Application for Temporary Air Permit
University of New Hampshire
Turnkey Landfill Gas to Energy Project

Prepared for:
University of New Hampshire
22 Colovos Road
Durham, NH 03824

March 23, 2007

March 23, 2007

Mr. Gary Milbury
New Hampshire Department of Environmental Services
Air Resources Division
29 Hazen Drive
P.O. Box 95
Concord, NH 03302-0095

Revised Application for Temporary Air Permit: University of New Hampshire Landfill Gas to Energy Project

Dear Gary:

On behalf of the University of New Hampshire, MacMillan & Donnelly is submitting the enclosed revised temporary air permit application for UNH's proposed landfill gas to energy (LFGTE) project at the Waste Management Turnkey Landfill site. Due to project design modifications, two stationary internal combustion engines will replace the proposed Centaur turbine at the Rochester site. UNH's permit application, including control technology analyses and modeling analyses, has been updated to reflect this design change.

All sources owned and operated by the University of New Hampshire are in compliance with all applicable emission limitations and standards under the Clean Air Act. Included with this application packet is a CD containing the necessary modeling files and a certification of accuracy statement signed by a UNH responsible official. Please call me if you have any questions or require additional information.

Sincerely,

Tim Donnelly

cc: Allan Braun, Braun Consulting
Paul Chamberlin, University of New Hampshire
Jim Dombrosk, University of New Hampshire
Jeff Pierce, SCS Energy

New Hampshire Department of Environmental Services
Air Resources Division

University of New Hampshire
22 Colovos Road
Durham, NH 03824

Certification of Accuracy Statement for UNH Landfill Gas to Energy Project
Temporary Air Permit Application

"I am authorized to make this submission on behalf of the facility for which the submission is made. Based on information and belief formed after reasonable inquiry, the statements and information in this submittal are true, accurate and complete. The University of New Hampshire will use the NOx emission reduction credits (ERCs) for offsetting purposes in a non-attainment area and the ERCs will not be used in a manner prohibited under New Hampshire DES regulation. This permit application includes an air impact analysis demonstrating compliance with the NAAQS, except for ground level ozone, for criteria pollutants and compliance with Env-A1400 for toxic air pollutants. Based the results of the modeling analysis, the University of New Hampshire is in compliance with all NAAQS, except for ground level ozone, and all AALs for toxics. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine or imprisonment."

Signed: _____

Title: _____ Date: _____

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Section 1
ARD-1 and ARD-2 Forms

STATE OF NEW HAMPSHIRE
Department of Environmental Services
Air Resources Division
P.O. Box 95
Concord, NH 03302-0095
Telephone: 603-271-1370

Form ARD-1

General Information for All Permit Applications

I. FACILITY INFORMATION - *Complete the following*:

A. Type of Application: ☒ New ☐ Renewal ☐ Modification

B. Physical Location:

UNH Gas Processing Facility
Facility Name

Rochester Neck Road
Street

Rochester NH 03839
Town/City State Zip Code

C. Mailing Address:

Rochester Neck Road
Street/P.O. Box

Rochester NH 03839
Town/City State Zip Code

N/A
Telephone Number

D. USGS Coordinates:

UTM	
Easting:	
Northing:	

or

Latitude/Longitude			
N Latitude:	Deg	Min	Sec
W Longitude:	Deg	Min	Sec

E. Owner:

The University of New Hampshire, c/o UNH Facilities Design & Construct.
Company

22 Colovos Road
Street/P.O. Box

Durham NH 03824
Town/City: State Zip Code

603-862-4452
Telephone Number

F. Parent Corporation:

University System of New Hampshire
Company

Edward MacKay, Vice Chancellor & Treasure
Contact Person/Title

27 Concord Road
Street/P.O. Box

Durham NH 03824
Town/City: State Zip Code

603-862-0963
Telephone Number

G. <u>Contact Information</u>

1. General/Technical Contact:

Jim Dombrosk
Contact Person

Director of Energy & Utilities
Title

17 Leavitt Lane
Address

Durham NH 03824
Town/City State Zip Code

603-862-2345
Telephone Number

jim.dombrosk@unh.edu
E-mail Address

2. Application Preparation:

MacMillan and Donnelly, Inc.
Company

Tim Donnelly
Contact Person

361 U.S. Route One
Address

Falmouth ME 04105
Town/City State Zip Code

207-781-7392
Telephone Number

tdonnelly@mdeec.com
E-mail Address

Form ARD-1

3. Legal Contact:

Ronald F. Rogers
Contact Person

General Counsel and Secretary, USNH
Title

Meyers Center, 27 Concord Road
Address

Durham NH 03824
Town/City State Zip Code

603-862-0960
Telephone Number

Ron.Rodgers@unh.edu
E-mail Address

4. Invoicing Contact:

Irving Canner
Contact Person

Exec. Director Facilities Management
Title

6 Leavitt Lane
Address

Durham NH 03824
Town/City State Zip Code

603-862-3754
Telephone Number

irving.canner@unh.edu
E-mail Address

H. Major Activity or Product Descriptions - *List all activities performed at this facility and provide SIC code(s):*

Description of Activity or Product	SIC Code
landfill gas processing	4939
electricity generation	4911

I. Other Sources or Devices - *List sources or devices at the facility (other than those that are the subject of this application) that are permitted pursuant to Env-A 600:*

Source or Device	Permit #	Expiration Date
EU1 -EU13	TV-OP-010	6/30/04
Combustion Turbine, Duct burner, and BSEG	FP-T-0110	10/31/06

II. Total Facility Emissions Data:

Pollutant	CAS #	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)
NOx					41.52
SO2					24.52
CO					155.22
VOC					48.24
PM10					23.14

Note: For Regulated Toxic Air Pollutants list name and Chemical Abstract Service Number (CAS #) – *use additional sheets if necessary*.

Form ARD-1

III. Support Data *The following data must be submitted with this application:*

- ☒ A copy of all calculations used in determining emissions;
- ☒ A copy of a USGS map section with the site location clearly indicated; and
- ☒ A to-scale site plan of the facility showing:
  1. the locations of all emission points;
  2. the dimensions of all buildings, including roof heights; and
  3. the facility's property boundary.

IV. Certification (To be completed by a responsible official only):

I am authorized to make this submission on behalf of the affected source or affected units for which this submission is made. I certify under penalty of law that I have personally examined, and am familiar with, the information submitted in this document and all of its attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the statements and information are to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine or imprisonment.

Print/Type Name: Paul D. Chamberlin Title: Interim Assistant V.P.-Facilities

Signed: _____ Date: _____

STATE OF NEW HAMPSHIRE
Department of Environmental Services
Air Resources Division

Form ARD-2

Information Required for Permits for Fuel Burning Devices

I. EQUIPMENT INFORMATION – *Complete a separate form for each device.*

Device Description: Reciprocating Engine #1
Date Construction Commenced: Expected Spring 2007 **Device Start-Up Date:** Early 2008 Expected

A. Boiler ☒ **Not Applicable**

Boiler Manufacturer
Boiler Model Number
Boiler Serial Number
Gross Heat Input Nameplate Rating (MMBtu/hr)
Burner Manufacturer
Burner Model Number
Burner Serial Number
Potential Fuel Flow Rate ☐ gal/hr ☐ mmcf/hr ☐ ton/hr

1. Type of Burner:

a. Solid Fuel:
- ☐ Cyclone
- ☐ Pulverized (☐ wet ☐ dry)
- ☐ Spreader Stoker
- ☐ Underfeed Stoker
- ☐ Overfeed Stoker
- ☐ Hand-Fired
- ☐ Fly Ash Re-injection
- ☐ Other (specify): _____

b. Liquid Fuel:
- ☐ Pressure Gun
- ☐ Rotary Cup
- ☐ Steam Atomization
- ☐ Air Atomization
- ☐ Other (specify): _____

c. Gaseous Fuel:
- ☐ Natural Gas
- ☐ Propane
- ☐ Other (specify): _____

2. Combustion Type:
- ☐ Tangential Firing
- ☐ Opposite End Firing
- ☐ Limited Excess Firing
- ☐ Flue Gas Recirculation
- ☐ Staged Combustion
- ☐ Biased Firing
- ☐ One End Only Firing
- ☐ Other (specify): _____

B. Internal Combustion Engines/Combustion Turbines ☐ **Not Applicable**

Caterpillar
Manufacturer

G3520C
Model Number

TBD
Serial Number

14.3 MMBtu/hr ☐ gal/hr ☐ mmcf/hr
Fuel Flow Rate

1600 ☐ hp ☒ kW
Engine Output Rating

Power Generation
Reason for Engine Use

Form ARD-2

C. Stack Information

Is unit equipped with multiple stacks? ☐ Yes ☒ No *(if yes, provide data for each stack)*

Identify other devices on this stack: _____

Is Section 123 of the Clean Air Act applicable? ☐ Yes ☒ No

Is stack monitoring used? ☐ Yes ☒ No

If yes, Describe: _____

Is stack capped or otherwise restricted? ☐ Yes ☐ No

If yes, Describe: _____

Stack exit orientation: ☒ Vertical ☐ Horizontal ☐ Downward

1.3	32
Stack ☒ Inside Diameter (ft) ☐ Exit Area (ft^2)	Discharge height above ground level (ft)
11,948	142.6
Exhaust Flow (acfm)	Exhaust Velocity (ft/sec)
896	
Exhaust Temperature (°F)	

II. OPERATIONAL INFORMATION

A. Fuel Usage Information

1. Fuel Supplier:

N/A
Supplier's Name

Street

Town/City State Zip Code

Telephone Number

2. Fuel Additives:

N/A
Manufacturer's Name

Street

Town/City State Zip Code

Telephone Number

Identification of Additive

Consumption Rate (gallons per 1000 gallons of fuel)

3. Fuel Information *(List each fuel utilized by this device)*:

Type	% Sulfur	% Ash	% Moisture (solid fuels only)	Heat Rating (specify units)	Potential Heat Input (MMBtu/hr)	Actual Annual Usage (specify units)
LFG	40 ppm	N/A	N/A	500Btu/cf	14.3	N/A

B. Hours of Operation

Hours per day: 24 Days per year: 365

Note: Emission calculations are based on 97% uptime.

Form ARD-2

III. POLLUTION CONTROL EQUIPMENT ☒ Not Applicable

A. Type of Equipment *Note: if process utilizes more than one control device, provide data for each device*

- ☐ baffled settling chamber
- ☐ long cone cyclone
- ☐ multiple cyclone (_____ inch diameter)
- ☐ electrostatic precipitator
- ☐ spray tower
- ☐ venturi scrubber
- ☐ afterburners (incineration)
- ☐ selective catalytic reduction
- ☐ reburn
- ☐ other (specify): _____
- ☐ wide bodied cyclone
- ☐ irrigated long cone cyclone
- ☐ carbon absorption
- ☐ irrigated electrostatic precipitator
- ☐ absorption tower
- ☐ baghouse
- ☐ packed tower/column
- ☐ selective non-catalytic reduction

B. Pollutant Input Information

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)

Method used to determine entering emissions:

☐ stack test ☐ vendor data ☐ emission factor ☐ material balance

☐ other (specify): _____

C. Operating Data

1. Capture Efficiency: _____% Verified by: ☐ test ☐ calculations
2. Control Efficiency: _____% Verified by: ☐ test ☐ calculations
3. Normal Operating Conditions *(supply the following data as applicable)*

Total gas volume through unit (acfm)	Temperature (°F)	Percent Carbon Dioxide (CO_2)
Voltage	Spark Rate	Milliamps
Pressure Drop (inches of water)	Liquid Recycle Rate (gallons per minute)	

Form ARD-2

IV. DEVICE EMISSIONS DATA:

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)
NOx	896	N/A	2.5	N/A	10.46
CO	896	N/A	13.5	N/A	57.52
VOC	896	N/A	3.4	N/A	14.64
PM10	896	N/A	0.5	N/A	2.09
SOx	896	N/A	0.2	N/A	0.97

Method used to determine exiting emissions:

☐ stack test ☒ vendor data ☐ emission factor ☐ material balance

☐ other (specify): _____

STATE OF NEW HAMPSHIRE
Department of Environmental Services
Air Resources Division

Form ARD-2

Information Required for Permits for Fuel Burning Devices

I. EQUIPMENT INFORMATION – *Complete a separate form for each device.*

Device Description: Reciprocating Engine #2
Date Construction Commenced: Expected Spring 2007 **Device Start-Up Date:** Expected Fall 2007

A. Boiler ☒ **Not Applicable**

Boiler Manufacturer
Boiler Model Number
Boiler Serial Number
Gross Heat Input Nameplate Rating (MMBtu/hr)
Burner Manufacturer
Burner Model Number
Burner Serial Number
Potential Fuel Flow Rate ☐ gal/hr ☐ mmcf/hr ☐ ton/hr

