Hyland Facility Associates

6653 Herdman Road
Angelica, New York 14709

Phone: (585) 466-7271
Fax: (585) 466-3206

September 2, 2011

Ms. Connie Laport
New York State Department of Environmental Conservation
Division of Air
270 Michigan Avenue
Buffalo, NY 14203-2999

RE: Title V Permit Modification Additional Information – Hyland Facility Associates
Permit ID: 9-0232-00003/00012

Dear Ms. Laport:

Hyland Facility Associates (Hyland) is submitting the enclosed three copies of a new Appendix D for Hyland's Title V permit modification application for the 49 percent tonnage increase prepared by McMahon & Mann Consulting Engineers, PC (MMCE). MMCE prepared Appendix D in response to your letter dated July 15, 2011 requesting additional information regarding the Title V permit modification application. Included with each copy of Appendix D is a letter from MMCE addressing each of the comments in your July 15, 2011 letter. Also, enclosed is an updated Table of Contents to the Title V permit modification request that references Appendix D.

Also, in accordance with 6NYCRR Part 231-8.6, Hyland is requesting that the New York State Department of Environmental Conservation establish a Title V permit limit of annual GHG emissions equal to the projected actual emission value of 201,042 tons per year estimated by MMCE. As part of the permit modification application, Hyland proposes to demonstrate compliance with the annual GHG emission limit by tracking incoming waste loads on a daily basis, and semi-annually (i.e., by July 30 and January 30) estimating the GHG emission rate as CO_2 equivalents using the latest version of LandGEM.

If there is any further information that you require or if you have any questions, please contact me at (585) 466-7271.

Sincerely,

HYLAND FACILITY ASSOCIATES

Joseph R. Boyles
General Manager

Enclosures

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<u>APPENDICES</u>

MMCE Cover Letter

And

Appendix D – Title V Permit Modification Application
Proposed 49 Percent Annual Acceptance Rate Increase
Additional Application Requirements

2495 Main Street, Suite 432, Buffalo, NY 14214

Donald R. McMahon, P.E.
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McMahon & Mann
Consulting Engineers, P.C.

August 30, 2011
File: 93-002

Mr. Joseph Boyles
Hyland Facility Associates
6653 Herdman Road
Angelica, New York 14709

RE: Hyland Facility Associates,
Title V Permit Modification Additional Information
49 Percent Tonnage Increase

Dear Mr. Boyles;

McMahon & Mann Consulting Engineers, P.C. (MMCE) has prepared the enclosed Appendix D to Hyland's Title V permit modification application for the 49 percent annual tonnage increase. MMCE prepared Appendix D in response to the New York State Department of Environmental Conservation's (NYSDEC) letter dated July 15, 2011 requesting additional information regarding the Title V permit modification application. In their letter, the NYSDEC indicated that beginning July 1, 2011, greenhouse gases (GHG) are subject to New Source Review (NSR) for the purposes of determining applicability of prevention of significant deterioration (PSD) under 6 NYCRR Part 231. The NYSDEC's letter indicated that the PSD requirements apply to existing sources that emit or have the potential to emit 100/250 tons per year (t/yr) of GHG[1] (i.e., major stationary source[2]) and 100,000 t/yr of carbon dioxide equivalents (CO_2e) or more, when such stationary sources undertake a physical or operational change that results in an emissions increase of 75,000 t/yr CO_2e or more.

As a result of the new rule, the NYSDEC's letter states that Hyland is required to provide additional information in support of the Title V permit modification. Below is a listing of information requested in the letter followed by our response to each request:

1. *GHG emission calculations (including fugitive emissions) for the existing landfill with the current permitted waste acceptance rates in the year of maximum methane production. If this value is equal to or greater than 100,000 tpy CO_2 equivalents then the facility is an existing major source for GHG emissions. Based on preliminary estimates, Hyland landfill appears to be an existing major source of GHG emissions;*

[1] GHG include carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride.

[2] The term "major stationary source" is defined as a stationary source that emits, or has the potential to emit, at least 100 t/yr, if the source is one of the 28 listed source categories in 6 NYCRR Part 231-2.1(b)(21)(iii)(a) through (b). If the source is not a listed source category then the 250 t/yr would apply for it to be a "major stationary source".

Response

Estimates for GHG emissions from the existing landfill with the current permitted waste acceptance rate are included on a spreadsheet (Hyland Facility Associates Greenhouse (GHG) Emissions Estimate for 312,000 T/YR Waste Acceptance Rate) in Attachment 1 of enclosed Appendix D. MMCE estimated the year of maximum methane (CH_4) generation to be 2032, based on using LandGEM 3.02 (see Attachment 1, LandGEM Summary Report, Hyland Landfill – 312,000 t/yr). Using the CH_4 and CO_2 generated in 2032, MMCE estimated total GHG emissions from the landfill gas to energy (LFGTE) plant and the landfill to be 152,612 Mg/yr (168,178 t/yr) biogenic CO_2/CO_2e. Therefore, Hyland is an existing major source of GHG emissions.

2. *Actual GHG emissions emitted by the landfill in the previous year. This value represents the* <u>*baseline actual emissions*</u> *of the landfill;*

Response

Estimates for GHG emissions from the existing landfill in the year 2010 are included on a spreadsheet (Hyland Facility Associates Baseline Actual Greenhouse (GHG) Emissions Estimate for 2010) in Attachment 1 of enclosed Appendix D. MMCE estimated the landfill gas generation rate for 2010 using LandGEM 3.02 (see Attachment 1, LandGEM Summary Report, Hyland Landfill – 312,000 t/yr). Using the CH_4 and CO_2 generated in 2010, MMCE estimated the baseline actual GHG emissions from the LFGTE plant and the landfill to be 65,642 Mg/yr (72,337 t/yr) biogenic CO_2/CO_2e.

3. *The projected GHG emissions with the proposed annual waste acceptance rate increase in the maximum methane production year. This value represents the* <u>*projected actual emissions*</u> *of the landfill after the proposed modification;*

Response

Estimates for the projected actual GHG emissions from the existing landfill with the proposed annual acceptance rate are included on a spreadsheet (Hyland Facility Associates Greenhouse (GHG) Emissions Estimate for 465,000 T/YR Waste Acceptance Rate) in Attachment 1 of enclosed Appendix D. MMCE estimated the year of maximum landfill gas generation to be 2025, based on using LandGEM 3.02 (see Attachment 1, LandGEM Summary Report, Hyland Landfill – 2011 Title V Modification). Using the CH_4 and CO_2 generated in 2025, MMCE estimated total GHG emissions from the LFGTE plant and from the landfill to be 182,434 Mg/yr (201,042 t/yr) biogenic CO_2/CO_2e.

4. *The difference between the baseline actual emissions and the projected actual emissions results in the* <u>*project emission potential*</u>*. If the* <u>*project emission potential*</u> *or increase of GHG emissions is equal to or greater than 75,000 tpy* CO_2 *equivalent, then the modification is a major NSR modification. Based on preliminary estimates, the proposed landfill modification appears to be a major NSR modification for GHG emissions;*

Response

Subtracting the estimated baseline actual emissions (72,337 t/yr) from the projected actual emissions (201,042 t/yr) results in a GHG emission increase of 128,705 t/yr. Therefore, the request to increase the Hyland annual disposal rate from 312,000 t/yr to 465,000 t/yr is a major NSR modification.

5. *A Best Available Control Technology (BACT) review in accordance with 6NYCRR Part 231-8.7;*

Response

MMCE performed a BACT analysis that is included in the enclosed Appendix D.

6. *In accordance with 6NYCRR Part 231-8.6, Hyland is required to establish a permit limit of GHG emissions equal to the projected actual emission value. As part of the permit modification application, Hyland shall propose monitoring to demonstrate compliance with an annual GHG limit. The proposed monitoring is to include a daily monitoring requirement.*

Response

MMCE estimated the annual GHG projected actual emission value for the Hyland Landfill to be 201,042 t/yr. Therefore, Hyland Facility Associates should request the NYSDEC to use that estimate in establishing the permitted GHG emission limit for the Hyland Landfill. In order to demonstrate compliance with the annual GHG emission limit, Hyland Landfill should propose to track incoming waste loads on a daily basis and semi-annually (i.e., by July 30 and January 30) estimate the GHG (i.e., CH_4 and biogenic CO_2) emission rate as CO_2 equivalents using the latest version of LandGEM.

Please contact our office (716-834-8932) should you have any questions regarding this document.

Sincerely yours,

McMAHON & MANN CONSULTING ENGINEERS, P.C.

John A. Minichiello, CPESC, CPSWQ

Michael J. Mann, P.E.

Enclosure

McMahon & Mann Consulting Engineers, P.C.

APPENDIX D

HYLAND FACILITY ASSOCIATES

TITLE V PERMIT MODIFICATION APPLICATION
PROPOSED 49 PERCENT ANNUAL ACCEPTANCE RATE INCREASE
ADDITIONAL APPLICATION REQUIREMENTS

Prepared for:

Hyland Facility Associates
6653 Herdman Road
Angelica, New York 14709

Prepared by:

McMahon & Mann Consulting Engineers, P.C.
2495 Main Street, Suite 432
Buffalo, New York 14214

AUGUST 2011

TABLE OF CONTENTS

1. INTRODUCTION

Hyland Facility Associates, Inc. operates the Hyland Facility Associates Landfill (Hyland Landfill) located in the Town of Angelica, Allegany County, New York. The Hyland Landfill began receiving waste in Cell 1 of the landfill in 1998 and in Cell 2 of the landfill in 2003. In December 2006, Hyland Landfill received a permit modification for a 48-acre lateral expansion. The first phase of the expansion (Cell 3) was completed in 2007, and waste placement began in February 2008. As a result of the permitted landfill expansion in 2006, the landfill capacity was approximately 14,169,300 cubic yards, which exceeded the New Source Performance Standards (NSPS) limit of 2.5 million cubic meters in 40 CFR Part 60, Subpart WWW. NSPS requires submittal of an annual report estimating non-methane organic compound emissions from the landfill. In general, when the annual NMOC emission estimate equals or exceeds 50 mega grams per year (Mg/yr) a gas collection and control system design in accordance with NSPS is required to be submitted to the permitting authority for approval and installed once the design is approved. Presently, Hyland Landfill does not exceed the 50 MG/yr of annual NMOC emissions.

In February 2011, Hyland Landfill submitted a Title V permit modification to the New York State Department of Environmental Conservation (NYSDEC) requesting that the annual waste disposal rate be increased from 312,000 tons per year (t/yr) to 465,000 t/yr. The request would not increase the beneficial use determination (BUD) materials acceptance rate nor would the design capacity (i.e., 14,169,300 cubic yards) be increased.

Hyland Landfill received a letter from the NYSDEC indicating that effective May 23, 2011 there was an emergency adoption of 6NYCRR Part 231 (Part 231) to incorporate EPA's June 3, 2010 New Source Review (NSR) final rule for regulation of Greenhouse Gases (GHG) under its Prevention of Significant Deterioration (PSD) and Title V programs. Beginning July 1, 2011 GHG were subject to regulation for determining applicability of 6 NYCRR Part 231 with respect to Prevention of Significant Deterioration (PSD). However, the NYSDEC rule is slightly different than the EPA rule in that Part 231 does not exclude fugitive emissions from the landfill and does not recognize EPA's action to defer for a period of three years the consideration of biogenic CO_2 emissions from bioenergy and other biogenic sources (e.g. landfills) when determining whether a stationary source meets the PSD and Title V applicability thresholds, including those for the application of Best Available control Technology (BACT).

The letter indicated that the Hyland Landfill appeared to be an existing major source of GHG emissions and based on preliminary estimates the proposed annual waste disposal modification appeared to be a major New Source Review (NSR) modification for GHG emissions.

The applicability of Part 231 pertains to a new or existing major stationary source[1] that emits or has the potential to emit GHG of 100/250 t/yr and 100,000 t/yr carbon dioxide equivalent (CO_2e). An existing facility (e.g., Hyland Landfill) that meets this criterion is considered an existing major source of GHG emissions. If a modification to an existing major source of GHG emissions results in a project emission potential or increase of GHG emissions equal to or greater than 75,000 t/yr, then the modification is a major NSR modification.

Under Part 231-8.6, issuance of a permit for a NSR modification requires establishing a permit limit for GHG emissions equal to the projected actual emission value. Also, the applicant is required to propose monitoring to demonstrate compliance with the annual GHG emission limit as part of the permit modification application. In addition, under Part 231-8.7 a Best Available Control Technology analysis is required.

GHG emission estimates (see Attachment 1), including fugitive emissions, for the Hyland Landfill, using the current waste acceptance rate of 312,000 t/yr and in the year of maximum methane generation show the facility GHG emissions to be greater than 250 t/yr and GHG emissions to be greater than 100,000 t/yr[2]. Based on this emission estimate, the Hyland Landfill is an existing major source of GHG emissions. Further, the project emission potential estimate shows the proposed annual waste acceptance rate

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[1] The term “major stationary source” is defined as a stationary source that emits, or has the potential to emit, at least 100 t/yr, if the source is one of the 28 listed source categories in 6 NYCRR Part 231-2.1(b)(21)(iii)(a) through (b). If the source is not a listed source category, then the 250 t/yr would apply for it to be a “major stationary source”.

2 LandGEM v3.02 was used to estimate CH4 and CO2 generation rates based on the current 312,000 t/yr waste acceptance rate and the proposed 465,000 t/yr waste acceptance rate. The LandGEM reports are included in Attachment 1.

modification will result in an increase in GHG emissions equal to or greater than 75,000 t/yr[3].

2. LANDFILL GAS COLLECTION AND CONTROL

Hyland Landfill began installing an active gas collection and control system in 2003 to reduce landfill gas (LFG) emissions (i.e., CH_4, biogenic CO_2, non-methane organic compounds (NMOC)) and odors at the facility. The LFG collection and control system consists of a combination of vertical gas wells and horizontal collectors connected to gas transfer piping, ultimately terminating at a 3,000 cubic feet per minute (CFM) open flare. The active LFG collection system has been expanded in cells 1, 2 and 3 (see Figure 1).

Hyland Landfill constructed a 3-engine LFG to energy (LFGTE) power plant that began operation in August 2008. Hyland Landfill has designated the LFGTE plant as the primary LFG user with the existing open flare combusting the LFG that the LFGTE plant doesn't use. Based on the LandGEM model results included in Attachment 1, Hyland Landfill is expected to produce a maximum of approximately 3,000 CFM of LFG at the current annual disposal rate of 312,000 tons per year (t/yr). The maximum LFG generation rate would increase to approximately 3,500 CFM, if the annual disposal rate is increased to 465,000 t/yr. Because each LFGTE engine consumes approximately 500 CFM of LFG at maximum power output, the LFGTE plant will use LFG at a rate of approximately 1,500 CFM for all three engines or 2,000 CFM if a fourth engine is added to the LFGTE. The LFG would be combusted in the existing open flare or some other control device. At the present time, the LFGTE plant is combusting approximately 1,500 CFM of LFG.

3. BEST AVAILABLE CONTROL TECHNOLOGY (BACT) ANALYSIS

The NYSDEC recommends that a BACT analysis be performed in accordance with the EPA Top-Down BACT Process[4]. In general the BACT analysis involves identifying all available control technologies for a given pollutant and ranking them in descending order

[3] The project emission potential is estimated by subtracting the baseline actual emissions (2010) from the projected actual emissions. Both are provided in Attachment 1.

[4] EPA has provided a guidance document entitled *PSD AND TITLE V PERMITTING GUIDANCE FOR GREEHOUSE GASES*, March 2011 that describes the BACT analysis process in more detail.

of control effectiveness. The applicant should first examine the first option (top ranked) on the list. The top ranked option is then established as BACT unless the applicant demonstrates to the satisfaction of the permitting authority (i.e. NYSDEC or EPA) that technical considerations, or energy, environmental, or economic impacts show that the top ranked technology as not achievable. If the most effective control strategy is eliminated, then the next BACT alternative on the list is evaluated, and so on, until an option is selected as BACT.

The BACT analysis process is broken down into the following five steps:

- Step 1 – Identify all available control technologies;
- Step 2 – Eliminate technically infeasible options;
- Step 3 – Rank remaining control technologies;
- Step 4 – Evaluate most effective controls and document results; and
- Step 5 – Select the BACT.

3.1 BACT Step 1 – Identify All Available Control Technologies

EPA guidance suggests that in order to meet the regulatory requirements of BACT, the applicant must focus on technologies that have been demonstrated to achieve the highest levels of control for the pollutant in question, regardless of the source type. In this case, the pollutant is the CH_4 in LFG and the source is the Hyland Landfill.

In general, NSPS provides some direction in selecting BACT technologies for controlling LFG emissions from a municipal solid waste landfill based on the LFG collection and control system (GCCS) requirements. The NSPS calls for an active collection system that is:

1. Designed to handle the maximum expected gas flow rate from the entire area of the landfill that warrants control over the intended use period of the gas control or treatment system equipment; and
2. Collect gas from each area, cell or group of cells in the landfill in which the solid waste has been placed for a period of:
    - 5 years or more if active; or
    - 2 years or more if closed or at final grade;
    - Collect gas at a sufficient extraction rate; and

- o Be designed to minimize off-site migration of subsurface gas.

