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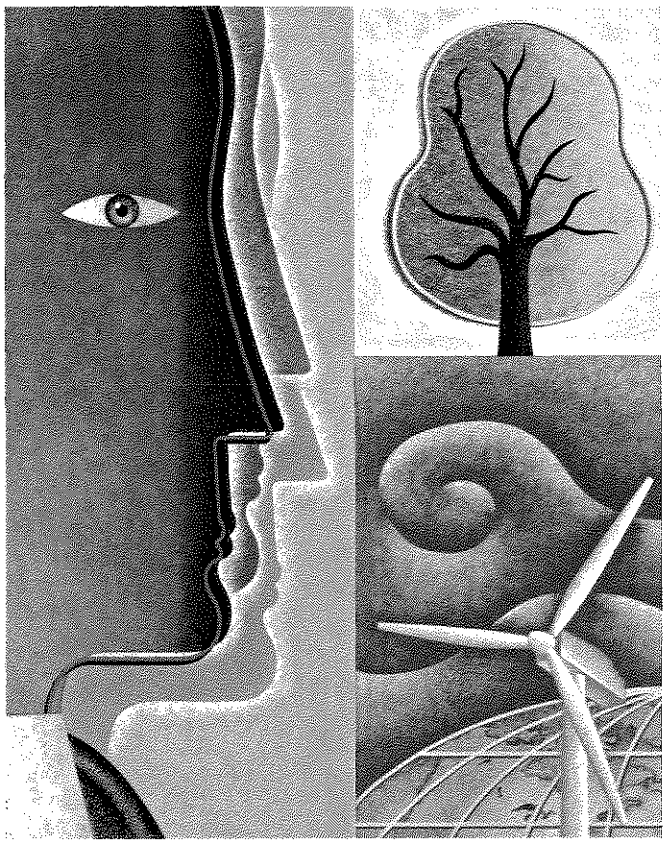
Solid Waste Permit Modification

Landfill Gas-to-Energy System

Durham Sanitary Landfill
Durham, North Carolina

December 2008



RMT

Letter of Transmittal

RMT North Carolina, Inc.
744 Heartland Trail (53717-1982)
PO Box 8923 (53708-8923)
Madison, WI
Tel. (608) 831-4444 • Fax (608) 831-3334

To:	Ming-tai Chao, P.E.	**Date:**	12/4/08
	Environmental Engineer II	**Project No.:**	8029.01
	Permitting Branch, Solid Wasate Section	**Subject:**	Solid Waste Permit Modification
	Divison of Waste Management		
Prepared By:	Lucy Tourdot		

Dear Mr. Chao:

Enclosed is the Solid Waste Permit Modification Report for the Landfill Gas-To-Energy System at the Durham Sanitary Landfill.

Please call me at 608-662-5476 if you have any questions.

Sincerely,

Dean R. Free
Senior Project Engineer

RMT

• ENVIRONMENT • ENERGY • ENGINEERING

Solid Waste Permit Modification

Landfill Gas-to-Energy System

Durham Sanitary Landfill
Durham, North Carolina

December 2008

R. Kent Nilsson, P.E.
Project Engineer

Dean Free
Senior Environmental Consultant

Chad Sell
Project Manager

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CREATING BALANCE℠

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Section 1
Introduction

1.1 Purpose and Scope

This request for a solid waste permit modification to the Municipal Solid Waste Landfill Permit No. 3201-MSWLF-1979 has been prepared for the installation of a landfill gas-to-energy (LFGTE) system for the closed City of Durham Sanitary Landfill in Durham, North Carolina. Refer to Drawing Sheet 1 for the project location map. The landfill gas generated by the closed Durham Sanitary Landfill and collected from the existing gas collection system, will be conditioned and compressed by the proposed system. The landfill gas will then be conveyed to engine generators for combustion and conversion to electricity. The electricity will be fed to the Duke Energy electrical grid system for use by the utility. Methane Power Durham, LLC, the project developer, has entered into agreements with the City of Durham for the use of their landfill gas, and with Duke Energy to purchase the generated electricity.

This modification request has been prepared in accordance with a guidance document titled "Permitting Guidance: Active Gas Collection Systems" (August 7, 1996), provided by the Solid Waste Section, Division of Waste Management, North Carolina Department of Environment and Natural Resources (SW-NCDENR). Refer to Appendix A for a copy of this guidance. North Carolina regulations 15A NCAC 13B .1603(a)(3) indicate that proposed modifications to the approved transition plan of the site's permit application shall be presented to the SW-NCDENR for review and approval in accordance with 15A NCAC 13B .1617(c). The transition plan was originally submitted in April 1994, with follow-on addenda, and was subsequently approved by SW-NCDENR July 29, 1996. Refer to the approval letter in Appendix A.

This modification provides the following items, which include applicable changes to approved permit documents, for review and approval by SW-NCDENR, in accordance with the provided guidance and applicable regulations:

- LFGTE system design information, including text and drawings
- LFGTE system construction quality assurance and quality control information
- Operations, maintenance, and monitoring (OM&M) plan details
- Closure and post-closure care plan, including financial assurance responsibilities

Modifications are not proposed for the existing landfill gas management system well field or final cover system. Changes to the existing blower/flare station area are proposed in order to connect this existing station to the new LFGTE system, and to accept condensate that will be

generated from the operation of the new system. The LFGTE system will be designed and installed in accordance with applicable federal, state, and local regulations. The installation and operation of the LFGTE system represents an efficient, environmentally acceptable, and beneficial solid waste management practice for the closed City of Durham Landfill. The LFGTE system design and construction project is being fast-tracked to the extent possible so that the beneficial result of generating electricity can be realized as soon as possible. The current project schedule has been established to bring the system online in approximately spring to early summer 2009.

1.2 General Site Information

The authorized contacts, mailing addresses, and general information for the proposed LFGTE system are as follows:

Project title:	Solid Waste Permit Modification, Landfill Gas-to-Energy System
Authorized project contact:	Mr. Leon LeBlanc Vice President Operations MP Durham, LLC 240 Island Beach Road Wells, ME 04090 Phone: 207.604.6964 email: leon.leblanc@yahoo.com
Landfill owner/contact:	Ms. Nancy Newell, P.E. Civil Engineer III City of Durham Department of Water Management 1600 Mist Lake Drive Durham, North Carolina 27704 Phone: 919-560-4381 Fax: 919-560-4479 Fax e-mail: nancy.newell@durhamnc.gov

Project Professional Engineer:	R. Kent Nilsson, P.E. RMT, Inc. 30 Patewood Drive, Suite 100 Patewood Plaza One Greenville, SC 29615 Phone: 864.234.9436 Fax: 864.281.0288 e-mail: kent.nilsson@rmtinc.com
Site location:	The landfill is located on the northeastern side of the City of Durham, North Carolina, west of I-85 and north of East Club Boulevard.
Electrical utility contact:	Mr. Tracey Kendrick tlkendrick@duke-energy.com Duke Energy/Engineering Department 4412 Hillsborough Road Durham, NC 27705 919.687.3139

Section 2
Landfill Gas-to-Energy System Design

2.1 Existing Landfill Gas Collection System Overview

The LFGTE system will utilize the existing landfill gas collection system, including the existing wells, conveyance piping, and the condensate handling systems. The existing gas collection system includes approximately 62 vertical gas extraction wells spaced throughout the landfill. The wells are connected to a series of gas conveyance piping systems, and the gas is carried to the existing blower/flare station located at the southern end of the site, outside the limits of waste, along the main site access road. The existing blower system induces a vacuum within the waste mass to extract the landfill gas and to direct it to the existing enclosed ground flare for combustion. Condensate is collected throughout the collection system and is directed to the sanitary sewer system for ultimate disposal at the neighboring sanitary wastewater treatment plant.

The proposed LFGTE system components will be located immediately adjacent to the existing blower/flare station. The proposed site work will not disturb the existing landfill's final cover system or gas collection system. The gas collected from the landfill will be conveyed to the proposed LFGTE system, where it will be conditioned, compressed, and combusted to produce electricity. Refer to Drawing Sheet 1 for the Project Location Map.

2.2 Gas Volume Estimates

The United States Environmental Protection Agency's (USEPA's) Landfill Gas Emissions Estimation Model (LandGEM) had been previously prepared (by the City) to estimate the gas generated throughout the life of the landfill. The LandGEM was again used as part of the Title V Air Permit Application recently submitted to the NC DENR by RMT. Refer to Appendix B for a copy of the air permit application recently submitted.

The volume of gas being produced at the site is estimated to be between 800 and 1,500 cubic feet per minute (cfm) based on actual site data and modeling efforts. The volume of gas extracted will vary based on site conditions, including the state of the existing collection system, the current and future maintenance performed, the operating and balancing efforts, and the characteristics and age of the deposited waste. A study performed in 2008 (Hazen and Sawyer) indicated that the actual landfill gas generation rate was lower than that predicted by the LandGEM; therefore, they adjusted the generation curve. Their model estimated that, in 2009,

the landfill would be generating approximately 1,300 cfm. Refer to Appendix C for the landfill gas generation information.

2.3 Condensate Handling System

Landfill gas is typically saturated at the temperatures and pressures that occur within the landfill. As gas enters the existing gas extraction system, it cools, and the moisture in the gas condenses and drops out of the gas. This condensate must be removed from the gas header piping system to prevent the liquids from impeding the flow of gas. The condensate in the current system is removed from the gas header pipes and is ultimately conveyed to the City's sanitary wastewater treatment plant for disposal.

Condensate generated and collected by the proposed LFGTE system will be directed to the existing condensate tank/lift station that is located at the existing blower/flare station. The tank includes a level-controlled condensate pumping lift station that pumps the condensate to the existing sanitary sewer system connection that ultimately conveys the liquid to the City's neighboring sanitary wastewater treatment plant for disposal. The condensate tank/lift station system has sufficient capacity to manage the small amount of additional condensate that will be generated from the proposed gas conditioning and compression system. If the condensate tank operations fail, a high level alarm will result. Operating personnel will be automatically notified. The operation of the LFGTE system will terminate if such a condition develops and will not be restarted until the condition is corrected. Refer to Drawing Sheet 3 for the location of the condensate handling system.

2.4 Back-up Flare System

In the event that the LFGTE system does not function for a specified amount of time, piping, valves, and controls will be available to direct the landfill gas to the existing flare system for combustion. The two existing system's blowers will continue to operate as part of the new LFGTE system. One blower operates at a time and the other functions as a back-up. The new LFGTE blower will draw gas from the discharge side of one of the operating existing blowers. If there is excess landfill gas that is not being used by the LFGTE system, it will also be combusted in either the existing flare system, or in a smaller flare system to be included with the new LFGTE system.

If the LFGTE system is not able to run for a period of time greater than approximately 4 hours, the system operation will revert back to the operation of the existing blower/flare station. Operations and maintenance (O&M) personnel will be able to initiate automatic operation of the existing blower/flare systems using the blower/flare control panel on-site or the Master Supervisory Control and Data Acquisition (SCADA) system remotely. The Master SCADA

system will monitor, report, and log the blower/flare systems operations. Refer to Drawing Sheet 2 for the location of the existing blower/flare station and the LFGTE system.

2.5 Site Work

The LFGTE project includes installing the following:

- Piping connections to the existing gas collection system at the existing blower/flare station area
- Piping connections to the existing condensate handling system at the existing blower/flare station
- Gas conditioning/compression system components, including the conditioning systems, the compression systems, concrete pads, the electrical and controls systems, protective structures, and related appurtenances
- Monitoring and control connections (with SCADA) to the existing blower/flare station to control and monitor its use in a back-up role
- Electrical generation system, including engine generators to combust the landfill gas to generate electricity, with excess gas being flared
- The electrical interconnection and supply systems, to operate the proposed equipment and to provide the generated power to the electrical grid, which will be coordinated with Duke Energy

The site work associated with these installations will include the following:

- Clearing and grubbing existing vegetation as necessary to facilitate grading
- Grading for positive surface drainage and preparing suitable base soil materials prior to the installation of concrete pads and buried conduits for the installation of the gas conditioning/compression system, the engine gensets, and the electrical interconnection equipment
- Protecting existing site features and buried utilities during site work, including excavations and utility crossings
- Installing access roadways to the existing and proposed equipment in the project area to facilitate construction, operation, monitoring, and maintenance activities
- Providing sediment and erosion control during the construction activities, including restoring the ground surface areas disturbed during the work

2.5.1 Concrete Pads

Concrete pads will be designed and installed for the conditioning/compression system, for the engine gensets, and for the electrical equipment. Each pad will be placed on an

engineered and compacted select granular fill foundation. The concrete pads will include reinforcement steel and will be designed for the anticipated loads.

2.5.2 Building Structures

Steel-sided structures or buildings will be installed for housing the master control center for the electrical and control systems. The structure will include various electrical and control systems, a computer system with internet connection, material storage areas, operator work space, lighting, air conditioning, and related appurtenances. The structures will be used to provide some protection of the equipment from the sun and precipitation. Similarly, structures may be installed over the gas conditioning/compression system, the engine gensets, and the electrical interconnection system (switch gear). The structures will be designed to meet local building code requirements, including those for wind loading. The structures will be placed on concrete footings, concrete slabs, or compacted granular soil, and will be located to protect the LFGTE system components. The structures will only be large enough to contain the necessary system components. The approximate footprint size of each system component is shown on attached Drawing Sheet 2.