1. Type of Burner:

a. Solid Fuel:
- ☐ Cyclone
- ☐ Pulverized (☐ wet ☐ dry)
- ☐ Spreader Stoker
- ☐ Underfeed Stoker
- ☐ Overfeed Stoker
- ☐ Hand-Fired
- ☐ Fly Ash Re-injection
- ☐ Other (specify): _____

b. Liquid Fuel:
- ☐ Pressure Gun
- ☐ Rotary Cup
- ☐ Steam Atomization
- ☐ Air Atomization
- ☐ Other (specify): _____

c. Gaseous Fuel:
- ☐ Natural Gas
- ☐ Propane
- ☐ Other (specify): _____

2. Combustion Type:
- ☐ Tangential Firing
- ☐ Opposite End Firing
- ☐ Limited Excess Firing
- ☐ Flue Gas Recirculation
- ☐ Staged Combustion
- ☐ Biased Firing
- ☐ One End Only Firing
- ☐ Other (specify): _____

B. Internal Combustion Engines/Combustion Turbines ☐ **Not Applicable**

Caterpillar
Manufacturer

G3520C
Model Number

TBD
Serial Number

14.3 MMBtu/hr ☐ gal/hr ☐ mmcf/hr
Fuel Flow Rate

1600 ☐ hp ☒ kW
Engine Output Rating

Power Generation
Reason for Engine Use

Form ARD-2

C. Stack Information

Is unit equipped with multiple stacks? ☐ Yes ☒ No *(if yes, provide data for each stack)*

Identify other devices on this stack: _____

Is Section 123 of the Clean Air Act applicable? ☐ Yes ☒ No

Is stack monitoring used? ☐ Yes ☒ No

If yes, Describe: _____

Is stack capped or otherwise restricted? ☐ Yes ☐ No

If yes, Describe: _____

Stack exit orientation: ☒ Vertical ☐ Horizontal ☐ Downward

1.3	32
Stack ☒ Inside Diameter (ft) ☐ Exit Area (ft^2)	Discharge height above ground level (ft)
11,948	142.6
Exhaust Flow (acfm)	Exhaust Velocity (ft/sec)
896	
Exhaust Temperature (°F)	

II. OPERATIONAL INFORMATION

A. Fuel Usage Information

1. Fuel Supplier:

N/A
Supplier's Name

Street

Town/City State Zip Code

Telephone Number

2. Fuel Additives:

N/A
Manufacturer's Name

Street

Town/City State Zip Code

Telephone Number

Identification of Additive

Consumption Rate (gallons per 1000 gallons of fuel)

3. Fuel Information *(List each fuel utilized by this device)*:

Type	% Sulfur	% Ash	% Moisture (solid fuels only)	Heat Rating (specify units)	Potential Heat Input (MMBtu/hr)	Actual Annual Usage (specify units)
LFG	40 ppm	N/A	N/A	500Btu/cf	14.3	N/A

B. Hours of Operation

Hours per day: 24 Days per year: 365

Note: Emission calculations are based on 97% uptime.

Form ARD-2

III. POLLUTION CONTROL EQUIPMENT ☒ Not Applicable

A. Type of Equipment *Note: if process utilizes more than one control device, provide data for each device*

- ☐ baffled settling chamber
- ☐ long cone cyclone
- ☐ multiple cyclone (_____ inch diameter)
- ☐ electrostatic precipitator
- ☐ spray tower
- ☐ venturi scrubber
- ☐ afterburners (incineration)
- ☐ selective catalytic reduction
- ☐ reburn
- ☐ other (specify): _____
- ☐ wide bodied cyclone
- ☐ irrigated long cone cyclone
- ☐ carbon absorption
- ☐ irrigated electrostatic precipitator
- ☐ absorption tower
- ☐ baghouse
- ☐ packed tower/column
- ☐ selective non-catalytic reduction

B. Pollutant Input Information

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)

Method used to determine entering emissions:

☐ stack test ☐ vendor data ☐ emission factor ☐ material balance

☐ other (specify): _____

C. Operating Data

1. Capture Efficiency: _____% Verified by: ☐ test ☐ calculations
2. Control Efficiency: _____% Verified by: ☐ test ☐ calculations
3. Normal Operating Conditions *(supply the following data as applicable)*

Total gas volume through unit (acfm)	Temperature (°F)	Percent Carbon Dioxide (CO_2)
Voltage	Spark Rate	Milliamps
Pressure Drop (inches of water)	Liquid Recycle Rate (gallons per minute)	

Form ARD-2

IV. DEVICE EMISSIONS DATA:

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)
NOx	896	N/A	2.5	N/A	10.46
CO	896	N/A	13.5	N/A	57.52
VOC	896	N/A	3.4	N/A	14.64
PM10	896	N/A	0.5	N/A	2.09
SOx	896	N/A	0.2	N/A	0.97

Method used to determine exiting emissions:

☐ stack test ☒ vendor data ☐ emission factor ☐ material balance

☐ other (specify): _____

STATE OF NEW HAMPSHIRE
Department of Environmental Services
Air Resources Division

Form ARD-2

Information Required for Permits for Fuel Burning Devices

I. EQUIPMENT INFORMATION – *Complete a separate form for each device.*

Device Description: 43.6 MMBtu/hr Recuperative Turbine
Date Construction Commenced: Expected Spring 2008 **Device Start-Up Date:** Early 2009 Expected

A. Boiler ☒ **Not Applicable**

Boiler Manufacturer

Boiler Model Number

Boiler Serial Number

Gross Heat Input Nameplate Rating (MMBtu/hr)

Burner Manufacturer

Burner Model Number

☐ gal/hr
☐ mmcf/hr
☐ ton/hr

Burner Serial Number

Potential Fuel Flow Rate

1. Type of Burner:

a. Solid Fuel:

- ☐ Cyclone
- ☐ Pulverized (☐ wet ☐ dry)
- ☐ Spreader Stoker
- ☐ Underfeed Stoker
- ☐ Overfeed Stoker
- ☐ Hand-Fired
- ☐ Fly Ash Re-injection
- ☐ Other (specify): _____

b. Liquid Fuel:

- ☐ Pressure Gun
- ☐ Rotary Cup
- ☐ Steam Atomization
- ☐ Air Atomization
- ☐ Other (specify): _____

c. Gaseous Fuel:

- ☐ Natural Gas
- ☐ Propane
- ☐ Other (specify): _____

2. Combustion Type:

- ☐ Tangential Firing
- ☐ Opposite End Firing
- ☐ Limited Excess Firing
- ☐ Flue Gas Recirculation
- ☐ Staged Combustion
- ☐ Biased Firing
- ☐ One End Only Firing
- ☐ Other (specify): _____

B. Internal Combustion Engines/Combustion Turbines ☐ **Not Applicable**

Solar Turbines
Manufacturer

Mercury 50-6000R
Model Number

TBD
Serial Number

0.058
Fuel Flow Rate
☐ gal/hr
☒ mmcf/hr

4,500
Engine Output Rating
☐ hp
☒ kW

Electrical Generation
Reason for Engine Use

Form ARD-2

C. Stack Information

Is unit equipped with multiple stacks? ☐ Yes ☒ No *(if yes, provide data for each stack)*

Identify other devices on this stack: _____

Is Section 123 of the Clean Air Act applicable? ☐ Yes ☒ No

Is stack monitoring used? ☐ Yes ☒ No

If yes, Describe: _____

Is stack capped or otherwise restricted? ☐ Yes ☐ No

If yes, Describe: _____

Stack exit orientation: ☒ Vertical ☐ Horizontal ☐ Downward

4.1	to be determined
Stack ☒ Inside Diameter (ft) ☐ Exit Area (ft^2)	Discharge height above ground level (ft)
69,756	120
Exhaust Flow (acfm)	Exhaust Velocity (ft/sec)
656-731	
Exhaust Temperature (°F)	

II. OPERATIONAL INFORMATION

A. Fuel Usage Information

1. Fuel Supplier:

N/A
Supplier's Name

Street

Town/City State Zip Code

Telephone Number

2. Fuel Additives:

N/A
Manufacturer's Name

Street

Town/City State Zip Code

Telephone Number

Identification of Additive

Consumption Rate (gallons per 1000 gallons of fuel)

3. Fuel Information *(List each fuel utilized by this device)*:

Type	% Sulfur	% Ash	% Moisture (solid fuels only)	Heat Rating (specify units)	Potential Heat Input (MMBtu/hr)	Actual Annual Usage (specify units)
LFG	4 ppm	N/A	N/A	752Btu/scf	43.6	N/A

B. Hours of Operation

Hours per day: 24 Days per year: 365

Note: Emission calculations are based on 97% uptime.

Form ARD-2

III. POLLUTION CONTROL EQUIPMENT ☒ Not Applicable

A. Type of Equipment *Note: if process utilizes more than one control device, provide data for each device*

- ☐ baffled settling chamber
- ☐ long cone cyclone
- ☐ multiple cyclone (_____ inch diameter)
- ☐ electrostatic precipitator
- ☐ spray tower
- ☐ venturi scrubber
- ☐ afterburners (incineration)
- ☐ selective catalytic reduction
- ☐ reburn
- ☐ other (specify): _____
- ☐ wide bodied cyclone
- ☐ irrigated long cone cyclone
- ☐ carbon absorption
- ☐ irrigated electrostatic precipitator
- ☐ absorption tower
- ☐ baghouse
- ☐ packed tower/column
- ☐ selective non-catalytic reduction

B. Pollutant Input Information

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)

Method used to determine entering emissions:

☐ stack test ☐ vendor data ☐ emission factor ☐ material balance

☐ other (specify): _____

C. Operating Data

1. Capture Efficiency: _____% Verified by: ☐ test ☐ calculations
2. Control Efficiency: _____% Verified by: ☐ test ☐ calculations
3. Normal Operating Conditions *(supply the following data as applicable)*

Total gas volume through unit (acfm)	Temperature (°F)	Percent Carbon Dioxide (CO_2)
Voltage	Spark Rate	Milliamps
Pressure Drop (inches of water)	Liquid Recycle Rate (gallons per minute)	

Form ARD-2

IV. DEVICE EMISSIONS DATA:

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)
NOx	731	N/A	0.8	N/A	3.17
CO	731	N/A	1.0	N/A	3.80
VOC	731	N/A	0.6	N/A	2.24
PM10	731	N/A	1.8	N/A	7.25
SOx	731	N/A	0.1	N/A	0.26

Method used to determine exiting emissions:

☐ stack test ☒ vendor data ☐ emission factor ☐ material balance

☐ other (specify): _____

STATE OF NEW HAMPSHIRE
Department of Environmental Services
Air Resources Division

Form ARD-2

Information Required for Permits for Fuel Burning Devices

I. EQUIPMENT INFORMATION – *Complete a separate form for each device.*

Device Description: 125.4 MMBtu/hr Supplemental Flare
Date Construction Commenced: Spring 2007 Expected **Device Start-Up Date:** Early 2008 Expected

A. Boiler ☒ Not Applicable

Boiler Manufacturer

Boiler Model Number

Boiler Serial Number

Gross Heat Input Nameplate Rating (MMBtu/hr)

Burner Manufacturer

Burner Model Number

☐ gal/hr
☐ mmcf/hr
☐ ton/hr

Burner Serial Number

Potential Fuel Flow Rate

1. Type of Burner:

a. Solid Fuel:

- ☐ Cyclone
- ☐ Pulverized (☐ wet ☐ dry)
- ☐ Spreader Stoker
- ☐ Underfeed Stoker
- ☐ Overfeed Stoker
- ☐ Hand-Fired
- ☐ Fly Ash Re-injection
- ☐ Other (specify): _____

b. Liquid Fuel:

- ☐ Pressure Gun
- ☐ Rotary Cup
- ☐ Steam Atomization
- ☐ Air Atomization
- ☐ Other (specify): _____

c. Gaseous Fuel:

- ☐ Natural Gas
- ☐ Propane
- ☐ Other (specify): _____

2. Combustion Type:

- ☐ Tangential Firing
- ☐ Opposite End Firing
- ☐ Limited Excess Firing
- ☐ Flue Gas Recirculation
- ☐ Staged Combustion
- ☐ Biased Firing
- ☐ One End Only Firing
- ☐ Other (specify): _____

B. Internal Combustion Engines/Combustion Turbines ☒ Not Applicable

John Zink Supplemental Flare
Manufacturer

Utility (Candle) Flare
Model Number

TBD
Serial Number

0.228
Fuel Flow Rate

☐ gal/hr
☒ mmcf/hr

N/A
Engine Output Rating

☐ hp
☐ kW

See Project Description
Reason for Engine Use

Form ARD-2

C. Stack Information

Is unit equipped with multiple stacks? ☐ Yes ☒ No *(if yes, provide data for each stack)*

Identify other devices on this stack: _____

Is Section 123 of the Clean Air Act applicable? ☐ Yes ☒ No

Is stack monitoring used? ☐ Yes ☒ No

If yes, Describe: _____

Is stack capped or otherwise restricted? ☐ Yes ☒ No

If yes, Describe: _____

Stack exit orientation: ☒ Vertical ☐ Horizontal ☐ Downward

----	30
Stack ☐ Inside Diameter (ft) ☐ Exit Area (ft^2)	Discharge height above ground level (ft)
----	----
Exhaust Flow (acfm)	Exhaust Velocity (ft/sec)
1832	
Exhaust Temperature (°F)	

II. OPERATIONAL INFORMATION

A. Fuel Usage Information

1. Fuel Supplier:

N/A
Supplier's Name

Street

Town/City State Zip Code

Telephone Number

2. Fuel Additives:

N/A
Manufacturer's Name

Street

Town/City State Zip Code

Telephone Number

Identification of Additive

Consumption Rate (gallons per 1000 gallons of fuel)

3. Fuel Information *(List each fuel utilized by this device)*:

Type	% Sulfur	% Ash	% Moisture (solid fuels only)	Heat Rating (specify units)	Potential Heat Input (MMBtu/hr)	Actual Annual Usage (specify units)
LFG	Varies	Varies	Varies	Varies	125.4	Varies

B. Hours of Operation

Hours per day: 24 Days per year: 365

Note: Emission calculations based on 99% uptime.