NSPS also provides for a control device(s) used to manage the gas after it is collected:

1. An open flare designed and operated in accordance with 40 CFR Part 60.18, except as noted in 40 CFR Part 60.754;
2. A control system designed and operated to reduce NMOC by 98 percent by weight, or, when an enclosed combustion device is used for control, to either reduce NMOC by 98 percent by weight or reduce the outlet NMOC concentration to less than 20 parts per million by volume, dry basis as hexane at 3 percent oxygen; or
3. Route the collected gas to a treatment system that processes the collected gas for subsequent sale or use.

In addition, NSPS provides details for operational standards for the GCCS, methods for estimating the maximum expected gas generation flow rate, methods for monitoring operation of the gas collection system and record keeping and reporting requirements.

NSPS provides regulatory guidance for controlling LFG emissions from the landfill. Controlling LFG emissions also controls the amount of GHG in the form of CH_4 emitted to the atmosphere. Based in part on the provisions of NSPS for controlling LFG emissions, Hyland Landfill has selected the following as available control technologies:

1. Active LFG collection and control system which includes vertical and horizontal extraction wells, a 3,000 CFM open flare and a LFGTE plant that only combusts the LFG;
2. An enclosed 3,000 CFM flare to replace the open flare;
3. Install vertical and horizontal collection wells sooner than the NSPS 5 year period after the initial solid waste is placed;
4. Monitor methane emissions from the landfill surface in accordance with NSPS;
5. Install final landfill cap; and
6. LFG pre-treatment system.

3.2 BACT Step 2 – Eliminate Technically Infeasible Options

In its guidance document, EPA generally considers a technology to be technically feasible if:

- It has been operated successfully on the same type of source under review; or
- It is available and applicable to the source type under review.

All of the technologies listed in Step 1 are technologically feasible for the purpose of controlling LFG emissions from the Hyland Landfill. However, at the present time a 3,000 CFM enclosed flare is not needed due to the presence of the already existing 3,000 CFM open flare, which is assumed to have a similar combustion efficiency to an enclosed flare[5]. The blower on the 3,000 CFM open flare might need replacement to a larger capacity blower that might be necessary for maintaining a vacuum at the furthest wells of the active gas collection system. Replacement of the blower would cost approximately $50,000, while a 3,000 CFM enclosed flare would cost approximately $250,000 to $300,000. Therefore, the enclosed flare can be removed from the list of control technologies.

The remaining control technologies are all feasible as they either exist or can be implemented under current rules regulating the design, monitoring and operation of the GCCS and the landfill.

3.3 BACT Step 3 – Ranking of Control Technologies

EPA's guidance calls for the remaining control technologies from Step 2 to be listed in order of overall control effectiveness for the regulated NSR pollutant under review:

1. Active GCCS which includes vertical and horizontal extraction wells, a 3,000 CFM open flare and a LFGTE plant that only combust the LFG;
2. Install vertical and horizontal collection wells sooner than the NSPS 5 year period after the initial solid waste is placed;
3. Monitor methane emissions from the landfill surface in accordance with NSPS;

5 In EPA's guidance document *Available and Emerging Technologies forRreducing Greenhouse Gas Emissions From Municipal Solid Waste Landfills*, dated June 2011, EPA states, "While open flares are thought to have combustion efficiencies similar to those of enclosed flares, data are not available to confirm this because open-air combustion makes them difficult to test."

4. Install final landfill cap; and
5. LFG pre-treatment system.

For the control technologies listed above, item #1 (active GCCS) is the most effective at controlling LFG emissions. The next four items as discussed below, support the effectiveness of the GCCS in maintaining it as BACT.

Active LFG collection system is connected to a flare or LFGTE plant have been shown to have the highest level of control of LFG emissions. Many of the existing municipal solid waste landfills that fall under NSPS have an active gas collection system connected to an open or enclosed flare, a LFGTE plant, or a LFG pre-treatment system. When operated in accordance with NSPS the GCCS is capable of collecting 75 to 95 percent of the landfill gas generated in the landfill, depending on the type of cover (e.g., daily cover, intermediate cover, or final synthetic and/or soil cover). As previously mentioned, the Hyland LFG collection system was initially connected to an open flare. In 2007, Hyland Landfill made application to the NYSDEC for a permit to construct and operate a LFGTE plant to convert LFG into a renewable energy resource consistent with New York policy regarding renewable energy resources. The timing of the permit application was such that the necessary approvals could be obtained from the NYSDEC so that construction of the LFGTE plant could be completed by the end of 2008, in order to qualify for certain government incentives related to renewable resource development.

The Hyland Landfill began installing an active LFG collection system in 2003 before it was subject to the NSPS requirements. Both vertical (designated as GW on Figure 1) and horizontal collectors (designated as HTW on Figure 1) have been installed and connected to a main header pipe that is connected to the open flare and the LFGTE plant. In general, a horizontal collector is installed across the landfill surface with each 30 foot lift of solid waste. Vacuum is not applied to the horizontal collector until it is covered with approximately 30 feet of waste and is producing landfill gas with high enough CH_4 to allow the flare and/or LFGTE plant to operate and low enough oxygen or nitrogen content not to exceed the NSPS limits of 5 percent oxygen and 20 percent nitrogen. The horizontal collectors are installed at approximately 100 foot intervals across the landfill surface as shown in Figure 1. Vertical collectors are installed to compliment or replace the horizontal collectors when the depth of the waste mass is approximately 50 to 60 feet deep.

The vertical and horizontal collectors are monitored on a monthly basis in accordance with the Title V permit for:

- Temperature;
- Vacuum;
- CH_4 content; and
- Percent oxygen or nitrogen.

Under NSPS, a GCCS is operated so that CH_4 concentration is less than 500 parts per million by volume (ppmv) above background at the surface of the landfill. This monitoring is required to demonstrate that the active GCCS is designed to handle the maximum expected gas flow rate from the entire area of the landfill that warrants control over the intended use period of the gas control or treatment system equipment. Hyland Landfill presently does not monitor the CH_4 concentrations at the surface of the landfill. However, to demonstrate that the 500 ppmv CH_4 concentration is not being exceeded, Hyland Landfill is proposing to include monitoring the CH_4 concentrations at the surface of the landfill in accordance with NSPS criteria as part of BACT for the active GCCS.

Installation of a final cover will occur when portions of the Hyland Landfill reach final grade. Installing the final cover will act as a barrier to fugitive emissions from the landfill surface and allow GCCS collection efficiencies as high as 95 percent and reduce LFG fugitive emissions by approximately 80 percent.

The existing pre-treatment system removes moisture and some impurities in the LFG prior to combustion in the Caterpillar (CAT) G3520C lean burn engines. The resulting pre-treatment prior to combustion generates a more consistent quality of LFG that results in minimizing the daily engine adjustments. The pre-treatment system provides the engines with a cleaner drier gas, which results in minimizing deposit build-ups in the engine cylinders, therefore reducing annual engine maintenance by as much as 50 percent and reducing downtime.

3.4 BACT Step 4 – Economic, Energy, and Environmental Impacts

Hyland Landfill committed to spending approximately ten million dollars for the construction of the LFGTE plant to convert LFG into a renewable energy resource consistent with New York policy regarding renewable energy resources. The timing of the permit application was such that the necessary approvals could be obtained from the NYSDEC so that construction of the LFGTE plant could be completed by the end of 2008, in order to qualify for certain government incentives related to renewable resource development.

Producing electrical energy from LFG reduces the need for petroleum based fuels to produce the same amount of energy. Based on the nominal heat value for LFG of 456 BTU per standard cubic foot, the fuel consumption for each engine at 100 percent load is approximately 6,354 BTU/bhp-hr (see Attachment 2 – Caterpillar Gas Engine Technical Data). Based on the data in Attachment 2, each engine has a power rating of approximately 2233 bhp. Using the power rating and the fuel consumption (see Attachment 3), each engine generates approximately 14,534,597 BTU/hr. A gallon of heating oil has a heating value of approximately 140,000 BTU/gal. In order to generate the same amount of energy per hour as the CAT G3520C engine using LFG, approximately 104 gal/hr of heating fuel would be required. Assuming the LFGTE plant is on line 97 percent of the time, this would equate to approximately 880,000 gallons of heating fuel per year or approximately 21,000 barrels of heating fuel per year for each engine or 63,000 barrels of heating oil annually for three engines (see Attachment 3).

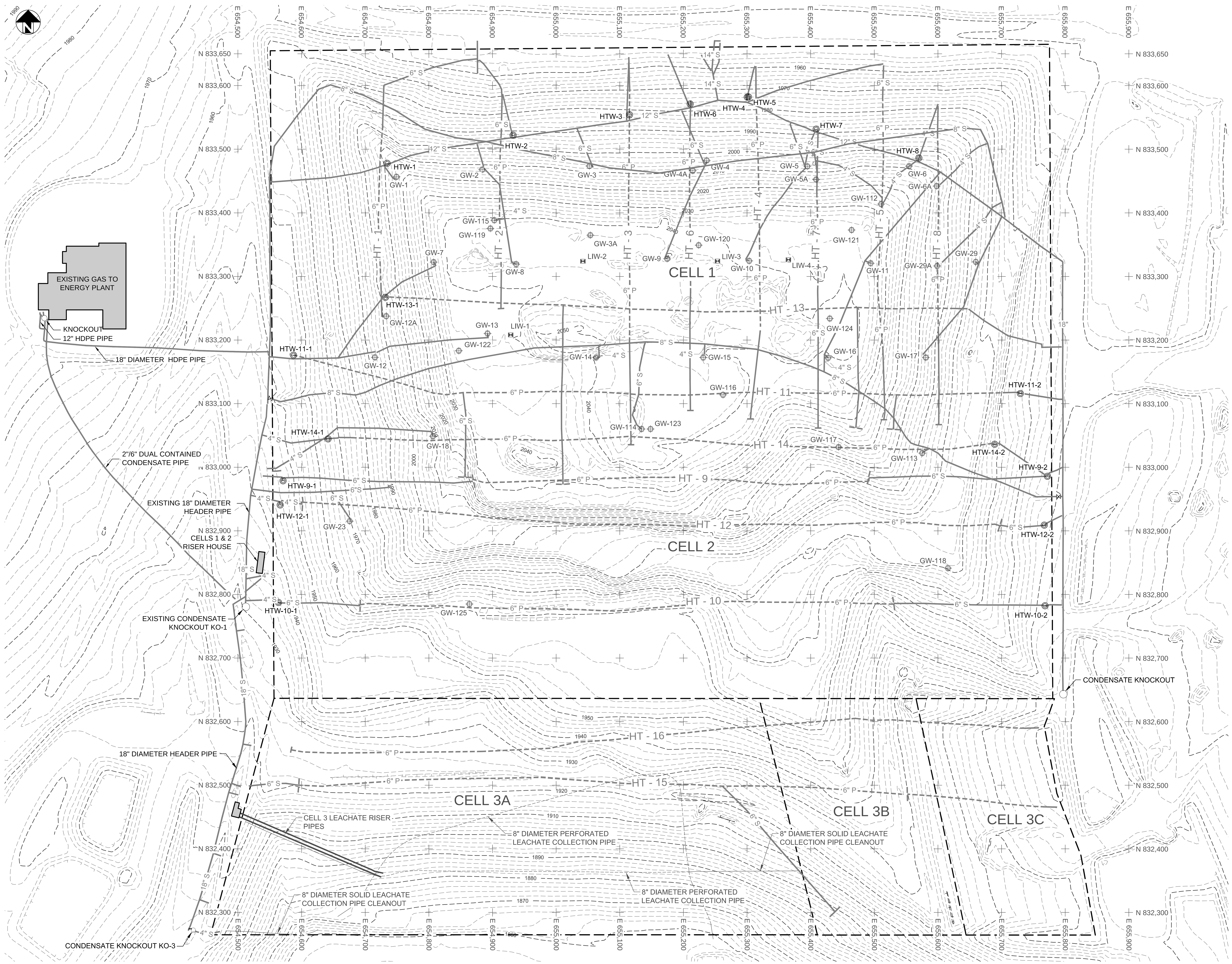
The three engines used for this energy conversion are CAT G3520C lean burn engines designed to produce low nitrogen oxides (NOx) and carbon monoxide (CO) stack emissions. NOx and CO emissions from each internal combustion engine are analyzed monthly using a portable combustion analyzer. This periodic monitoring is being used to confirm that the engines consistently operate within the permitted emission rates for internal combustion engines for NOx (i.e., 0.6 grams per brake horsepower-hour (g/bhp-hr)) and CO (i.e., 3.0 g/bhp-hr). The NOx and CO emissions monitoring results using the combustion analyzer show emission levels to be consistently below the permitted emission rates. An Operation and Maintenance Plan has been prepared for the LFGTE plant and approved by the NYSDEC to assure that the plant is operated efficiently.

3.5 BACT Step 5 – Selecting BACT

Given that the active GCCS is the most effective option for controlling LFG emissions from the Hyland Landfill it should be selected as BACT. The remaining options should also be included in the BACT determination as these options support the effectiveness of the active GCCS. Therefore, complying with the landfill design and operation requirements of NSPS for controlling LFG emissions should be considered as BACT for the purposes of the Title V permit modification to increase the Hyland Landfill annual tonnage acceptance rate from 312,000 t/yr to 465,000 t/yr.

FIGURE

Figure 1 – Hyland Facility Existing Gas Collection System Plan



LEGEND

---1970---	EXISTING CONTOURS (SEE NOTE 1)
— — —	CELL LIMITS
———	EXISTING SOLID GAS COLLECTION PIPE (SEE NOTE 2)
- - - -	EXISTING PERFORATED GAS COLLECTION PIPE (SEE NOTE 2)
GW-4	EXISTING GAS WELL LOCATION AND DESIGNATION (SEE NOTE 2)
HTW-9-2	EXISTING TRENCH WELLHEAD LOCATION AND DESIGNATION (SEE NOTE 2)
LIW-1	LEACHATE INJECTION WELL LOCATION AND DESIGNATION

NOTES:

1. Existing contours compiled by aero-metric using photogrammetric methods from aerial photography dated November 2, 2010.
2. Existing gas collection system components based on the following plans prepared by B&R Surveying, P.L.L.C.
   a. Cell #1 & #2 Gas Collection System Record Drawing dated January 20, 2008.
   b. 2008 Additions Made to Gas Collection System dated June 13, 2008 and July 11, 2008.
   c. West Gas Header Extension Record Plan dated December 30, 2009.
   d. HT-15 and HT-16 Record Plan dated January 19, 2010.
   e. Additions Made to Gas Collection System and Revised to Show 2009 Alteration.
   f. HT-15 and HT-16 Record Plan dated January 19, 2010.

1 / 1 EXISTING GAS COLLECTION SYSTEM PLAN

SCALE: 1" = 80'

80' 0 40' 80'
SCALE: 1" = 80'

NOTE:
UNAUTHORIZED ALTERATION OR ADDITION TO ANY SURVEY, DRAWING, DESIGN, SPECIFICATION, PLAN, OR REPORT IS A VIOLATION OF SECTION 7209 PROVISION 2 OF THE NEW YORK STATE EDUCATION LAW.

REV 1
REV 2
REV 3
REV 4
REV 5

McMahon & Mann
Consulting Engineers, P.C.
2495 MAIN STREET, SUITE 432
BUFFALO, NY 14214
(716) 834-8932
FAX: (716) 834-8934

HYLAND FACILITY EXISTING GAS COLLECTION SYSTEM PLAN

ALLEGANY COUNTY NEW YORK

DRAWN BY:	C.R.G.
CHECKED BY:	S.W.L.
SCALE:	1" = 80'
DATE:	AUGUST 2011
JOB NO.	93-002
FIGURE	1
DWG. NO.	93002-573
REVISION NUMBER -	0

ATTACHMENT 1

NSR GHG Emission Estimates

Hyland Facility Associates Greenhouse Gas (GHG) Emissions Estimate for 312,000 T/YR Waste Acceptance Rate

Year of Maximum Landfill Gas Generation - 2032 Based on LandGem 3.02 Model

Methane (CH4) Generation[1]	14,580	Mg/yr
Biogenic Carbon Dioxide (biogenic CO2) Generation[2]	40,010	Mg/yr

Assume 75 % Collection Efficiency

CH4 Generation x 0.25 =	3,645	Mg/yr	CH4 landfill fugitive emissions
CH4 Generation x 0.75 =	10,935	Mg/yr	CH4 collected for combustion
biogenic CO2 Generation x 0.25 =	10,003	Mg/yr	biogenic CO2 landfill fugitive emissions
biogenic CO2 Generation x 0.75 =	30,008	Mg/yr	biogenic CO2 collected

GHG Emissions Biogenic CO2/CO2 Equivalents (CO2e)

Fugitive Landfill Emissions:

3,645	Mg/yr	CH4 landfill fugitive emissions x 21 CO2e/CH4 =	76,545	Mg/yr CO2e
10,003	Mg/yr	biogenic CO2 landfill fugitive emissions	10,003	Mg/yr biogenic CO2
		Total fugitive emissions	**86,548**	**Mg/yr biogenic CO2e**

LFGTE Plant GHG Emissions:

Convert collected CH4 to biogenic CO2 via combustion assuming the LFGTE plant has 97% CH4 destruction efficiency..

MW CH4 = 16 g/mole
MW CO2 = 44 g/mole

Ratio of MW CO2:MW CH4 = 2.75

10,935 Mg/yr CH4 collected for combustion x 0.97 x 2.75 = **29,169 Mg/yr biogenic CO2**

Convert 3% of uncombusted CH4 to CO2e

10,935 Mg/yr CH4 collected for combustion x 0.03 x 21 CO2e/CH4 = **6,889 Mg/yr CO2e**

Add biogenic CO2 from collected landfill gas.