2.6 Landfill Gas Conditioning

The landfill gas will be conditioned to remove sufficient moisture before being compressed to the necessary discharge pressure. The landfill gas will be taken from the discharge side of the existing blower system. Before entering the gas conditioning portion of the system, the landfill gas will pass through a condensate knock-out device that includes a particulate filter. The condensate from the knock-out will be directed to the existing condensate management system at the blower/flare station for disposal. This consists of the existing buried 4,000-gallon tank with a level-controlled lift station. During compression, the landfill gas is further dried using an ethylene glycol chiller system. The condensate removed during the chilling process will also be directed to the existing condensate management system. All condensate generated as part of landfill gas conditioning and compression is collected and directed to the existing condensate handling system.

2.7 Landfill Gas Compression

The landfill gas compressor system, which utilizes a multi-stage centrifugal blower, will be selected to provide sufficient pressurization of the landfill gas, and to deliver the gas at the proper delivery pressure to the engine gensets, which is approximately 5 pounds per square inch gauge (psig). The gas conditioning/compression system will include all necessary appurtenances and controls, and operation will be linked with the site's Master SCADA system.

The instrumentation and controls for the gas conditioning/compression system have been designed for safety and ease of troubleshooting. The system will shut down if the following conditions occur:

- Low inlet gas pressure
- High blower temperature or pressure
- High heat exchanger drain level
- High particulate scrubber drain level
- High/low delivery pressure

2.8 Landfill Gas Combustion and Electrical Interconnections

The landfill gas combustion system, using internal combustion engine gensets designed for landfill gas, will combust the landfill gas and generate electricity. The engine gensets will interface with the electrical and control system (SCADA) and with the electrical interconnection equipment that will feed the generated power onto the Duke Energy grid system. The interconnection equipment will be designed by the electrical interconnection contractor and will be approved by Duke Energy. The system will be designed to meet applicable regulations and will include the necessary operational and safety equipment.

2.9 Automated Metering and Control System

Overall system operation will be controlled and interlocked by a programmable logic controller (PLC) and monitored by the use of the Master SCADA system. The Master SCADA system's main control panel will be housed in a panel located within a separate structure near the gas conditioning/compression system. The Master SCADA system will be accessible by authorized users via an on-site display or by use of the Internet. The Internet-based Master SCADA system provides live data maintenance and access, and can be queried for observation of trends, historical system reports, and for automatic alarm notifications. Additional control panels will be included for the LFGTE system as necessary to operate the other components. Electrical system components and wiring will be intrinsically-safe and applicable, and will meet local code requirements.

The metering systems that will be automated include a landfill gas flow meter, a gas header pipe pressure transducer, automated monitoring systems associated with the gas conditioning/compression system, and the flare system(s). The main gas header pipe's flow meter provides the total cumulative flow extracted from the landfill and combusted. The flow meter will transmit the real-time flow data to the Master SCADA system, which will maintain flow records. The Master SCADA system will also track the main gas header pipe pressure and other appropriate data to ensure proper system operation. Gas pipe pressure will indicate that

the system, in general, is providing sufficient vacuum to the existing well field to extract available landfill gas to control migration.

2.10 Electrical Power Needs

Duke Energy will assist with the design and supply of the electrical power needed by the LFGTE system. Electrical power is anticipated to be supplied to the proposed system from the existing transformers located near the existing blower/flare station. The electrical power used by the proposed equipment includes that for the gas conditioning/compression system, the engine gensets, metering and controls, and associated lighting and appurtenances. In addition to interaction with Duke Energy, Methane Power Durham, LLC, has contacted the NC Utilities Commission to secure a Certificate of Public Convenience for the project.

2.11 Local Zoning and Inspection Permits

The design information for the components and activities of the LFGTE system that are applicable to the review and approval of the local City of Durham zoning and inspection permitting process will be provided to the appropriate City entities for their action. The City approvals and permits will be forwarded to the SW-NCDENR when available and will be made part of the project's construction documentation report that will be submitted following project completion.

Section 3
Construction Quality Assurance/ Quality Control Program

3.1 Introduction

This section presents general construction quality assurance/quality control program (CQA/QC program) information that will be employed during the construction of the LFGTE system. Prior to beginning construction activities that involve the mobilization of heavy equipment or soil excavation, buffer zones and setbacks will be established. Buffer zones will be clearly marked with stakes, flagging, erosion control fencing, and/or temporary fencing. The buffer zones between construction areas and adjacent perimeter areas will be established to prohibit improper access by non-project personnel.

The construction of the LFGTE system will be documented under the supervision of one or more professional engineers, based on applicable discipline, registered in the State of North Carolina, as the Project P.E. A registered P.E., or a qualified professional under the direct supervision of a Project P.E., will be present during key aspects of the implementation of the project as a CQA/QC Officer. Some of these activities may include site work preparations, grading and soil compaction efforts, the gas and condensate piping connections to the existing system, flare modifications, and installations of the gas conditioning/compression system, the engine gensets, the electrical interconnection, and the electrical and control system.

A CQA/QC Officer will be responsible for observations, testing, and other activities required to be implemented as part of the CQA/QC program. A construction documentation report, documenting the installation of the LFGTE system, will be prepared and submitted to SW-NCDENR following project completion and successful LFGTE system successful startup.

3.2 General Construction Operations

The area designated for the installation of the LFGTE system will be prepared to meet applicable local permitting requirements for storm water runoff management, safety, and accessibility. Existing site features and landfill components will be protected from site work activities. The area will initially be rough-graded to provide for sufficient work area platforms. The area will be surveyed and graded to establish the locations of the concrete pads and the system components, the electrical components, access, utilities, and positive surface water drainage. Existing soil that is not structurally sound will be removed and replaced with suitable compacted soil. Suitable base soil foundation will be necessary to support the concrete

pads and the site access roads, as well as the construction equipment. Fill soil will be tested by visual observation of compactive efforts and proof-rolling in accordance with project specifications.

3.2.1 Concrete Construction

Proposed concrete mix designs, concrete reinforcement requirements, and the use of prefabricated structures will be submitted to a Project P.E. for approval prior to installation.

- **Prefabricated structure** - Prefabricated structures will be inspected by a CQA/QC Officer for manufacturing defects. Defective structures will not be used. A CQA/QC Officer will document that prefabricated structures used for construction conform to the design requirements.
- **Cast-in-place structures** - Concrete for these structures, including reinforcement material, will be tested and inspected in accordance with the project specifications.

3.2.2 Electrical Installation

Duke Energy will provide design and construction support for the LFGTE system electrical power needs. Duke Energy will supply electrical power as needed to the project area, including that for the gas conditioning and compression system, the metering and controls, the back-up blower/flare system, and associated lighting and appurtenances. The LFGTE system installation will include installation of the required foundations for the electrical system components, including that for ground-based transformers. Electrical and control systems will be designed and installed by qualified project contractors and will meet applicable federal, state, and local electrical requirements.

3.2.3 Site Restoration

Following installation of the LFGTE system, the project areas disturbed during construction will be restored. Proper surface water drainage will be maintained as part of restoration. Restoration will include grading, fertilizing, seeding, and mulching of disturbed areas. Seed mixes will be selected as approved by the City of Durham facility manager. Erosion matting, ditch checks, and silt fencing will be installed as appropriate to control erosion while vegetation is being re-established. Gravel access and roadways will be extended as necessary to LFGTE system components to facilitate access for operations, monitoring, and maintenance activities.

3.3 Construction Documentation Report

Each CQA/QC Officer will complete, at a minimum, a daily summary report prepared that will include the following:

- Date
- Description of the weather conditions
- Description of the construction that occurred
- List of equipment and the name of the personnel on the project
- List of any meetings held and the names of attendees
- Description of all materials used and references or results of the testing and documentation of such material
- Calibration and recalibration of applicable equipment
- Daily inspection information from each inspector present
- Photographic records of construction activities will be maintained

Upon completion of the work, a Project P.E. will submit a construction documentation report to the City of Durham (Landfill Owner) and the SW-NCDENR. The report will summarize the activities of the project, and will document the construction activities achieved in accordance with the engineering design. A Project P.E. will state in the report that the installation was completed in accordance with the CQA/QC program. At a minimum, the report will contain the following:

- A certification by a Project P.E. that the construction has been completed in accordance with the engineering design and approved permits
- A description of any deviations from the originally submitted design documents
- Record drawings

Section 4
Maintenance, Inspection, and Monitoring Plans

4.1 Introduction

The maintenance, inspection, and monitoring plans prepared and submitted as part of the landfill's Post-Closure Plan (April 1994) do not change with respect to the existing system. A copy of the approved Post-Closure Plan is attached in Appendix D. The existing system activities will continue to be followed to the extent applicable going forward. The existing documents do not include sections regarding an LFGTE system; therefore, this section provides information for the additional efforts that will be necessary for the LFGTE system.

Maintenance, inspection, and monitoring efforts are necessary for the efficient performance of the LFGTE system, in accordance with agreed-upon requirements. General monitoring activities are described below.

4.2 Overall LFGTE System Monitoring

Periodically, the entire existing landfill gas collection system will be monitored and balanced to maximize proper operation. Only trained personnel, with the proper experience and equipment, will perform system monitoring and balancing. These efforts will be critical to supplying suitable landfill gas to the LFGTE system while balancing migration control efforts. The closed landfill and its systems will continue to be operated to meet the landfill migration requirements of 15A NCAC 13B.1626(4).

The gas collection system components will be routinely inspected by monitoring personnel, at a minimum frequency based on the component's monitoring schedule, to verify proper operation. System components will typically be inspected at the time monitoring or maintenance takes place. Inspections and maintenance of the system will be required to keep it operating properly and efficiently.

The frequency of monitoring will vary depending on the consistency of landfill gas generation. The Master SCADA System will continuously monitor and report specified operating data. The Master SCADA System will be Internet-based. Operating personnel will be able to evaluate operating parameters on an as-needed basis, and the system will automatically notify operating personnel when specified alarm conditions occur. The Master SCADA system will provide the current values of key parameters and will log specific key parameter data and record it at specified frequencies. The key parameters are as follows:

- The status of which systems are operating (gas conditioning/gas compression, blowers, flares, engine gensets, electrical interconnections, etc.)
- The key operating conditions of the gas conditioning/compression system and of the engine gensets
- The flare combustion temperature
- The total landfill gas flow rate
- The total vacuum pressure being applied to the landfill
- The overall methane content of the landfill gas
- The specific parameters required by the gas conditioning and compression system

A detailed Maintenance, Inspection, and Monitoring Plan for the LFGTE system will be developed during the construction phase of the project and will be provided to the SW-NCDENR with the construction documentation report. The detailed plan will include that information which is specific to the actual components, equipment, and instrumentation installed. The plan will include contingency and response plans for anticipated and unanticipated operational issues, including emergencies.

Section 5
Post-Closure Plan Addendum

5.1 Amendments to the Post-Closure Plan

The Closure and Post-Closure Plan, submitted in April 1994, and followed by subsequent Addenda, was approved by the SW-NCDENR on July 29, 1996. A copy of the approved Post-Closure Plan is Attached in Appendix D. These documents provided the agreed-upon requirements to be performed during the closure and post-closure care periods at the landfill. The landfill is now in its post-closure care period of operation, and the activities presented in the approved plans remain unchanged. This LFGTE project adds new equipment and infrastructure to the existing landfill gas management systems to beneficially utilize the landfill gas to generate electricity. And, as a result, additional activities are necessary to properly maintain proper operation of the proposed systems.

This section has been prepared to provide additional information to addend the existing Post-Closure Plan for the inclusion of the LFGTE system and its components. The following aspects of the Post-Closure Plan are discussed as part of this submittal:

- The inspection plan
- The maintenance plan
- The monitoring plan

Post-closure maintenance and monitoring activities are discussed in the previous sections of this modification request. Inspections, monitoring, and maintenance will be performed routinely to meet the equipment manufacturer's recommendations to maintain warranties and the longevity of equipment operation. Operations will be maintained to maximize the sale of electricity and to provide sufficient vacuum to the existing landfill collection system to control migration and emissions.

5.2 Post-Closure Cost Estimate and Financial Assurance

A post-closure cost estimate was originally prepared as part of the Post-Closure Plan. The cost estimate indicates the amount of money that was determined necessary on an annual basis to meet landfill post-closure obligations in accordance with 15A NCAC 13B.1627(d) and .1628. The City of Durham continues to financially assure the post-closure care period with annual updates to the determined dollar value. The installation and operation of the proposed LFGTE system is not included as part of this process. If operation of the LFGTE system is terminated,

the existing landfill gas collection system will continue to operate as originally intended. Financial assurance for maintaining the LFGTE system is currently under negotiation between the City and MP Durham, LLC.

Appendix A

Appendix A
Guidance and Correspondence

August 7, 1996

PERMITTING GUIDANCE: ACTIVE GAS COLLECTION SYSTEMS

TO: Municipal Solid Waste Landfill Owners and Operators, Consultants, and Interested Parties

FROM: Solid Waste Section, Division of Waste Management

DISCUSSION: Owners, operators and vendors have contacted the Solid Waste Section (Section) regarding clarification of rules and requirements for active gas collection systems at municipal solid waste landfills (MSWLFs). Active gas collection systems are installed at MSWLFs for a variety of reasons, including the following:

In response to an operational violation of 15A NCAC 13B .1626(4), which requires a remediation plan for methane gas releases or as a preventive measure to ensure compliance with the rule.

As an element of the closure system required by 15A NCAC 13B .1627(c)(3)(B), which requires a gas venting or collection system below the low-permeability barrier to minimize pressures exerted on the barrier.

In response to the new emissions guidelines for MSWLFs regulated under the Clean Air Act, as recently amended.

Please note that pursuant to 15A NCAC 13B .1603(a)(3), an owner and operator proposing changes to the construction, operation, closure, and post-closure plans approved in the MSWLF permit shall request prior approval from the Section in accordance with 15A NCAC 13B Rule .1617(c).