Form ARD-2

III. POLLUTION CONTROL EQUIPMENT ☒ Not Applicable

A. Type of Equipment *Note: if process utilizes more than one control device, provide data for each device*

- ☐ baffled settling chamber
- ☐ long cone cyclone
- ☐ multiple cyclone (_____ inch diameter)
- ☐ electrostatic precipitator
- ☐ spray tower
- ☐ venturi scrubber
- ☐ afterburners (incineration)
- ☐ selective catalytic reduction
- ☐ reburn
- ☐ other (specify): _____
- ☐ wide bodied cyclone
- ☐ irrigated long cone cyclone
- ☐ carbon absorption
- ☐ irrigated electrostatic precipitator
- ☐ absorption tower
- ☐ baghouse
- ☐ packed tower/column
- ☐ selective non-catalytic reduction

B. Pollutant Input Information

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)

Method used to determine entering emissions:

☐ stack test ☐ vendor data ☐ emission factor ☐ material balance

☐ other (specify): _____

C. Operating Data

1. Capture Efficiency: _____% Verified by: ☐ test ☐ calculations
2. Control Efficiency: _____% Verified by: ☐ test ☐ calculations
3. Normal Operating Conditions *(supply the following data as applicable)*

Total gas volume through unit (acfm)	Temperature (°F)	Percent Carbon Dioxide (CO_2)
Voltage	Spark Rate	Milliamps
Pressure Drop (inches of water)	Liquid Recycle Rate (gallons per minute)	

Form ARD-2

IV. DEVICE EMISSIONS DATA:

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)
NOx	1832	N/A	8.5	N/A	4.40
CO	1832	N/A	46.4	N/A	23.94
PM10	1832	N/A	5.3	N/A	2.72
VOC	1832	N/A	7.5	N/A	3.88
SOx	1832	N/A	18.7	N/A	9.64

Method used to determine exiting emissions:

☐ stack test ☐ vendor data ☒ emission factor ☐ material balance

☐ other (specify): _____

STATE OF NEW HAMPSHIRE
Department of Environmental Services
Air Resources Division

Form ARD-2

Information Required for Permits for Fuel Burning Devices

I. EQUIPMENT INFORMATION – *Complete a separate form for each device.*

Device Description: 105.06 MMBtu/hr Standby Flare

Date Construction Commenced: Spring 2007 Expected **Device Start-Up Date:** Early 2008 Expected

A. Boiler ☒ **Not Applicable**

Boiler Manufacturer

Boiler Model Number

Boiler Serial Number

Gross Heat Input Nameplate Rating (MMBtu/hr)

Burner Manufacturer

Burner Model Number

☐ gal/hr
☐ mmcf/hr
☐ ton/hr

Burner Serial Number

Potential Fuel Flow Rate

1. Type of Burner:

a. Solid Fuel:

- ☐ Cyclone
- ☐ Pulverized (☐ wet ☐ dry)
- ☐ Spreader Stoker
- ☐ Underfeed Stoker
- ☐ Overfeed Stoker
- ☐ Hand-Fired
- ☐ Fly Ash Re-injection
- ☐ Other (specify): _____

b. Liquid Fuel:

- ☐ Pressure Gun
- ☐ Rotary Cup
- ☐ Steam Atomization
- ☐ Air Atomization
- ☐ Other (specify): _____

c. Gaseous Fuel:

- ☐ Natural Gas
- ☐ Propane
- ☐ Other (specify): _____

2. Combustion Type:

- ☐ Tangential Firing
- ☐ Opposite End Firing
- ☐ Limited Excess Firing
- ☐ Flue Gas Recirculation
- ☐ Staged Combustion
- ☐ Biased Firing
- ☐ One End Only Firing
- ☐ Other (specify): _____

B. Internal Combustion Engines/Combustion Turbines ☒ **Not Applicable**

John Zink
Manufacturer

Utility (Candle) Flare
Model Number

TBD
Serial Number

0.192
Fuel Flow Rate

☐ gal/hr
☒ mmcf/hr

N/A
Engine Output Rating

☐ hp
☐ kW

See Project Description
Reason for Engine Use

Form ARD-2

C. Stack Information

Is unit equipped with multiple stacks? ☐ Yes ☒ No *(if yes, provide data for each stack)*

Identify other devices on this stack: _____

Is Section 123 of the Clean Air Act applicable? ☐ Yes ☒ No

Is stack monitoring used? ☐ Yes ☒ No

If yes, Describe: _____

Is stack capped or otherwise restricted? ☐ Yes ☒ No

If yes, Describe: _____

Stack exit orientation: ☒ Vertical ☐ Horizontal ☐ Downward

----	30
Stack ☐ Inside Diameter (ft) ☐ Exit Area (ft^2)	Discharge height above ground level (ft)
----	----
Exhaust Flow (acfm)	Exhaust Velocity (ft/sec)
1832	
Exhaust Temperature (°F)	

II. OPERATIONAL INFORMATION

A. Fuel Usage Information

1. Fuel Supplier:

N/A
Supplier's Name

Street

Town/City State Zip Code

Telephone Number

2. Fuel Additives:

N/A
Manufacturer's Name

Street

Town/City State Zip Code

Telephone Number

Identification of Additive

Consumption Rate (gallons per 1000 gallons of fuel)

3. Fuel Information *(List each fuel utilized by this device)*:

Type	% Sulfur	% Ash	% Moisture (solid fuels only)	Heat Rating (specify units)	Potential Heat Input (MMBtu/hr)	Actual Annual Usage (specify units)
LFG	Varies	Varies	Varies	Varies	105.06	Varies

B. Hours of Operation

Hours per day: 24 Days per year: 365

Note: Emission calculations based on 7% uptime.

Form ARD-2

III. POLLUTION CONTROL EQUIPMENT ☒ Not Applicable

A. Type of Equipment *Note: if process utilizes more than one control device, provide data for each device*

- ☐ baffled settling chamber
- ☐ long cone cyclone
- ☐ multiple cyclone (_____ inch diameter)
- ☐ electrostatic precipitator
- ☐ spray tower
- ☐ venturi scrubber
- ☐ afterburners (incineration)
- ☐ selective catalytic reduction
- ☐ reburn
- ☐ other (specify): _____
- ☐ wide bodied cyclone
- ☐ irrigated long cone cyclone
- ☐ carbon absorption
- ☐ irrigated electrostatic precipitator
- ☐ absorption tower
- ☐ baghouse
- ☐ packed tower/column
- ☐ selective non-catalytic reduction

B. Pollutant Input Information

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)

Method used to determine entering emissions:

☐ stack test ☐ vendor data ☐ emission factor ☐ material balance

☐ other (specify): _____

C. Operating Data

1. Capture Efficiency: _____% Verified by: ☐ test ☐ calculations
2. Control Efficiency: _____% Verified by: ☐ test ☐ calculations
3. Normal Operating Conditions *(supply the following data as applicable)*

Total gas volume through unit (acfm)	Temperature (°F)	Percent Carbon Dioxide (CO_2)
Voltage	Spark Rate	Milliamps
Pressure Drop (inches of water)	Liquid Recycle Rate (gallons per minute)	

Form ARD-2

IV. DEVICE EMISSIONS DATA:

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)
NOx	1832	N/A	7.1	N/A	2.19
CO	1832	N/A	38.9	N/A	11.92
VOC	1832	N/A	6.3	N/A	1.93
SOx	1832	N/A	15.7	N/A	4.80
PM10	1832	N/A	4.4	N/A	1.35

Method used to determine exiting emissions:

☐ stack test ☐ vendor data ☒ emission factor ☐ material balance

☐ other (specify): _____

STATE OF NEW HAMPSHIRE
Department of Environmental Services
Air Resources Division

Form ARD-2

Information Required for Permits for Fuel Burning Devices

I. EQUIPMENT INFORMATION – *Complete a separate form for each device.*

Device Description: 36 MMBtu/hr Thermal Oxidizer

Date Construction Commenced: Spring 2007 Expected **Device Start-Up Date:** Early 2008 Expected

A. Boiler ☒ Not Applicable

Boiler Manufacturer

Boiler Model Number

Boiler Serial Number

Gross Heat Input Nameplate Rating (MMBtu/hr)

Burner Manufacturer

Burner Model Number ☐ gal/hr ☐ mmcf/hr ☐ ton/hr

Burner Serial Number

Potential Fuel Flow Rate

1. Type of Burner:

a. Solid Fuel:

- ☐ Cyclone
- ☐ Pulverized (☐ wet ☐ dry)
- ☐ Spreader Stoker
- ☐ Underfeed Stoker
- ☐ Overfeed Stoker
- ☐ Hand-Fired
- ☐ Fly Ash Re-injection
- ☐ Other (specify): _____

b. Liquid Fuel:

- ☐ Pressure Gun
- ☐ Rotary Cup
- ☐ Steam Atomization
- ☐ Air Atomization
- ☐ Other (specify): _____

c. Gaseous Fuel:

- ☐ Natural Gas
- ☐ Propane
- ☐ Other (specify): _____

2. Combustion Type:

- ☐ Tangential Firing
- ☐ Opposite End Firing
- ☐ Limited Excess Firing
- ☐ Flue Gas Recirculation
- ☐ Staged Combustion
- ☐ Biased Firing
- ☐ One End Only Firing
- ☐ Other (specify): _____

B. Internal Combustion Engines/Combustion Turbines ☒ Not Applicable

TBD
Manufacturer

TBD
Model Number

TBD
Serial Number

Varies ☐ gal/hr ☐ mmcf/hr
Fuel Flow Rate

N/A ☐ hp ☐ kW
Engine Output Rating

See Project Description
Reason for Engine Use

Form ARD-2

C. Stack Information

Is unit equipped with multiple stacks? ☐ Yes ☒ No *(if yes, provide data for each stack)*

Identify other devices on this stack: _____

Is Section 123 of the Clean Air Act applicable? ☐ Yes ☒ No

Is stack monitoring used? ☐ Yes ☒ No

If yes, Describe: _____

Is stack capped or otherwise restricted? ☐ Yes ☒ No

If yes, Describe: _____

Stack exit orientation: ☒ Vertical ☐ Horizontal ☐ Downward

4	30
Stack ☒ Inside Diameter (ft) ☐ Exit Area (ft^2)	Discharge height above ground level (ft)
32,830	43.5
Exhaust Flow (acfm)	Exhaust Velocity (ft/sec)
1280	
Exhaust Temperature (°F)	

II. OPERATIONAL INFORMATION

A. Fuel Usage Information

1. Fuel Supplier:

N/A
Supplier's Name

Street

Town/City State Zip Code

Telephone Number

2. Fuel Additives:

N/A
Manufacturer's Name

Street

Town/City State Zip Code

Telephone Number

Identification of Additive

Consumption Rate (gallons per 1000 gallons of fuel)

3. Fuel Information *(List each fuel utilized by this device)*:

Type	% Sulfur	% Ash	% Moisture (solid fuels only)	Heat Rating (specify units)	Potential Heat Input (MMBtu/hr)	Actual Annual Usage (specify units)
Process	Varies	Varies	Varies	Varies	~36	Varies

B. Hours of Operation

Hours per day: 24 Days per year: 365

Note: Emission calculations based on 97% uptime.