30,008 Mg/yr biogenic CO2 collected

Total LFGTE plant GHG emissions: **66,066 Mg/yr biogenic CO2/CO2e**

Total GHG Emissions From LFGTE Plant and Landfill Fugitive Emissions

Fugitive Landfill GHG Emissions:	86,548	Mg/yr biogenic CO2/CO2e
LFGTE Plant GHG Emissions:	66,066	Mg/yr biogenic CO2/CO2e
	152,613	**Mg/yr biogenic CO2/CO2e**

Convert Mg/yr to tons per year (t/yr)

1 Mg = 1.102 t **168,180 t/yr biogenic CO2/CO2e**

Notes:
1. Global warming potential (GWP) for CH4 is 21 CO2 equivalents
2. GWP for CO2 is 1 CO2 equivalent

Hyland Facility Associates Baseline Actual Greenhouse Gas (GHG) Emissions Estimate for 2010

Year of Maximum Landfill Gas Generation - 2010 Based on LandGem 3.02 Model

Methane (CH_4) Generation	6,271	Mg/yr
Biogenic Carbon Dioxide (biogenic CO_2) Generation	17,210	Mg/yr

Assume 75 % Collection Efficiency

CH4 Generation x 0.25 =	1,568	Mg/yr CH4 landfill fugitive emissions
CH4 Generation x 0.75 =	4,703	Mg/yr CH4 collected for combustion
biogenic CO2 Generation x 0.25 =	4,303	Mg/yr biogenic CO2 landfill fugitive emissions
biogenic CO2 Generation x 0.75 =	12,908	Mg/yr biogenic CO2 collected

GHG Emissions Biogenic CO2/CO2 Equivalents (CO2e)

Fugitive Landfill Emissions:

1,568 Mg/yr CH4 landfill fugitive emissions x 21 CO2 Equiv./CH4 =	32,923	Mg/yr CO2e
4,303 Mg/yr biogenic CO2 landfill fugitive emissions	4,303	Mg/yr biogenic CO2
Total fugitive emissions	**37,225**	**Mg/yr biogenic CO2/CO2e**

LFGTE Plant GHG Emissions:

Convert collected CH4 to biogenic CO2 via combustion assuming the LFGTE plant has 97% CH4 destruction efficiency..

MW CH4 = 16 g/mole
MW CO2 = 44 g/mole

Ratio of MW CO2:MW CH4 = 2.75

4,703 Mg/yr CH4 collected for combustion x 0.97 x 2.75 = **12,546 Mg/yr biogenic CO2**

Convert 3% of uncombusted CH4 to CO2e

4,703 Mg/yr CH4 collected for combustion x 0.03 x 21 CO2e/CH4 = **2,963 Mg/yr CO2e**

Add CO2 from collected landfill gas.

12,908 Mg/yr biogenic CO2 collected

Total LFGTE plant GHG emissions: **28,416 Mg/yr biogenic CO2/CO2e**

Total GHG Emissions From LFGTE Plant and Landfill Fugitive Emissions

Fugitive Landfill GHG Emissions:	37,225	Mg/yr biogenic CO2/CO2e
LFGTE Plant GHG Emissions:	28,416	Mg/yr biogenic CO2/CO2e
	65,642	**Mg/yr biogenic CO2/CO2e**

Convert Mg/yr to tons per year (t/yr)

1 Mg = 1.102 t **72,337 t/yr biogenic CO2/CO2e**

Hyland Facility Associates Projected Actual Greenhouse Gas (GHG) Emissions Estimate for 465,000 T/YR Waste Acceptance Rate

Year of Maximum Landfill Gas Generation - 2025 Based on LandGem 3.02 Model

Methane (CH_4) Generation 17,430 Mg/yr
Biogenic Carbon Dioxide (biogenic CO_2) Generation 47,820 Mg/yr

Assume 75 % Collection Efficiency

CH_4 Generation x 0.25 = 4,358 Mg/yr CH_4 landfill fugitive emissions
CH_4 Generation x 0.75 = 13,073 Mg/yr CH_4 collected for combustion

biogenic CO_2 Generation x 0.25 = 11,955 Mg/yr biogenic CO_2 landfill fugitive emissions
biogenic CO_2 Generation x 0.75 = 35,865 Mg/yr biogenic CO_2 collected

GHG Emissions Biogenic CO2/CO2 Equivalents (CO2e)

Fugitive Landfill Emissions:

4,358 Mg/yr CH_4 landfill fugitive emissions x 21 CO_2 Equiv./CH_4 = 91,508 Mg/yr CO_2e
11,955 Mg/yr biogenic CO_2 landfill fugitive emissions 11,955 Mg/yr biogenic CO_2
Total fugitive emissions **103,463 Mg/yr biogenic CO2/CO2e**

LFGTE Plant GHG Emissions:

Convert collected CH_4 to biogenic CO_2 via combustion assuming the LFGTE plant has 97% CH_4 destruction efficiency..

MW CH_4 = 16 g/mole
MW CO_2 = 44 g/mole

Ratio of MW CO_2:MW CH_4 = 2.75

13,073 Mg/yr CH_4 collected for combustion x 0.97 x 2.75 = **34,871 Mg/yr biogenic CO2**

Convert 3% of uncombusted CH_4 to CO_2e

13,073 Mg/yr CH_4 collected for combustion x 0.03 x 21 CO_2e/CH_4 = **8,236 Mg/yr CO2e**

Add CO_2 from collected landfill gas.

35,865 Mg/yr biogenic CO2 collected

Total LFGTE plant GHG emissions: **78,972 Mg/yr biogenic CO2/CO2e**

Total GHG Emissions From LFGTE Plant and Landfill Fugitive Emissions

Fugitive Landfill GHG Emissions: 103,463 Mg/yr biogenic CO_2/CO_2e
LFGTE Plant GHG Emissions: 78,972 Mg/yr biogenic CO_2/CO_2e
182,434 Mg/yr biogenic CO2/CO2e

Convert Mg/yr to tons per year (t/yr)

1 Mg = 1.102 t **201,042 t/yr biogenic CO2/CO2e**

Estimated Project Emission Potential

Baseline Actual Emissions = **72,337 t/yr biogenic CO2/CO2e**
Project Actual Emissions = **201,042 t/yr biogenic CO2/CO2e**

Project Actual Emissions - Baseline Actual Emissions = **128,705 t/yr biogenic CO2/CO2e Project Emission Potential**

Summary Report

Landfill Name or Identifier: Hyland Landfill - 2011 Title V Modification

Date: Thursday, August 18, 2011

Description/Comments:

About LandGEM:

First-Order Decomposition Rate Equation:

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

Where,

Q_{CH4} = 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/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 convential 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	**1998**	
Landfill Closure Year (with 80-year limit)	**2025**	
Actual Closure Year (without limit)	***2025***	
Have Model Calculate Closure Year?	**Yes**	
Waste Design Capacity	**9,567,778**	*short tons*

MODEL PARAMETERS

Methane Generation Rate, k	**0.050**	*$year^{-1}$*
Potential Methane Generation Capacity, L_o	**100**	*m^3/Mg*
NMOC Concentration	**211**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1998	112,387	123,626	0	0
1999	112,387	123,626	112,387	123,626
2000	112,387	123,626	224,774	247,251
2001	208,895	229,784	337,161	370,877
2002	204,673	225,140	546,055	600,661
2003	217,893	239,682	750,728	825,801
2004	209,612	230,573	968,621	1,065,483
2005	214,460	235,906	1,178,233	1,296,056
2006	224,391	246,830	1,392,693	1,531,962
2007	310,784	341,862	1,617,084	1,778,792
2008	277,865	305,652	1,927,867	2,120,654
2009	194,805	214,285	2,205,733	2,426,306
2010	143,926	158,319	2,400,537	2,640,591
2011	422,727	465,000	2,544,464	2,798,910
2012	422,727	465,000	2,967,191	3,263,910
2013	422,727	465,000	3,389,918	3,728,910
2014	422,727	465,000	3,812,645	4,193,910
2015	422,727	465,000	4,235,373	4,658,910
2016	422,727	465,000	4,658,100	5,123,910
2017	422,727	465,000	5,080,827	5,588,910
2018	422,727	465,000	5,503,555	6,053,910
2019	422,727	465,000	5,926,282	6,518,910
2020	422,727	465,000	6,349,009	6,983,910
2021	422,727	465,000	6,771,736	7,448,910
2022	422,727	465,000	7,194,464	7,913,910
2023	422,727	465,000	7,617,191	8,378,910
2024	422,727	465,000	8,039,918	8,843,910
2025	235,334	258,868	8,462,645	9,308,910
2026	0	0	8,697,980	9,567,778
2027	0	0	8,697,980	9,567,778
2028	0	0	8,697,980	9,567,778
2029	0	0	8,697,980	9,567,778
2030	0	0	8,697,980	9,567,778
2031	0	0	8,697,980	9,567,778
2032	0	0	8,697,980	9,567,778
2033	0	0	8,697,980	9,567,778
2034	0	0	8,697,980	9,567,778
2035	0	0	8,697,980	9,567,778
2036	0	0	8,697,980	9,567,778
2037	0	0	8,697,980	9,567,778

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2038	0	0	8,697,980	9,567,778
2039	0	0	8,697,980	9,567,778
2040	0	0	8,697,980	9,567,778
2041	0	0	8,697,980	9,567,778
2042	0	0	8,697,980	9,567,778
2043	0	0	8,697,980	9,567,778
2044	0	0	8,697,980	9,567,778
2045	0	0	8,697,980	9,567,778
2046	0	0	8,697,980	9,567,778
2047	0	0	8,697,980	9,567,778
2048	0	0	8,697,980	9,567,778
2049	0	0	8,697,980	9,567,778
2050	0	0	8,697,980	9,567,778
2051	0	0	8,697,980	9,567,778
2052	0	0	8,697,980	9,567,778
2053	0	0	8,697,980	9,567,778
2054	0	0	8,697,980	9,567,778
2055	0	0	8,697,980	9,567,778
2056	0	0	8,697,980	9,567,778
2057	0	0	8,697,980	9,567,778
2058	0	0	8,697,980	9,567,778
2059	0	0	8,697,980	9,567,778
2060	0	0	8,697,980	9,567,778
2061	0	0	8,697,980	9,567,778
2062	0	0	8,697,980	9,567,778
2063	0	0	8,697,980	9,567,778
2064	0	0	8,697,980	9,567,778
2065	0	0	8,697,980	9,567,778
2066	0	0	8,697,980	9,567,778
2067	0	0	8,697,980	9,567,778
2068	0	0	8,697,980	9,567,778
2069	0	0	8,697,980	9,567,778
2070	0	0	8,697,980	9,567,778
2071	0	0	8,697,980	9,567,778
2072	0	0	8,697,980	9,567,778
2073	0	0	8,697,980	9,567,778
2074	0	0	8,697,980	9,567,778
2075	0	0	8,697,980	9,567,778
2076	0	0	8,697,980	9,567,778
2077	0	0	8,697,980	9,567,778

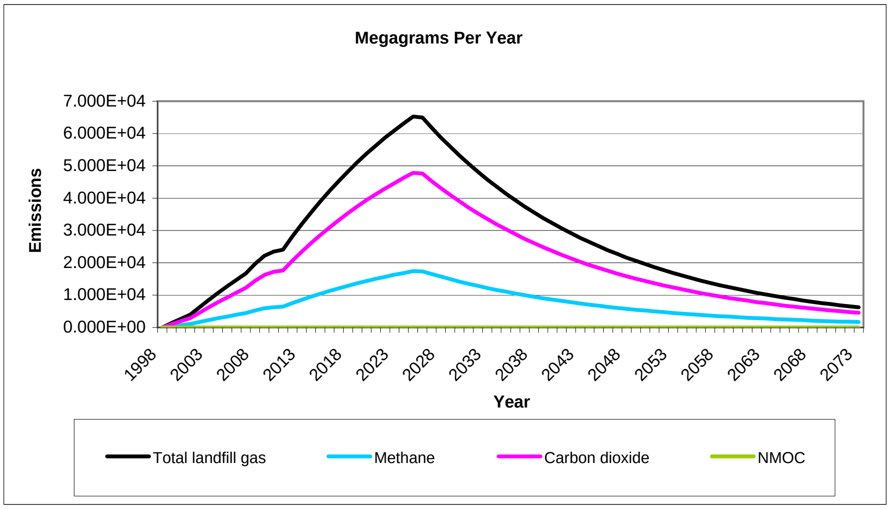
Pollutant Parameters

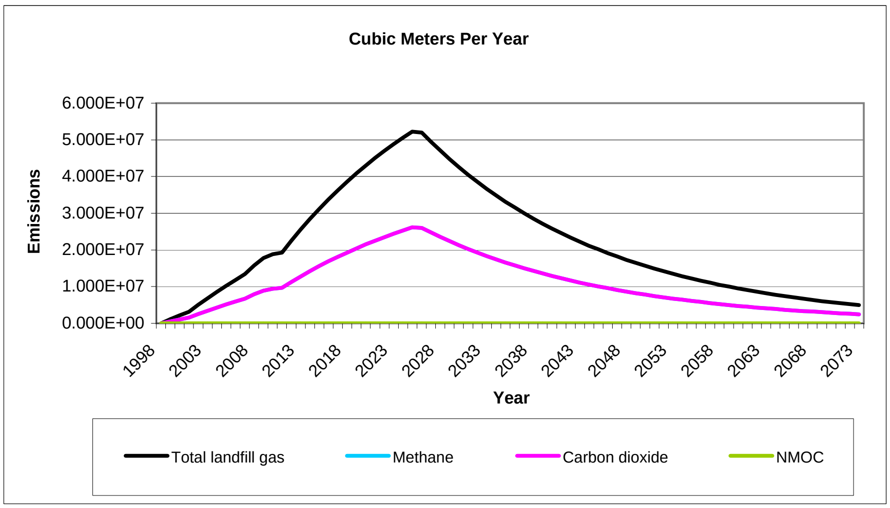
		Gas / Pollutant Default Parameters:		User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl 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		

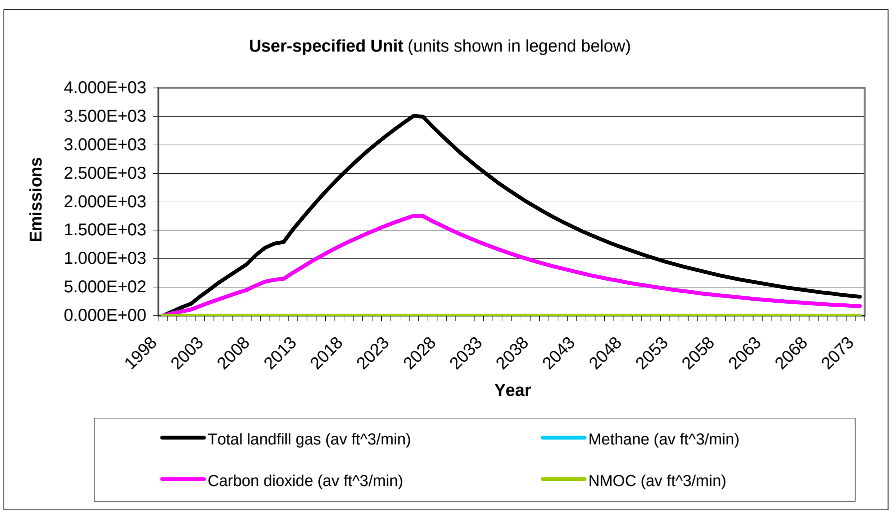
Pollutant Parameters (Continued)

	Gas / Pollutant Default Parameters:			User-specified Pollutant Parameters:	
	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		
	Hydrogen sulfide			280.00	34.08
	Reduced sulfur as sulfur dioxide			285.00	64.07