PERMIT MODIFICATION REQUIREMENTS: Submittal of the following information and Section approval is required prior to the installation of an active gas collection system:

1. Submittal of a conceptual plan for placement of gas wells, blowers, flares or other control devices, and proposed location of related infrastructure.
2. Plan for disposal of gas condensate. Pursuant to .1626(9)(a)(ii), gas condensate derived from a MSWLF unit may not be placed in the unit unless the unit is designed with a composite liner. Requests or proposals for recirculation of gas condensate in MSWLF units designed with a composite liner and leachate collection system as described in Rule .1624 must be included in the submittal.
3. A modification to the operations plan which includes a detailed emergency response plan for a landfill fire. The plan should include provisions to train landfill employees in the proper response to a fire, specifically steps to be taken concerning the gas collection system.

4. A modification to the operations plan describing how the installation and presence of the gas collection system will be coordinated with the operation of the MSWLF unit.
5. A modification to the operations plan describing the routine maintenance requirements of the gas collection system.
6. A modification to the closure plan describing how the installation and presence of the gas collection system will be coordinated with the closure of the MSWLF unit. Plan should include proposed well design, engineering details concerning penetration through the final cover system, and provisions for maintenance and repair of the closure cap system should it become damaged during the operation, installation, or repair of the gas system.
7. A plan defining the steps necessary to decommission the wells at the end of their useful life.
8. All necessary approvals and permits from the Division of Air Quality.
9. Revisions to the closure and post-closure cost estimates for financial assurance.

Following installation of the gas collection system, as-built drawings and an engineering report sealed by a Professional Engineer registered in the State of North Carolina shall be submitted to the Section in accordance with the requirements of (1) above.

FINANCIAL ASSURANCE: The installation of an active gas collection system, regardless of the reason and timing of installation has ramifications for the closure and post-closure requirements for the MSWLF facility. Please note that in accordance with Rule.1628, financial assurance for a MSWLF is the responsibility of the facility owner and operator.

OSURE

Systems proposed for installation at closure, or additions to an active system required by closure must be included in closure cost estimates. (i.e. additional wells or vents that may be installed when the cap system is put in place, adjustments to blowers, flares, etc.)

POST-CLOSURE

The costs for post-closure operation, maintenance, and decommissioning of the landfill gas system must be included in the post-closure cost estimates for the facility.

The closure and post-closure cost adjustments must be submitted with the permit modification application for approval by the Section and placed in the facility operating record in accordance with .1628(a)(4) and (5). Financial assurance mechanisms must be updated on the next anniversary of their filing.

If there are any questions, please contact the permitting engineers in either the Raleigh Central Office or the Winston-Salem and Fayetteville Regional Offices.

State of North Carolina
Department of Environment,
Health and Natural Resources
Division of Solid Waste Management

James B. Hunt, Jr., Governor
Jonathan B. Howes, Secretary
William L. Meyer, Director

DEHNR

July 29, 1996

Ms. Nancy Newell, P.E.
Solid Waste Process Engineer
City of Durham
1833 Camden Avenue
Durham, NC 27704

Re: Full Approval of the Transition Plan for the Durham County MSW Landfill, Permit Number 32-01

Dear Ms. Newell:

The Division of Waste Management has completed its review of the Transition Plan for the referenced landfill submitted by the consultant, Malcom Pirnie, on behalf of the owner and operator, Durham County.

Rule .1603(a)(4)(A) of the Solid Waste Management Rules codified at 15A NCAC 13B requires the owner and operator of an existing MSWLF unit to submit a Transition Plan application for continuing operation and closure of the existing MSWLF unit by April 9, 1994. Rule .1617(d) requires that the plan contain: an operation plan in accordance with Rule .1625, a closure and post-closure plan in accordance with Rule .1629, a water quality plan in accordance with .1623(b)(3), and a report that contains a schedule for closure of the existing MSWLF unit and, if necessary, submittal of an application for a new facility, a lateral expansion or permit renewal.

Rule .1603(d)(2) requires the Division to establish a review schedule for the Transition Plan applications which determines the adequacy of all the plans by October 9, 1996. The rule allows the Division to issue full or partial approvals and to determine the schedule for closure of the existing MSWLF unit based on its review of the complete transition plan application.

In accordance with Rule .1603(d)(2), the Division has completed its review of the submitted application as amended through July 23, 1996, and hereby issues full approval of the Transition Plan for the referenced landfill.

The approved Transition Plan shall be effective through December 1997, or until the permitted contours are reached. Rule .1625(b)(3)(C) requires that operation drawings illustrate annual phases of development which are consistent with the minimum and maximum closure slope requirements. In accordance with this rule and Rule .1627(c)(10)(A), the existing unlined MSWLF unit shall be operated in such a manner as to cease receiving solid waste on or before

P.O. Box 27687,
Raleigh, North Carolina 27611-7687
Voice 919-733-4996

NC Reduce Reuse Recycle

FAX 919-715-3605

January 1,1998, regardless of the approved final contours.

If there are any questions or comments, please contact Greg Eades @ (919) 733-0692, extension 344.

Sincerely,

James C. Coffey, Head
Permitting Branch
Solid Waste Section

cc: Dexter Matthews, SWS
Terry Dover, SWS
Mark Fry, SWS
Richard Stahr, P.E., Malcom Pirnie

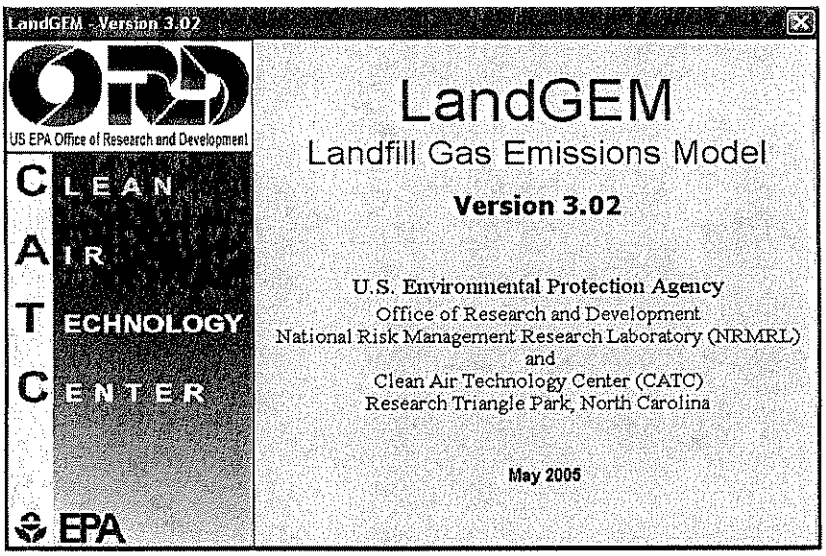
Appendix B

Appendix B
Air Construction Permit Application

Refer to separately bound document.

Appendix C

Appendix C
Landfill Gas Generation Information



Summary Report

Landfill Name or Identifier: Durham Municipal Landfill, Durham, NC

Date: Wednesday, September 10, 2008

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	1973	
Landfill Closure Year (with 80-year limit)	1997	
Actual Closure Year (without limit)	*1997*	
Have Model Calculate Closure Year?	No	
Waste Design Capacity		*megagrams*

MODEL PARAMETERS

Methane Generation Rate, k	0.050	$year^{-1}$
Potential Methane Generation Capacity, L_o	170	m^3/Mg
NMOC Concentration	4,000	*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)*
1973	22,680	24,948	0	0
1974	32,451	35,696	22,680	24,948
1975	42,221	46,443	55,131	60,644
1976	51,992	57,191	97,352	107,087
1977	61,762	67,938	149,344	164,278
1978	71,533	78,686	211,106	232,217
1979	81,303	89,433	282,639	310,903
1980	91,074	100,181	363,942	400,336
1981	100,844	110,928	455,016	500,518
1982	110,615	121,677	555,860	611,446
1983	120,217	132,239	666,475	733,123
1984	130,156	143,172	786,692	865,361
1985	169,068	185,975	916,848	1,008,533
1986	172,369	189,606	1,085,916	1,194,508
1987	197,363	217,099	1,258,285	1,384,114
1988	203,387	223,726	1,455,648	1,601,213
1989	207,208	227,929	1,659,035	1,824,939
1990	196,877	216,565	1,866,243	2,052,867
1991	189,021	207,923	2,063,120	2,269,432
1992	176,362	193,998	2,252,141	2,477,355
1993	187,402	206,142	2,428,503	2,671,353
1994	187,072	205,779	2,615,905	2,877,496
1995	160,898	176,988	2,802,977	3,083,275
1996	188,342	207,176	2,963,875	3,260,263
1997	191,968	211,165	3,152,217	3,467,439
1998	0	0	3,344,185	3,678,604
1999	0	0	3,344,185	3,678,604
2000	0	0	3,344,185	3,678,604
2001	0	0	3,344,185	3,678,604
2002	0	0	3,344,185	3,678,604
2003	0	0	3,344,185	3,678,604
2004	0	0	3,344,185	3,678,604
2005	0	0	3,344,185	3,678,604
2006	0	0	3,344,185	3,678,604
2007	0	0	3,344,185	3,678,604
2008	0	0	3,344,185	3,678,604
2009	0	0	3,344,185	3,678,604
2010	0	0	3,344,185	3,678,604
2011	0	0	3,344,185	3,678,604
2012	0	0	3,344,185	3,678,604

WASTE ACCEPTANCE RATES (Continued)

Year	Waste Accepted		Waste-In-Place	
	(Mg/year)	*(short tons/year)*	*(Mg)*	*(short tons)*
2013	0	0	3,344,185	3,678,604
2014	0	0	3,344,185	3,678,604
2015	0	0	3,344,185	3,678,604
2016	0	0	3,344,185	3,678,604
2017	0	0	3,344,185	3,678,604
2018	0	0	3,344,185	3,678,604
2019	0	0	3,344,185	3,678,604
2020	0	0	3,344,185	3,678,604
2021	0	0	3,344,185	3,678,604
2022	0	0	3,344,185	3,678,604
2023	0	0	3,344,185	3,678,604
2024	0	0	3,344,185	3,678,604
2025	0	0	3,344,185	3,678,604
2026	0	0	3,344,185	3,678,604
2027	0	0	3,344,185	3,678,604
2028	0	0	3,344,185	3,678,604
2029	0	0	3,344,185	3,678,604
2030	0	0	3,344,185	3,678,604
2031	0	0	3,344,185	3,678,604
2032	0	0	3,344,185	3,678,604
2033	0	0	3,344,185	3,678,604
2034	0	0	3,344,185	3,678,604
2035	0	0	3,344,185	3,678,604
2036	0	0	3,344,185	3,678,604
2037	0	0	3,344,185	3,678,604
2038	0	0	3,344,185	3,678,604
2039	0	0	3,344,185	3,678,604
2040	0	0	3,344,185	3,678,604
2041	0	0	3,344,185	3,678,604
2042	0	0	3,344,185	3,678,604
2043	0	0	3,344,185	3,678,604
2044	0	0	3,344,185	3,678,604
2045	0	0	3,344,185	3,678,604
2046	0	0	3,344,185	3,678,604
2047	0	0	3,344,185	3,678,604
2048	0	0	3,344,185	3,678,604
2049	0	0	3,344,185	3,678,604
2050	0	0	3,344,185	3,678,604
2051	0	0	3,344,185	3,678,604
2052	0	0	3,344,185	3,678,604

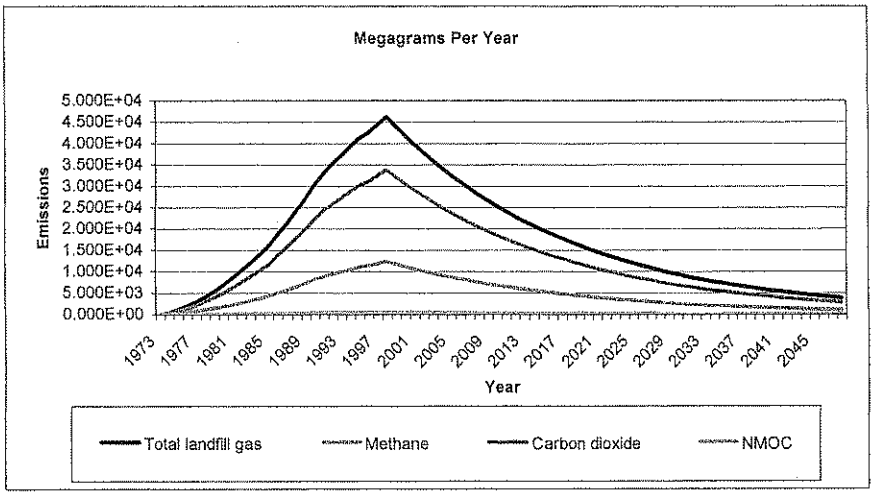
Pollutant Parameters

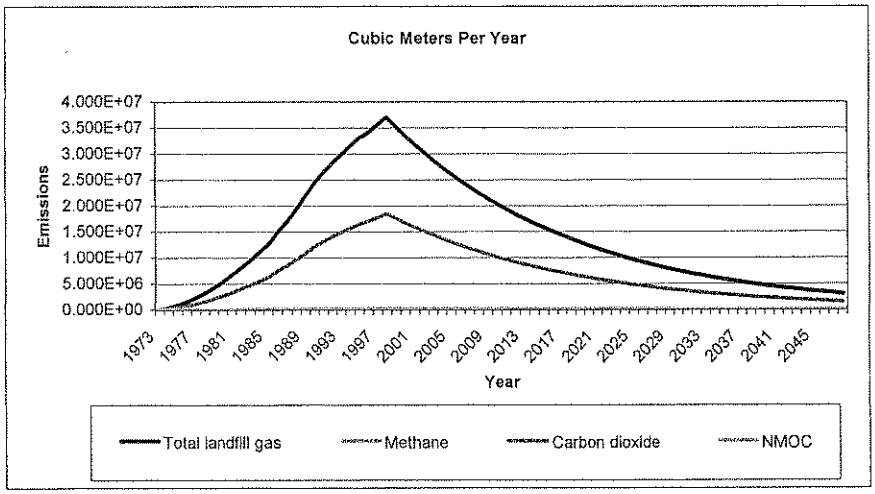
		Gas / Pollutant Default Parameters:		*User-specified Pollutant Parameters:*	
	Compound	Concentration (*ppmv*)	Molecular Weight	Concentration (*ppmv*)	Molecular Weight
Gases	Total landfill gas		0.00		
	Methane		16.04		
	Carbon dioxide		44.01		
	NMOC	4,000	86.18		
Pollutants	1,1,1-Trichloroethane (methyl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