Form ARD-2

III. POLLUTION CONTROL EQUIPMENT ☒ Not Applicable

A. Type of Equipment *Note: if process utilizes more than one control device, provide data for each device*

- ☐ baffled settling chamber
- ☐ long cone cyclone
- ☐ multiple cyclone (_____ inch diameter)
- ☐ electrostatic precipitator
- ☐ spray tower
- ☐ venturi scrubber
- ☐ afterburners (incineration)
- ☐ selective catalytic reduction
- ☐ reburn
- ☐ other (specify): _____
- ☐ wide bodied cyclone
- ☐ irrigated long cone cyclone
- ☐ carbon absorption
- ☐ irrigated electrostatic precipitator
- ☐ absorption tower
- ☐ baghouse
- ☐ packed tower/column
- ☐ selective non-catalytic reduction

B. Pollutant Input Information

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)

Method used to determine entering emissions:

☐ stack test ☐ vendor data ☐ emission factor ☐ material balance

☐ other (specify): _____

C. Operating Data

1. Capture Efficiency: _____% Verified by: ☐ test ☐ calculations
2. Control Efficiency: _____% Verified by: ☐ test ☐ calculations
3. Normal Operating Conditions *(supply the following data as applicable)*

Total gas volume through unit (acfm)	Temperature (°F)	Percent Carbon Dioxide (CO_2)
Voltage	Spark Rate	Milliamps
Pressure Drop (inches of water)	Liquid Recycle Rate (gallons per minute)	

Form ARD-2

IV. DEVICE EMISSIONS DATA:

Pollutant	Temperature (°F)	Actual (lb/hr)	Potential (lb/hr)	Actual (ton/yr)	Potential (ton/yr)
NOx	1280	N/A	2.3	N/A	9.31
CO	1280	N/A	2.3	N/A	9.31
VOC	1280	N/A	2.1	N/A	8.60
SOx	1280	N/A	0.5	N/A	2.13
PM10	1280	N/A	1.5	N/A	6.02

Method used to determine exiting emissions:

☐ stack test ☐ vendor data ☒ emission factor ☐ material balance

☐ other (specify): _____

Section 2
Control Technology Analyses

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Section 2
Control Technology Analyses

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1. Background

Municipal solid waste (MSW) begins to decompose in a number of stages after deposited in a landfill. Anaerobic decomposition, which is the longest stage (typically 30-40 years), produces landfill gas (LFG) containing methane. LFG is a valuable source of alternative energy, which is becoming more attractive as incentives increase to develop renewable sources.

Federal rules, including NSPS and MACT, require new and existing major landfills with LFG collection and control systems to destroy non-methane organic compounds (NMOC) present in the LFG. NMOC contains multiple hazardous air pollutants (HAPs) and odor forming compounds. Useful energy can be produced by combusting the landfill gas in a landfill-gas-to-energy (LFGTE) facility. Generating energy from landfill gas creates a number of environmental benefits such as directly reducing greenhouse gas emissions, indirectly reducing air pollution by offsetting the use of non-renewable resources, and reducing landfill gas odors.

2. Project Description

The University of New Hampshire (UNH) proposes to construct and operate a LFGTE facility at the Turnkey Landfill located in Rochester, NH. Landfill gas will be treated and transferred by pipeline to the UNH cogeneration facility in Durham which is located approximately twelve miles from the Turnkey landfill. The LFGTE facility is considered a support facility to the UNH cogeneration facility and is therefore considered a modification to the existing UNH facility. Please refer to Attachment A for a facility site plan and the location of the facility on a USGS topographical map.

The five basic steps involved in the LFGTE facility will be: 1) gas preparation and sulfur removal; 2) electricity generation by LFG engines; 3) LFG treatment and thermal oxidation of waste gas; 4) flaring of excess gas; and 5) product gas transfer to cogeneration or supplemental turbine.

The initial stage of processing consists of pressurizing the gas, lowering the gas temperature and removing moisture. The next step is to remove sulfur-bearing compounds known as total reduced sulfur compounds (TRS). At this point, the LFG required to operate the power generation equipment and thermal oxidizer is supplied. The remaining LFG is further compressed, additional moisture is removed, and it is treated to remove siloxanes and volatile organic compounds by use of activated carbon. Activated carbon is followed by pressure swing adsorption, which employs a molecular sieve to remove carbon dioxide.

The power generation equipment will consist of two reciprocating engines designed to operate on LFG, each capable of generating 1600 kW of electricity. The thermal oxidizer will dispose of the waste gas streams produced during the regeneration of the activated carbon and the pressure swing adsorption's molecular sieve. The thermal oxidizer's maximum heat input is expected to be approximately 36 MMBtu/hr. Because of the

variability of the energy content of the waste gas stream, LFG will be provided as a supplemental fuel for flame stabilization.

UNH has agreed to continuously take 7,000 scfm of LFG, regardless of the processing demand. UNH will install two flares to be operated for supplemental and standby purposes. The supplemental flare will essentially operate continuously, at an average of 12% of its rated capacity. When the processing equipment and engines are not operating (conservative assumption of 7% of the time), the flares will operate at their maximum rated capacity.

The amount of excess product gas will vary on a seasonal basis such that the greatest amount of excess gas will be available in the warmer months. In order to fully utilize the product gas, UNH proposes to install a supplemental turbine at the Durham campus cogeneration facility. UNH has not made a final decision regarding the installation of a turbine, but would like to permit the proposed unit should they decide to do so. The flare load described above is based on the assumption that the turbine will be installed. If the turbine is not installed, the quantity of gas flared will increase.

In summary, the pollutant emitting equipment which require permitting are two 1600 kW (2233 BHP) reciprocating engines, one 36 MMBtu/hr thermal oxidizer, one 50 MMBtu/hr supplemental turbine, and two flares rated at 125 MMBtu/hr and 105 MMBtu/hr.

UNH must apply for and obtain a temporary permit from the New Hampshire Department of Environmental Services (NHDES) Air Resources Division (ARD) in accordance with Env-A 607. As part of this application process, UNH must comply with EPA's New Source Review (NSR) Program, which includes Prevention of Significant deterioration (PSD) and Non-attainment Area Permitting. The NHDES has adopted the NSR regulations and based on approval by EPA has the authority to administer the program (Env-A 618 and Env-A 619). Based on potential emissions from this project, UNH must comply with the PSD requirements for CO and PM_{10} and the Non-attainment requirements for NOx.

Alternative Siting Analysis

The NHDES requests that applicants undergoing NSR permitting perform an alternative siting analysis to demonstrate that the source would not have a lower environmental impact at a location other than the proposed location, so long as it is feasible. UNH is proposing to locate the LFGTE facility at the Turnkey Landfill. The LFGTE facility must be located between the Turnkey Landfill and UNH's Durham campus, as it will process landfill gas for use at the existing cogeneration facility. Due to land ownership and accessibility, the only two feasible site locations are the Turnkey Landfill or the Durham campus. Locating the source on the Durham campus would increase pollutant impacts in a highly congested area, making the location less favorable from an environmental impact perspective. In addition, location of the LFGTE facility on the

Durham campus would decrease the aesthetic value of the campus. Therefore, the proposed location will have the lowest environmental impact among feasible options.

Research Methods

EPA's RACT/BACT/LAER Clearinghouse (RBLC), a compilation of emission limits and/or controls on emission units that have obtained air permits from various state and local regulatory agencies within the United States, is referenced within this control technology analysis. The information contained in the RBLC is voluntarily supplied by the permitting agencies and may be accessed via the Internet on EPA's transfer technology network (TTN) web page. In addition to a review of EPA's RBLC, a review of the BACT Clearinghouses managed by California Air Resources Board (CARB) and South Coast Air Quality Management District (SCAQMD) were conducted, as well as a review of information provided by EPA's Landfill Methane Outreach Program (LMOP). Additional information was also obtained from various state and/or local air permitting agencies and air pollution control equipment manufacturers and vendors.

3. New Source Review: Non-Attainment Pollutants

3.1 Introduction

A new major source or a major modification to an existing source located within the geographical boundaries of a non-attainment area must comply with the non-attainment area permitting requirements and demonstrate that emissions of the non-attainment pollutant will meet lowest achievable emission rate (LAER). UNH is an existing major source of NOx, therefore a major modification for NOx is defined as a significant emissions increase. Significant emissions for NOx are defined as 25 tpy for the four county non-attainment region in New Hampshire. The proposed LFGTE facility will be located at the Turnkey Landfill in Rochester, NH. Rochester is located in Strafford County, which is one of the four counties defined as non-attainment. Based on proposed potential emissions of NOx (Table 1), the LFGTE facility is a major modification for NOx and must demonstrate that emissions will meet LAER. UNH is not a major source for VOC, therefore an increase of greater than 50 tpy of VOC would be considered a major modification. Based on proposed potential emissions of VOC (Table 1), the LFGTE facility is not a major modification for VOC and therefore not subject to non-attainment review. LAER is defined as the more stringent rate of emissions based on the following:

A. The most stringent emission limitation which is contained in the implementation plan of any State (SIP) for that class or category of source, unless the owner or operator of the proposed source demonstrates that those limitations are not achievable; or

B. The most stringent emission limitation achieved in practice by that class or category of source, which ever is more stringent. In no event may LAER result in emission of any pollutant in excess of those standards and

limitations promulgated pursuant to Section 111 or 112 of the United States Clean Air Act as amended, or any emission standard established by the Department.

LAER is an emissions rate specific to each emissions unit, and is considered a starting point for a top down approach similar to BACT. Unlike BACT however, a LAER determination does not consider economic factors. Table 1 summarizes the proposed increase in NOx and VOC emissions, by device. Attachment B contains emission calculations for all criteria pollutants.

Table 1
Proposed Annual Increase in NOx and VOC Emissions

Equipment	Proposed Increase in NOx Emissions (tpy)	Proposed Increase in VOC Emissions (tpy)
Two 2,233 bhp Caterpillar G3520C Reciprocating Engines	20.9	29.3
One 43.6 MMBtu/hr Solar Mercury 50 Supplemental Turbine	3.2	2.2
One 36 MMBtu Thermal Oxidizer (make/model unknown)	9.3	8.6
One Supplemental Flare and One Standby Flare	9.2	8.1
Total	**42.6**	**48.2**

3.2 Nitrogen Oxides (NOx)

Sources of nitrogen in the combustion process include atmospheric nitrogen and fuel bound nitrogen. NOx formation from these sources of nitrogen are differentiated by the expressions "thermal" NOx and "fuel" NOx, respectively. The formation of NOx in combustion devices is exponentially related to combustion temperature. Therefore, the principal mechanism of NOx formation is thermal NOx, which occurs through the thermal dissociation and subsequent reaction of nitrogen (N_2) and oxygen (O_2) molecules in the combustion air. Most NOx formed through the thermal NOx mechanism occurs in high temperature regions where combustion air has mixed sufficiently with the fuel to produce the peak temperature fuel/air interface.

3.2.1 Reciprocating Engines

Reciprocating engines are a type of internal combustion engine, and are classified as 2-stroke or 4-stroke engines. An intake/compression cycle and power/exhaust cycle are the basic mechanisms of a reciprocating engine. A 2-stroke engine uses one revolution to complete the mechanism, while a 4-stroke engine uses a separate revolution for each cycle. Reciprocating engines are also classified as either rich-burn engines or lean-burn engines. Rich-burn engines generally operate near the stoichiometric air-to-fuel ratio (16:1), with lower exhaust excess oxygen levels. Lean-burn engines operate in higher

air-to-fuel ratios (typically greater than 24:1). Lean-burn engines typically produce lower NOx emissions than rich-burn engines.

Landfill Gas Reciprocating Engines

Landfill gas consists mainly of methane (CH_4), carbon dioxide (CO_2), Nitrogen (N_2), and Oxygen (O_2). Impurities in landfill gas include siloxanes and total reduced sulfur compounds (TRS), mainly hydrogen sulfide (H_2S). Based on monthly averages during 2004 and 2005, Table 2 summarizes the basis of the design for the UNH LFGTE facility. The amount of nitrogen, which is an inert gas, present in the stream allows designation of an average inert scenario.

Table 2
Expected Landfill Gas Composition

	Average Inert Scenario (Basis of Design)
Methane	**51.6%**
Carbon Dioxide	**41.1%**
Nitrogen	**6.5%**
Oxygen	**0.8%**

An average methane content of 51.6% results in a low-Btu fuel, which is characteristic of all landfill gas. Due to the lower heating value and contaminants present in landfill gas, modifications must be made to an engine to allow for proper operation when fueled by landfill gas.

The U.S. Department of Energy Advanced Reciprocating Engine Systems (ARES) program has helped develop technologies for the latest generation of gas engines available for the LFGTE markets. These four-stroke, lean-burn engines are designed to resist corrosion and to deliver maximum performance from low-Btu fuels. Technologies that enable landfill gas-fired engines to perform well include elevated jacket water temperatures to prevent condensation of caustics, enhanced crankcase ventilation to remove caustics from the system, as well as modifications to enhance fuel flow. State of the art self-diagnostics and controls enable engines to adjust to variable heating values, as well as varying levels of contaminants and inert gases. The engines are equipped with a low-pressure fuel system, without the need for fuel compressors. This allows the engine to operate on fuel pressures as low as 0.50 psi, and therefore is well suited for untreated landfill gas. These lean-burn engines are capable of creating very low emissions without the need for exhaust after-treatment.

Proposed Engines and Operating Conditions

Two Caterpillar G3520C lean-burn reciprocating engines are being proposed for the UNH LFGTE project. Caterpillar has extensive experience with LFGTE projects, and its engines are utilized in more than half of all LFGTE facilities in the world. The G3520C design is based on technologies developed as part of the ARES program. The engines are four-stroke lean-burn spark ignited engines, which incorporate an advanced combustion

system designed to minimize NOx emissions. The Caterpillar lean burn technology will be discussed in the following section. Table 3 summarizes the expected performance and guaranteed NOx emissions from an Emissions Warranty provided by Milton CAT Power Systems Division. The performance and emissions are based on the expected operating conditions and landfill gas characteristics at the Turnkey landfill.