Graphs


Megagrams Per Year
7.000E+04
6.000E+04
5.000E+04
4.000E+04
3.000E+04
2.000E+04
1.000E+04
0.000E+00
Emissions
1998
2003
2008
2013
2018
2023
2028
2033
2038
2043
2048
2053
2058
2063
2068
2073
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
6.000E+07
5.000E+07
4.000E+07
3.000E+07
2.000E+07
1.000E+07
0.000E+00
Emissions
1998
2003
2008
2013
2018
2023
2028
2033
2038
2043
2048
2053
2058
2063
2068
2073
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
4.000E+03
3.500E+03
3.000E+03
2.500E+03
2.000E+03
1.500E+03
1.000E+03
5.000E+02
0.000E+00
Emissions
1998
2003
2008
2013
2018
2023
2028
2033
2038
2043
2048
2053
2058
2063
2068
2073
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1998	0	0	0	0	0	0
1999	1.372E+03	1.099E+06	7.384E+01	3.666E+02	5.495E+05	3.692E+01
2000	2.678E+03	2.144E+06	1.441E+02	7.153E+02	1.072E+06	7.204E+01
2001	3.920E+03	3.139E+06	2.109E+02	1.047E+03	1.569E+06	1.054E+02
2002	6.280E+03	5.028E+06	3.379E+02	1.677E+03	2.514E+06	1.689E+02
2003	8.473E+03	6.785E+06	4.559E+02	2.263E+03	3.392E+06	2.279E+02
2004	1.072E+04	8.584E+06	5.768E+02	2.864E+03	4.292E+06	2.884E+02
2005	1.276E+04	1.022E+07	6.864E+02	3.408E+03	5.108E+06	3.432E+02
2006	1.475E+04	1.181E+07	7.938E+02	3.941E+03	5.907E+06	3.969E+02
2007	1.677E+04	1.343E+07	9.025E+02	4.481E+03	6.716E+06	4.513E+02
2008	1.975E+04	1.582E+07	1.063E+03	5.276E+03	7.908E+06	5.313E+02
2009	2.218E+04	1.776E+07	1.193E+03	5.925E+03	8.881E+06	5.967E+02
2010	2.348E+04	1.880E+07	1.263E+03	6.271E+03	9.400E+06	6.316E+02
2011	2.409E+04	1.929E+07	1.296E+03	6.435E+03	9.646E+06	6.481E+02
2012	2.808E+04	2.248E+07	1.511E+03	7.500E+03	1.124E+07	7.553E+02
2013	3.187E+04	2.552E+07	1.715E+03	8.513E+03	1.276E+07	8.574E+02
2014	3.548E+04	2.841E+07	1.909E+03	9.477E+03	1.420E+07	9.544E+02
2015	3.891E+04	3.116E+07	2.094E+03	1.039E+04	1.558E+07	1.047E+03
2016	4.218E+04	3.377E+07	2.269E+03	1.127E+04	1.689E+07	1.135E+03
2017	4.528E+04	3.626E+07	2.436E+03	1.209E+04	1.813E+07	1.218E+03
2018	4.823E+04	3.862E+07	2.595E+03	1.288E+04	1.931E+07	1.298E+03
2019	5.104E+04	4.087E+07	2.746E+03	1.363E+04	2.044E+07	1.373E+03
2020	5.372E+04	4.301E+07	2.890E+03	1.435E+04	2.151E+07	1.445E+03
2021	5.626E+04	4.505E+07	3.027E+03	1.503E+04	2.252E+07	1.513E+03
2022	5.868E+04	4.699E+07	3.157E+03	1.567E+04	2.349E+07	1.579E+03
2023	6.098E+04	4.883E+07	3.281E+03	1.629E+04	2.441E+07	1.640E+03
2024	6.317E+04	5.058E+07	3.399E+03	1.687E+04	2.529E+07	1.699E+03
2025	6.525E+04	5.225E+07	3.511E+03	1.743E+04	2.612E+07	1.755E+03
2026	6.494E+04	5.200E+07	3.494E+03	1.735E+04	2.600E+07	1.747E+03
2027	6.177E+04	4.946E+07	3.324E+03	1.650E+04	2.473E+07	1.662E+03
2028	5.876E+04	4.705E+07	3.161E+03	1.570E+04	2.353E+07	1.581E+03
2029	5.589E+04	4.476E+07	3.007E+03	1.493E+04	2.238E+07	1.504E+03
2030	5.317E+04	4.257E+07	2.861E+03	1.420E+04	2.129E+07	1.430E+03
2031	5.058E+04	4.050E+07	2.721E+03	1.351E+04	2.025E+07	1.361E+03
2032	4.811E+04	3.852E+07	2.588E+03	1.285E+04	1.926E+07	1.294E+03
2033	4.576E+04	3.664E+07	2.462E+03	1.222E+04	1.832E+07	1.231E+03
2034	4.353E+04	3.486E+07	2.342E+03	1.163E+04	1.743E+07	1.171E+03
2035	4.141E+04	3.316E+07	2.228E+03	1.106E+04	1.658E+07	1.114E+03
2036	3.939E+04	3.154E+07	2.119E+03	1.052E+04	1.577E+07	1.060E+03
2037	3.747E+04	3.000E+07	2.016E+03	1.001E+04	1.500E+07	1.008E+03
2038	3.564E+04	2.854E+07	1.918E+03	9.520E+03	1.427E+07	9.588E+02
2039	3.390E+04	2.715E+07	1.824E+03	9.055E+03	1.357E+07	9.120E+02
2040	3.225E+04	2.582E+07	1.735E+03	8.614E+03	1.291E+07	8.675E+02
2041	3.068E+04	2.456E+07	1.650E+03	8.194E+03	1.228E+07	8.252E+02
2042	2.918E+04	2.337E+07	1.570E+03	7.794E+03	1.168E+07	7.850E+02
2043	2.776E+04	2.223E+07	1.493E+03	7.414E+03	1.111E+07	7.467E+02
2044	2.640E+04	2.114E+07	1.421E+03	7.052E+03	1.057E+07	7.103E+02
2045	2.511E+04	2.011E+07	1.351E+03	6.708E+03	1.006E+07	6.756E+02
2046	2.389E+04	1.913E+07	1.285E+03	6.381E+03	9.565E+06	6.427E+02
2047	2.272E+04	1.820E+07	1.223E+03	6.070E+03	9.098E+06	6.113E+02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2048	2.162E+04	1.731E+07	1.163E+03	5.774E+03	8.655E+06	5.815E+02
2049	2.056E+04	1.647E+07	1.106E+03	5.492E+03	8.233E+06	5.532E+02
2050	1.956E+04	1.566E+07	1.052E+03	5.225E+03	7.831E+06	5.262E+02
2051	1.861E+04	1.490E+07	1.001E+03	4.970E+03	7.449E+06	5.005E+02
2052	1.770E+04	1.417E+07	9.522E+02	4.727E+03	7.086E+06	4.761E+02
2053	1.683E+04	1.348E+07	9.058E+02	4.497E+03	6.740E+06	4.529E+02
2054	1.601E+04	1.282E+07	8.616E+02	4.277E+03	6.412E+06	4.308E+02
2055	1.523E+04	1.220E+07	8.196E+02	4.069E+03	6.099E+06	4.098E+02
2056	1.449E+04	1.160E+07	7.796E+02	3.870E+03	5.801E+06	3.898E+02
2057	1.378E+04	1.104E+07	7.416E+02	3.682E+03	5.519E+06	3.708E+02
2058	1.311E+04	1.050E+07	7.054E+02	3.502E+03	5.249E+06	3.527E+02
2059	1.247E+04	9.987E+06	6.710E+02	3.331E+03	4.993E+06	3.355E+02
2060	1.186E+04	9.500E+06	6.383E+02	3.169E+03	4.750E+06	3.191E+02
2061	1.128E+04	9.036E+06	6.072E+02	3.014E+03	4.518E+06	3.036E+02
2062	1.073E+04	8.596E+06	5.775E+02	2.867E+03	4.298E+06	2.888E+02
2063	1.021E+04	8.176E+06	5.494E+02	2.727E+03	4.088E+06	2.747E+02
2064	9.713E+03	7.778E+06	5.226E+02	2.594E+03	3.889E+06	2.613E+02
2065	9.239E+03	7.398E+06	4.971E+02	2.468E+03	3.699E+06	2.485E+02
2066	8.789E+03	7.038E+06	4.729E+02	2.348E+03	3.519E+06	2.364E+02
2067	8.360E+03	6.694E+06	4.498E+02	2.233E+03	3.347E+06	2.249E+02
2068	7.952E+03	6.368E+06	4.279E+02	2.124E+03	3.184E+06	2.139E+02
2069	7.564E+03	6.057E+06	4.070E+02	2.021E+03	3.029E+06	2.035E+02
2070	7.196E+03	5.762E+06	3.871E+02	1.922E+03	2.881E+06	1.936E+02
2071	6.845E+03	5.481E+06	3.683E+02	1.828E+03	2.740E+06	1.841E+02
2072	6.511E+03	5.214E+06	3.503E+02	1.739E+03	2.607E+06	1.751E+02
2073	6.193E+03	4.959E+06	3.332E+02	1.654E+03	2.480E+06	1.666E+02
2074	5.891E+03	4.717E+06	3.170E+02	1.574E+03	2.359E+06	1.585E+02
2075	5.604E+03	4.487E+06	3.015E+02	1.497E+03	2.244E+06	1.508E+02
2076	5.331E+03	4.268E+06	2.868E+02	1.424E+03	2.134E+06	1.434E+02
2077	5.071E+03	4.060E+06	2.728E+02	1.354E+03	2.030E+06	1.364E+02
2078	4.823E+03	3.862E+06	2.595E+02	1.288E+03	1.931E+06	1.298E+02
2079	4.588E+03	3.674E+06	2.468E+02	1.226E+03	1.837E+06	1.234E+02
2080	4.364E+03	3.495E+06	2.348E+02	1.166E+03	1.747E+06	1.174E+02
2081	4.151E+03	3.324E+06	2.234E+02	1.109E+03	1.662E+06	1.117E+02
2082	3.949E+03	3.162E+06	2.125E+02	1.055E+03	1.581E+06	1.062E+02
2083	3.756E+03	3.008E+06	2.021E+02	1.003E+03	1.504E+06	1.011E+02
2084	3.573E+03	2.861E+06	1.922E+02	9.544E+02	1.431E+06	9.612E+01
2085	3.399E+03	2.722E+06	1.829E+02	9.079E+02	1.361E+06	9.144E+01
2086	3.233E+03	2.589E+06	1.740E+02	8.636E+02	1.294E+06	8.698E+01
2087	3.075E+03	2.463E+06	1.655E+02	8.215E+02	1.231E+06	8.273E+01
2088	2.925E+03	2.343E+06	1.574E+02	7.814E+02	1.171E+06	7.870E+01
2089	2.783E+03	2.228E+06	1.497E+02	7.433E+02	1.114E+06	7.486E+01
2090	2.647E+03	2.120E+06	1.424E+02	7.071E+02	1.060E+06	7.121E+01
2091	2.518E+03	2.016E+06	1.355E+02	6.726E+02	1.008E+06	6.774E+01
2092	2.395E+03	1.918E+06	1.289E+02	6.398E+02	9.590E+05	6.443E+01
2093	2.278E+03	1.824E+06	1.226E+02	6.086E+02	9.122E+05	6.129E+01
2094	2.167E+03	1.735E+06	1.166E+02	5.789E+02	8.677E+05	5.830E+01
2095	2.062E+03	1.651E+06	1.109E+02	5.507E+02	8.254E+05	5.546E+01
2096	1.961E+03	1.570E+06	1.055E+02	5.238E+02	7.851E+05	5.275E+01
2097	1.865E+03	1.494E+06	1.004E+02	4.983E+02	7.468E+05	5.018E+01
2098	1.774E+03	1.421E+06	9.547E+01	4.740E+02	7.104E+05	4.773E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2099	1.688E+03	1.352E+06	9.081E+01	4.508E+02	6.758E+05	4.541E+01
2100	1.606E+03	1.286E+06	8.638E+01	4.289E+02	6.428E+05	4.319E+01
2101	1.527E+03	1.223E+06	8.217E+01	4.079E+02	6.115E+05	4.108E+01
2102	1.453E+03	1.163E+06	7.816E+01	3.880E+02	5.816E+05	3.908E+01
2103	1.382E+03	1.107E+06	7.435E+01	3.691E+02	5.533E+05	3.717E+01
2104	1.315E+03	1.053E+06	7.072E+01	3.511E+02	5.263E+05	3.536E+01
2105	1.250E+03	1.001E+06	6.727E+01	3.340E+02	5.006E+05	3.364E+01
2106	1.189E+03	9.524E+05	6.399E+01	3.177E+02	4.762E+05	3.200E+01
2107	1.131E+03	9.060E+05	6.087E+01	3.022E+02	4.530E+05	3.044E+01
2108	1.076E+03	8.618E+05	5.790E+01	2.875E+02	4.309E+05	2.895E+01
2109	1.024E+03	8.198E+05	5.508E+01	2.735E+02	4.099E+05	2.754E+01
2110	9.738E+02	7.798E+05	5.239E+01	2.601E+02	3.899E+05	2.620E+01
2111	9.263E+02	7.417E+05	4.984E+01	2.474E+02	3.709E+05	2.492E+01
2112	8.811E+02	7.056E+05	4.741E+01	2.354E+02	3.528E+05	2.370E+01
2113	8.382E+02	6.712E+05	4.510E+01	2.239E+02	3.356E+05	2.255E+01
2114	7.973E+02	6.384E+05	4.290E+01	2.130E+02	3.192E+05	2.145E+01
2115	7.584E+02	6.073E+05	4.080E+01	2.026E+02	3.036E+05	2.040E+01
2116	7.214E+02	5.777E+05	3.881E+01	1.927E+02	2.888E+05	1.941E+01
2117	6.862E+02	5.495E+05	3.692E+01	1.833E+02	2.748E+05	1.846E+01
2118	6.528E+02	5.227E+05	3.512E+01	1.744E+02	2.614E+05	1.756E+01
2119	6.209E+02	4.972E+05	3.341E+01	1.659E+02	2.486E+05	1.670E+01
2120	5.906E+02	4.730E+05	3.178E+01	1.578E+02	2.365E+05	1.589E+01
2121	5.618E+02	4.499E+05	3.023E+01	1.501E+02	2.249E+05	1.511E+01
2122	5.344E+02	4.280E+05	2.875E+01	1.428E+02	2.140E+05	1.438E+01
2123	5.084E+02	4.071E+05	2.735E+01	1.358E+02	2.035E+05	1.368E+01
2124	4.836E+02	3.872E+05	2.602E+01	1.292E+02	1.936E+05	1.301E+01
2125	4.600E+02	3.683E+05	2.475E+01	1.229E+02	1.842E+05	1.237E+01
2126	4.376E+02	3.504E+05	2.354E+01	1.169E+02	1.752E+05	1.177E+01
2127	4.162E+02	3.333E+05	2.239E+01	1.112E+02	1.666E+05	1.120E+01
2128	3.959E+02	3.170E+05	2.130E+01	1.058E+02	1.585E+05	1.065E+01
2129	3.766E+02	3.016E+05	2.026E+01	1.006E+02	1.508E+05	1.013E+01
2130	3.582E+02	2.869E+05	1.927E+01	9.569E+01	1.434E+05	9.637E+00
2131	3.408E+02	2.729E+05	1.833E+01	9.102E+01	1.364E+05	9.167E+00
2132	3.242E+02	2.596E+05	1.744E+01	8.658E+01	1.298E+05	8.720E+00
2133	3.083E+02	2.469E+05	1.659E+01	8.236E+01	1.235E+05	8.295E+00
2134	2.933E+02	2.349E+05	1.578E+01	7.834E+01	1.174E+05	7.890E+00
2135	2.790E+02	2.234E+05	1.501E+01	7.452E+01	1.117E+05	7.505E+00
2136	2.654E+02	2.125E+05	1.428E+01	7.089E+01	1.063E+05	7.139E+00
2137	2.524E+02	2.022E+05	1.358E+01	6.743E+01	1.011E+05	6.791E+00
2138	2.401E+02	1.923E+05	1.292E+01	6.414E+01	9.615E+04	6.460E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1998	0	0	0	0	0	0
1999	1.006E+03	5.495E+05	3.692E+01	8.312E-01	2.319E+02	1.558E-02
2000	1.963E+03	1.072E+06	7.204E+01	1.622E+00	4.525E+02	3.040E-02
2001	2.873E+03	1.569E+06	1.054E+02	2.374E+00	6.623E+02	4.450E-02
2002	4.602E+03	2.514E+06	1.689E+02	3.803E+00	1.061E+03	7.129E-02
2003	6.210E+03	3.392E+06	2.279E+02	5.131E+00	1.432E+03	9.618E-02
2004	7.857E+03	4.292E+06	2.884E+02	6.492E+00	1.811E+03	1.217E-01
2005	9.350E+03	5.108E+06	3.432E+02	7.726E+00	2.155E+03	1.448E-01
2006	1.081E+04	5.907E+06	3.969E+02	8.935E+00	2.493E+03	1.675E-01
2007	1.229E+04	6.716E+06	4.513E+02	1.016E+01	2.834E+03	1.904E-01
2008	1.448E+04	7.908E+06	5.313E+02	1.196E+01	3.337E+03	2.242E-01
2009	1.626E+04	8.881E+06	5.967E+02	1.343E+01	3.748E+03	2.518E-01
2010	1.721E+04	9.400E+06	6.316E+02	1.422E+01	3.967E+03	2.665E-01
2011	1.766E+04	9.646E+06	6.481E+02	1.459E+01	4.070E+03	2.735E-01
2012	2.058E+04	1.124E+07	7.553E+02	1.701E+01	4.744E+03	3.188E-01
2013	2.336E+04	1.276E+07	8.574E+02	1.930E+01	5.385E+03	3.618E-01
2014	2.600E+04	1.420E+07	9.544E+02	2.149E+01	5.994E+03	4.028E-01
2015	2.852E+04	1.558E+07	1.047E+03	2.357E+01	6.574E+03	4.417E-01
2016	3.091E+04	1.689E+07	1.135E+03	2.554E+01	7.126E+03	4.788E-01
2017	3.319E+04	1.813E+07	1.218E+03	2.742E+01	7.651E+03	5.140E-01
2018	3.535E+04	1.931E+07	1.298E+03	2.921E+01	8.150E+03	5.476E-01
2019	3.741E+04	2.044E+07	1.373E+03	3.091E+01	8.624E+03	5.795E-01
2020	3.937E+04	2.151E+07	1.445E+03	3.253E+01	9.076E+03	6.098E-01
2021	4.123E+04	2.252E+07	1.513E+03	3.407E+01	9.506E+03	6.387E-01
2022	4.300E+04	2.349E+07	1.579E+03	3.554E+01	9.914E+03	6.661E-01
2023	4.469E+04	2.441E+07	1.640E+03	3.693E+01	1.030E+04	6.922E-01
2024	4.629E+04	2.529E+07	1.699E+03	3.826E+01	1.067E+04	7.171E-01
2025	4.782E+04	2.612E+07	1.755E+03	3.952E+01	1.102E+04	7.407E-01
2026	4.759E+04	2.600E+07	1.747E+03	3.933E+01	1.097E+04	7.372E-01
2027	4.527E+04	2.473E+07	1.662E+03	3.741E+01	1.044E+04	7.013E-01
2028	4.306E+04	2.353E+07	1.581E+03	3.559E+01	9.928E+03	6.671E-01
2029	4.096E+04	2.238E+07	1.504E+03	3.385E+01	9.444E+03	6.345E-01
2030	3.897E+04	2.129E+07	1.430E+03	3.220E+01	8.983E+03	6.036E-01
2031	3.707E+04	2.025E+07	1.361E+03	3.063E+01	8.545E+03	5.741E-01
2032	3.526E+04	1.926E+07	1.294E+03	2.914E+01	8.128E+03	5.461E-01
2033	3.354E+04	1.832E+07	1.231E+03	2.771E+01	7.732E+03	5.195E-01
2034	3.190E+04	1.743E+07	1.171E+03	2.636E+01	7.355E+03	4.942E-01
2035	3.035E+04	1.658E+07	1.114E+03	2.508E+01	6.996E+03	4.701E-01
2036	2.887E+04	1.577E+07	1.060E+03	2.385E+01	6.655E+03	4.471E-01
2037	2.746E+04	1.500E+07	1.008E+03	2.269E+01	6.330E+03	4.253E-01
2038	2.612E+04	1.427E+07	9.588E+02	2.158E+01	6.022E+03	4.046E-01
2039	2.485E+04	1.357E+07	9.120E+02	2.053E+01	5.728E+03	3.849E-01
2040	2.363E+04	1.291E+07	8.675E+02	1.953E+01	5.449E+03	3.661E-01
2041	2.248E+04	1.228E+07	8.252E+02	1.858E+01	5.183E+03	3.482E-01
2042	2.139E+04	1.168E+07	7.850E+02	1.767E+01	4.930E+03	3.313E-01
2043	2.034E+04	1.111E+07	7.467E+02	1.681E+01	4.690E+03	3.151E-01
2044	1.935E+04	1.057E+07	7.103E+02	1.599E+01	4.461E+03	2.997E-01
2045	1.841E+04	1.006E+07	6.756E+02	1.521E+01	4.243E+03	2.851E-01
2046	1.751E+04	9.565E+06	6.427E+02	1.447E+01	4.036E+03	2.712E-01
2047	1.665E+04	9.098E+06	6.113E+02	1.376E+01	3.840E+03	2.580E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2048	1.584E+04	8.655E+06	5.815E+02	1.309E+01	3.652E+03	2.454E-01
2049	1.507E+04	8.233E+06	5.532E+02	1.245E+01	3.474E+03	2.334E-01
2050	1.433E+04	7.831E+06	5.262E+02	1.185E+01	3.305E+03	2.220E-01
2051	1.364E+04	7.449E+06	5.005E+02	1.127E+01	3.144E+03	2.112E-01
2052	1.297E+04	7.086E+06	4.761E+02	1.072E+01	2.990E+03	2.009E-01
2053	1.234E+04	6.740E+06	4.529E+02	1.020E+01	2.844E+03	1.911E-01
2054	1.174E+04	6.412E+06	4.308E+02	9.698E+00	2.706E+03	1.818E-01
2055	1.116E+04	6.099E+06	4.098E+02	9.225E+00	2.574E+03	1.729E-01
2056	1.062E+04	5.801E+06	3.898E+02	8.776E+00	2.448E+03	1.645E-01
2057	1.010E+04	5.519E+06	3.708E+02	8.348E+00	2.329E+03	1.565E-01
2058	9.609E+03	5.249E+06	3.527E+02	7.940E+00	2.215E+03	1.488E-01
2059	9.140E+03	4.993E+06	3.355E+02	7.553E+00	2.107E+03	1.416E-01
2060	8.695E+03	4.750E+06	3.191E+02	7.185E+00	2.004E+03	1.347E-01
2061	8.271E+03	4.518E+06	3.036E+02	6.834E+00	1.907E+03	1.281E-01
2062	7.867E+03	4.298E+06	2.888E+02	6.501E+00	1.814E+03	1.219E-01
2063	7.483E+03	4.088E+06	2.747E+02	6.184E+00	1.725E+03	1.159E-01
2064	7.119E+03	3.889E+06	2.613E+02	5.882E+00	1.641E+03	1.103E-01
2065	6.771E+03	3.699E+06	2.485E+02	5.596E+00	1.561E+03	1.049E-01
2066	6.441E+03	3.519E+06	2.364E+02	5.323E+00	1.485E+03	9.977E-02
2067	6.127E+03	3.347E+06	2.249E+02	5.063E+00	1.412E+03	9.491E-02
2068	5.828E+03	3.184E+06	2.139E+02	4.816E+00	1.344E+03	9.028E-02
2069	5.544E+03	3.029E+06	2.035E+02	4.581E+00	1.278E+03	8.587E-02
2070	5.274E+03	2.881E+06	1.936E+02	4.358E+00	1.216E+03	8.169E-02
2071	5.016E+03	2.740E+06	1.841E+02	4.145E+00	1.156E+03	7.770E-02
2072	4.772E+03	2.607E+06	1.751E+02	3.943E+00	1.100E+03	7.391E-02
2073	4.539E+03	2.480E+06	1.666E+02	3.751E+00	1.046E+03	7.031E-02
2074	4.318E+03	2.359E+06	1.585E+02	3.568E+00	9.954E+02	6.688E-02
2075	4.107E+03	2.244E+06	1.508E+02	3.394E+00	9.468E+02	6.362E-02
2076	3.907E+03	2.134E+06	1.434E+02	3.228E+00	9.006E+02	6.051E-02
2077	3.716E+03	2.030E+06	1.364E+02	3.071E+00	8.567E+02	5.756E-02
2078	3.535E+03	1.931E+06	1.298E+02	2.921E+00	8.149E+02	5.476E-02
2079	3.363E+03	1.837E+06	1.234E+02	2.779E+00	7.752E+02	5.209E-02
2080	3.199E+03	1.747E+06	1.174E+02	2.643E+00	7.374E+02	4.955E-02
2081	3.043E+03	1.662E+06	1.117E+02	2.514E+00	7.014E+02	4.713E-02
2082	2.894E+03	1.581E+06	1.062E+02	2.392E+00	6.672E+02	4.483E-02
2083	2.753E+03	1.504E+06	1.011E+02	2.275E+00	6.347E+02	4.264E-02
2084	2.619E+03	1.431E+06	9.612E+01	2.164E+00	6.037E+02	4.056E-02
2085	2.491E+03	1.361E+06	9.144E+01	2.058E+00	5.743E+02	3.859E-02
2086	2.370E+03	1.294E+06	8.698E+01	1.958E+00	5.463E+02	3.670E-02
2087	2.254E+03	1.231E+06	8.273E+01	1.863E+00	5.196E+02	3.491E-02
2088	2.144E+03	1.171E+06	7.870E+01	1.772E+00	4.943E+02	3.321E-02
2089	2.039E+03	1.114E+06	7.486E+01	1.685E+00	4.702E+02	3.159E-02
2090	1.940E+03	1.060E+06	7.121E+01	1.603E+00	4.472E+02	3.005E-02
2091	1.845E+03	1.008E+06	6.774E+01	1.525E+00	4.254E+02	2.858E-02
2092	1.755E+03	9.590E+05	6.443E+01	1.451E+00	4.047E+02	2.719E-02
2093	1.670E+03	9.122E+05	6.129E+01	1.380E+00	3.850E+02	2.586E-02
2094	1.588E+03	8.677E+05	5.830E+01	1.313E+00	3.662E+02	2.460E-02
2095	1.511E+03	8.254E+05	5.546E+01	1.249E+00	3.483E+02	2.340E-02
2096	1.437E+03	7.851E+05	5.275E+01	1.188E+00	3.313E+02	2.226E-02
2097	1.367E+03	7.468E+05	5.018E+01	1.130E+00	3.152E+02	2.118E-02
2098	1.300E+03	7.104E+05	4.773E+01	1.075E+00	2.998E+02	2.014E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2099	1.237E+03	6.758E+05	4.541E+01	1.022E+00	2.852E+02	1.916E-02
2100	1.177E+03	6.428E+05	4.319E+01	9.724E-01	2.713E+02	1.823E-02
2101	1.119E+03	6.115E+05	4.108E+01	9.249E-01	2.580E+02	1.734E-02
2102	1.065E+03	5.816E+05	3.908E+01	8.798E-01	2.455E+02	1.649E-02
2103	1.013E+03	5.533E+05	3.717E+01	8.369E-01	2.335E+02	1.569E-02
2104	9.634E+02	5.263E+05	3.536E+01	7.961E-01	2.221E+02	1.492E-02
2105	9.164E+02	5.006E+05	3.364E+01	7.573E-01	2.113E+02	1.419E-02
2106	8.717E+02	4.762E+05	3.200E+01	7.203E-01	2.010E+02	1.350E-02
2107	8.292E+02	4.530E+05	3.044E+01	6.852E-01	1.912E+02	1.284E-02
2108	7.888E+02	4.309E+05	2.895E+01	6.518E-01	1.818E+02	1.222E-02
2109	7.503E+02	4.099E+05	2.754E+01	6.200E-01	1.730E+02	1.162E-02
2110	7.137E+02	3.899E+05	2.620E+01	5.898E-01	1.645E+02	1.105E-02
2111	6.789E+02	3.709E+05	2.492E+01	5.610E-01	1.565E+02	1.052E-02
2112	6.458E+02	3.528E+05	2.370E+01	5.336E-01	1.489E+02	1.000E-02
2113	6.143E+02	3.356E+05	2.255E+01	5.076E-01	1.416E+02	9.515E-03
2114	5.843E+02	3.192E+05	2.145E+01	4.829E-01	1.347E+02	9.051E-03
2115	5.558E+02	3.036E+05	2.040E+01	4.593E-01	1.281E+02	8.610E-03
2116	5.287E+02	2.888E+05	1.941E+01	4.369E-01	1.219E+02	8.190E-03
2117	5.029E+02	2.748E+05	1.846E+01	4.156E-01	1.159E+02	7.790E-03
2118	4.784E+02	2.614E+05	1.756E+01	3.953E-01	1.103E+02	7.410E-03
2119	4.551E+02	2.486E+05	1.670E+01	3.761E-01	1.049E+02	7.049E-03
2120	4.329E+02	2.365E+05	1.589E+01	3.577E-01	9.979E+01	6.705E-03
2121	4.118E+02	2.249E+05	1.511E+01	3.403E-01	9.493E+01	6.378E-03
2122	3.917E+02	2.140E+05	1.438E+01	3.237E-01	9.030E+01	6.067E-03
2123	3.726E+02	2.035E+05	1.368E+01	3.079E-01	8.589E+01	5.771E-03
2124	3.544E+02	1.936E+05	1.301E+01	2.929E-01	8.170E+01	5.490E-03
2125	3.371E+02	1.842E+05	1.237E+01	2.786E-01	7.772E+01	5.222E-03
2126	3.207E+02	1.752E+05	1.177E+01	2.650E-01	7.393E+01	4.967E-03
2127	3.050E+02	1.666E+05	1.120E+01	2.521E-01	7.032E+01	4.725E-03
2128	2.902E+02	1.585E+05	1.065E+01	2.398E-01	6.689E+01	4.495E-03
2129	2.760E+02	1.508E+05	1.013E+01	2.281E-01	6.363E+01	4.275E-03
2130	2.626E+02	1.434E+05	9.637E+00	2.170E-01	6.053E+01	4.067E-03
2131	2.497E+02	1.364E+05	9.167E+00	2.064E-01	5.758E+01	3.869E-03
2132	2.376E+02	1.298E+05	8.720E+00	1.963E-01	5.477E+01	3.680E-03
2133	2.260E+02	1.235E+05	8.295E+00	1.867E-01	5.210E+01	3.500E-03
2134	2.150E+02	1.174E+05	7.890E+00	1.776E-01	4.956E+01	3.330E-03
2135	2.045E+02	1.117E+05	7.505E+00	1.690E-01	4.714E+01	3.167E-03
2136	1.945E+02	1.063E+05	7.139E+00	1.607E-01	4.484E+01	3.013E-03
2137	1.850E+02	1.011E+05	6.791E+00	1.529E-01	4.265E+01	2.866E-03
2138	1.760E+02	9.615E+04	6.460E+00	1.454E-01	4.057E+01	2.726E-03

