Vertical Well ROI Calculation CALC NO: SHEET 3 OF 6

PREP. BY: PJL DATE: 11/15/10 CHKD BY: TAB DATE: 11/15/10

Then:

$$R = 0.8938 \left(\frac{Q_w}{t G} \right)^{1/2}$$

Converting results from meters to feet (1 ft = 0.3048 m):

$$0.3048R = 0.8938 \left(\frac{Q_w}{t G} \right)^{1/2}$$

$$R = 2.932 \left(\frac{Q_w}{t G} \right)^{1/2}$$

B) NSPS Method (from EPA NSPS Bid, 1991, pg. G-1)

$$R = \left(\frac{Q_w DC}{\pi L \rho Q_{gen} \eta} \right)^{1/2}$$

Where: ρ = in-place density of refuse [kg/m³]
 Q_w = LFG flow rate per well [m³/s]
DC = design capacity of landfill [kg]
L = perforated pipe length [m]
 Q_{gen} = peak LFG generation rate [m³/s]
 η = system collection efficiency [%]
R = radius of influence [m]

1. Converting from metric to English units yields the following conversion factors (allowing input in English units):

Q_w (from cfm to m³/s):

$$\frac{1 \text{ ft}^3}{1 \text{ min}} \times \frac{1 \text{ min}}{60 \text{ sec}} \times \left(\frac{0.3048 \text{ m}}{\text{ft}} \right)^3 = 4.719 \times 10^{-4}$$

DC (from tons to kg):

$$1 \text{ ton} \times \frac{2,000 \text{ lb}}{1 \text{ ton}} \times \frac{0.4536 \text{ kg}}{1 \text{ lb}} = 907.2$$

L (from ft to m):

COMPUTATION SHEET

PROJECT TITLE: Lorain County Landfill GCCS PROJECT NO: 100452
DESCRIPTION: Vertical Well ROI Calculation CALC NO: _____ SHEET 4 OF 6
PREP. BY: PJL DATE: 11/15/10 CHKD BY: TAB DATE: 11/15/10

$$1 \text{ ft} \times \frac{0.3048 \text{ m}}{\text{ft}} = 0.3048$$

ρ (from lb/cy to kg/m³):

$$\frac{1 \text{ lb}}{\text{yd}^3} \times \frac{0.4536 \text{ kg}}{1 \text{ lb}} \times \frac{1 \text{ yd}^3}{27 \text{ ft}^3} \times \left(\frac{1 \text{ ft}}{0.3048 \text{ m}} \right)^3 = 0.5933$$

Converting results from meters to feet (1 ft = 0.3048 m):

$$0.3048R = \left[\frac{(4.719 \times 10^{-4}) Q_w (907.2) DC}{\pi (0.3048L) (0.5933\rho) (4.719 \times 10^{-4} Q_{gen}) \eta} \right]^{1/2}$$

$$R = \frac{1}{0.3048} \left[\frac{(4.719 \times 10^{-4}) Q_w (907.2) DC}{\pi (0.3048L) (0.5933\rho) (4.719 \times 10^{-4} Q_{gen}) \eta} \right]^{1/2}$$

Example Calculation:

Estimate the ROI for the following average LFG flow rate condition at the XYZ Landfill

Given:

Design Capacity	=	2.5 x 10 ⁷ tons
Collection efficiency	=	70%
Average LFG generation rate	=	2,469 scfm
In-place refuse density	=	1,400 lb/cy
Depth of well	=	100 ft
Well flow rate	=	26 scfm

COMPUTATION SHEET

PROJECT TITLE: Lorain County Landfill GCCS PROJECT NO: 100452

DESCRIPTION: Vertical Well ROI Calculation CALC NO: SHEET 5 OF 6

PREP. BY: PJL DATE: 11/15/10 CHKD BY: TAB DATE: 11/15/10

A) EMCON Method

$$R = 2.932 \left(\frac{26 \text{ scfm}}{(100 \text{ ft}) \left(\frac{2,469 \text{ scfm}}{25,000,000 \text{ tons}} \right) \left(\frac{1 \text{ ton}}{2,000 \text{ lb}} \right) \left(\frac{1,400 \text{ lb}}{1 \text{ cy}} \right)} \right)^{1/2}$$