Table 3
Reciprocating Engine Performance

Specification	Value[1]
Engine Power	2,233 bhp
Generator Power	1,600 kWe
Fuel Input	6,387 BTU/bhp-hr[2]
Exhaust Stack Temp	896 deg F
Guaranteed NOx Emission Rate	≤0.5 gm/bhp-hr[3]

[1]Values are for one engine operating continuously at full load.
[2]Maximum expected fuel consumption + 5% Full Load Data.
[3]Emission level based on a 3-hr averaging period.

The performance specifications listed in Table 3 are based on the following fuel supply conditions:

Table 4
Reciprocating Engine Operating Conditions

Landfill Gas Characteristic	Value
Methane Content Operating Range	450-550 Btu/cf
O_2 Limit	≤1.0%
Pressure and Stability Tolerance	3.0 psi +/- 0.1 psi
Sulfur Content	≤60 ppm[1]

[1]Higher sulfur levels may be tolerated

As discussed, the average inert scenario (51.6% CH_4, 6.5% N_2, 0.8% O_2) is the basis for the design of the project. The LFG will go through a desulfurization process before combusted in the engines. Based on the average inert scenario, the LFG will be within the above listed operating ranges necessary to guarantee emissions.

3.2.1.1. Identification of Control Technologies

Lean Burn Technology in Landfill-gas Engines

Lean burn technology is the most effective method of controlling NOx emissions from landfill gas-fired reciprocating engines. Following a review of EPA's RBLC and state and region air pollution control agencies, lean burn technology without the use of add-on emissions control was listed as the control description for all landfill gas-fired engines currently in use.

The Caterpillar G3520C engine was designed as a result of the ARES program, and is recognized as an inherently low emissions engine for CO and NOx. The G3520C is a turbocharged engine with inter-cooled intake air and after coolers. The intercooler lowers the temperature of the air compressed by the turbocharger and improves the

volumetric efficiency of the engine. After-cooling is a technology to lower the intake air temperature, which lowers the peak cylinder temperature and NOx formation. It operates with lean burn combustion with a sophisticated air to fuel ratio and spark/torch ignited controls. The air to fuel ratio controller adjusts the inlet air to fuel ratio so that the desired exhaust oxygen concentration is maintained to minimize NOx and CO emissions.

After Exhaust (Add-on) Control Technologies

Selective Catalytic Reduction (SCR) may be employed as a NOx emissions control for some reciprocating engines. SCR uses a catalyst to selectively reduce NOx emissions from exhaust streams by reacting it with a reagent. Ammonia (NH_3) or an ammonia-based reductant such as urea is usually used as the reagent, which reduces the NO and NO_2 to nitrogen and water. Siloxanes present in the landfill gas have been shown to poison catalysts. Catalytic reduction is not considered a feasible control option for landfill gas-fired engines, and can therefore be dismissed as a possible control technology.

Pre-combustion chambers are sometimes used to promote stable combustion in lean-burn engines. Engines equipped with pre-combustion chambers require higher fuel pressures (45 psi) and are particularly sensitive to ignition system fouling from siloxane contaminants in untreated landfill gas and are therefore susceptible to increased maintenance and service. Pre-combustion chambers are not considered a feasible technology for NOx control in landfill-gas fired engines.

3.2.1.2. Selection of LAER

Table 5 lists recently permitted LFG reciprocating engines and the corresponding NOx permit levels obtained from the multiple Clearinghouses and agencies previously mentioned.

Table 5
Summary of BACT/LAER Determinations for Reciprocating Engines (NOx)

Facility[1]	County/State	Equipment	Control Description	Permit Date	NOx Limit (gm/bhp-hr)	Basis
Ridgewood Power Management	Providence, Rhode Island	(4) Caterpillar 3520C, 2,233 hp each	Lean Burn, Air/Fuel Ratio Controller, Intercooler	1/5/2005	0.50	LAER
New England Waste Services (NEWSVT)	Orleans, Vermont	(4) Caterpillar 3520C, 2,233 hp each	Lean Burn, Air/Fuel Ratio Controller, Intercooler	12/16/2004	0.50	BACT
Seminole Landfill (Ellenwood)	DeKalb, Georgia	(2) Caterpillar 3520C, 2,233 hp each	Lean Burn, Air/Fuel Ratio Controller, Intercooler	Early 2006	0.50	OTHER
Monmouth County Reclamation Center	Monmouth, New Jersey	(1) Jenbacker JGS320 1468 hp each	Lean Burn Technology	12/12/06	0.53	LAER
Minnesota Methane Tajiguas Landfill	Santa Barbara, California	(1) Caterpillar 3616, 4231 hp	Lean Burn Technology	2/20/02	0.53	BACT/ LAER
Manchester Renewable Power Corp	Ocean, New Jersey	(6) Caterpillar 3520C 2,233 hp each	Lean Burn Technology, Air/Fuel Ratio Controller	10/06/06	0.60	LAER
Northwest Regional Landfill	Maricopa, Arizona	Make/Model not specified	Not specified	10/27/2003	0.60	LAER
BioEnergy LLC	Bexar, Texas	(8) Caterpillar 3520C 2,172 hp each	Lean Burn Technology	7/23/04	0.60	BACT
Reliant Energy Renewables Security	Montgomery, Texas	(4) Jenbacher JGS616, 2,677 hp each	Good Combustion Practice	1/31/2002	0.60	OTHER
Reliant Energy Renewables (Coastal Plains)	Galveston, Texas	(7) Jenbacher JGS616, 2,677 hp each	Good Combustion Practice	1/24/2002	0.60	OTHER
Carbon Limestone LFG Power Plant	Mahoning, Ohio	(16) Deutz TBG620V16K, 1,850 hp each	Lean Burn Technology	4/10/2003	0.60	BACT-PSD
Lorain County LFG Power Plant	Lorain, Ohio	Deutz TBG620V16K, 1,850 hp	Lean Burn Technology	4/22/2003	0.60	BACT
Chino Basin Desalter Authority	California	Waukesha L7042GL, 1,408 hp[2]	Turbocharged, Intercooled, Air/Fuel Ratio Controller	6/18/2002	0.60	BACT/ LAER

[1]One other source located in California's SCAQMD (Minnesota Methane San Bernardino Energy, CA-1092) was listed in EPA's RBLC. It was discovered that this facility was never constructed. The pre-construction NOx limit for this project was 0.6 gm/bhp-hr.
[2]Primary fuel is digester gas, which is included in the landfill gas category in RBLC.

Source test results were requested for all of the above listed sources to determine if the permit limits were being achieved in practice. Table 6 summarizes the results of the available source tests.

Table 6
Source Test Results for Recently Permitted Reciprocating Engines (NOx)

Facility	Source Test Date	Equipment	Measured NOx emissions (gm/bhp-hr)	Permit Limit (gm/bhp-hr)
Ridgewood Power Management[1]	1/23/06	Cat 3520C #1 Cat 3520C #2 Cat 3520C #3 Cat 3520C #4	0.31 0.37 0.26 0.33	0.50
New England Waste Services[2]	9/22/05	Cat 3520C	0.44	0.50
Minnesota Methane Tajiguas Landfill[3]	5/9/02 5/28/03	Cat 3616	0.42 0.41	0.53

[1]Measured NOx emissions for Ridgewood Power Management's four engines are an average of three 1-hr. tests per engine.
[2]Landfill gas conditions: 48% CH_4, 42.3% CO_2, 1.4% O_2, 57ºF. 1-hr test averaging period.
[3]Testing averaging times not available.

Source test results indicate that the most stringent limits are being achieved in practice. In addition, both Ridgewood Power Management and New England Waste Services are using the same engine being proposed for UNH's LFGTE facility. Seminole County Landfill, which also utilizes a G3520C and has a NOx emission limit of 0.50 gm/bhp-hr, has not been required to perform source tests yet, as they just recently received their permit.

LAER Determination

The proposed engines are equipped with an advanced lean-burn combustion technology to achieve a NOx emissions guarantee of 0.50 gm/bhp-hr or lower when fueled by landfill gas at the Turnkey landfill. As discussed in the control technologies section, add-on NOx controls are not used on landfill gas engines and are not warranted for this device. Similar to the proposed location for UNH's LFGTE facility, Ridgewood Power Management (Rhode Island) and Minnesota Methane's Tajiguas Landfill (California) are also located in "moderate" non-attainment areas for ozone. The engines located at these facilities are permitted for NOx levels of 0.50 gm/bhp-hr and 0.53 bhp-hr, respectively. Both facilities have demonstrated that these permit limits are achieved in practice based on source test results.

Extensive research and discussions with multiple State air pollution control agencies, including New Jersey and California's BAAQMD and SCAQMD, did not result in any findings with NOx limits lower than 0.50 gm/bhp-hr for landfill gas-fired engines. Therefore, UNH proposes a LAER of 0.50 gm/bhp-hr (3-hr averaging period) for each Caterpillar G3520C.

3.2.2. Combustion Turbine

Turbines are also classified as internal combustion engines, but operate on a rotary motion, rather than a reciprocating motion. There are four basic categories of turbines: simple cycle, regenerative cycle, cogeneration, and combined cycle. In simple cycle turbines, the heat content of the exhaust gases is discarded without heat recovery. Regenerative cycle turbines use a heat exchanger to preheat combustion air entering the combustor. A cogeneration turbine uses a heat recovery steam generator (HRSG) to recover heat and raise process steam, with or without supplementary firing. Lastly, a combined cycle recovers heat to raise steam for a steam turbine, with or without supplementary firing.

Proposed Turbine

UNH is considering the installation of a supplemental turbine as part of the proposed project. Although a final decision has not been made, UNH is submitting a permit application for a supplemental turbine should they decide to install the proposed unit. The proposed unit is a Solar Mercury 50 recuperative turbine, which would be installed at the existing cogeneration facility located on UNH's Durham campus.

As discussed in the project description, multiple technologies will be used to treat landfill gas before it is piped to the existing cogeneration facility. Since the composition of natural gas varies greatly, processed landfill gas is sometimes referred to as "choice natural gas". The processed LFG at UNH will not be considered "pipeline quality" natural gas. Due to the lack of information on processed LFG turbines, discussion on control technologies is conservatively based on turbines fueled by pipeline quality natural gas. Consideration should be given to the unique characteristics and variability of processed LFG. Table 7 compares the expected composition of the processed landfill gas to the typical composition ranges of pipeline quality natural gas.

Table 7
Processed Landfill Gas Compared to Natural Gas

Fuel Gas Component	Processed Landfill Gas	Typical Composition of Natural Gas
Methane (CH_4)	77%	70-90%
Carbon Dioxide (CO_2)	2%	0-8%
Nitrogen (N_2)	18%	0-5%
Oxygen (O_2)	3%	0-0.2%
Sulfur	0.0001%	20 gr/100 scf
Ethane, Propane, Butane	NA	0-20%

The Solar Mercury 50 Turbine was developed as part of the Advanced Turbine Systems (ATS) Program initiated by the Department of Energy to produce more efficient and cleaner engines. The Mercury 50 turbine is a "recuperative gas turbine" which has increased efficiency with limited NOx and CO emissions. In the recuperative process, the exhaust gas from the combustor is used to heat the air exiting the compressor prior to

entering the combustor. As a result of heating the incoming air, the efficiency of the turbine is increased and the combustor can operate very lean. Lean burn combustion contains more oxygen than is necessary to support complete combustion and results in low NOx and CO emissions. The turbine was originally designed for natural gas; however it has been modified to support landfill gas by changing the fuel injectors to allow a greater fuel flow rate. The NOx emissions guarantee, which is based on the expected operating conditions and fuel gas composition for the proposed project is summarized in Table 8.

Table 8
Mercury 50 NOx Emissions Guarantee

Emission Units	Value
ppmvd @15% O_2	5
lb/hr	0.81
lb/MMBtu	0.020
lb/MW-hr	0.17
gm/bhp-hr	0.16

3.2.2.1. Identification of Control Technologies

Selective Catalytic Reduction (SCR)

As discussed in the control technologies section for reciprocating engines, SCR involves the injection of ammonia into the flue gas stream, where it selectively reacts with NOx in the presence of O_2 and a catalyst to form N_2 and H_2O. The use of ammonia in SCR presents some environmental concerns. Release of ammonia to the atmosphere may occur due to unreacted ammonia going out the stack, which is referred to as ammonia slip. Ammonia may also be accidentally released during transport, transfer, or storage.

Although SCR is technically feasible for the proposed turbine, it has never been installed on a Mercury 50 because the concerns associated with ammonia slip are not considered a reasonable trade-off for a reduction in NOx emissions of 5 ppmvd to 2.5 ppmvd on a turbine of this size. Solar Turbines has had multiple discussions with California's SCAQMD regarding the company's concern with SCR installation on a Mercury 50. SCAQMD agreed with Solar that this is a strong argument, and will be considered for any future BACT/LAER applications including a Mercury 50. SCAQMD and CARB's current BACT/LAER policy for gas turbines are discussed in a later section of this analysis.