Summary Report

Landfill Name or Identifier: Hyland Landfill - 312,000 t/yr

Date: Thursday, August 18, 2011

Description/Comments:

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_{CH4} = 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/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 convential 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	**1998**	
Landfill Closure Year (with 80-year limit)	**2032**	
Actual Closure Year (without limit)	***2032***	
Have Model Calculate Closure Year?	**Yes**	
Waste Design Capacity	**9,567,778**	*short tons*

MODEL PARAMETERS

Methane Generation Rate, k	**0.050**	*year* $^{-1}$
Potential Methane Generation Capacity, L_o	**100**	*m^3/Mg*
NMOC Concentration	**211**	*ppmv as hexane*
Methane Content	**50**	*% by volume*

GASES / POLLUTANTS SELECTED

Gas / Pollutant #1:	**Total landfill gas**
Gas / Pollutant #2:	**Methane**
Gas / Pollutant #3:	**Carbon dioxide**
Gas / Pollutant #4:	**NMOC**

WASTE ACCEPTANCE RATES

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
1998	112,387	123,626	0	0
1999	112,387	123,626	112,387	123,626
2000	112,387	123,626	224,774	247,251
2001	208,895	229,784	337,161	370,877
2002	204,673	225,140	546,055	600,661
2003	217,893	239,682	750,728	825,801
2004	209,612	230,573	968,621	1,065,483
2005	214,460	235,906	1,178,233	1,296,056
2006	224,391	246,830	1,392,693	1,531,962
2007	310,784	341,862	1,617,084	1,778,792
2008	277,865	305,652	1,927,867	2,120,654
2009	194,805	214,285	2,205,733	2,426,306
2010	143,926	158,319	2,400,537	2,640,591
2011	283,636	312,000	2,544,464	2,798,910
2012	283,636	312,000	2,828,100	3,110,910
2013	283,636	312,000	3,111,736	3,422,910
2014	283,636	312,000	3,395,373	3,734,910
2015	283,636	312,000	3,679,009	4,046,910
2016	283,636	312,000	3,962,645	4,358,910
2017	283,636	312,000	4,246,282	4,670,910
2018	283,636	312,000	4,529,918	4,982,910
2019	283,636	312,000	4,813,555	5,294,910
2020	283,636	312,000	5,097,191	5,606,910
2021	283,636	312,000	5,380,827	5,918,910
2022	283,636	312,000	5,664,464	6,230,910
2023	283,636	312,000	5,948,100	6,542,910
2024	283,636	312,000	6,231,736	6,854,910
2025	283,636	312,000	6,515,373	7,166,910
2026	283,636	312,000	6,799,009	7,478,910
2027	283,636	312,000	7,082,645	7,790,910
2028	283,636	312,000	7,366,282	8,102,910
2029	283,636	312,000	7,649,918	8,414,910
2030	283,636	312,000	7,933,555	8,726,910
2031	283,636	312,000	8,217,191	9,038,910
2032	197,153	216,868	8,500,827	9,350,910
2033	0	0	8,697,980	9,567,778
2034	0	0	8,697,980	9,567,778
2035	0	0	8,697,980	9,567,778
2036	0	0	8,697,980	9,567,778
2037	0	0	8,697,980	9,567,778

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	(short tons/year)	(Mg)	(short tons)
2038	0	0	8,697,980	9,567,778
2039	0	0	8,697,980	9,567,778
2040	0	0	8,697,980	9,567,778
2041	0	0	8,697,980	9,567,778
2042	0	0	8,697,980	9,567,778
2043	0	0	8,697,980	9,567,778
2044	0	0	8,697,980	9,567,778
2045	0	0	8,697,980	9,567,778
2046	0	0	8,697,980	9,567,778
2047	0	0	8,697,980	9,567,778
2048	0	0	8,697,980	9,567,778
2049	0	0	8,697,980	9,567,778
2050	0	0	8,697,980	9,567,778
2051	0	0	8,697,980	9,567,778
2052	0	0	8,697,980	9,567,778
2053	0	0	8,697,980	9,567,778
2054	0	0	8,697,980	9,567,778
2055	0	0	8,697,980	9,567,778
2056	0	0	8,697,980	9,567,778
2057	0	0	8,697,980	9,567,778
2058	0	0	8,697,980	9,567,778
2059	0	0	8,697,980	9,567,778
2060	0	0	8,697,980	9,567,778
2061	0	0	8,697,980	9,567,778
2062	0	0	8,697,980	9,567,778
2063	0	0	8,697,980	9,567,778
2064	0	0	8,697,980	9,567,778
2065	0	0	8,697,980	9,567,778
2066	0	0	8,697,980	9,567,778
2067	0	0	8,697,980	9,567,778
2068	0	0	8,697,980	9,567,778
2069	0	0	8,697,980	9,567,778
2070	0	0	8,697,980	9,567,778
2071	0	0	8,697,980	9,567,778
2072	0	0	8,697,980	9,567,778
2073	0	0	8,697,980	9,567,778
2074	0	0	8,697,980	9,567,778
2075	0	0	8,697,980	9,567,778
2076	0	0	8,697,980	9,567,778
2077	0	0	8,697,980	9,567,778