Graphs


Megagrams Per Year
Emissions
5.000E+04
4.500E+04
4.000E+04
3.500E+04
3.000E+04
2.500E+04
2.000E+04
1.500E+04
1.000E+04
5.000E+03
0.000E+00
1973 1977 1981 1985 1989 1993 1997 2001 2005 2009 2013 2017 2021 2025 2029 2033 2037 2041 2045
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


Cubic Meters Per Year
Emissions
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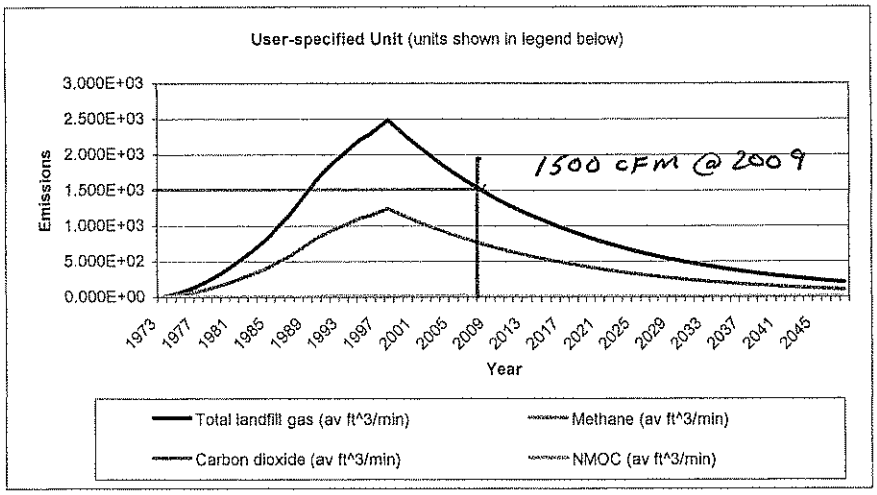
3.500E+07
3.000E+07
2.500E+07
2.000E+07
1.500E+07
1.000E+07
5.000E+06
0.000E+00
1973 1977 1981 1985 1989 1993 1997 2001 2005 2009 2013 2017 2021 2025 2029 2033 2037 2041 2045
Year
Total landfill gas
Methane
Carbon dioxide
NMOC