According to a search on EPA's RBLC, there is one source in the size range of the proposed unit that utilizes SCR as a NOx control technology. St. Agnes Medical Center, located in California, uses SCR on two 3.5 MW Solar Centaur 40 combined cycle turbines. The current NOx permit limit for the source is 5 ppmvd @ 15% O_2. Due to the lack of information on similar sources achieving NOx emissions limits lower than 5 ppmvd when employing SCR, and the environmental concerns associated with ammonia slip, SCR is dismissed from further consideration in this LAER analysis.

SCONOx™ (EMx)

EmeraChem LLC of Knoxville, Tennessee (formerly Goal Line Environmental Technologies) designs and manufactures the SCONOx™ catalyst technology. This technology uses a catalyst to oxidize CO, NOx, and VOCs. The most common benefit cited by supporters of this technology is that no ammonia is emitted from the system, since the technology does not require the injection of ammonia reagent.

NOx present in the combustion turbine exhaust is oxidized by the catalyst to nitrogen dioxide. The nitrogen dioxide is absorbed onto the catalyst surface through the use of a potassium carbonate coating. The catalyst undergoes regeneration periodically to maintain NOx absorption rates. The catalyst is regenerated by passing a controlled mixture of regeneration gases across its surface in the absence of oxygen. The regeneration gases react with the absorbed nitrogen dioxide to form water and nitrogen gas, which are then released into the exhaust gas.

Table 9 lists recent SCONOx installations, obtained from EmeraChem's White Paper, dated January 2004.

Table 9
Commercial SCONOx™ Installations

Turbine & Fuel	Facility	Location	Start-up Date	NOx Permit Limit
5 MW Solar Taurus 60 dual-fuel[1] turbine	Wyeth BioPharma cogeneration facility Unit #2	Andover, MA	September 2003	2.5 ppm
5 MW Solar Taurus 60 dual-fuel[1] turbine	Montefiore Medical Center cogeneration facility	Bronx, NY	June 2002	2.5 ppm
45 MW Alstom GTX100 gas turbine	Redding Electric municipal plant	Redding, CA	June 2002	2.0 ppm
Two 15 MW Solar Titan 130 gas turbines	University of California (UCSD) cogeneration facility	San Diego, CA	July 2001	2.5 ppm

Problems with catalyst effectiveness have been reported for two of the above listed facilities when utilizing pipeline quality natural gas. The combustion turbines at UCSD must be shut down every four months for catalyst washings. Each outage lasts for three days. The Redding Power Plant had to replace its leading layer of SCONOx catalyst after only 8,300 hours of operation, and has required catalyst washings three times per year.

SCONOx has been previously examined by State air permitting agencies in the Northeastern United States and by EPA Region I as a possible BACT and LAER technology during air permit application reviews for new combustion turbines. SCONOx has repeatedly been rejected due to lack of demonstrated commercial experience on a variety of turbine classes and sizes, and maintenance concerns associated with catalyst masking and moving parts (louvers). For these reasons, and in particular the concern that SCONOx has not been demonstrated on a turbine fueled by processed LFG, SCONOx has been removed from further consideration in this LAER analysis.

Dry Low NOx (DLN) Combustion Technology

The most popular DLN technology is lean premix combustion, where the air and fuel are mixed before introduced to the combustor. This technology will be incorporated into the design of the Solar Mercury 50, and is referred to as the Ultra-Lean Premix (ULP) combustion system. The ULP system includes ULP injectors, augmented backside cooling (ABC) with a thermal barrier coating (TBC) on the combustion liner, and an air diverted valve (ADV) placed upstream of the combustor to vary flow distribution within the combustion system. The recuperator will increase the combustion inlet air temperature. The exhaust gas from the combustor is used to heat the air coming out of the compressor (800 deg F) to approximately 1150 deg F, before it is introduced to the combustor. Heating the incoming air allows the combustor to run very lean without a water injection system. All of these technologies help create the low emissions guarantee over a wide range of temperatures and loads.

XONON™

A specific type of DLN combustion technology available on the market is XONON™, a catalytic combustor manufactured by Catalytica. The technology employs a catalyst inside the combustor where the air and fuel mixture passes through the catalyst as combustion occurs at much lower temperatures compared to a standard combustor.

The XONON™ has been installed on a 1.5MW Kawasaki M1A-13X simple cycle turbine located in California's BAAQMD (Silicon Valley Power - Genxon Power Systems, LLC). Although source test results are promising, the unit maintains a NOx permit limit of 5 ppmvd @ 15% O_2, based on a 3-hr averaging period. BAAQMD expressed concern with trying to achieve a NOx limit of 2.5 ppmvd when considering varying loads and operating temperatures. The 5 ppmvd limit remains in place for this device, and is considered BACT/LAER for other natural gas fired simple cycle turbines of this size in California's BAAQMD.

The source test results for Silicon Valley Power - Genxon Power Systems are shown in Table 10. The source test results suggest that a NOx emission guarantee of 2.5 ppmvd @ 15% O_2 is highly dependant on turbine operating conditions and source test averaging times.

Table 10
Source Test Results for Turbine Equipped with XONON™

Facility	Source Test Date	Equipment/Conditions	Measured NOx emissions (ppmvd @ 15% O_2)
Silicon Valley Power (Genxon Power Systems)	7/18/2000	Kawasaki – Average of 12 32-minute tests	1.13 +/- 0.026
	Unavailable	Kawasaki – 70% Load, Avg. Time: 26 min.	4.04
		Kawasaki – 73% Load, Avg. Time: 101 min.	1.94
		Kawasaki – 83% Load, Avg. Time: 66 min.	3.44
		Kawasaki – 87% Load, Avg. Time: 22 min.	4.82

Further, XONON™ is not available on turbines manufactured by Solar. Therefore, three Kawasaki 1.5 MW engines would be required to meet the power requirements for the project, which would result in an additional 1.3 MW of electricity. Due to the lack of demonstrated performance achieving a NOx limit lower than 5 ppmvd with the use of XONON™, and the infeasibility of three Kawasaki turbines, XONON™ is no longer considered in this LAER analysis.

Water/Steam Injection

In a water/steam injection system, the injection of water or steam into the combustor quenches the flame and absorbs heat, reducing the combustion temperature and therefore minimizing thermal NOx. As water or steam injection rates increase, an increase in noise and engine wear occurs. Turbines manufactured by Solar incorporate DLN technology, which produces lower NOx emissions and improves the efficiency of the turbine. This technology eliminates problems associated with water/steam injection, such as noise and engine wear. Water/steam injection does not enhance reduction of NOx emissions on combustion turbines already equipped with DLN technology. Although technically feasible, water/steam injection technology will not result in lower NOx emissions and is therefore dismissed as a potential control technology in this LAER analysis.

3.2.2.2. Selection of LAER

Table 11 contains recently permitted combustion turbines. Sources with varying sizes and types of turbines, as well as different primary fuel types are listed due to the lack of sources that are similar to the proposed project.

Table 11
Summary of BACT/LAER Determinations for Combustion Turbines (NOx)

Facility	State	Equipment	NOx Limit	Control Technology	Primary Fuel	Basis	Permit Date
Silicon Valley Power (Genxon Power Systems)	CA	Kawasaki M1A-13X 1.5 MW Simple Cycle, XONON	5 ppmvd @ 15% O_2 (3-hr avg)	XONON™	Natural Gas	BACT/ LAER	3/9/99
Cheyenne Plains Gas Pipeline Company	CO	Solar Taurus 60 (5.67 MW with SOLONOX	15 ppmvd (1-hr avg)	DLN, SoLoNOx	Natural Gas	BACT-PSD	6/12/04
Northwest Pipeline Corporation (Mt. Vernon Compressor Station)	WA	Solar Centaur 50, 4.6 MW	25 ppm @ 15% O_2 (3-hr avg)	DLN, SoLoNOx	Natural Gas	BACT-PSD	3/27/03
Los Angeles County Sanitation Districts	CA	Solar Combined Cycle 9.9 MW	25 ppmvd @ 15% O_2	Water Injection	Digester Gas	BACT/ LAER	7/25/00
MCUA gas utilization project	NJ	8.9 MW Turbine	32 ppmvd	Good Combustion Practices	LFG	LAER	3/9/99
DQE Energy/ Monmouth Energy	NJ	8.6 MW Turbine	32 ppmvd	Good Combustion Practices	LFG	LAER	6/11/02
St. Agnes Medical Center	CA	3.5 MW Solar Centaur 40 Combined Cycle	5 ppmvd @ 15% O2	Low NOx, SCR	Natural Gas	BACT/ LAER	2/16/00

LAER Determination

The current California Air Resources Board (CARB) BACT/LAER determination for combustion turbines is 5 ppmvd @ 15% O_2. SCAQMD's current LAER for NOx from combustion turbines is 2.5 ppmvd @ 15% O_2. However, SCAQMD is currently not requiring this limit for all combustion turbines. BACT/LAER determinations in SCAQMD are now somewhere between 2.5 ppmvd and 5 ppmvd, depending on the installation. For large power plants with combined cycle turbines, the BACT/LAER determination is 2.5 ppmvd. With smaller turbines that are not combined cycle, NOx limits are not always 2.5 ppmvd, and are usually 5 ppmvd.

Although the processed landfill gas will be similar to natural gas, it is not considered pipeline quality natural gas. The emission guarantee of 5 ppm is based on processed LFG with a nitrogen content of 18%. Pipeline quality natural gas has a very low nitrogen content, usually in the range of 0-5%. Due to lack of information on sources utilizing processed LFG, this LAER analysis was performed on the assumption that the turbine would be fueled by pipeline quality natural gas. As a comparative measure, the current LAER for combustion turbines fueled by pre-treated ("raw") landfill gas is 25 ppm @ 15% O_2.

The proposed unit will be equipped with an ultra lean premix (ULP) technology to achieve a NOx emissions guarantee of 5 ppmvd @ 15% O_2 when fueled by processed LFG at UNH's existing cogeneration facility. Due to the lack of demonstrated performance for turbines fueled by processed LFG, add-on control technologies are not being proposed. UNH proposes a LAER of 5 ppmvd @ 15% O_2 (3-hr averaging period) for the Solar Mercury 50 supplemental turbine.

Additional Equipment

The LAER analysis for the flares and thermal oxidizer will be addressed in conjunction with a BACT analysis for the equipment in a future section.

4. New Source Review - Prevention of Significant Deterioration

4.1 Introduction

As discussed, PSD/NSR requirements apply to new and modified sources located within areas known as attainment areas where the air quality meets the national ambient air quality standards promulgated in 40 CFR 52.21. The project area is designated as attainment or unclassified for CO, SO_2 and PM/PM_{10}.

The existing UNH facility is classified as a major source for PSD purposes since its current potential to emit one or more regulated air pollutants is 250 tons per year or greater. UNH is currently major for SO_2. An existing major source is subject to the PSD requirements if the proposed emissions increase for any criteria pollutant is greater than or equal to the respective pollutants' significant emission rate. If a modification results in an emissions increase above a significant threshold for a pollutant, the proposed change is classified as a "major modification" and must comply with the PSD regulations.

As shown Table 12, the proposed project is classified as a major modification for carbon monoxide (CO) and particulate matter less than 10 microns (PM_{10}).

Table 12
Proposed Emissions Increase (tons per year)

Equipment	CO	SO_2	PM/PM_{10}
(2) IC engines	115.0	1.9	4.2
Supplemental turbine	3.8	0.3	7.3
Thermal oxidizer	9.3	2.1	6.0
(2) utility flares	50.1	20.2	5.7
Total	178.2	24.5	23.2
Significant Emissions Level	100	40	25/15

4.2 Best Available Control Technology (BACT)

Under PSD review, a Best Available Control Technology (BACT) analysis must be conducted for each pollutant for which the modification is determined to be major. As stated previously, UNH's modification is major for CO and PM_{10} and BACT must be applied to each piece of equipment being modified. The following is the federal definition of BACT found in 40 CFR Part 52.21:

"….an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant, which would exceed the emissions allowed by any applicable standard within 40 CFR parts 60 and 61. If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by implementation of such design, equipment, work practice or operation, and shall provide for compliance by means which achieve equivalent results."

4.3 BACT Analysis Procedure

PSD/NSR regulations require a "top down" BACT analysis, as outlined by EPA's New Source Review Workshop Manual (Draft, October, 1990), be undertaken to determine the level of pollution control that must be applied to a particular emission unit. In no case can BACT result in the release of emissions that would violate national ambient air quality standards. BACT must also comply with federal and state emission standards. Federal and state emission standards applicable to the proposed project are summarized in Table 13.