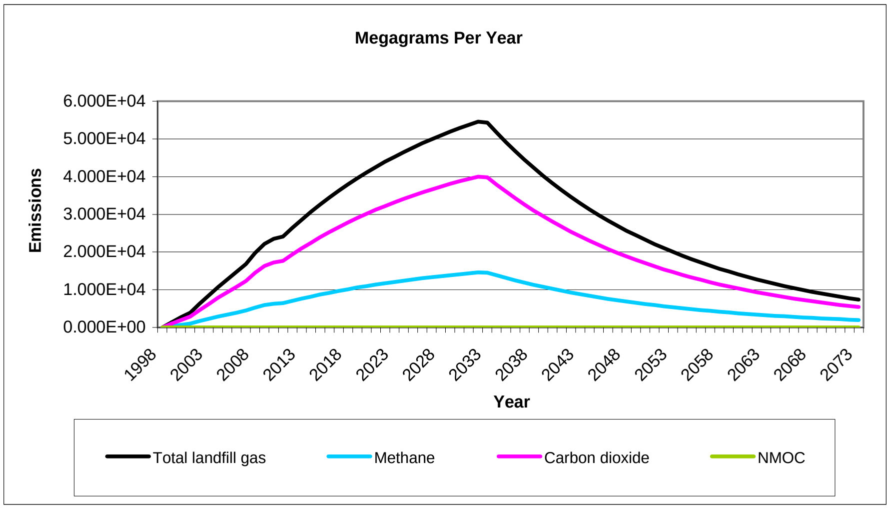
Pollutant Parameters

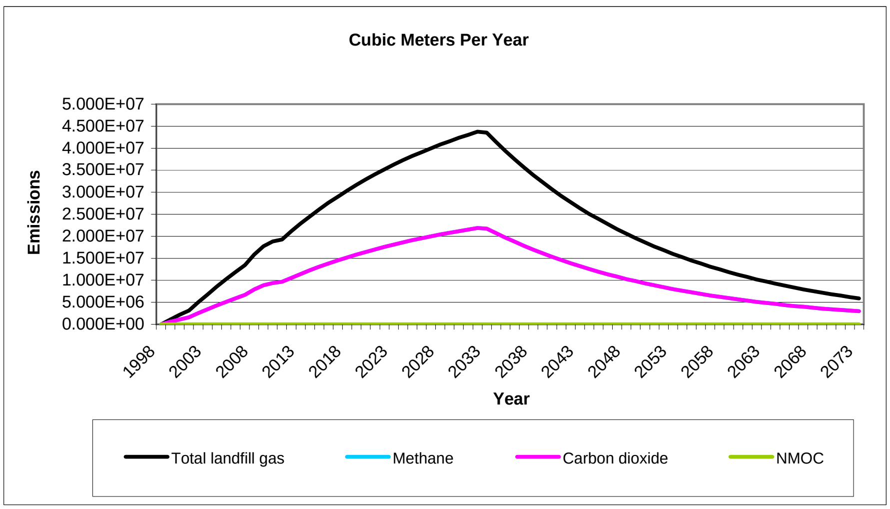
		Gas / Pollutant Default Parameters:		User-specified Pollutant Parameters:	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl 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		

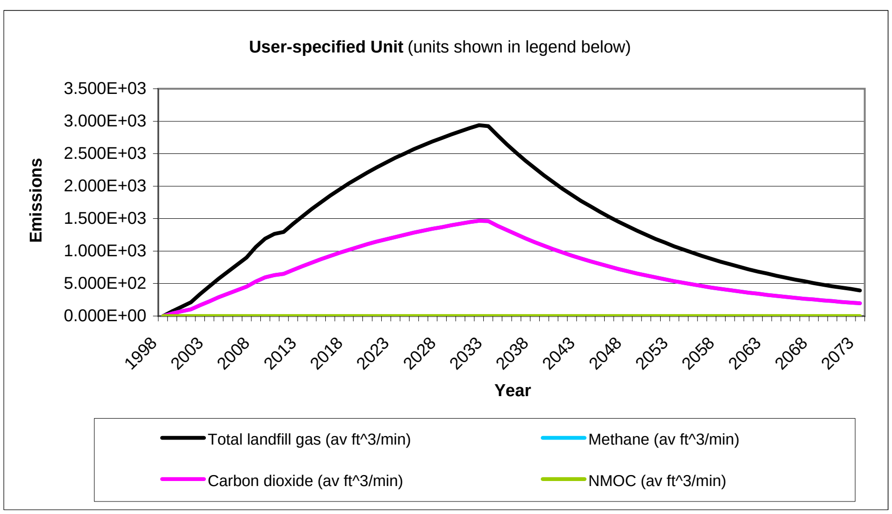
Pollutant Parameters (Continued)

		Gas / Pollutant Default Parameters:		***User-specified Pollutant Parameters:***	
	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		
	Hydrogen sulfide			280.00	34.08
	Reduced sulfur as sulfur dioxide			285.00	64.07

Graphs


Megagrams Per Year
6.000E+04
5.000E+04
4.000E+04
3.000E+04
2.000E+04
1.000E+04
0.000E+00
Emissions
1998 2003 2008 2013 2018 2023 2028 2033 2038 2043 2048 2053 2058 2063 2068 2073
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
5.000E+07
4.500E+07
4.000E+07
3.500E+07
3.000E+07
2.500E+07
2.000E+07
1.500E+07
1.000E+07
5.000E+06
0.000E+00
Emissions
1998 2003 2008 2013 2018 2023 2028 2033 2038 2043 2048 2053 2058 2063 2068 2073
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
3.500E+03
3.000E+03
2.500E+03
2.000E+03
1.500E+03
1.000E+03
5.000E+02
0.000E+00
Emissions
1998 2003 2008 2013 2018 2023 2028 2033 2038 2043 2048 2053 2058 2063 2068 2073
Year
Total landfill gas (av ft^3/min)
Methane (av ft^3/min)
Carbon dioxide (av ft^3/min)
NMOC (av ft^3/min)

Results

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1998	0	0	0	0	0	0
1999	1.372E+03	1.099E+06	7.384E+01	3.666E+02	5.495E+05	3.692E+01
2000	2.678E+03	2.144E+06	1.441E+02	7.153E+02	1.072E+06	7.204E+01
2001	3.920E+03	3.139E+06	2.109E+02	1.047E+03	1.569E+06	1.054E+02
2002	6.280E+03	5.028E+06	3.379E+02	1.677E+03	2.514E+06	1.689E+02
2003	8.473E+03	6.785E+06	4.559E+02	2.263E+03	3.392E+06	2.279E+02
2004	1.072E+04	8.584E+06	5.768E+02	2.864E+03	4.292E+06	2.884E+02
2005	1.276E+04	1.022E+07	6.864E+02	3.408E+03	5.108E+06	3.432E+02
2006	1.475E+04	1.181E+07	7.938E+02	3.941E+03	5.907E+06	3.969E+02
2007	1.677E+04	1.343E+07	9.025E+02	4.481E+03	6.716E+06	4.513E+02
2008	1.975E+04	1.582E+07	1.063E+03	5.276E+03	7.908E+06	5.313E+02
2009	2.218E+04	1.776E+07	1.193E+03	5.925E+03	8.881E+06	5.967E+02
2010	2.348E+04	1.880E+07	1.263E+03	6.271E+03	9.400E+06	6.316E+02
2011	2.409E+04	1.929E+07	1.296E+03	6.435E+03	9.646E+06	6.481E+02
2012	2.638E+04	2.112E+07	1.419E+03	7.046E+03	1.056E+07	7.097E+02
2013	2.856E+04	2.287E+07	1.536E+03	7.628E+03	1.143E+07	7.682E+02
2014	3.063E+04	2.453E+07	1.648E+03	8.181E+03	1.226E+07	8.239E+02
2015	3.260E+04	2.610E+07	1.754E+03	8.707E+03	1.305E+07	8.769E+02
2016	3.447E+04	2.760E+07	1.855E+03	9.208E+03	1.380E+07	9.273E+02
2017	3.625E+04	2.903E+07	1.951E+03	9.684E+03	1.452E+07	9.753E+02
2018	3.795E+04	3.039E+07	2.042E+03	1.014E+04	1.519E+07	1.021E+03
2019	3.956E+04	3.168E+07	2.129E+03	1.057E+04	1.584E+07	1.064E+03
2020	4.110E+04	3.291E+07	2.211E+03	1.098E+04	1.645E+07	1.106E+03
2021	4.256E+04	3.408E+07	2.290E+03	1.137E+04	1.704E+07	1.145E+03
2022	4.394E+04	3.519E+07	2.364E+03	1.174E+04	1.759E+07	1.182E+03
2023	4.526E+04	3.625E+07	2.435E+03	1.209E+04	1.812E+07	1.218E+03
2024	4.652E+04	3.725E+07	2.503E+03	1.243E+04	1.863E+07	1.251E+03
2025	4.772E+04	3.821E+07	2.567E+03	1.275E+04	1.910E+07	1.284E+03
2026	4.885E+04	3.912E+07	2.628E+03	1.305E+04	1.956E+07	1.314E+03
2027	4.993E+04	3.998E+07	2.687E+03	1.334E+04	1.999E+07	1.343E+03
2028	5.096E+04	4.081E+07	2.742E+03	1.361E+04	2.040E+07	1.371E+03
2029	5.194E+04	4.159E+07	2.794E+03	1.387E+04	2.080E+07	1.397E+03
2030	5.287E+04	4.234E+07	2.845E+03	1.412E+04	2.117E+07	1.422E+03
2031	5.376E+04	4.304E+07	2.892E+03	1.436E+04	2.152E+07	1.446E+03
2032	5.460E+04	4.372E+07	2.937E+03	1.458E+04	2.186E+07	1.469E+03
2033	5.434E+04	4.351E+07	2.924E+03	1.452E+04	2.176E+07	1.462E+03
2034	5.169E+04	4.139E+07	2.781E+03	1.381E+04	2.070E+07	1.391E+03
2035	4.917E+04	3.937E+07	2.646E+03	1.313E+04	1.969E+07	1.323E+03
2036	4.677E+04	3.745E+07	2.517E+03	1.249E+04	1.873E+07	1.258E+03
2037	4.449E+04	3.563E+07	2.394E+03	1.188E+04	1.781E+07	1.197E+03
2038	4.232E+04	3.389E+07	2.277E+03	1.130E+04	1.694E+07	1.139E+03
2039	4.026E+04	3.224E+07	2.166E+03	1.075E+04	1.612E+07	1.083E+03
2040	3.829E+04	3.066E+07	2.060E+03	1.023E+04	1.533E+07	1.030E+03
2041	3.643E+04	2.917E+07	1.960E+03	9.730E+03	1.458E+07	9.799E+02
2042	3.465E+04	2.775E+07	1.864E+03	9.255E+03	1.387E+07	9.321E+02
2043	3.296E+04	2.639E+07	1.773E+03	8.804E+03	1.320E+07	8.867E+02
2044	3.135E+04	2.511E+07	1.687E+03	8.375E+03	1.255E+07	8.434E+02
2045	2.982E+04	2.388E+07	1.605E+03	7.966E+03	1.194E+07	8.023E+02
2046	2.837E+04	2.272E+07	1.526E+03	7.578E+03	1.136E+07	7.632E+02
2047	2.699E+04	2.161E+07	1.452E+03	7.208E+03	1.080E+07	7.259E+02

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2048	2.567E+04	2.055E+07	1.381E+03	6.857E+03	1.028E+07	6.905E+02
2049	2.442E+04	1.955E+07	1.314E+03	6.522E+03	9.776E+06	6.569E+02
2050	2.323E+04	1.860E+07	1.250E+03	6.204E+03	9.299E+06	6.248E+02
2051	2.209E+04	1.769E+07	1.189E+03	5.902E+03	8.846E+06	5.944E+02
2052	2.102E+04	1.683E+07	1.131E+03	5.614E+03	8.414E+06	5.654E+02
2053	1.999E+04	1.601E+07	1.076E+03	5.340E+03	8.004E+06	5.378E+02
2054	1.902E+04	1.523E+07	1.023E+03	5.079E+03	7.614E+06	5.116E+02
2055	1.809E+04	1.448E+07	9.732E+02	4.832E+03	7.242E+06	4.866E+02
2056	1.721E+04	1.378E+07	9.258E+02	4.596E+03	6.889E+06	4.629E+02
2057	1.637E+04	1.311E+07	8.806E+02	4.372E+03	6.553E+06	4.403E+02
2058	1.557E+04	1.247E+07	8.377E+02	4.159E+03	6.234E+06	4.188E+02
2059	1.481E+04	1.186E+07	7.968E+02	3.956E+03	5.930E+06	3.984E+02
2060	1.409E+04	1.128E+07	7.580E+02	3.763E+03	5.640E+06	3.790E+02
2061	1.340E+04	1.073E+07	7.210E+02	3.579E+03	5.365E+06	3.605E+02
2062	1.275E+04	1.021E+07	6.858E+02	3.405E+03	5.104E+06	3.429E+02
2063	1.213E+04	9.709E+06	6.524E+02	3.239E+03	4.855E+06	3.262E+02
2064	1.153E+04	9.236E+06	6.206E+02	3.081E+03	4.618E+06	3.103E+02
2065	1.097E+04	8.785E+06	5.903E+02	2.931E+03	4.393E+06	2.951E+02
2066	1.044E+04	8.357E+06	5.615E+02	2.788E+03	4.179E+06	2.808E+02
2067	9.927E+03	7.949E+06	5.341E+02	2.652E+03	3.975E+06	2.671E+02
2068	9.443E+03	7.562E+06	5.081E+02	2.522E+03	3.781E+06	2.540E+02
2069	8.983E+03	7.193E+06	4.833E+02	2.399E+03	3.596E+06	2.416E+02
2070	8.545E+03	6.842E+06	4.597E+02	2.282E+03	3.421E+06	2.299E+02
2071	8.128E+03	6.508E+06	4.373E+02	2.171E+03	3.254E+06	2.187E+02
2072	7.732E+03	6.191E+06	4.160E+02	2.065E+03	3.096E+06	2.080E+02
2073	7.354E+03	5.889E+06	3.957E+02	1.964E+03	2.945E+06	1.978E+02
2074	6.996E+03	5.602E+06	3.764E+02	1.869E+03	2.801E+06	1.882E+02
2075	6.655E+03	5.329E+06	3.580E+02	1.778E+03	2.664E+06	1.790E+02
2076	6.330E+03	5.069E+06	3.406E+02	1.691E+03	2.534E+06	1.703E+02
2077	6.021E+03	4.822E+06	3.240E+02	1.608E+03	2.411E+06	1.620E+02
2078	5.728E+03	4.586E+06	3.082E+02	1.530E+03	2.293E+06	1.541E+02
2079	5.448E+03	4.363E+06	2.931E+02	1.455E+03	2.181E+06	1.466E+02
2080	5.183E+03	4.150E+06	2.788E+02	1.384E+03	2.075E+06	1.394E+02
2081	4.930E+03	3.948E+06	2.652E+02	1.317E+03	1.974E+06	1.326E+02
2082	4.689E+03	3.755E+06	2.523E+02	1.253E+03	1.878E+06	1.262E+02
2083	4.461E+03	3.572E+06	2.400E+02	1.191E+03	1.786E+06	1.200E+02
2084	4.243E+03	3.398E+06	2.283E+02	1.133E+03	1.699E+06	1.141E+02
2085	4.036E+03	3.232E+06	2.172E+02	1.078E+03	1.616E+06	1.086E+02
2086	3.839E+03	3.074E+06	2.066E+02	1.026E+03	1.537E+06	1.033E+02
2087	3.652E+03	2.924E+06	1.965E+02	9.755E+02	1.462E+06	9.825E+01
2088	3.474E+03	2.782E+06	1.869E+02	9.279E+02	1.391E+06	9.345E+01
2089	3.305E+03	2.646E+06	1.778E+02	8.827E+02	1.323E+06	8.890E+01
2090	3.143E+03	2.517E+06	1.691E+02	8.396E+02	1.259E+06	8.456E+01
2091	2.990E+03	2.394E+06	1.609E+02	7.987E+02	1.197E+06	8.044E+01
2092	2.844E+03	2.278E+06	1.530E+02	7.597E+02	1.139E+06	7.651E+01
2093	2.706E+03	2.166E+06	1.456E+02	7.227E+02	1.083E+06	7.278E+01
2094	2.574E+03	2.061E+06	1.385E+02	6.874E+02	1.030E+06	6.923E+01
2095	2.448E+03	1.960E+06	1.317E+02	6.539E+02	9.802E+05	6.586E+01
2096	2.329E+03	1.865E+06	1.253E+02	6.220E+02	9.324E+05	6.264E+01
2097	2.215E+03	1.774E+06	1.192E+02	5.917E+02	8.869E+05	5.959E+01
2098	2.107E+03	1.687E+06	1.134E+02	5.628E+02	8.436E+05	5.668E+01

Results (Continued)