User-specified Unit (units shown in legend below)
Emissions
3.000E+03
2.500E+03
2.000E+03
1.500E+03
1.000E+03
5.000E+02
0.000E+00
1500 cFM @ 2009
1973 1977 1981 1985 1989 1993 1997 2001 2005 2009 2013 2017 2021 2025 2029 2033 2037 2041 2045
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)
1973	0	0	0	0	0	0
1974	4.708E+02	3.770E+05	2.533E+01	1.258E+02	1.885E+05	1.267E+01
1975	1.122E+03	8.981E+05	6.034E+01	2.996E+02	4.490E+05	3.017E+01
1976	1.943E+03	1.556E+06	1.046E+02	5.191E+02	7.781E+05	5.228E+01
1977	2.928E+03	2.345E+06	1.575E+02	7.821E+02	1.172E+06	7.876E+01
1978	4.067E+03	3.257E+06	2.188E+02	1.086E+03	1.628E+06	1.094E+02
1979	5.354E+03	4.287E+06	2.881E+02	1.430E+03	2.144E+06	1.440E+02
1980	6.781E+03	5.430E+06	3.648E+02	1.811E+03	2.715E+06	1.824E+02
1981	8.341E+03	6.679E+06	4.487E+02	2.228E+03	3.339E+06	2.244E+02
1982	1.003E+04	8.029E+06	5.395E+02	2.678E+03	4.015E+06	2.697E+02
1983	1.183E+04	9.477E+06	6.367E+02	3.161E+03	4.738E+06	3.184E+02
1984	1.375E+04	1.101E+07	7.400E+02	3.674E+03	5.506E+06	3.700E+02
1985	1.578E+04	1.264E+07	8.492E+02	4.216E+03	6.320E+06	4.246E+02
1986	1.852E+04	1.483E+07	9.967E+02	4.948E+03	7.417E+06	4.983E+02
1987	2.120E+04	1.698E+07	1.141E+03	5.663E+03	8.488E+06	5.703E+02
1988	2.426E+04	1.943E+07	1.305E+03	6.481E+03	9.714E+06	6.527E+02
1989	2.730E+04	2.186E+07	1.469E+03	7.293E+03	1.093E+07	7.344E+02
1990	3.027E+04	2.424E+07	1.629E+03	8.086E+03	1.212E+07	8.143E+02
1991	3.288E+04	2.633E+07	1.769E+03	8.783E+03	1.317E+07	8.846E+02
1992	3.520E+04	2.819E+07	1.894E+03	9.403E+03	1.409E+07	9.470E+02
1993	3.715E+04	2.975E+07	1.999E+03	9.922E+03	1.487E+07	9.993E+02
1994	3.923E+04	3.141E+07	2.110E+03	1.048E+04	1.571E+07	1.055E+03
1995	4.120E+04	3.299E+07	2.216E+03	1.100E+04	1.649E+07	1.108E+03
1996	4.253E+04	3.405E+07	2.288E+03	1.136E+04	1.703E+07	1.144E+03
1997	4.436E+04	3.552E+07	2.387E+03	1.185E+04	1.776E+07	1.193E+03
1998	4.618E+04	3.698E+07	2.485E+03	1.234E+04	1.849E+07	1.242E+03
1999	4.393E+04	3.518E+07	2.364E+03	1.173E+04	1.759E+07	1.182E+03
2000	4.179E+04	3.346E+07	2.248E+03	1.116E+04	1.673E+07	1.124E+03
2001	3.975E+04	3.183E+07	2.139E+03	1.062E+04	1.592E+07	1.069E+03
2002	3.781E+04	3.028E+07	2.034E+03	1.010E+04	1.514E+07	1.017E+03
2003	3.597E+04	2.880E+07	1.935E+03	9.608E+03	1.440E+07	9.676E+02
2004	3.421E+04	2.740E+07	1.841E+03	9.139E+03	1.370E+07	9.204E+02
2005	3.255E+04	2.606E+07	1.751E+03	8.693E+03	1.303E+07	8.755E+02
2006	3.096E+04	2.479E+07	1.666E+03	8.269E+03	1.240E+07	8.328E+02
2007	2.945E+04	2.358E+07	1.584E+03	7.866E+03	1.179E+07	7.922E+02
2008	2.801E+04	2.243E+07	1.507E+03	7.482E+03	1.122E+07	7.536E+02
2009	2.665E+04	2.134E+07	1.434E+03	7.118E+03	1.067E+07	7.168E+02
2010	2.535E+04	2.030E+07	1.364E+03	6.770E+03	1.015E+07	6.819E+02
2011	2.411E+04	1.931E+07	1.297E+03	6.440E+03	9.653E+06	6.486E+02
2012	2.293E+04	1.837E+07	1.234E+03	6.126E+03	9.183E+06	6.170E+02
2013	2.182E+04	1.747E+07	1.174E+03	5.827E+03	8.735E+06	5.869E+02
2014	2.075E+04	1.662E+07	1.117E+03	5.543E+03	8.309E+06	5.583E+02
2015	1.974E+04	1.581E+07	1.062E+03	5.273E+03	7.903E+06	5.310E+02
2016	1.878E+04	1.504E+07	1.010E+03	5.016E+03	7.518E+06	5.051E+02
2017	1.786E+04	1.430E+07	9.610E+02	4.771E+03	7.151E+06	4.805E+02
2018	1.699E+04	1.361E+07	9.141E+02	4.538E+03	6.803E+06	4.571E+02
2019	1.616E+04	1.294E+07	8.695E+02	4.317E+03	6.471E+06	4.348E+02
2020	1.537E+04	1.231E+07	8.271E+02	4.106E+03	6.155E+06	4.136E+02
2021	1.462E+04	1.171E+07	7.868E+02	3.906E+03	5.855E+06	3.934E+02
2022	1.391E+04	1.114E+07	7.484E+02	3.716E+03	5.569E+06	3.742E+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)
2023	1.323E+04	1.060E+07	7.119E+02	3.534E+03	5.298E+06	3.560E+02
2024	1.259E+04	1.008E+07	6.772E+02	3.362E+03	5.039E+06	3.386E+02
2025	1.197E+04	9.587E+06	6.442E+02	3.198E+03	4.794E+06	3.221E+02
2026	1.139E+04	9.120E+06	6.128E+02	3.042E+03	4.560E+06	3.064E+02
2027	1.083E+04	8.675E+06	5.829E+02	2.894E+03	4.338E+06	2.914E+02
2028	1.031E+04	8.252E+06	5.544E+02	2.753E+03	4.126E+06	2.772E+02
2029	9.803E+03	7.850E+06	5.274E+02	2.618E+03	3.925E+06	2.637E+02
2030	9.325E+03	7.467E+06	5.017E+02	2.491E+03	3.733E+06	2.508E+02
2031	8.870E+03	7.103E+06	4.772E+02	2.369E+03	3.551E+06	2.386E+02
2032	8.437E+03	6.756E+06	4.539E+02	2.254E+03	3.378E+06	2.270E+02
2033	8.026E+03	6.427E+06	4.318E+02	2.144E+03	3.213E+06	2.159E+02
2034	7.634E+03	6.113E+06	4.107E+02	2.039E+03	3.057E+06	2.054E+02
2035	7.262E+03	5.815E+06	3.907E+02	1.940E+03	2.908E+06	1.954E+02
2036	6.908E+03	5.531E+06	3.717E+02	1.845E+03	2.766E+06	1.858E+02
2037	6.571E+03	5.262E+06	3.535E+02	1.755E+03	2.631E+06	1.768E+02
2038	6.250E+03	5.005E+06	3.363E+02	1.670E+03	2.503E+06	1.681E+02
2039	5.946E+03	4.761E+06	3.199E+02	1.588E+03	2.380E+06	1.599E+02
2040	5.656E+03	4.529E+06	3.043E+02	1.511E+03	2.264E+06	1.521E+02
2041	5.380E+03	4.308E+06	2.894E+02	1.437E+03	2.154E+06	1.447E+02
2042	5.117E+03	4.098E+06	2.753E+02	1.367E+03	2.049E+06	1.377E+02
2043	4.868E+03	3.898E+06	2.619E+02	1.300E+03	1.949E+06	1.310E+02
2044	4.630E+03	3.708E+06	2.491E+02	1.237E+03	1.854E+06	1.246E+02
2045	4.405E+03	3.527E+06	2.370E+02	1.177E+03	1.764E+06	1.185E+02
2046	4.190E+03	3.355E+06	2.254E+02	1.119E+03	1.677E+06	1.127E+02
2047	3.985E+03	3.191E+06	2.144E+02	1.065E+03	1.596E+06	1.072E+02
2048	3.791E+03	3.036E+06	2.040E+02	1.013E+03	1.518E+06	1.020E+02
2049	3.606E+03	2.888E+06	1.940E+02	9.633E+02	1.444E+06	9.701E+01
2050	3.430E+03	2.747E+06	1.846E+02	9.163E+02	1.373E+06	9.228E+01
2051	3.263E+03	2.613E+06	1.756E+02	8.716E+02	1.306E+06	8.778E+01
2052	3.104E+03	2.485E+06	1.670E+02	8.291E+02	1.243E+06	8.350E+01
2053	2.953E+03	2.364E+06	1.589E+02	7.886E+02	1.182E+06	7.943E+01
2054	2.809E+03	2.249E+06	1.511E+02	7.502E+02	1.124E+06	7.555E+01
2055	2.672E+03	2.139E+06	1.437E+02	7.136E+02	1.070E+06	7.187E+01
2056	2.541E+03	2.035E+06	1.367E+02	6.788E+02	1.017E+06	6.836E+01
2057	2.417E+03	1.936E+06	1.301E+02	6.457E+02	9.678E+05	6.503E+01
2058	2.299E+03	1.841E+06	1.237E+02	6.142E+02	9.206E+05	6.186E+01
2059	2.187E+03	1.751E+06	1.177E+02	5.842E+02	8.757E+05	5.884E+01
2060	2.081E+03	1.666E+06	1.119E+02	5.557E+02	8.330E+05	5.597E+01
2061	1.979E+03	1.585E+06	1.065E+02	5.286E+02	7.924E+05	5.324E+01
2062	1.883E+03	1.507E+06	1.013E+02	5.029E+02	7.537E+05	5.064E+01
2063	1.791E+03	1.434E+06	9.635E+01	4.783E+02	7.170E+05	4.817E+01
2064	1.703E+03	1.364E+06	9.165E+01	4.550E+02	6.820E+05	4.582E+01
2065	1.620E+03	1.298E+06	8.718E+01	4.328E+02	6.488E+05	4.359E+01
2066	1.541E+03	1.234E+06	8.293E+01	4.117E+02	6.171E+05	4.146E+01
2067	1.466E+03	1.174E+06	7.888E+01	3.916E+02	5.870E+05	3.944E+01
2068	1.395E+03	1.117E+06	7.504E+01	3.725E+02	5.584E+05	3.752E+01
2069	1.327E+03	1.062E+06	7.138E+01	3.544E+02	5.312E+05	3.569E+01
2070	1.262E+03	1.011E+06	6.790E+01	3.371E+02	5.053E+05	3.395E+01
2071	1.200E+03	9.612E+05	6.458E+01	3.206E+02	4.806E+05	3.229E+01
2072	1.142E+03	9.143E+05	6.143E+01	3.050E+02	4.572E+05	3.072E+01
2073	1.086E+03	8.698E+05	5.844E+01	2.901E+02	4.349E+05	2.922E+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)
2074	1.033E+03	8.273E+05	5.559E+01	2.760E+02	4.137E+05	2.779E+01
2075	9.828E+02	7.870E+05	5.288E+01	2.625E+02	3.935E+05	2.644E+01
2076	9.349E+02	7.486E+05	5.030E+01	2.497E+02	3.743E+05	2.515E+01
2077	8.893E+02	7.121E+05	4.785E+01	2.375E+02	3.560E+05	2.392E+01
2078	8.459E+02	6.774E+05	4.551E+01	2.260E+02	3.387E+05	2.276E+01
2079	8.047E+02	6.443E+05	4.329E+01	2.149E+02	3.222E+05	2.165E+01
2080	7.654E+02	6.129E+05	4.118E+01	2.044E+02	3.065E+05	2.059E+01
2081	7.281E+02	5.830E+05	3.917E+01	1.945E+02	2.915E+05	1.959E+01
2082	6.926E+02	5.546E+05	3.726E+01	1.850E+02	2.773E+05	1.863E+01
2083	6.588E+02	5.275E+05	3.544E+01	1.760E+02	2.638E+05	1.772E+01
2084	6.267E+02	5.018E+05	3.372E+01	1.674E+02	2.509E+05	1.686E+01
2085	5.961E+02	4.773E+05	3.207E+01	1.592E+02	2.387E+05	1.604E+01
2086	5.670E+02	4.540E+05	3.051E+01	1.515E+02	2.270E+05	1.525E+01
2087	5.394E+02	4.319E+05	2.902E+01	1.441E+02	2.160E+05	1.451E+01
2088	5.131E+02	4.108E+05	2.760E+01	1.370E+02	2.054E+05	1.380E+01
2089	4.880E+02	3.908E+05	2.626E+01	1.304E+02	1.954E+05	1.313E+01
2090	4.642E+02	3.717E+05	2.498E+01	1.240E+02	1.859E+05	1.249E+01
2091	4.416E+02	3.536E+05	2.376E+01	1.180E+02	1.768E+05	1.188E+01
2092	4.201E+02	3.364E+05	2.260E+01	1.122E+02	1.682E+05	1.130E+01
2093	3.996E+02	3.200E+05	2.150E+01	1.067E+02	1.600E+05	1.075E+01
2094	3.801E+02	3.044E+05	2.045E+01	1.015E+02	1.522E+05	1.022E+01
2095	3.616E+02	2.895E+05	1.945E+01	9.657E+01	1.448E+05	9.726E+00
2096	3.439E+02	2.754E+05	1.850E+01	9.186E+01	1.377E+05	9.252E+00
2097	3.271E+02	2.620E+05	1.760E+01	8.738E+01	1.310E+05	8.801E+00
2098	3.112E+02	2.492E+05	1.674E+01	8.312E+01	1.246E+05	8.371E+00
2099	2.960E+02	2.370E+05	1.593E+01	7.907E+01	1.185E+05	7.963E+00
2100	2.816E+02	2.255E+05	1.515E+01	7.521E+01	1.127E+05	7.575E+00
2101	2.678E+02	2.145E+05	1.441E+01	7.154E+01	1.072E+05	7.205E+00
2102	2.548E+02	2.040E+05	1.371E+01	6.806E+01	1.020E+05	6.854E+00
2103	2.424E+02	1.941E+05	1.304E+01	6.474E+01	9.703E+04	6.520E+00
2104	2.305E+02	1.846E+05	1.240E+01	6.158E+01	9.230E+04	6.202E+00
2105	2.193E+02	1.756E+05	1.180E+01	5.858E+01	8.780E+04	5.899E+00
2106	2.086E+02	1.670E+05	1.122E+01	5.572E+01	8.352E+04	5.612E+00
2107	1.984E+02	1.589E+05	1.068E+01	5.300E+01	7.944E+04	5.338E+00
2108	1.887E+02	1.511E+05	1.016E+01	5.042E+01	7.557E+04	5.078E+00
2109	1.795E+02	1.438E+05	9.660E+00	4.796E+01	7.188E+04	4.830E+00
2110	1.708E+02	1.368E+05	9.189E+00	4.562E+01	6.838E+04	4.594E+00
2111	1.625E+02	1.301E+05	8.741E+00	4.339E+01	6.504E+04	4.370E+00
2112	1.545E+02	1.237E+05	8.314E+00	4.128E+01	6.187E+04	4.157E+00
2113	1.470E+02	1.177E+05	7.909E+00	3.926E+01	5.885E+04	3.954E+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)*
1973	0	0	0	0	0	0
1974	3.451E+02	1.885E+05	1.267E+01	5.406E+00	1.508E+03	1.013E-01
1975	8.220E+02	4.490E+05	3.017E+01	1.288E+01	3.592E+03	2.414E-01
1976	1.424E+03	7.781E+05	5.228E+01	2.231E+01	6.225E+03	4.182E-01
1977	2.146E+03	1.172E+06	7.876E+01	3.362E+01	9.378E+03	6.301E-01
1978	2.981E+03	1.628E+06	1.094E+02	4.670E+01	1.303E+04	8.753E-01
1979	3.924E+03	2.144E+06	1.440E+02	6.147E+01	1.715E+04	1.152E+00
1980	4.969E+03	2.715E+06	1.824E+02	7.785E+01	2.172E+04	1.459E+00
1981	6.113E+03	3.339E+06	2.244E+02	9.576E+01	2.672E+04	1.795E+00
1982	7.349E+03	4.015E+06	2.697E+02	1.151E+02	3.212E+04	2.158E+00
1983	8.673E+03	4.738E+06	3.184E+02	1.359E+02	3.791E+04	2.547E+00
1984	1.008E+04	5.506E+06	3.700E+02	1.579E+02	4.405E+04	2.960E+00
1985	1.157E+04	6.320E+06	4.246E+02	1.812E+02	5.056E+04	3.397E+00
1986	1.358E+04	7.417E+06	4.983E+02	2.127E+02	5.933E+04	3.987E+00
1987	1.554E+04	8.488E+06	5.703E+02	2.434E+02	6.790E+04	4.562E+00
1988	1.778E+04	9.714E+06	6.527E+02	2.786E+02	7.771E+04	5.222E+00
1989	2.001E+04	1.093E+07	7.344E+02	3.135E+02	8.745E+04	5.876E+00
1990	2.219E+04	1.212E+07	8.143E+02	3.476E+02	9.696E+04	6.515E+00
1991	2.410E+04	1.317E+07	8.846E+02	3.775E+02	1.053E+05	7.077E+00
1992	2.580E+04	1.409E+07	9.470E+02	4.042E+02	1.128E+05	7.576E+00
1993	2.722E+04	1.487E+07	9.993E+02	4.265E+02	1.190E+05	7.994E+00
1994	2.875E+04	1.571E+07	1.055E+03	4.504E+02	1.256E+05	8.442E+00
1995	3.019E+04	1.649E+07	1.108E+03	4.730E+02	1.320E+05	8.866E+00
1996	3.117E+04	1.703E+07	1.144E+03	4.883E+02	1.362E+05	9.152E+00
1997	3.251E+04	1.776E+07	1.193E+03	5.093E+02	1.421E+05	9.547E+00
1998	3.385E+04	1.849E+07	1.242E+03	5.303E+02	1.479E+05	9.939E+00
1999	3.220E+04	1.759E+07	1.182E+03	5.044E+02	1.407E+05	9.455E+00
2000	3.063E+04	1.673E+07	1.124E+03	4.798E+02	1.339E+05	8.994E+00
2001	2.913E+04	1.592E+07	1.069E+03	4.564E+02	1.273E+05	8.555E+00
2002	2.771E+04	1.514E+07	1.017E+03	4.341E+02	1.211E+05	8.138E+00
2003	2.636E+04	1.440E+07	9.676E+02	4.130E+02	1.152E+05	7.741E+00
2004	2.508E+04	1.370E+07	9.204E+02	3.928E+02	1.096E+05	7.363E+00
2005	2.385E+04	1.303E+07	8.755E+02	3.737E+02	1.042E+05	7.004E+00
2006	2.269E+04	1.240E+07	8.328E+02	3.554E+02	9.916E+04	6.663E+00
2007	2.158E+04	1.179E+07	7.922E+02	3.381E+02	9.432E+04	6.338E+00
2008	2.053E+04	1.122E+07	7.536E+02	3.216E+02	8.972E+04	6.029E+00
2009	1.953E+04	1.067E+07	7.168E+02	3.059E+02	8.535E+04	5.735E+00
2010	1.858E+04	1.015E+07	6.819E+02	2.910E+02	8.119E+04	5.455E+00
2011	1.767E+04	9.653E+06	6.486E+02	2.768E+02	7.723E+04	5.189E+00
2012	1.681E+04	9.183E+06	6.170E+02	2.633E+02	7.346E+04	4.936E+00
2013	1.599E+04	8.735E+06	5.869E+02	2.505E+02	6.988E+04	4.695E+00
2014	1.521E+04	8.309E+06	5.583E+02	2.383E+02	6.647E+04	4.466E+00
2015	1.447E+04	7.903E+06	5.310E+02	2.266E+02	6.323E+04	4.248E+00
2016	1.376E+04	7.518E+06	5.051E+02	2.156E+02	6.014E+04	4.041E+00
2017	1.309E+04	7.151E+06	4.805E+02	2.051E+02	5.721E+04	3.844E+00
2018	1.245E+04	6.803E+06	4.571E+02	1.951E+02	5.442E+04	3.657E+00
2019	1.184E+04	6.471E+06	4.348E+02	1.856E+02	5.177E+04	3.478E+00
2020	1.127E+04	6.155E+06	4.136E+02	1.765E+02	4.924E+04	3.309E+00
2021	1.072E+04	5.855E+06	3.934E+02	1.679E+02	4.684E+04	3.147E+00
2022	1.019E+04	5.569E+06	3.742E+02	1.597E+02	4.456E+04	2.994E+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)
2023	9.698E+03	5.298E+06	3.560E+02	1.519E+02	4.238E+04	2.848E+00
2024	9.225E+03	5.039E+06	3.386E+02	1.445E+02	4.032E+04	2.709E+00
2025	8.775E+03	4.794E+06	3.221E+02	1.375E+02	3.835E+04	2.577E+00
2026	8.347E+03	4.560E+06	3.064E+02	1.308E+02	3.648E+04	2.451E+00
2027	7.940E+03	4.338E+06	2.914E+02	1.244E+02	3.470E+04	2.332E+00
2028	7.553E+03	4.126E+06	2.772E+02	1.183E+02	3.301E+04	2.218E+00
2029	7.184E+03	3.925E+06	2.637E+02	1.125E+02	3.140E+04	2.110E+00
2030	6.834E+03	3.733E+06	2.508E+02	1.071E+02	2.987E+04	2.007E+00
2031	6.501E+03	3.551E+06	2.386E+02	1.018E+02	2.841E+04	1.909E+00
2032	6.184E+03	3.378E+06	2.270E+02	9.687E+01	2.702E+04	1.816E+00
2033	5.882E+03	3.213E+06	2.159E+02	9.214E+01	2.571E+04	1.727E+00
2034	5.595E+03	3.057E+06	2.054E+02	8.765E+01	2.445E+04	1.643E+00
2035	5.322E+03	2.908E+06	1.954E+02	8.338E+01	2.326E+04	1.563E+00
2036	5.063E+03	2.766E+06	1.858E+02	7.931E+01	2.213E+04	1.487E+00
2037	4.816E+03	2.631E+06	1.768E+02	7.544E+01	2.105E+04	1.414E+00
2038	4.581E+03	2.503E+06	1.681E+02	7.176E+01	2.002E+04	1.345E+00
2039	4.357E+03	2.380E+06	1.599E+02	6.826E+01	1.904E+04	1.280E+00
2040	4.145E+03	2.264E+06	1.521E+02	6.493E+01	1.812E+04	1.217E+00
2041	3.943E+03	2.154E+06	1.447E+02	6.177E+01	1.723E+04	1.158E+00
2042	3.751E+03	2.049E+06	1.377E+02	5.875E+01	1.639E+04	1.101E+00
2043	3.568E+03	1.949E+06	1.310E+02	5.589E+01	1.559E+04	1.048E+00
2044	3.394E+03	1.854E+06	1.246E+02	5.316E+01	1.483E+04	9.965E-01
2045	3.228E+03	1.764E+06	1.185E+02	5.057E+01	1.411E+04	9.479E-01
2046	3.071E+03	1.677E+06	1.127E+02	4.810E+01	1.342E+04	9.017E-01
2047	2.921E+03	1.596E+06	1.072E+02	4.576E+01	1.277E+04	8.577E-01
2048	2.778E+03	1.518E+06	1.020E+02	4.353E+01	1.214E+04	8.159E-01
2049	2.643E+03	1.444E+06	9.701E+01	4.140E+01	1.155E+04	7.761E-01
2050	2.514E+03	1.373E+06	9.228E+01	3.938E+01	1.099E+04	7.382E-01
2051	2.391E+03	1.306E+06	8.778E+01	3.746E+01	1.045E+04	7.022E-01
2052	2.275E+03	1.243E+06	8.350E+01	3.564E+01	9.942E+03	6.680E-01
2053	2.164E+03	1.182E+06	7.943E+01	3.390E+01	9.457E+03	6.354E-01
2054	2.058E+03	1.124E+06	7.555E+01	3.224E+01	8.996E+03	6.044E-01
2055	1.958E+03	1.070E+06	7.187E+01	3.067E+01	8.557E+03	5.749E-01
2056	1.862E+03	1.017E+06	6.836E+01	2.918E+01	8.140E+03	5.469E-01
2057	1.772E+03	9.678E+05	6.503E+01	2.775E+01	7.743E+03	5.202E-01
2058	1.685E+03	9.206E+05	6.186E+01	2.640E+01	7.365E+03	4.949E-01
2059	1.603E+03	8.757E+05	5.884E+01	2.511E+01	7.006E+03	4.707E-01
2060	1.525E+03	8.330E+05	5.597E+01	2.389E+01	6.664E+03	4.478E-01
2061	1.450E+03	7.924E+05	5.324E+01	2.272E+01	6.339E+03	4.259E-01
2062	1.380E+03	7.537E+05	5.064E+01	2.161E+01	6.030E+03	4.052E-01
2063	1.312E+03	7.170E+05	4.817E+01	2.056E+01	5.736E+03	3.854E-01
2064	1.248E+03	6.820E+05	4.582E+01	1.956E+01	5.456E+03	3.666E-01
2065	1.188E+03	6.488E+05	4.359E+01	1.860E+01	5.190E+03	3.487E-01
2066	1.130E+03	6.171E+05	4.146E+01	1.770E+01	4.937E+03	3.317E-01
2067	1.075E+03	5.870E+05	3.944E+01	1.683E+01	4.696E+03	3.155E-01
2068	1.022E+03	5.584E+05	3.752E+01	1.601E+01	4.467E+03	3.001E-01
2069	9.723E+02	5.312E+05	3.569E+01	1.523E+01	4.249E+03	2.855E-01
2070	9.249E+02	5.053E+05	3.395E+01	1.449E+01	4.042E+03	2.716E-01
2071	8.798E+02	4.806E+05	3.229E+01	1.378E+01	3.845E+03	2.583E-01
2072	8.369E+02	4.572E+05	3.072E+01	1.311E+01	3.657E+03	2.457E-01
2073	7.960E+02	4.349E+05	2.922E+01	1.247E+01	3.479E+03	2.338E-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)*
2074	7.572E+02	4.137E+05	2.779E+01	1.186E+01	3.309E+03	2.224E-01
2075	7.203E+02	3.935E+05	2.644E+01	1.128E+01	3.148E+03	2.115E-01
2076	6.852E+02	3.743E+05	2.515E+01	1.073E+01	2.994E+03	2.012E-01
2077	6.517E+02	3.560E+05	2.392E+01	1.021E+01	2.848E+03	1.914E-01
2078	6.200E+02	3.387E+05	2.276E+01	9.712E+00	2.709E+03	1.820E-01
2079	5.897E+02	3.222E+05	2.165E+01	9.238E+00	2.577E+03	1.732E-01
2080	5.610E+02	3.065E+05	2.059E+01	8.788E+00	2.452E+03	1.647E-01
2081	5.336E+02	2.915E+05	1.959E+01	8.359E+00	2.332E+03	1.567E-01
2082	5.076E+02	2.773E+05	1.863E+01	7.951E+00	2.218E+03	1.490E-01
2083	4.828E+02	2.638E+05	1.772E+01	7.564E+00	2.110E+03	1.418E-01
2084	4.593E+02	2.509E+05	1.686E+01	7.195E+00	2.007E+03	1.349E-01
2085	4.369E+02	2.387E+05	1.604E+01	6.844E+00	1.909E+03	1.283E-01
2086	4.156E+02	2.270E+05	1.525E+01	6.510E+00	1.816E+03	1.220E-01
2087	3.953E+02	2.160E+05	1.451E+01	6.193E+00	1.728E+03	1.161E-01
2088	3.760E+02	2.054E+05	1.380E+01	5.891E+00	1.643E+03	1.104E-01
2089	3.577E+02	1.954E+05	1.313E+01	5.603E+00	1.563E+03	1.050E-01
2090	3.402E+02	1.859E+05	1.249E+01	5.330E+00	1.487E+03	9.991E-02
2091	3.236E+02	1.768E+05	1.188E+01	5.070E+00	1.414E+03	9.504E-02
2092	3.079E+02	1.682E+05	1.130E+01	4.823E+00	1.345E+03	9.040E-02
2093	2.928E+02	1.600E+05	1.075E+01	4.588E+00	1.280E+03	8.599E-02
2094	2.786E+02	1.522E+05	1.022E+01	4.364E+00	1.217E+03	8.180E-02
2095	2.650E+02	1.448E+05	9.726E+00	4.151E+00	1.158E+03	7.781E-02
2096	2.521E+02	1.377E+05	9.252E+00	3.949E+00	1.102E+03	7.402E-02
2097	2.398E+02	1.310E+05	8.801E+00	3.756E+00	1.048E+03	7.041E-02
2098	2.281E+02	1.246E+05	8.371E+00	3.573E+00	9.968E+02	6.697E-02
2099	2.169E+02	1.185E+05	7.963E+00	3.399E+00	9.481E+02	6.371E-02
2100	2.064E+02	1.127E+05	7.575E+00	3.233E+00	9.019E+02	6.060E-02
2101	1.963E+02	1.072E+05	7.205E+00	3.075E+00	8.579E+02	5.764E-02
2102	1.867E+02	1.020E+05	6.854E+00	2.925E+00	8.161E+02	5.483E-02
2103	1.776E+02	9.703E+04	6.520E+00	2.783E+00	7.763E+02	5.216E-02
2104	1.690E+02	9.230E+04	6.202E+00	2.647E+00	7.384E+02	4.961E-02
2105	1.607E+02	8.780E+04	5.899E+00	2.518E+00	7.024E+02	4.719E-02
2106	1.529E+02	8.352E+04	5.612E+00	2.395E+00	6.681E+02	4.489E-02
2107	1.454E+02	7.944E+04	5.338E+00	2.278E+00	6.356E+02	4.270E-02
2108	1.383E+02	7.557E+04	5.078E+00	2.167E+00	6.046E+02	4.062E-02
2109	1.316E+02	7.188E+04	4.830E+00	2.061E+00	5.751E+02	3.864E-02
2110	1.252E+02	6.838E+04	4.594E+00	1.961E+00	5.470E+02	3.675E-02
2111	1.191E+02	6.504E+04	4.370E+00	1.865E+00	5.203E+02	3.496E-02
2112	1.133E+02	6.187E+04	4.157E+00	1.774E+00	4.950E+02	3.326E-02
2113	1.077E+02	5.885E+04	3.954E+00	1.688E+00	4.708E+02	3.164E-02