Table 13
Applicable Federal and State Emission Standards

Regulation	Pollutant	Emission Standard
New Source Performance Standard (NSPS) for Combustion Turbines 40 CFR Part 60, Subpart KKKK	NOx	96 ppm
Proposed New Source Performance Standard (NSPS) for stationary Spark Ignition Internal Combustion Engines 40 CFR Part 60 Subpart JJJJ	NOx CO NMHC	3.0 gm/hp-hr 5.0 gm/hp-hr 1.0 gm/hp-hr
Proposed National Emission Standards for Hazardous Air Pollutants for Reciprocating Internal Combustion Engines 40 CFR Part 63 Subpart ZZZZ	NMHC	1.0 gm/hp-hr
Visible Emission Standard for Fuel Burning Equipment Env-A 2002.04	opacity	20%
Particulate Emission Standards for Fuel Burning Devices Env-A 2002.08	PM	0.3 lb/MMBtu

CO and PM_{10} emission controls for the UNH LFGTE facility equipment were evaluated using the procedure for a "top down" BACT analysis. The procedure for a "top down" BACT analysis consists of the following steps:

1. Identify control technologies;
2. Eliminate technically infeasible options;
3. Rank remaining control technologies by control effectiveness;
4. Evaluate most effective controls and document results, including case-by-case consideration of energy, environmental, and economic impacts, and an evaluation of the next most effective control option if top option is not selected as BACT; and
5. Select BACT, the most effective control option not rejected.

The "top down" BACT procedure was used to evaluate CO and PM_{10} emission controls for the reciprocating engines, turbine, thermal oxidizer and flares.

4.4 BACT Analysis

4.4.1 Carbon Monoxide (CO)

CO Formation

Carbon monoxide forms in combustion devices as a product of incomplete combustion. Production of CO results when there is a lack of oxygen and insufficient residence time at high enough temperatures to complete the final step in oxidation. Controlling these factors to decrease CO, however, also tends to result in increased emissions of NOx. Conversely, a lower NOx emission rate achieved through flame temperature control may result in higher levels of CO emissions. Thus a compromise must be established, whereby the flame temperature, residence time and excess oxygen are set to achieve the

lowest NOx emission rate possible to comply with LAER while keeping CO emissions to an acceptable level.

4.4.1.1 Reciprocating Engines

4.4.1.1.1 Identification of Control Technologies

Combustion Controls

CO emissions from reciprocating engines are a function of available oxygen (excess air), flame temperature, residence time, combustion zone design and turbulence. Table 14 contains a list of landfill gas reciprocating engines contained in the RBLC and CARB databases. In all cases, good combustion practices are utilized for CO controls. CO permitted levels identified in the RBLC/CARB database for landfill gas combustion, without add-on controls range from approximately 2.5 to 3.0 grams per brake horsepower hour (gm/bhp-hr).

Table 14
CO Emission Limitations for Recently Permitted Engine Projects

Facility	State	Engine size (bhp)	Permit Date	Basis	CO Limit	Control
Carbon Limestone LFG Power Station	OH	(16) 1,850	4/10/03	BACT	2.3	GCP
Loraine County LFG Power Station	OH	1,850	4/22/03	BACT	2.4	GCP
Minnesota Methane Tajiguas Energy	CA	4,231	2/20/02	BACT	2.45	GCP
MM San Bernardino Energy (never constructed)	CA	1,850	6/18/02	BACT	2.5	GCP
Chino Basin Desalter Authority	CA	1,408	6/18/02	BACT	2.5	GCP
Northwest Regional Landfill	AZ	1,410	10/27/03	Other	2.5	GCP
Monmouth County Reclamation Center	NJ	1,468	12/12/06	Other	2.53	GCP
New England Waste Services	VT	(4) 2,221	12/16/04	MSER*	2.75	GCP
Ridgewood Power Management	RI	(4) 2,233	1/05/05	BACT	2.75	GCP
Manchester Renewable Power Corp	NJ	(6) 2,233	10/06/06	BACT	2.75	GCP
BioEnergy LLC	TX	(8) 2,172	7/23/04	BACT	2.8	GCP
Reliant Energy Renewables Galveston Plant	TX	(7) 2,677	1/24/02	Other	3.0	GCP
Reliant Energy Renewables Security	TX	(4) 2,677	1/31/02	BACT	3.0	GCP

CO emission limitations in grams per brake horsepower hour (gm/bhp-hr)
GCP = good combustion practices
*Vermont Most Stringent Emission Rate is equivalent to BACT

Add-on Emission Control

The one post combustion control device available to control CO is an oxidation catalyst. The oxidation of CO to CO_2 utilizes excess air present in the combustion exhaust. The catalyst lowers the activation energy, which is required for the reaction to proceed. Products of combustion are introduced into a catalytic bed where the catalyst, typically a noble metal, promotes the oxidation reaction of CO to CO_2.

An oxidation catalyst is not technically feasible for CO control in reciprocating engines burning unfiltered or untreated gas. Landfill gas contains impurities such as siloxanes,

which poison the catalyst by sticking to the catalyst surface rendering it inactive. According to a representative of Süd-Chemie (formerly Prototech), a catalyst vendor, the catalyst would become blocked by the build up of impurities and would require replacing anywhere from one week to three months, depending on the concentration of siloxanes in the gas. Typically a catalyst life is three years. Süd-Chemie would not incur the liability by recommending or designing an oxidation catalyst for a landfill gas engine unless the gas was treated with activated carbon to remove siloxanes prior to combustion. Based on the RBLC and CARB database searches and agency and vendor contacts, no installations of CO catalysts on landfill gas reciprocating engines have been identified.

4.4.1.1.2 Good Combustion Practices for Reciprocating Engines

The lean-burn technology incorporated on the proposed reciprocating engines is designed to reduce CO emissions, and is described in *Section 3.2.1 Reciprocating Engines*.

4.4.1.1.3 BACT Selection

Good combustion practices are considered the acceptable and only feasible and commercially demonstrated CO control technology for LFG reciprocating engines. Through a combination of engine design and good combustion practices, UNH proposes a CO BACT limit of 2.75 gm/bhp-hr. Test results obtained from Ridgewood Power Management (Ridgewood), which has four Caterpillar G3520C engines, demonstrate their engines can achieve an average CO emission rate of 2.63 gm/bhp-hr. This emission rate is achieved by Ridgewood based on site conditions and landfill gas composition specific to the facility. The Ridgewood permit limits the CO emissions to 2.75 gm/bhp-hr. The average CO limit from the sources summarized in Table 15 is 2.6 gm/bhp-hr, with a high and low of 3.0 and 2.45 gm/bhp-hr, respectively. Due to the variability of the landfill gas composition, UNH proposes a CO emission limit of 2.75 gm/bhp-hr (3-hr averaging period).

4.4.1.2 Turbine

4.4.1.2.1 Identification of Control Technologies

Combustion Controls

CO emissions from turbines are a function of available oxygen (excess air), flame temperature, residence time, combustion zone design and turbulence. Table 15 contains a list of recently permitted LFG and natural gas simple cycle turbines contained in the RBLC database of similar size to the proposed supplemental turbine.

Table 15
CO Emission Limitations for Recently Permitted Turbine Projects

Facility	State	Turbine size	Permit Date	CO Emission Limit	Control*
Cheyenne Station	CO	71.42 MMBtu/hr (natural gas)	3/29/05	25 ppm @ 15% O_2	GCP
Cheyenne Station	CO	58 MMBtu/hr (natural gas)	6/12/04	25 ppm @ 15% O_2	GCP
Williams Field Services	WY	39.7 MMBtu/hr (natural gas)	5/17/99	4.8 lb/hr (50 ppm)	GCP
MCUA gas utilization project	NJ	74 MMBtu/hr (LFG)	3/9/99	72 ppm @ 15% O_2	GCP
DQE Energy/ Monmouth Energy	NJ	70.8 MMBtu/hr (LFG)	6/11/02	72 ppm @ 15% O_2	GCP
Deltic Timber Corp.	AR	63.32 MMBtu/hr (natural gas)	8/20/03	50 ppm @ 15% O_2	GCP
Algonquin Gas	NJ	67.84 MMBtu/hr (natural gas)	4/5/02	48.8 ppm @ 15% O_2	GCP
The Goodyear Tire and Rubber	TX	5 MW (natural gas)	1/6/99	50 ppm @ 15% O_2	GCP
Silicon Valley Power (Genxon Power Systems)	CA	1.5 MW (natural gas)	3/9/99	10 ppm @ 15% O_2	GCP

GCP=good combustion practices
*Add on control (oxidation catalyst) was determined to be too costly.

Add-on Emission Control

The one post combustion control device occasionally employed on combustion turbines to control CO has been an oxidation catalyst, which is described in *Section 4.4.1.1.1 Identification of Control Technologies*. The landfill gas is processed prior to entering the turbine to remove siloxanes that could poison the catalyst. Therefore, unlike the reciprocating engines, an oxidation catalyst is potentially feasible for CO control from the turbine.

4.4.1.2.2. Ranking of Control Options

The control options evaluated in this analysis are listed in Table 16 and are ranked based on their control effectiveness.

Table 16
CO Control Options for Supplemental Turbine

Control Option	Emissions after Control	Ranking
Mercury 50 turbine with oxidation catalyst	0.1 tpy	1
Mercury 50 combustion system	3.8 tpy	2

Turbine with Oxidation Catalyst

Energy Impacts

The increase flow resistance created by the oxidation catalyst creates a pressure drop across the combustion chamber and corresponding decrease in performance for the turbine. A Solar Turbine representative estimates an energy loss of 10 kW. The performance loss is for every hour of operation. The estimated negative energy impact caused by the pressure drop is:

10 kW x 24 hours/day x 365 days/year = 87,600 kW-hours/year

Economic Impacts

An economic analysis was performed to identify the average cost effectiveness of installing and operating an oxidation catalyst to reduce CO emissions by approximately 97%. The total capital cost estimate is presented in Table 17 in a format consistent with the cost estimation procedures in EPA's Office of Air Quality Planning and standards (OAQPS) Control Cost Manual, sixth edition (January 2002). The total annualized capital investment and annual cost of operating an oxidation catalyst were calculated using procedures in the OAQPS Control Cost Manual. The annual costs for the construction and operation of an oxidation catalyst is presented in Table 18.

Table 17
Oxidation Catalyst Capital Expenses

Equipment Costs		
	Oxidation catalyst	$67,200
	Frame and housing	$15,000
	Total system (A)	$82,200
	Freight (0.05A)	$4,110
	Taxes (0.05A)	$4,110
Total purchased equipment cost (B):		$90,420
Direct Installation Costs		
	Foundations and supports (0.08B)	$7,234
	Handling and Erection (0.14B)	$12,659
	Electrical (0.01B)	$904
Total direct installation cost:		$20,797
	Total direct cost:	$111,217
Indirect Costs (installation)		
	Engineering and Supervision (0.10B)	$9,042
	Construction and Field Expenses (0.05B)	$4,521
	Contractor fees (0.10B)	$9,042
	Startup (0.02B)	$1,808
	Performance Test (0.01B)	$904
	Contingencies (0.03B)	$2,713
	Total indirect cost:	$28,030
	Total Capital investment (TCI):	$139,247

Capital Cost Notes:

- Oxidation catalyst purchase cost estimate by provided Michael Pope of Süd-Chemie.
- Frame and housing cost estimate based on discussions with Michael Pope.

Table 18
Oxidation Catalyst Construction and Annual Operating Costs

Direct Annual Cost		
Operating Labor		---
Supervisory Labor		---
Maintenance Labor and Materials		$24,638
Catalyst replacement (3 year life, 7% interest)		$25,606
Spent catalyst handling		----
performance loss		$5,256
	Total direct annual cost:	$55,500
Indirect Annual Costs		
Overhead (60% total labor and materials)		$14,783
Administrative charges (0.02 TCI)		$2,785
Insurance (0.01 TCI)		$1,392
Capital recovery (10 year at 7% interest)		$10,259
(TCI - replacement cost of catalyst = 72,047)		
(72,047*0.1424)		
	Total indirect annual cost:	$29,220
	Total Annual Costs	$84,720
Average Cost Effectiveness		
CO emissions removed (tons/year)		3.76
Cost effectiveness (dollars/ton CO removed)		**$22,532**

Annual Cost Notes:

- Labor rate estimated at $45 per hour, including benefits and insurance. Maintenance, labor and materials: 2 x 0.25 hr/shift x 3 shifts/day x 365 days/year x $45/hour = $24,638.
- 7% interest rate on capital recovery cost calculations, based on written guidance in CO$T-AIR Control Cost Spreadsheets, William M. Vatavuk, Innovative Strategies and Economics Group, OAQPS, July 1999.
- A three-year catalyst life was used to evaluate the catalyst expense as this represents a typical catalyst life vender guarantee.
- The annual cost of the catalyst is calculated by annualizing a $67,200 replacement cost over 3 years at 7% (0.38105 x 67,200 = $25,606).
- Spent catalyst removal/disposal cost was not estimated as a conservative measure. The spent catalyst is returned to the vendor for metal recovery and the cost for removal/disposal is indirectly factored in the cost of a new catalyst.
- Energy loss from pressure drop caused by catalyst: 10kW, assumed $0.06 per kW-hr from energy impact calculations: 87,600 kW-hr/yr x $0.06/kW-hr = $5,256.
- Capital recovery cost equals capital cost minus the replacement cost of the catalyst annualized over 10 years at 7% interest rate: 0.1424 x $72,047 = $10,259.