Year	Total landfill gas			Methane		
	(Mg/year)	(m^3/year)	(av ft^3/min)	(Mg/year)	(m^3/year)	(av ft^3/min)
2099	2.004E+03	1.605E+06	1.078E+02	5.354E+02	8.025E+05	5.392E+01
2100	1.907E+03	1.527E+06	1.026E+02	5.093E+02	7.633E+05	5.129E+01
2101	1.814E+03	1.452E+06	9.758E+01	4.844E+02	7.261E+05	4.879E+01
2102	1.725E+03	1.381E+06	9.282E+01	4.608E+02	6.907E+05	4.641E+01
2103	1.641E+03	1.314E+06	8.829E+01	4.383E+02	6.570E+05	4.414E+01
2104	1.561E+03	1.250E+06	8.398E+01	4.170E+02	6.250E+05	4.199E+01
2105	1.485E+03	1.189E+06	7.989E+01	3.966E+02	5.945E+05	3.994E+01
2106	1.412E+03	1.131E+06	7.599E+01	3.773E+02	5.655E+05	3.800E+01
2107	1.344E+03	1.076E+06	7.229E+01	3.589E+02	5.379E+05	3.614E+01
2108	1.278E+03	1.023E+06	6.876E+01	3.414E+02	5.117E+05	3.438E+01
2109	1.216E+03	9.735E+05	6.541E+01	3.247E+02	4.867E+05	3.270E+01
2110	1.156E+03	9.260E+05	6.222E+01	3.089E+02	4.630E+05	3.111E+01
2111	1.100E+03	8.808E+05	5.918E+01	2.938E+02	4.404E+05	2.959E+01
2112	1.046E+03	8.379E+05	5.630E+01	2.795E+02	4.189E+05	2.815E+01
2113	9.953E+02	7.970E+05	5.355E+01	2.659E+02	3.985E+05	2.678E+01
2114	9.468E+02	7.581E+05	5.094E+01	2.529E+02	3.791E+05	2.547E+01
2115	9.006E+02	7.212E+05	4.845E+01	2.406E+02	3.606E+05	2.423E+01
2116	8.567E+02	6.860E+05	4.609E+01	2.288E+02	3.430E+05	2.305E+01
2117	8.149E+02	6.525E+05	4.384E+01	2.177E+02	3.263E+05	2.192E+01
2118	7.752E+02	6.207E+05	4.171E+01	2.071E+02	3.104E+05	2.085E+01
2119	7.373E+02	5.904E+05	3.967E+01	1.970E+02	2.952E+05	1.984E+01
2120	7.014E+02	5.616E+05	3.774E+01	1.873E+02	2.808E+05	1.887E+01
2121	6.672E+02	5.342E+05	3.590E+01	1.782E+02	2.671E+05	1.795E+01
2122	6.346E+02	5.082E+05	3.415E+01	1.695E+02	2.541E+05	1.707E+01
2123	6.037E+02	4.834E+05	3.248E+01	1.613E+02	2.417E+05	1.624E+01
2124	5.742E+02	4.598E+05	3.090E+01	1.534E+02	2.299E+05	1.545E+01
2125	5.462E+02	4.374E+05	2.939E+01	1.459E+02	2.187E+05	1.469E+01
2126	5.196E+02	4.161E+05	2.796E+01	1.388E+02	2.080E+05	1.398E+01
2127	4.943E+02	3.958E+05	2.659E+01	1.320E+02	1.979E+05	1.330E+01
2128	4.702E+02	3.765E+05	2.530E+01	1.256E+02	1.882E+05	1.265E+01
2129	4.472E+02	3.581E+05	2.406E+01	1.195E+02	1.791E+05	1.203E+01
2130	4.254E+02	3.407E+05	2.289E+01	1.136E+02	1.703E+05	1.144E+01
2131	4.047E+02	3.240E+05	2.177E+01	1.081E+02	1.620E+05	1.089E+01
2132	3.849E+02	3.082E+05	2.071E+01	1.028E+02	1.541E+05	1.036E+01
2133	3.662E+02	2.932E+05	1.970E+01	9.780E+01	1.466E+05	9.850E+00
2134	3.483E+02	2.789E+05	1.874E+01	9.303E+01	1.395E+05	9.370E+00
2135	3.313E+02	2.653E+05	1.783E+01	8.850E+01	1.326E+05	8.913E+00
2136	3.152E+02	2.524E+05	1.696E+01	8.418E+01	1.262E+05	8.478E+00
2137	2.998E+02	2.401E+05	1.613E+01	8.008E+01	1.200E+05	8.065E+00
2138	2.852E+02	2.283E+05	1.534E+01	7.617E+01	1.142E+05	7.671E+00

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
1998	0	0	0	0	0	0
1999	1.006E+03	5.495E+05	3.692E+01	8.312E-01	2.319E+02	1.558E-02
2000	1.963E+03	1.072E+06	7.204E+01	1.622E+00	4.525E+02	3.040E-02
2001	2.873E+03	1.569E+06	1.054E+02	2.374E+00	6.623E+02	4.450E-02
2002	4.602E+03	2.514E+06	1.689E+02	3.803E+00	1.061E+03	7.129E-02
2003	6.210E+03	3.392E+06	2.279E+02	5.131E+00	1.432E+03	9.618E-02
2004	7.857E+03	4.292E+06	2.884E+02	6.492E+00	1.811E+03	1.217E-01
2005	9.350E+03	5.108E+06	3.432E+02	7.726E+00	2.155E+03	1.448E-01
2006	1.081E+04	5.907E+06	3.969E+02	8.935E+00	2.493E+03	1.675E-01
2007	1.229E+04	6.716E+06	4.513E+02	1.016E+01	2.834E+03	1.904E-01
2008	1.448E+04	7.908E+06	5.313E+02	1.196E+01	3.337E+03	2.242E-01
2009	1.626E+04	8.881E+06	5.967E+02	1.343E+01	3.748E+03	2.518E-01
2010	1.721E+04	9.400E+06	6.316E+02	1.422E+01	3.967E+03	2.665E-01
2011	1.766E+04	9.646E+06	6.481E+02	1.459E+01	4.070E+03	2.735E-01
2012	1.933E+04	1.056E+07	7.097E+02	1.598E+01	4.457E+03	2.995E-01
2013	2.093E+04	1.143E+07	7.682E+02	1.729E+01	4.825E+03	3.242E-01
2014	2.245E+04	1.226E+07	8.239E+02	1.855E+01	5.175E+03	3.477E-01
2015	2.389E+04	1.305E+07	8.769E+02	1.974E+01	5.508E+03	3.701E-01
2016	2.526E+04	1.380E+07	9.273E+02	2.088E+01	5.824E+03	3.913E-01
2017	2.657E+04	1.452E+07	9.753E+02	2.196E+01	6.125E+03	4.116E-01
2018	2.781E+04	1.519E+07	1.021E+03	2.298E+01	6.412E+03	4.308E-01
2019	2.899E+04	1.584E+07	1.064E+03	2.396E+01	6.684E+03	4.491E-01
2020	3.012E+04	1.645E+07	1.106E+03	2.489E+01	6.944E+03	4.665E-01
2021	3.119E+04	1.704E+07	1.145E+03	2.577E+01	7.190E+03	4.831E-01
2022	3.221E+04	1.759E+07	1.182E+03	2.661E+01	7.425E+03	4.989E-01
2023	3.317E+04	1.812E+07	1.218E+03	2.741E+01	7.648E+03	5.139E-01
2024	3.409E+04	1.863E+07	1.251E+03	2.817E+01	7.860E+03	5.281E-01
2025	3.497E+04	1.910E+07	1.284E+03	2.890E+01	8.062E+03	5.417E-01
2026	3.580E+04	1.956E+07	1.314E+03	2.959E+01	8.254E+03	5.546E-01
2027	3.660E+04	1.999E+07	1.343E+03	3.024E+01	8.437E+03	5.669E-01
2028	3.735E+04	2.040E+07	1.371E+03	3.086E+01	8.610E+03	5.785E-01
2029	3.807E+04	2.080E+07	1.397E+03	3.146E+01	8.776E+03	5.896E-01
2030	3.875E+04	2.117E+07	1.422E+03	3.202E+01	8.933E+03	6.002E-01
2031	3.940E+04	2.152E+07	1.446E+03	3.256E+01	9.082E+03	6.103E-01
2032	4.001E+04	2.186E+07	1.469E+03	3.307E+01	9.225E+03	6.198E-01
2033	3.983E+04	2.176E+07	1.462E+03	3.291E+01	9.182E+03	6.169E-01
2034	3.788E+04	2.070E+07	1.391E+03	3.131E+01	8.734E+03	5.868E-01
2035	3.604E+04	1.969E+07	1.323E+03	2.978E+01	8.308E+03	5.582E-01
2036	3.428E+04	1.873E+07	1.258E+03	2.833E+01	7.903E+03	5.310E-01
2037	3.261E+04	1.781E+07	1.197E+03	2.695E+01	7.517E+03	5.051E-01
2038	3.102E+04	1.694E+07	1.139E+03	2.563E+01	7.151E+03	4.805E-01
2039	2.950E+04	1.612E+07	1.083E+03	2.438E+01	6.802E+03	4.570E-01
2040	2.807E+04	1.533E+07	1.030E+03	2.319E+01	6.470E+03	4.347E-01
2041	2.670E+04	1.458E+07	9.799E+02	2.206E+01	6.155E+03	4.135E-01
2042	2.539E+04	1.387E+07	9.321E+02	2.099E+01	5.854E+03	3.934E-01
2043	2.416E+04	1.320E+07	8.867E+02	1.996E+01	5.569E+03	3.742E-01
2044	2.298E+04	1.255E+07	8.434E+02	1.899E+01	5.297E+03	3.559E-01
2045	2.186E+04	1.194E+07	8.023E+02	1.806E+01	5.039E+03	3.386E-01
2046	2.079E+04	1.136E+07	7.632E+02	1.718E+01	4.793E+03	3.221E-01
2047	1.978E+04	1.080E+07	7.259E+02	1.634E+01	4.559E+03	3.063E-01

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2048	1.881E+04	1.028E+07	6.905E+02	1.555E+01	4.337E+03	2.914E-01
2049	1.790E+04	9.776E+06	6.569E+02	1.479E+01	4.126E+03	2.772E-01
2050	1.702E+04	9.299E+06	6.248E+02	1.407E+01	3.924E+03	2.637E-01
2051	1.619E+04	8.846E+06	5.944E+02	1.338E+01	3.733E+03	2.508E-01
2052	1.540E+04	8.414E+06	5.654E+02	1.273E+01	3.551E+03	2.386E-01
2053	1.465E+04	8.004E+06	5.378E+02	1.211E+01	3.378E+03	2.269E-01
2054	1.394E+04	7.614E+06	5.116E+02	1.152E+01	3.213E+03	2.159E-01
2055	1.326E+04	7.242E+06	4.866E+02	1.096E+01	3.056E+03	2.054E-01
2056	1.261E+04	6.889E+06	4.629E+02	1.042E+01	2.907E+03	1.953E-01
2057	1.200E+04	6.553E+06	4.403E+02	9.913E+00	2.765E+03	1.858E-01
2058	1.141E+04	6.234E+06	4.188E+02	9.429E+00	2.631E+03	1.767E-01
2059	1.085E+04	5.930E+06	3.984E+02	8.969E+00	2.502E+03	1.681E-01
2060	1.032E+04	5.640E+06	3.790E+02	8.532E+00	2.380E+03	1.599E-01
2061	9.821E+03	5.365E+06	3.605E+02	8.116E+00	2.264E+03	1.521E-01
2062	9.342E+03	5.104E+06	3.429E+02	7.720E+00	2.154E+03	1.447E-01
2063	8.887E+03	4.855E+06	3.262E+02	7.343E+00	2.049E+03	1.377E-01
2064	8.453E+03	4.618E+06	3.103E+02	6.985E+00	1.949E+03	1.309E-01
2065	8.041E+03	4.393E+06	2.951E+02	6.645E+00	1.854E+03	1.246E-01
2066	7.649E+03	4.179E+06	2.808E+02	6.321E+00	1.763E+03	1.185E-01
2067	7.276E+03	3.975E+06	2.671E+02	6.012E+00	1.677E+03	1.127E-01
2068	6.921E+03	3.781E+06	2.540E+02	5.719E+00	1.596E+03	1.072E-01
2069	6.583E+03	3.596E+06	2.416E+02	5.440E+00	1.518E+03	1.020E-01
2070	6.262E+03	3.421E+06	2.299E+02	5.175E+00	1.444E+03	9.700E-02
2071	5.957E+03	3.254E+06	2.187E+02	4.922E+00	1.373E+03	9.227E-02
2072	5.666E+03	3.096E+06	2.080E+02	4.682E+00	1.306E+03	8.777E-02
2073	5.390E+03	2.945E+06	1.978E+02	4.454E+00	1.243E+03	8.349E-02
2074	5.127E+03	2.801E+06	1.882E+02	4.237E+00	1.182E+03	7.942E-02
2075	4.877E+03	2.664E+06	1.790E+02	4.030E+00	1.124E+03	7.554E-02
2076	4.639E+03	2.534E+06	1.703E+02	3.834E+00	1.070E+03	7.186E-02
2077	4.413E+03	2.411E+06	1.620E+02	3.647E+00	1.017E+03	6.836E-02
2078	4.198E+03	2.293E+06	1.541E+02	3.469E+00	9.677E+02	6.502E-02
2079	3.993E+03	2.181E+06	1.466E+02	3.300E+00	9.205E+02	6.185E-02
2080	3.798E+03	2.075E+06	1.394E+02	3.139E+00	8.756E+02	5.883E-02
2081	3.613E+03	1.974E+06	1.326E+02	2.986E+00	8.329E+02	5.597E-02
2082	3.437E+03	1.878E+06	1.262E+02	2.840E+00	7.923E+02	5.324E-02
2083	3.269E+03	1.786E+06	1.200E+02	2.702E+00	7.537E+02	5.064E-02
2084	3.110E+03	1.699E+06	1.141E+02	2.570E+00	7.169E+02	4.817E-02
2085	2.958E+03	1.616E+06	1.086E+02	2.444E+00	6.820E+02	4.582E-02
2086	2.814E+03	1.537E+06	1.033E+02	2.325E+00	6.487E+02	4.359E-02
2087	2.677E+03	1.462E+06	9.825E+01	2.212E+00	6.171E+02	4.146E-02
2088	2.546E+03	1.391E+06	9.345E+01	2.104E+00	5.870E+02	3.944E-02
2089	2.422E+03	1.323E+06	8.890E+01	2.001E+00	5.583E+02	3.751E-02
2090	2.304E+03	1.259E+06	8.456E+01	1.904E+00	5.311E+02	3.568E-02
2091	2.191E+03	1.197E+06	8.044E+01	1.811E+00	5.052E+02	3.394E-02
2092	2.085E+03	1.139E+06	7.651E+01	1.723E+00	4.806E+02	3.229E-02
2093	1.983E+03	1.083E+06	7.278E+01	1.639E+00	4.571E+02	3.071E-02
2094	1.886E+03	1.030E+06	6.923E+01	1.559E+00	4.348E+02	2.922E-02
2095	1.794E+03	9.802E+05	6.586E+01	1.483E+00	4.136E+02	2.779E-02
2096	1.707E+03	9.324E+05	6.264E+01	1.410E+00	3.935E+02	2.644E-02
2097	1.623E+03	8.869E+05	5.959E+01	1.342E+00	3.743E+02	2.515E-02
2098	1.544E+03	8.436E+05	5.668E+01	1.276E+00	3.560E+02	2.392E-02

Results (Continued)