HAZEN AND SAWYER
Environmental Engineers & Scientists

TO:	Nancy Newell, P.E., City of Durham	DATE:	13 February 2008
FROM:	C. Michael Bullard, P.E.	REVISED:	11 March 2008
RE:	North Durham WRF Digester and Landfill Gas Utilization Study H&S Project No.: 30751-001-101		

1.0 Summary

1.1 Statement of Purpose

Hazen and Sawyer was tasked to evaluate utilization of biogas gas recovered from the landfill adjacent to the North Durham Water Reclamation Facility (NDWRF) to power process related equipment at the treatment facility. Specifically, Hazen and Sawyer was tasked to evaluate engine-driven equipment or microturbines for potential utilization of recovered biogas from the landfill. In addition to the landfill gas beneficial use study, Hazen and Sawyer was tasked to examine potential utilization of anaerobic digester gas for energy recovery beyond the current practice of driving gas-fired reciprocating engines attached to process air blowers in the existing treatment works.

1.2 Recommendation

Electrical power generation in both the 1.0 MW and 2.0 MW power increments appears to be an economically viable beneficial use of the landfill gas stream. Additional engineering development work is recommended to define project requirements, confirm environmental permitting requirements, and refine economic issues related to power production and generation to the Duke Energy grid.

2.0 Background

2.1 Gas Handling and Utilization Equipment

Digester gas and landfill gas handling equipment currently exists at the North Durham WRF (NDWRF). Existing digester gas and landfill gas equipment is described in the following sections.

2.2.1 Digester Gas

Currently, methane gas from the digesters is used to mix and heat digester contents. Additionally, digester gas fueled engine driven blowers can provide process air to sections of the wastewater treatment plant. Digester gas is also utilized to generate building heat for the Biosolids Handling Building and the "A-Side" Control Building via a heat recovery system associated with the engine driven blowers. Hot water boilers are also provided in the anaerobic digestion unit process to provide supplemental heating, beyond heat recovered from the engine driven blowers, for anaerobic digester process control. Lastly, surplus digester gas which is not utilized for digester heating or in the engine driven blower equipment is processed through waste gas flares installed on the NDWRF A-Side. Digester gas handling equipment installed at the North Durham WRF is summarized in **Table 2-1**.

Table 2-1
Digester Gas Handling Equipment

Engine Driven Blowers	
Manufacturer – Blower	Sutorbilt
Model – Blower	GFMBFBN
Maximum Speed – Blower	1125 rpm
Maximum Pressure – Blower	~ 9.0 psig
Manufacturer – Engine Driver	Waukesha
Model – Engine	F2895GU
Size – Engine	8 1/2 x 8 1/2
Hot Water Boilers	
Manufacturer	Cleaver Brooks
Model	CB700-125
Heat Capacity – Output	4,184,000 BTU/hr
Heat Capacity – Input	

Table 2-1 (Cont'd) Digester Gas Handling Equipment	
Digester Mixing Compressors	
Manufacturer	Nash
Model	SC4S
Speed	1170 rpm
Gas Flow Rate	270 SCFM
Discharge Pressure	13.1 psig
DG Compressor and Drying System	
Manufacturer	
Type	Multistage Centrifugal
Design Flow	400 SCFM
Design Pressure	3.5 to 7.0 psig
Waste Gas Flare	
Manufacturer	Oceco
Model	221
Flow Capacity (max)	24,000 CFH

2.2.2 Landfill Gas

Landfill gas (LFG) is collected via a system of gas wells and collection pipes located across the landfill cover area. Blowers located near the LFG waste gas flare provide a vacuum in the system which pulls gas from under the landfill cover and routes the LFG to the waste gas flare for combustion. Currently, 100% of the landfill gas collected in the system is routed to the waste gas flare. The landfill gas system is described in **Table 2-2.**

Table 2-2 Landfill Gas Handling Equipment	
Engine Driven Blowers	
Manufacturer – Blower	Hoffman
Model – Blower	38304C
Waste Gas Flare	
Manufacturer	John Zink
Model	B-F-907191-701
Flow Capacity (max)	3600 CFM

2.2 Digester and Landfill Gas Generation Rates

Gas generation rates from both the anaerobic digestion unit process and the landfill were prepared based on plant operating records for the anaerobic digester gas and from Title V emissions estimates for the landfill gas stream. Estimated gas production rates are summarized in the following sections.

2.2.1 Digester Gas

Digester gas generation rates are based on measurements provided by the NDWRF plant operations staff. Digester gas is currently generated at an average rate of approximately 200 SCFM. This rate should remain relatively constant barring any major process changes in the digesters.

2.2.2 Landfill Gas

Landfill gas generation rates were based on a computer estimation model [LANDGEM] and then corrected to correlate with data found in Title V emissions reports and data given by plant staff. The LANDGEM model was corrected to fit empirical data in two ways: 1) shifting the curve seven years into the future; 2) scaling the curve to 60% of its magnitude. Chronological shifting of the curve accounts for an apparent lag in the models prediction of peak digester gas production. Magnitude scaling of the gas generation rate curve accounts for fugitive emissions from the landfill which are not captured and routed to the waste gas flare. Typical values for landfill fugitive gasses range from 25% to 35% total gas production. These curves are shown in **Figure 2-1** alongside empirical data. It should be noted that the observed 1995 and 2005 gas production rates closely overlap the chronologically shifted, magnitude reduced gas production estimates.