$$\underline{R = 180 \text{ ft}}$$

B) NSPS Method

$$R = \frac{1}{0.3048} \left[\frac{(4.719 \times 10^{-4})(26 \text{ scfm})(907.2)(25,000,000 \text{ tons})}{\pi (0.3048)(100 \text{ ft})(0.5933)(1,400 \text{ lb / cy})(4.719 \times 10^{-4})(2,469 \text{ scfm})(0.70)} \right]^{1/2}$$

$$\underline{R = 215 \text{ ft}}$$

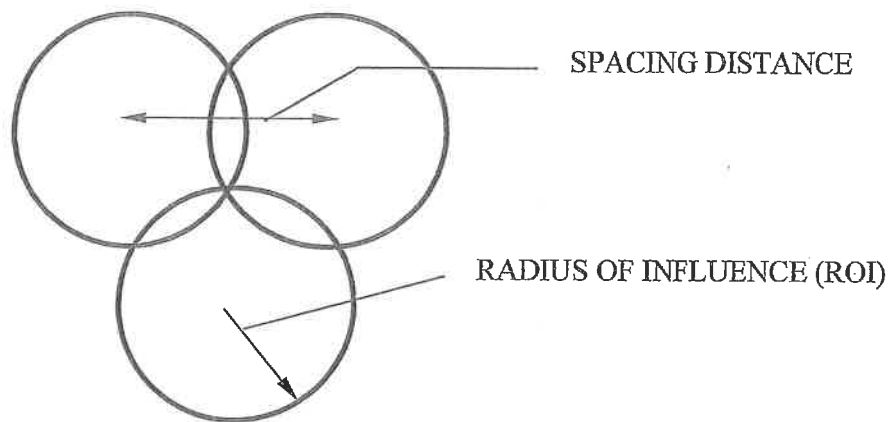
COMPUTATION SHEET

PROJECT TITLE: Lorain County Landfill GCCS PROJECT NO: 100452
DESCRIPTION: Vertical Well ROI Calculation CALC NO: SHEET 6 OF 6
PREP. BY: PJL DATE: 11/15/10 CHKD BY: TAB DATE: 11/15/10

Well Spacing

Utilizing the more conservative (EMCON) value for ROI of $R = 180$ ft for this extraction well, and applying the criteria for well spacing of:

$$\text{SPACING} = \sqrt{3} \text{ ROI}$$



$$\text{SPACING} = 312 \text{ ft}$$

Site Specific Calculations:

ROI and Well Spacing calculations for the Lorain County Landfill are shown on the attached spreadsheet (Table A-2). These calculations were performed for a series of typical well depths, ranging from 40 feet to 100 feet and will be utilized as the basis for determining well placement across the selected area of the Project.

Table A-2 (Updated per August 6, 2012 Response to Comments)
Landfill Gas Extraction Well Radii of Influence and Well Spacing
Based on Volume of Affected Refuse
Lorain Landfill, Oberlin, OH

Well Number	Well Depth (ft)	LFG Flow Rate Condition	LFG Flow Rate (scfm)	Radius of Influence (ft) ^{(a)(b)(c)}	
				NSPS	EMCON
A	40	Low	20	112	97
		Average	30	137	119
		High	40	159	138
B	60	Low	40	130	112
		Average	50	145	126
		High	60	159	138
C	80	Low	60	137	119
		Average	70	149	129
		High	80	159	138
D	100	Low	80	142	123
		Average	90	151	130
		High	100	159	138
E	120	Low	100	145	126
		Average	110	152	132
		High	120	159	138
F	140	Low	120	147	127
		Average	130	153	133
		High	140	159	138

MSW Design Capacity	36,973,926 Mg	LFG Generation Rate	21,000 scfm
MSW Design Tonnage	40,765,078 tons	Refuse Density	1,765 lb/cy
MSW Design Volume	46,192,723 cy	NSPS Collection Efficiency	75 %

Average ROI of Shallow Wells (< 45 Feet in Depth)
Average ROI of Medium Depth Wells (45 to 80 Feet in Depth)
Average ROI of Deep Wells (>80 feet in Depth)

119 feet	Well Spacing = >	206 feet
128 feet	Well Spacing = >	222 feet
132 feet	Well Spacing = >	229 feet

Notes:

- Radius of influence based on the estimated capacity of the facility
- Anticipated LFG generation rate.
- Calculations assume 20 feet of solid well casing from ground surface to start of perforations.
- Calculations based on Lorain II data. Lorain I GCCS previously completed.
- Calculations based on EMCON values. NSPS values provided for reference.