Year	Carbon dioxide			NMOC		
	(Mg/year)	*(m^3/year)*	*(av ft^3/min)*	*(Mg/year)*	*(m^3/year)*	*(av ft^3/min)*
2099	1.469E+03	8.025E+05	5.392E+01	1.214E+00	3.386E+02	2.275E-02
2100	1.397E+03	7.633E+05	5.129E+01	1.155E+00	3.221E+02	2.164E-02
2101	1.329E+03	7.261E+05	4.879E+01	1.098E+00	3.064E+02	2.059E-02
2102	1.264E+03	6.907E+05	4.641E+01	1.045E+00	2.915E+02	1.958E-02
2103	1.203E+03	6.570E+05	4.414E+01	9.938E-01	2.773E+02	1.863E-02
2104	1.144E+03	6.250E+05	4.199E+01	9.454E-01	2.637E+02	1.772E-02
2105	1.088E+03	5.945E+05	3.994E+01	8.993E-01	2.509E+02	1.686E-02
2106	1.035E+03	5.655E+05	3.800E+01	8.554E-01	2.386E+02	1.603E-02
2107	9.847E+02	5.379E+05	3.614E+01	8.137E-01	2.270E+02	1.525E-02
2108	9.366E+02	5.117E+05	3.438E+01	7.740E-01	2.159E+02	1.451E-02
2109	8.910E+02	4.867E+05	3.270E+01	7.363E-01	2.054E+02	1.380E-02
2110	8.475E+02	4.630E+05	3.111E+01	7.003E-01	1.954E+02	1.313E-02
2111	8.062E+02	4.404E+05	2.959E+01	6.662E-01	1.859E+02	1.249E-02
2112	7.669E+02	4.189E+05	2.815E+01	6.337E-01	1.768E+02	1.188E-02
2113	7.295E+02	3.985E+05	2.678E+01	6.028E-01	1.682E+02	1.130E-02
2114	6.939E+02	3.791E+05	2.547E+01	5.734E-01	1.600E+02	1.075E-02
2115	6.600E+02	3.606E+05	2.423E+01	5.454E-01	1.522E+02	1.022E-02
2116	6.278E+02	3.430E+05	2.305E+01	5.188E-01	1.447E+02	9.725E-03
2117	5.972E+02	3.263E+05	2.192E+01	4.935E-01	1.377E+02	9.251E-03
2118	5.681E+02	3.104E+05	2.085E+01	4.695E-01	1.310E+02	8.800E-03
2119	5.404E+02	2.952E+05	1.984E+01	4.466E-01	1.246E+02	8.371E-03
2120	5.140E+02	2.808E+05	1.887E+01	4.248E-01	1.185E+02	7.962E-03
2121	4.890E+02	2.671E+05	1.795E+01	4.041E-01	1.127E+02	7.574E-03
2122	4.651E+02	2.541E+05	1.707E+01	3.844E-01	1.072E+02	7.205E-03
2123	4.424E+02	2.417E+05	1.624E+01	3.656E-01	1.020E+02	6.853E-03
2124	4.209E+02	2.299E+05	1.545E+01	3.478E-01	9.702E+01	6.519E-03
2125	4.003E+02	2.187E+05	1.469E+01	3.308E-01	9.229E+01	6.201E-03
2126	3.808E+02	2.080E+05	1.398E+01	3.147E-01	8.779E+01	5.899E-03
2127	3.622E+02	1.979E+05	1.330E+01	2.993E-01	8.351E+01	5.611E-03
2128	3.446E+02	1.882E+05	1.265E+01	2.847E-01	7.944E+01	5.337E-03
2129	3.278E+02	1.791E+05	1.203E+01	2.709E-01	7.556E+01	5.077E-03
2130	3.118E+02	1.703E+05	1.144E+01	2.576E-01	7.188E+01	4.829E-03
2131	2.966E+02	1.620E+05	1.089E+01	2.451E-01	6.837E+01	4.594E-03
2132	2.821E+02	1.541E+05	1.036E+01	2.331E-01	6.504E+01	4.370E-03
2133	2.684E+02	1.466E+05	9.850E+00	2.218E-01	6.187E+01	4.157E-03
2134	2.553E+02	1.395E+05	9.370E+00	2.109E-01	5.885E+01	3.954E-03
2135	2.428E+02	1.326E+05	8.913E+00	2.007E-01	5.598E+01	3.761E-03
2136	2.310E+02	1.262E+05	8.478E+00	1.909E-01	5.325E+01	3.578E-03
2137	2.197E+02	1.200E+05	8.065E+00	1.816E-01	5.065E+01	3.403E-03
2138	2.090E+02	1.142E+05	7.671E+00	1.727E-01	4.818E+01	3.237E-03

ATTACHMENT 2

Caterpillar Gas Engine Technical Data

G3520C

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

ENGINE SPEED:	1200	FUEL:	LOW ENERGY (1.43 CH4:CO2 RATIO)
COMPRESSION RATIO:	11.3:1	FUEL SYSTEM:	CAT LOW PRESSURE WITH AIR FUEL RATIO CONTROL
AFTERCOOLER - STAGE 1 MAX. INLET (°F):	218		
AFTERCOOLER - STAGE 2 MAX. INLET (°F):	130	FUEL PRESS. RANGE (PSIG):	1.5 - 5.0
JACKET WATER - MAX. OUTLET (°F):	230	MIN. METHANE NUMBER:	135
COOLING SYSTEM:	JW+1AC, OC+2AC	RATED ALTITUDE (FT):	1378
IGNITION SYSTEM:	ADEM3	AT AIR TO TURBO. TEMP. (°F):	77
SPARK PLUG TYPE:	J-GAP	NOx EMISSION LEVEL:	0.5 g/bhp-hr
EXHAUST MANIFOLD:	DRY	FUEL LHV (BTU/SCF):	456
COMBUSTION:	LOW EMISSION	APPLICATION:	GENSET

RATING AND EFFICIENCY		NOTES	LOAD	100%	75%	50%
ENGINE POWER	(WITHOUT FAN)	(1)	BHP	2233	1675	1116
GENERATOR POWER	(WITHOUT FAN)	(2)	EKW	1600	1200	800
ENGINE EFFICIENCY	**(ISO 3046/1)**	**(3)**	**%**	**40.1**	**38.6**	**36.1**
ENGINE EFFICIENCY	(NOMINAL)	(3)	%	39.1	37.7	35.2
THERMAL EFFICIENCY	(NOMINAL)	(4)	%	40.1	39.3	40.8
TOTAL EFFICIENCY	(NOMINAL)	(5)	%	79.2	77.0	76.0

ENGINE DATA						
FUEL CONSUMPTION	**(ISO 3046/1)**	**(6)**	**BTU/bhp-hr**	**6354**	**6592**	**7047**
FUEL CONSUMPTION	(NOMINAL)	(6)	BTU/bhp-hr	6509	6753	7219
AIR FLOW (77 °F, 14.7 psi)		(7)	SCFM	4512	3415	2286
AIR FLOW		(7)	lb/hr	20006	15141	10136
COMPRESSOR OUT PRESSURE			in. HG (abs)	105.8	80.8	55.5
COMPRESSOR OUT TEMPERATURE			°F	375	306	220
AFTERCOOLER AIR OUT TEMPERATURE			°F	142	138	135
INLET MAN. PRESSURE		(8)	in. HG (abs)	94.4	71.5	48.9
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	(9)	°F	142	138	135
TIMING		(10)	°BTDC	27	27	27
EXHAUST STACK TEMPERATURE		(11)	°F	898	943	984
EXHAUST GAS FLOW (@ stack temp.)		(12)	CFM	12476	9780	6770
EXHAUST MASS FLOW		(12)	lb/hr	22318	16940	11418

EMISSIONS DATA					
NOx (as NO2)	(13)	g/bhp-hr	0.5	0.5	0.5
NTE CO	(14)	g/bhp-hr	4.13	4.25	4.4
NOMINAL CO	(15)	g/bhp-hr	2.5	2.5	2.5
THC (molecular weight of 15.84)	(14)	g/bhp-hr	5.84	6.49	7.51
NMHC (molecular weight of 15.84)	(14)	g/bhp-hr	0.88	0.98	1.13
EXHAUST O2	(16)	% DRY	9.0	8.8	8.6
LAMBDA	(16)		1.71	1.67	1.57

HEAT BALANCE DATA					
LHV INPUT	(17)	BTU/min	242216	188451	134313
HEAT REJECTION TO JACKET	(18)	BTU/min	28738	23806	21929
HEAT REJECTION TO ATMOSPHERE	(19)	BTU/min	7210	6034	4857
HEAT REJECTION TO LUBE OIL	(20)	BTU/min	10108	9524	8917
HEAT REJECTION TO EXHAUST (LHV to 77°F)	(21)	BTU/min	76779	65253	45101
HEAT REJECTION TO EXHAUST (LHV to 350°F)	(21)	BTU/min	54657	45140	32710
HEAT REJECTION TO A/C - STAGE 1	(22)	BTU/min	13823	5157	102
HEAT REJECTION TO A/C - STAGE 2	(23)	BTU/min	8895	5684	4086

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1. DATA REPRESENTS CONDITIONS OF 77°F, 29.6 IN HG BAROMETRIC PRESSURE, 30% RELATIVE HUMIDITY, 10 IN H2O AIR FILTER RESTRICTION, AND 20 IN H2O EXHAUST STACK PRESSURE. ENGINE EFFICIENCY AND FUEL CONSUMPTION SPECIFICALLY NOTED AS ISO 3046/1 ARE REPRESENTED WITH 5 IN H2O AIR FILTER RESTRICTION AND 0 IN H2O EXHAUST STACK PRESSURE. CONSULT ALTITUDE CURVES FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE. NO OVERLOAD PERMITTED AT RATING SHOWN.

EMISSION LEVELS ARE BASED ON THE ENGINE OPERATING AT STEADY STATE CONDITIONS AND ADJUSTED TO THE SPECIFIED NOx LEVEL AT 100% LOAD. EMISSION TOLERANCES SPECIFIED ARE DEPENDENT UPON FUEL QUALITY. METHANE NUMBER CANNOT VARY MORE THAN ± 3. PUBLISHED PART LOAD DATA IS WITH AIR FUEL RATIO CONTROL.

ENGINE RATING IS WITH 2 ENGINE DRIVEN WATER PUMPS. PUMP POWER IS NOT INCLUDED IN HEAT BALANCE DATA.

FOR NOTES INFORMATION CONSULT PAGE THREE.

FUEL USAGE GUIDE

CAT METHANE NUMBER	40	50	60	70	80	90	100	110	120	130	140	150
IGNITION TIMING	-	-	-	-	-	-	-	-	24	26	28	30
DERATION FACTOR	0	0	0	0	0	0	0	0	1.00	1.00	1.00	1.00

ALTITUDE DERATION FACTORS

AIR TO TURBO (°F)	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	0.96	0.93	0.89	0.86	0.83	0.79	0.76	0.74	0.71	0.68	0.65	0.63	0.60
120	0.98	0.94	0.91	0.87	0.84	0.81	0.78	0.75	0.72	0.69	0.66	0.64	0.61
110	0.99	0.96	0.92	0.89	0.86	0.82	0.79	0.76	0.73	0.70	0.68	0.65	0.62
100	1.00	0.97	0.94	0.90	0.87	0.84	0.81	0.77	0.74	0.72	0.69	0.66	0.63
90	1.00	0.99	0.96	0.92	0.89	0.85	0.82	0.79	0.76	0.73	0.70	0.67	0.65
80	1.00	1.00	0.97	0.94	0.90	0.87	0.84	0.80	0.77	0.74	0.71	0.68	0.66
70	1.00	1.00	0.99	0.96	0.92	0.89	0.85	0.82	0.79	0.76	0.73	0.70	0.67
60	1.00	1.00	1.00	0.97	0.94	0.90	0.87	0.83	0.80	0.77	0.74	0.71	0.68
50	1.00	1.00	1.00	0.99	0.96	0.92	0.88	0.85	0.82	0.79	0.76	0.73	0.70

ALTITUDE (FEET ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS

AIR TO TURBO (°F)	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000
130	1.33	1.37	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
120	1.26	1.31	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
110	1.19	1.24	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26	1.26
100	1.13	1.17	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
90	1.06	1.11	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
80	1.00	1.04	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06
70	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
60	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
50	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALTITUDE (FEET ABOVE SEA LEVEL)

FUEL USAGE GUIDE:

This table shows the derate factor required for a given fuel. Note that deration occurs as the methane number decreases. Methane number is a scale to measure detonation characteristics of various fuels. The methane number of a fuel is determined by using the Caterpillar Methane Number Calculation program.

ALTITUDE DERATION FACTORS:

This table shows the deration required for various air inlet temperatures and altitudes. Use this information along with the fuel usage guide chart to help determine actual engine power for your site.

INLET AND EXHAUST RESTRICTION CORRECTIONS FOR ALTITUDE CAPABILITY:

To determine the appropriate altitude derate factor to be applied to this engine for inlet or exhaust restrictions differering from the standard conditions listed on page 1, a correction to the site altitude can be made to adjust for this difference. Add 141 feet to the site altitude for each additional inch of H2O of exhaust stack pressure greater than spec sheet conditions. Add 282 feet to the site altitude for each additional inch of H2O of inlet restriction greater than spec sheet conditions. If site inlet restriction or exhaust stack pressure are less than spec sheet conditions, the same trends apply to lower the site altitude.

ACTUAL ENGINE RATING:

It is important to note that the Altitude/Temperature deration and the Fuel Usage Guide deration are not cumulative. They are not to be added together. The same is true for the Low Energy Fuel deration (reference the Caterpillar Methane Number Program) and the Fuel Usage Guide deration. However, the Altitude/Temperature deration and Low Energy Fuel deration are cumulative; and they must be added together in the method shown below. To determine the actual power available, take the lowest rating between 1) and 2).

1) (Altitude/Temperature Deration) + (Low Energy Fuel Deration)
2) Fuel Usage Guide Deration

Note: For NA's always add the Low Energy Fuel deration to the Altitude/Temperature deration. For TA engines only add the Low Energy Fuel deration to the Altitude/Temperature deration whenever the Altitude/Temperature deration is less than 1.0 (100%). This will give the actual rating for the engine at the conditions specified.

AFTERCOOLER HEAT REJECTION FACTORS:

Aftercooler heat rejection is given for standard conditions of 77°F and 500 ft altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbocharger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor to adjust for ambient and altitude conditions. Multiply this factor by the standard aftercooler heat rejection. Failure to properly account for these factors could result in detonation and cause the engine to shutdown or fail. For 2 Stage Aftercoolers with separate circuits, the 1st stage will collect 90% of the additional heat.

NOTES

1 ENGINE RATING IS WITH 2 ENGINE DRIVEN WATER PUMPS. TOLERANCE IS ± 3% OF FULL LOAD.

2 GENERATOR POWER DETERMINED WITH AN ASSUMED GENERATOR EFFICIENCY OF 96.1% AND POWER FACTOR OF 0.8 [GENERATOR POWER = ENGINE POWER x GENERATOR EFFICIENCY].

3 ISO 3046/1 ENGINE EFFICIENCY TOLERANCE IS (+)0, (-)5% OF FULL LOAD % EFFICIENCY VALUE. NOMINAL ENGINE EFFICIENCY TOLERANCE IS ± 2.5% OF FULL LOAD % EFFICIENCY VALUE.

4 THERMAL EFFICIENCY: JACKET HEAT + STAGE 1 A/C HEAT + EXH. HEAT TO 350°F.

5 TOTAL EFFICIENCY = ENGINE EFF. + THERMAL EFF. TOLERANCE IS ± 10% OF FULL LOAD DATA.

6 ISO 3046/1 FUEL CONSUMPTION TOLERANCE IS (+)5, (-)0% OF FULL LOAD DATA. NOMINAL FUEL CONSUMPTION TOLERANCE IS ± 2.5 % OF FULL LOAD DATA.

7 UNDRIED AIR. FLOW TOLERANCE IS ± 5 %

8 INLET MANIFOLD PRESSURE TOLERANCE IS ± 5 %

9 INLET MANIFOLD TEMPERATURE TOLERANCE IS ± 9°F.

10 TIMING INDICATED IS FOR USE WITH THE MINIMUM FUEL METHANE NUMBER SPECIFIED. CONSULT THE APPROPRIATE FUEL USAGE GUIDE FOR TIMING AT OTHER METHANE NUMBERS.

11 EXHAUST STACK TEMPERATURE TOLERANCE IS (+)63°F, (-)54°F.

12 WET EXHAUST. FLOW TOLERANCE IS ± 6 %

13 NOX TOLERANCES ARE ± 18 % OF SPECIFIED VALUE.

14 NTE CO, CO2, THC, and NMHC VALUES ARE "NOT TO EXCEED".

15 NOMINAL CO IS A NOMINAL VALUE AND IS REPRESENTATIVE OF A NEW ENGINE DURING THE FIRST 100 HOURS OF ENGINE OPERATION.

16 O2% TOLERANCE IS ± 0.5; LAMBDA TOLERANCE IS ± 0.05. LAMBDA AND O2 LEVEL ARE THE RESULT OF ADJUSTING THE ENGINE TO OPERATE AT THE SPECIFIED NOX LEVEL.

17 LHV RATE TOLERANCE IS ± 2.5%.

18 TOTAL JW HEAT (based on treated water) = JACKET HEAT + STAGE 1 A/C HEAT + 0.90 x (STAGE 1 + STAGE 2) x (ACHRF-1). TOLERANCE IS ± 10 % OF FULL LOAD DATA.

19 RADIATION HEAT RATE BASED ON TREATED WATER. TOLERANCE IS ± 50% OF FULL LOAD DATA.

20 LUBE OIL HEAT RATE BASED ON TREATED WATER. TOLERANCE IS ± 20% OF FULL LOAD DATA.

21 EXHAUST HEAT RATE BASED ON TREATED WATER. TOLERANCE IS ± 10% OF FULL LOAD DATA.

22 STAGE 1 A/C HEAT (based on treated water) = STAGE 1 A/C HEAT + 0.90 x (STAGE 1 + STAGE 2) x (ACHRF-1). TOLERANCE IS ± 5 % OF FULL LOAD DATA.

23 STAGE 2 A/C HEAT (based on treated water) = (STAGE 2 A/C HEAT + (STAGE 1 + STAGE 2) x 0.10 x (ACHRF - 1)) + LUBE OIL HEAT. TOLERANCE IS ± 5 % OF FULL LOAD DATA.

ATTACHMENT 3

Fuel Oil Saved Combusting LFG in a LFGTE Plant at Hyland Landfill

ESTIMATED FUEL OIL SAVED COMBUSTING LFG IN A LFGTE PLANT AT HYLAND LANDFILL

Maximum LFG to the LFGTE Plant

Maximum LFG input to each of the CAT 3520 engines is based on engine power at 100% load (2233 bhp) and nominal fuel consumption (6509 BTU/bhp-hr) as provided on the Caterpillar G3520 specification sheet included as Attachment 2. Using these two values the nominal heat rate for each engine can be estimated:

2233 bhp x 6509 BTU/bhp-hr = 14,534,597 BTU/hr

Energy Equivalent in Barrels of Heating Oil Per Year

Heat value of #2 heating oil is approximately:	140,000	BTU/gal
# gallons of fuel oil saved by combusting landfill gas at Hyland Landfill	104	gal/hr
# gallons of fuel oil saved on an annual basis combusting landfill gas assuming a 97 percent run time	882,167	gal/year
At 42 gallons per barrel the amount of fuel oil saved annually is approximately	21,004	barrels/yr per engine
For 3 engines the fuel oil saved annually is approximately	**63,012**	**barrels/yr**