~1326 @ 2008 CFM

~1250 @ 2009 CFM

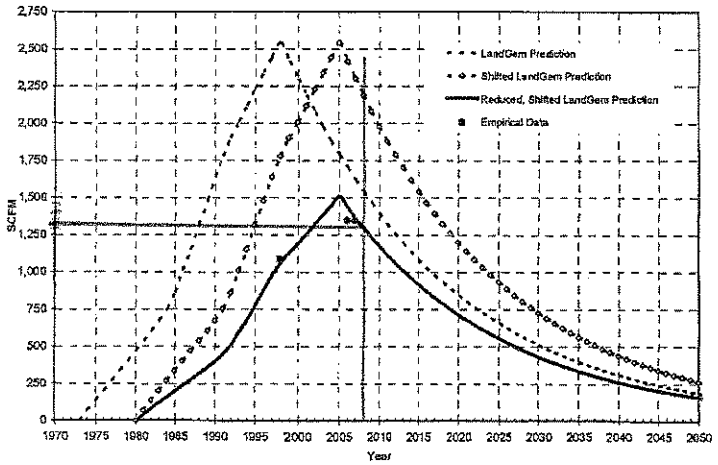


Figure 2-1
Estimated Landfill Gas Production Rate

Appendix D

Appendix D
Approved Post-Closure Plan

CITY OF DURHAM
SANITARY LANDFILL
TRANSITION PLAN

DURHAM

1869

CITY OF MEDICINE

City of Durham, North Carolina

APPROVED
DIVISION OF SOLID WASTE MANAGEMENT
DATE 7/29/96 BY

April 1994

0759-022

MALCOLM PIRNIE

ENVIRONMENTAL ENGINEERS, SCIENTISTS & PLANNERS

CITY OF DURHAM SANITARY LANDFILL CLOSURE AND POST-CLOSURE PLAN

CITY OF DURHAM, NORTH CAROLINA

APRIL 1994

MALCOLM PIRNIE, INC.

11832 Rock Landing Drive, Suite 400
Newport News, Virginia 23606

0759-022-340

Transition Plan Amendment
December 1994

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3.0 POST-CLOSURE

3.1 POST-CLOSURE CONTACT

The City of Durham is the owner, permit holder and operator of the facility. The primary contact person and address is:

Mr. Don Robinson
Acting Director Sanitation Department
City of Durham
101 City Hall Plaza
Durham, North Carolina 27201

Telephone: (919) 560-4185

3.2 MAINTENANCE PLAN

In accordance with Rule .1629(c)(1) and Rule .1627(d), post-closure care will be conducted for 30 years. The following sections describe post-closure maintenance procedures, equipment requirements and material needs for preventative and corrective maintenance of active landfill systems including:

- Groundwater and surface water monitoring
- Gas control
- Gas monitoring
- Final cover
- Storm water management

Anticipated preventive and corrective maintenance requirements of these systems are summarized in Table 3-1 and the following sections.

Groundwater Monitoring System

The groundwater monitoring system will be maintained so as to remain operational in accordance with Rules .1631 through .1637. The system, shown on the Site Plan Sheet,

TABLE 3-1

SUMMARY OF POST-CLOSURE MAINTENANCE

CLOSURE SYSTEM	*SYSTEM COMPONENT*	*MAINTENANCE PROCEDURES*	*FREQUENCY*
Groundwater Monitoring	▪ Monitoring Wells	▪ Development in conjunction with water quality monitoring.	▪ Semi-Annual
	▪ Protective Casing	▪ N/A	▪ N/A
	▪ Lock Mechanism	▪ Lubricate	▪ As Necessary
Gas Control	▪ Extraction Wells	▪ Repair as necessary	▪ Annually
	▪ Gas Blower	▪ Check shaft packing and seals, repair as necessary.	▪ Monthly
		▪ Check oil level, add oil as required.	▪ Monthly
		▪ Check belts or drive, adjust as required.	▪ Monthly
		▪ Lubricate all bearings and grease fittings.	▪ Semi-Annually
		▪ Clean motor.	▪ Semi-Annually
		▪ Change oil.	▪ Annually
	▪ Moisture Separator	▪ Drain moisture trap, clean out collected debris, as necessary.	▪ Monthly

TABLE 3-1
(Continued)

SUMMARY OF POST-CLOSURE MAINTENANCE

CLOSURE SYSTEM	*SYSTEM COMPONENT*	*MAINTENANCE PROCEDURES*	*FREQUENCY*
Gas Control (Continued)	▪ Waste Gas Burner	▪ Fill propane tank, as required. ▪ Drain condensate traps. ▪ Clean flame trap. ▪ Check gas piping for leaks.	▪ Monthly ▪ Monthly ▪ Semi-Annually ▪ Semi-Annually
	▪ Valves and Appurtenances	▪ Exercise components and repair as required.	▪ Annually
Gas Monitoring System	▪ PVC piping, bentonite seal, valve and concrete pad	▪ Repair as necessary.	▪ As neccessary
Cap	▪ Final Cover	▪ Erosion Repair ▪ Re-vegetation	▪ As necessary
Storm Water Drainage System	▪ Storm Water Detention Basins	▪ Repair localized erosion ▪ Clear debris and sediment	▪ Semi-annual ▪ As necessary when sediment reaches 85 percent clean out elevation
	▪ Ditches, Reverse Slope Benches, Diversion Berms, Chutes ▪ Culverts	▪ Repair localized erosion ▪ Remove sediment ▪ Regrade ▪ Revegetate ▪ Remove debris or obstructions ▪ Clean-out via high pressure wash	▪ As necessary ▪ Semi-annual ▪ Annual ▪ As necessary ▪ Semi-annual ▪ As necessary

Sheet 1 of the Operation Plan drawings, is comprised of permanent, low maintenance, PVC monitoring wells with dedicated bladder sampling pumps. These PVC wells do not contain any other active components and will be maintained by monitoring well development coincident with groundwater quality sampling throughout the post-closure period. No other preventive maintenance of this system is required. Groundwater monitoring wells which sustain damage or become unable to provide representative samples will be replaced as necessary. This may include decommissioning and appropriate abandonment of any non-functional wells. Materials and equipment anticipated for well installation and/or decommissioning abandonment includes standard geotechnical drilling rig equipped with hollow stem augers, tri-cone rotary drilling bit, bentonite slurry and tremie pump. Bladder pumps will be subject to corrective maintenance as necessary to maintain.

Gas Control

The proposed gas control is shown on the Gas Monitoring and Collection Sheet, Sheet 4 of the Operation Plan drawings. The following information summarizes the anticipated preventive and corrective maintenance activities to be performed through the duration of the post-closure period.

Extraction Wells

The extraction wells will consist of 3-inch diameter High Density Polyethylene (HDPE) pipe. Wells will be spaced relatively uniformly across the landfill topdeck. The wells will be capped at the bottom, perforated for gas accumulation, screened through the waste, and surrounded with open graded coarse aggregate.

Preventive maintenance includes only an annual inspection of the extraction wells to determine the condition of the well head, valve, and flexible pipe. Corrective maintenance would consist of replacement of well head components as needed.

Gas Blower

A blower is proposed to extract gas from the wells and deliver collected gas to the adjacent flare.

Preventive maintenance for the blower should include the following:

- Check shaft packing and seals monthly. Under normal operating conditions, seals generally last up to 3 years.
- Inspect impeller vanes every 2 years. Replace if worn or show evidence of corrosion.

- Replace impeller vanes after 6 years of operation.
- Lubricate all bearings and grease fittings every 6 months.
- Check oil level at site glass monthly. Add to fill line as needed.
- Change oil annually.
- Inspect bearings annually. Replace after 6 years of operation.
- Check condition of drive mechanism monthly. Adjust as needed.

Corrective measures consist of replacing or repairing components as needed according to the preventive maintenance duties listed above.

Moisture Separator

A cyclone separator is proposed to remove and collect any moisture. Gas drawn from the landfill by the blower passes through the separator in a spiral pattern, forcing moisture out and down to be collected and drained.

Preventive maintenance consists of monthly moisture trap drainage and annual inspection of the internals of the separator to observe for any corrosion.

No corrective maintenance is anticipated.

Waste Gas Burner

An automatic ignition gas burner is proposed to ignite and burn the collected gas. A propane tank is proposed for the ignition pilot light. The blower forces the collected gas up through the flare and is ignited by the propane pilot. The system also includes a flame trap and back pressure regulator. A control panel performs all control functions automatically.

Preventive maintenance duties consist of the following:

- Refill propane tank as needed.
- Drain condensate traps monthly.
- Disassemble and clean flame trap (gas piping) semi-annually.
- Check all gas piping for leaks semi-annually. Repair as needed.

capacity and function. Spillways and outlet structures will be cleared of all loose debris on an as needed basis. Basin sideslopes will be uniformly graded to their original design slope on an annual basis to minimize sloughing and potential impacts on storage capacity and water quality.

Corrective maintenance, including repair and/or replacement of damaged structures, will occur as needed for satisfactory performance.

3.3 INSPECTION PLAN

The following section describes post-closure inspection procedures, frequency and recordkeeping associated with the post-closure care of the following landfill closure systems:

- Groundwater monitoring
- Gas collection and flare
- Gas monitoring
- Landfill cap
- Storm drainage including run-on/run-off control devices such as storm water detention basins, outlet structures, ditches, chutes and reverse slope benches

Inspection of the landfill facility closure systems will be conducted by City personnel to prevent and/or detect malfunction or damage to system components. The following information will be recorded in conjunction with each inspection activity:

- Date and time of inspection
- Name of inspector
- Observation made
- Data measurements (if any)
- Recommended corrective measure (if any)

Inspection procedures, frequency and rationale are summarized in Table 3-2 and the following sections.

Groundwater Monitoring System

The groundwater monitoring system will be inspected on a semi-annual basis in conjunction with post-closure groundwater quality monitoring activities. The integrity of each well will be verified by visual inspection and observation of damage (if any) to the well installation, riser pipe, protective casing, and lock mechanism.

Gas Control System

Inspection of the gas control system will be inspected on a regular basis as described in Table 3-2. Visual inspection will be made of the condition of the extraction wells, gas blower, moisture separator, waste gas flare, and valves and appurtenances. Specifically, inspection will be made for any evidence of malfunction, corrosion, and operation of any of these components.

Gas Monitoring System

Inspection of gas monitoring probes will be performed prior to each monitoring event. The inspection will include examination of the PVC pipe, bentonite seal and valve for physical damage. Probes will also be examined for accumulation of water above the bentonite seal. Any excess water will be removed.

Final Cover System

Inspection of final cover system components will occur semi-annually for the first 5 years and annually throughout the remaining post-closure period, corresponding with site monitoring and other preventive maintenance activities, or on an as-needed basis following heavy precipitation events. Integrity of the final cover system will be evaluated over the entire landfill surface by visual inspection and observation of damage related to soil loss via erosion, differential settlement and resulting ponding of surface water, sloughing of surficial materials along slopes due to inadequate drainage of cover system, consistency and adequacy of vegetative cover condition.

Storm Water Drainage System

Storm water system components will be inspected on a semi-annual basis in late summer and late winter, prior to anticipated seasons with typically high precipitation levels, and subsequent to heavy rainfall events. Integrity of the drainage system components, including detention basins, ditches, culverts, diversion berms, release structures and reverse slope benches, as well as miscellaneous sediment and erosion control devices, will be verified

TABLE 3-2

SUMMARY OF POST-CLOSURE INSPECTION

CLOSURE SYSTEM	*SYSTEM COMPONENT*	*INSPECTION PROCEDURE*	*FREQUENCY*
Groundwater Monitoring System	▪ Monitoring Wells - Riser Pipe - Protective Casing - Lock Mechanism	▪ Visual inspection of damage, corrosion.	▪ Semi-Annual
Gas Control	▪ Extraction Wells	▪ Visual inspection for possible damage.	▪ Annually
	▪ Gas Blower	▪ Check shaft packing and seals. ▪ Visual inspection of oil level. ▪ Visual inspection of drive mechanism. ▪ Measure pressure on either side. ▪ Check gages via pitot tube. ▪ Check bearings for wear. ▪ Check impeller vanes for wear.	▪ Monthly ▪ Monthly ▪ Monthly ▪ Monthly ▪ Monthly ▪ Annually ▪ Bi-Annually
	▪ Moisture Separator	▪ Inspect condensate drainage system. ▪ Internal inspection.	▪ Monthly ▪ Monthly ▪ Annually

TABLE 3-2
(Continued)

SUMMARY OF POST-CLOSURE INSPECTION

CLOSURE SYSTEM	*SYSTEM COMPONENT*	*INSPECTION PROCEDURE*	*FREQUENCY*
Gas Control (Continued)	▪ Waste Gas Burner	▪ Inspect propane tank status. ▪ Inspect gas piping for leaks. ▪ Inspect status of fire fighting equipment.	▪ Monthly ▪ Semi-Annually ▪ Semi-Annually
	▪ Valves and Appurtenances	▪ Inspect and exercise components for visable malfunction or leakage.	▪ Annually
Gas Monitoring Probe	▪ PVC Piping ▪ Bentonite Soil ▪ Valve	▪ Visual inspection of condition.	▪ Quarterly
Final Cover System	▪ Vegetation Cover ▪ Topsoil	▪ Visual inspection and observation of damage.	▪ Semi-Annual for first five years. ▪ Annual for remaining post-closure period or an as needed basis following heavy precipitation.

TABLE 3-2
(Continued)

SUMMARY OF POST-CLOSURE INSPECTION

CLOSURE SYSTEM	*SYSTEM COMPONENT*	*INSPECTION PROCEDURE*	*FREQUENCY*
Storm Water Drainage System	▪ Storm Water Detention Basins ▪ Ditches ▪ Culverts ▪ Chutes ▪ Release Structures ▪ Reverse Slope Benches ▪ Erosion and Sediment Control Devices	▪ Visual inspection and observation of damage.	▪ Semi-Annual

by visual inspection and observation of damage (if any) which would result or impact surface water flow and/or cause further soil loss or damage to structures. Specifically, visual inspection will be made for obstruction, accumulation of sediment or debris, vegetation stress, evidence of scour, erosion of channel lining and soils, as well as structural integrity and corrosion of release structures.

3.4 MONITORING PLAN

Post-closure monitoring activities and locations are shown on Table 3-3.

Post-closure activities will include monitoring of the following closure systems:

- Groundwater monitoring wells
- Storm water runoff
- Landfill gas

Groundwater Monitoring

Groundwater monitoring activities to be performed throughout the post-closure care period are summarized in the Water Quality Monitoring Plan. The plan indicates that groundwater monitoring wells will be monitored on a regular basis throughout the duration of the post-closure care period. These monitoring wells have been selected on the basis of their location relative to the landfill unit, and will be used to evaluate variations in groundwater quality and flow direction in the uppermost aquifer.

Landfill Gas Monitoring

Perimeter gas monitoring probes are shown on Sheet 4 of the Operations Drawings. All perimeter gas monitoring probes and structures will be monitored on a quarterly basis for percent lower explosive limit (percent LEL) and percent total volume (percent TV) of methane. All data will be recorded on a monitoring sheet and maintained on file at the landfill site.

In the event that any gas probe indicates a concentration of methane exceeding 25 percent LEL, contingency measures detailed in the Operations Plan will be taken to further evaluate the source of landfill gas and mitigate any detrimental effects.

TABLE 3-3

SUMMARY OF POST-CLOSURE MONITORING [1]

CLOSURE SYSTEM	*MONITORING LOCATION(S)*	*PARAMETERS*	*FREQUENCY*
Storm Water Management	▪ Storm Water Detention Basins	▪ Surface Water Quality	▪ Quarterly and/or following storm events for first year. ▪ Semi-annual basis after first year.
Gas Management	▪ Gas Monitoring Probes ▪ Buildings	▪ Methane Concentration (%LEL/%TV)	▪ Quarterly
[1] See Water Quality Monitoring Plan, for details of groundwater quality monitoring frequency and sampling protocol.			

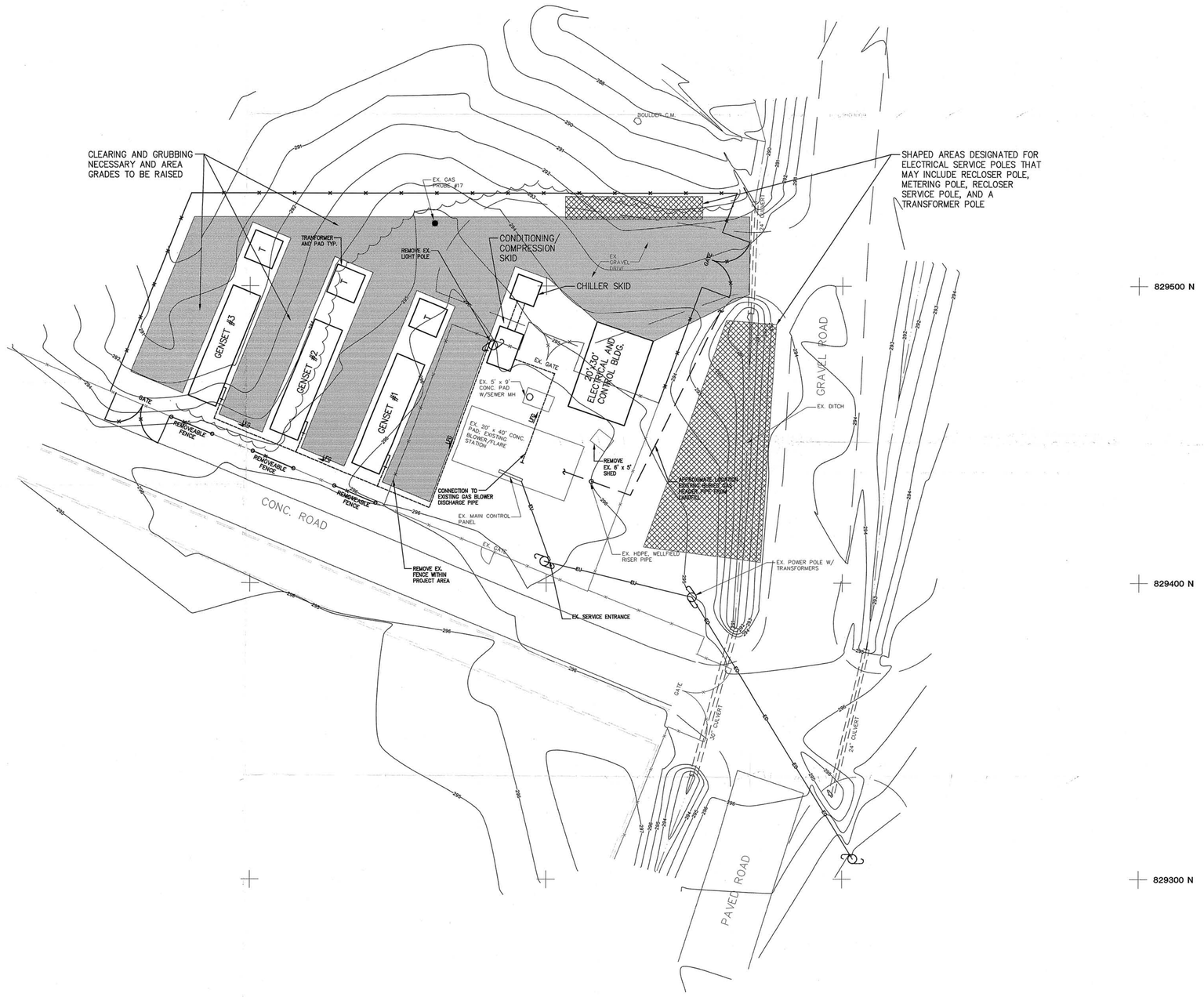
3.5 POST-CLOSURE LAND USE

The City of Durham plans a passive use of the landfill during the post-closure period. No disturbance will be made to the integrity of the final cap, waste containment systems, or monitoring systems. Following completion of the post-closure care period, the City shall notify the Solid Waste Section that a certification, signed by a registered Professional Engineer, has been placed in the operating record. The certification will verify that post-closure care has been completed in accordance with the post-closure plan.

3.6 POST-CLOSURE COST ESTIMATE

The capital cost estimate for post-closure activities for the City of Durham Sanitary Landfill is included in Appendix F. The estimated maximum annual total post-closure cost is approximately $256,300 (in 1994 dollars). Given a 30-year post-closure period, the estimated present worth of post-closure care and maintenance throughout the maximum anticipated post-closure period at year 1996 is approximately $8,477,000 (in 1996 dollars). The City will provide financial assurance for this amount in accordance with one of the financial instruments outlined in Rule .1628.2

Drawings



LEGEND

- EXISTING LANDFILL GAS HEADER PIPE
- EXISTING LIGHT POLE OR UTILITY POLE
- EXISTING FENCE LINE
- EXISTING WOODS LINE
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING DITCH
- PROPOSED LFG PIPE
- PROPOSED LFG PIPE CONNECTION AT GENSET
- PROPOSED GRAVEL AREAS

NOTES

1. EX. = EXISTING
2. LFG = LANDFILL GAS
3. BASE MAP TOPOGRAPHIC AND EXISTING CONDITIONS SURVEY BY MUNICIPAL ENGINEERING SERVICES COMPANY, GARNER, NORTH CAROLINA, SEPTEMBER 23, 2008.
4. CITY OF DURHAM TO PROVIDE LOCATIONS OF BURIED SANITARY SEWER, SANITARY FORCEMAIN, ETC.
5. LOCATION OF UNDERGROUND ELECTRICAL LINES IS APPROXIMATE AND OTHER LINES MAY EXIST. THEREFORE, LOCATING OF ACTUAL LINES IS NECESSARY PRIOR TO WORK.

N

0 20 40

SCALE: 1"=20'

PROJECT: SOLID WASTE PERMIT MODIFICATION
LANDFILL GAS-TO-ENERGY SYSTEM
DURHAM SANITARY LANDFILLL

SHEET TITLE: SITE WORK PLAN

DRAWN BY: FIEBRANT	SCALE:	PROJ. NO.	08029.01
CHECKED BY: DRF	AS SHOWN	FILE NO.	80290104.DWG
APPROVED BY: CMS	DATE PRINTED:	SHEET	2 OF 3
DATE: NOVEMBER 2008	11/21/2008		

RMT
744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608-831-4444
Fax: 608-831-3334

N

0 300 600 FEET

1" = 300'

1:3,600

PROJECT:	SOLID WASTE PERMIT MODIFICATION LANDFILL GAS-TO-ENERGY SYSTEM DURHAM SANITARY LANDFILL
SHEET TITLE:	PROJECT LOCATION MAP

DRAWN BY:	METZA	SCALE:	PROJ. NO. 00-08029.01
CHECKED BY:	D. FREE	AS SHOWN	FILE NO. 080290101.mxd
APPROVED BY:	C. SELL	DATE PRINTED:	SHEET 1 OF 3
DATE:	NOVEMBER 2008	11/11/2008	

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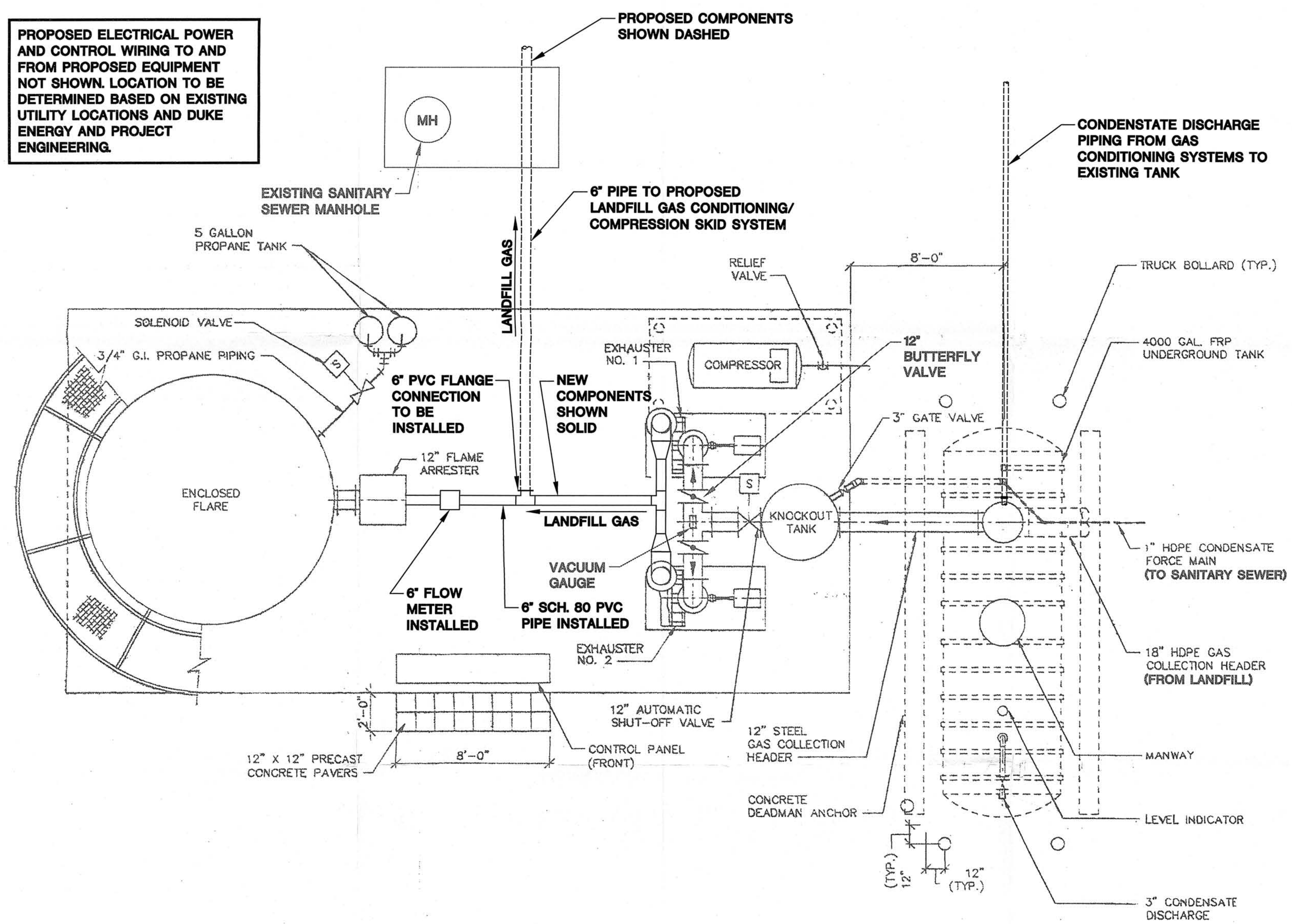
NOTES

1. THE BASEMAP DRAWING IMAGE OF THE BLOWER/FLARE STATION WAS PROVIDED BY THE CITY OF DURHAM, AS DESIGNED BY MALCOM PIRNIE, INC., SEPTEMBER 1996. EXISTING FEATURES (BASEMAP) SHOWN IN SCREENED TONE.
2. THE BASEMAP DRAWING IS SET TO APPROXIMATELY MATCH THE DRAWING SCALE. THEREFORE ACTUAL MEASUREMENTS SHOULD BE FIELD-VERIFIED.



CONNECTIONS TO EXISTING BLOWER/FLARE STATION - PLAN VIEW

SCALE: 1/4"=1' (APPROXIMATELY)

PROJECT:	SOLID WASTE PERMIT MODIFICATION LANDFILL GAS-TO-ENERGY SYSTEM DURHAM SANITARY LANDFILLL		
SHEET TITLE:	CONNECTIONS TO EXISTING SYSTEM		
DRAWN BY: FIEBRANT	SCALE:	PROJ. NO. 08029.01	
CHECKED BY: DRF	AS SHOWN	FILE NO. 80290101.DWG	
APPROVED BY: CMS	DATE PRINTED:	SHEET 3 OF 3	
DATE: NOVEMBER 2008	11/25/08		

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