Based on the cost analysis shown in Tables 17 and 18, the average cost effectiveness of an oxidation catalyst equals $22,532 per ton of CO removed. The dollar per ton value does not support the use of an oxidation catalyst as BACT for the supplemental turbine. To be conservative and simplify the cost estimate, the cost of a duct burner required to preheat the catalyst inlet air was not evaluated in the cost analysis. The dollar per ton CO would increase with the addition of the duct burner.

Energy and Environmental Impacts

The negative energy and environmental impacts associated with the application of an oxidation catalyst for CO removal include the increased energy requirements for operation, performance loss, and the waste generated from the spent catalyst. The marginal environmental benefit associated with reducing CO emissions by 3.76 tons per year in the project area does not justify the application of an oxidation catalyst, especially when considering the negative impacts.

Turbine with Good Combustion Practices

The technologies incorporated on the proposed turbine are designed to reduce CO emissions, and is described in *Section 3.2.2 Combustion Turbines*. The vender guarantee for CO emissions is 10 ppm at 15% O_2. The CO emission limits associated with recently permitted simple cycle turbines range from 10 ppm to 72 ppm at 15% O_2. According to the RBLC database, all of these limits were determined as a result of PSD compliance. The best available control technology for all of the identified turbines is good combustion practices.

4.4.1.2.3 BACT Selection

The energy, economic and environmental impacts of an oxidation catalyst do not support its selection as BACT. BACT for the UNH supplemental turbine is a well-designed turbine with good combustion practices and a CO limitation of 10 ppm at 15% O_2 (3-hr averaging period).

Additional Equipment

The BACT analysis for the flares and thermal oxidizer will be addressed in conjunction with a LAER analysis for the equipment in a future section.

4.4.2 Particulate Matter

UNH's LFGTE project exceeds the significant emissions levels for particulate matter less than or equal to 10 micrometers in diameter, also referred to as PM_{10}. PM_{10} includes both filterable and condensable particulates. As a conservative measure, UNH is assuming all calculated PM is PM_{10}.

PM_{10} emissions from the engines, turbine, flares and thermal oxidizer are produced from non-combustible inert material in the fuels, and trace inorganic material drawn in with the inlet air. Table 19 provides the estimated potential PM_{10} emissions from each piece of equipment.

Table 19

Potential PM_{10} Emissions by Device

Equipment	Potential PM_{10} Emissions (tpy)
(2) IC Caterpillar Engines	4.2
Solar Mercury Combustion Turbine	7.2
(2) Utility Flares	5.7
Thermal Oxidizer	6.0

The engine PM_{10} emissions are based on an emission factor of 0.1 gm/bhp-hr as provided by the plant's engineer/constructor. The estimated PM_{10} emissions from the turbine are based on an emission factor of 0.042 lb/MMBtu, which was provided by Solar Turbines. An emission factor of 0.042 lb/MMBtu, provided by the plant's engineer/constructor, was used to determine the PM_{10} emissions from the flares and oxidizer. All factors are based on a 3-hr block average.

Prior to use in the reciprocating engines, turbine, flares or thermal oxidizer, landfill gas will be sent through a moisture separator, which will have an internal mesh pad filter. The mesh pad will collect water droplets and some particulate. The engines will be equipped with coalescing filters that call for 99% removal of all water droplets and particulates over 1 micron. During the compression and chilling stages of landfill gas processing, water vapor is condensed and another moisture separator and coalescing filter is provided. The primary purpose is to remove moisture, however particulate removal also occurs. Total Reduced Sulfur is also removed before the gas reaches the engines and turbine. Further particulate removal indirectly takes place in the activated carbon and PSA molecular sieve before the gas is combusted in the turbine. In addition, the inlet air to the turbine is filtered to remove particulates.

Add-on controls would not provide any appreciable control due to the low particulate matter concentration in the equipment exhaust. Based on general knowledge of purchase and installation costs for PM_{10} control devices, add on control devices would not prove to be cost effective for any of the proposed equipment. Based on research and database

searches, no landfill or natural gas fired engines, turbines, flares or thermal oxidizers of similar size to those being proposed are known to operate with add-on particulate matter controls.

Furthermore, EPA recognizes that particulate emissions from stationary gas turbines are minimal and as a result did not promulgate performance standards in the recently published Standards of Performance for Stationary Combustion Turbines (Subpart KKKK). Thus, in general, gas turbine controls for particulate matter have been limited to the use of clean fuels. Similarly, the proposed NSPS for stationary spark ignition internal combustion engines does not impose emission limitations for PM as EPA recognizes that particulate emissions from reciprocating engines are inherently low due to the low ash and sulfur content of the gas.

Thermal oxidizers and flares are typically employed for oxidizing combustible components of waste gas streams. The waste gas streams do not contain high levels of particulate and the permitting agencies normally do not address PM emissions from these sources. In addition, the temperature of the exhaust gases from the flares and thermal oxidizer are very high and would not allow for the addition of control equipment without a reduction in temperature. It would be unprecedented to install PM_{10} add-on controls to flares or thermal oxidizers.

An RBLC/CARB database search was conducted to identify PM_{10} limits for similar landfill gas equipment. It was discovered that PM_{10} emission limits for landfill gas engines, turbines and flares, if they exist, are generally provided in pounds per hour, tons per year, or in the case of flares pounds per million cubic feet. Emission limits not based on heat rate or engine speed are difficult to make comparisons to without detailed information, which is usually not provided in the database. However, it's important to note that Ridgewood Power Management which employs four Caterpillar G3520C engines has a PM emission limit of 0.1 gm/bhp-hr. No PM emission limits were identified for thermal oxidizers installed at the landfill gas processing facilities identified in Section 6.

4.4.2.1 BACT Selection

Based on feasibility and cost, UNH proposes BACT for the engines, turbine, flares and thermal oxidizer to be good combustion practices and the use of "clean" fuels. The proposed emission limits are summarized in Table 20.

Table 20
Proposed PM_{10} Emission Limits[1]

Equipment	Proposed PM_{10} Limit
(2) IC engines	0.1 gm/bhp-hr
Combustion turbine	0.042 lb/MMBtu
(2) Utility flares	0.042 lb/MMBtu
Thermal oxidizer	0.042 lb/MMBtu

[1]all limits are based on a 3-hr block average

5.0 Flares

Flaring is a high temperature oxidation process used to burn combustible and odorous components such as methane (CH_4) and volatile organic compounds (VOCs) present in landfill gas. The combustible components react with atmospheric oxygen to form CO_2 and water. Combustion co-products include NOx and CO. The three types of flares commonly used for landfill gases are utility, enclosed, and low-emission flares.

A utility flare, which is sometimes referred to as an open, candlestick, or elevated flare is used to destroy odorous greenhouse gases present in LFG, while still resulting in low NOx and CO emissions. A typical turndown ratio for utility flares is 40:1 (it can operate at 2.5% of its capacity). Enclosed flares completely encapsulate the flame, which provides for a pulsation and vibration free operation. Enclosed flares are capable of turndown ratios in the range of 6:1 of 10:1, and produce slightly lower emissions than utility flares. Ultra-low emission (ULE) LFG flares create very low NOx and CO emissions (0.025 lb/MMBtu and 0.060 lb/MMBtu, respectively). However, ULE flares are limited to a turndown ratio of 5:1; and therefore must operate at 20% of its capacity to function properly.
Table 21 compares the emission rates and turndown ratios among the three different types of flares.

Table 21
Comparison of Flare Emission Rates and Turndown Ratios

	Utility Flare	Enclosed Flare	ULE Flare
NOx (lb/MMBtu)	0.068	0.06	0.025
CO (lb/MMBtu)	0.37	0.20	0.06
Turndown Ratio	40:1	6:1 to 10:1	5:1

UNH must install a total flare capacity of 7,000 scfm, and is proposing to install one 125 MMBtu/hr utility flare as supplemental and one 105 MMBtu/hr utility flare as standby. The purpose of the supplemental flare is to burn the excess landfill gas that is not being processed or used by the engines. The design of the project specifies that the supplemental flare will operate at an average of 12% of its rated capacity when the landfill gas treatment equipment is operating. Therefore, a turndown ratio of at least 9:1 would be required for the flare to operate properly. At times, the flares would operate at a capacity as low as 5%, which would require a turndown ratio of 20:1. A ULE flare is not considered a feasible option for the supplemental flare because the turndown ratio for a ULE flare is 5:1. In addition to operating when the treatment equipment and engines are off-line, there may be times when the standby flare will operate in place of the supplemental flare. This large fluctuation in flow rate would not make it feasible to employ a ULE flare as the standby flare because of the low turndown ratio.

Based on vendor data, and multiple discussions with permitting agencies, many reliability and performance issues have been associated with ULE flares when LFG flow rates are not constant, or of sufficient capacity to meet turndown ratio requirements, as would be the case for the proposed project.

The two remaining options to consider are utility flares and enclosed flares. Table 22 compares the net NOx and CO emissions of two utility flares and two enclosed flares.

Table 22
Comparison of Emissions from Utility Flares and Enclosed Flares

	Two Utility Flares	Two Enclosed Flares	Difference
NOx (tpy)	9.2	8.12	1.08
CO (tpy)	50.09	27.07	23.02

Table 23 lists recently permitted sources that employ the use of flares, obtained from California's CARB database.

Table 23
Summary of BACT/LAER Determinations for Recently Permitted Flares

Facility	State/County	Equipment	NOx Limit (lb/MMBtu)	CO Limit (lb/MMBtu	Basis	Permit Date
City of Los Angeles Bureau of Sanitation	Los Angeles, California	(7) enclosed flares, total capacity of 8,750 scfm	0.06	0.01	BACT/ LAER	6/8/01
Waste Management of New Hampshire	Strafford, New Hampshire	John Zink ULE, capacity of 3,500 scfm	0.025	0.06	BACT	6/2002
Rhode Island Resource Recovery Corporation	Johnston, Rhode Island	John Zink ULE, total capacity of 6,000 scfm	0.025	0.06	LAER	7/2003
Tajiguas Landfill	Goleta, California	LFG Specialties enclosed flare, 63.68 MMBtu/hr	0.048	0.232	BACT/ LAER	9/8/04

Although the flare employed at the Tajiguas Landfill is an enclosed flare, the NOx limit of 0.048 lb/MMBtu and CO limit of 0.232 can only be achieved with a turndown ratio of 6:1. These emission limits are not California's current BACT/LAER determination for enclosed flares. Depending on the district, current limits in California are 0.06 lb/MMBtu or 0.025 lb/MMBtu for NOx, and 0.2 lb/MMBtu or 0.06 lb/MMBtu for CO. The lower limits are a result of the introduction of the John Zink ULE flare. As discussed, a ULE flare is not feasible for this project.

Enclosed flares are being employed at several landfills, and are meeting a NOx limit of 0.06 lb/MMBtu. However, many of these landfills are using the flares as a primary means of destroying harmful landfill gases. For landfills that utilize a LFGTE process, design factors will determine if a high turndown ratio is necessary and what type of flare will be best suited for the project, based on proven reliability from other sources with a similar design.

The UNH LFGTE project will be utilizing the majority of the landfill gas as an energy source, and will only be using the flares to treat the remaining landfill gas. A difference of 1.08 tons of NOx in one year is minor when considering the environmental and energy benefits associated with the project. Therefore, UNH proposes LAER to be 0.068 lb/MMBtu for NOx from each proposed flare.

The use of an enclosed flare verses a utility flare would reduce CO emissions by approximately 23 tons per year. John Zink Co. estimated the cost differential between a utility and an enclosed flare to be approximately $80,000 per flare for equipment and $40,000 per flare for installation. John Zink also suggested that the maintenance cost of an enclosed flare would be higher than that of an open flare. A cursory cost effectiveness was calculated to determine the economic feasibility of the enclosed flare. The cost effectiveness was calculated based on the difference in equipment, installation and maintenance cost between two open flares and two enclosed flares. The increase in total annual cost, assuming a capital recovery of 10 years at 7% interest is approximately $54,600. The average cost effectiveness of installing two enclosed flares instead of two open flares is approximately $2,375 per ton of CO removed. Based on economics and infeasible alternatives, UNH proposes installing two open flares with a BACT emission limit of 0.37 lb/MMBtu for each flare.

6.0 Thermal Oxidizer

Background

Thermal oxidizers (TOX) are an effective means of destroying organics in process exhaust gas streams. TOX systems are widely used because of the durability and adaptability over a wide range of operating conditions. The combustion chamber, also referred to as the reactor, is insulated and sized to provide the required residence time to allow for the desired conversion efficiency. The oxidation reaction breaks down the Hydrogen-Carbon bonds using heat energy, and produces CO_2 and water vapor. Certain types of thermal oxidizers require the use of supplemental fuel, therefore creating products of combustion, mainly NOx and CO.

In a recuperative oxidizer, a heat exchanger is used to heat the process gas by means of the hot exhaust gas exiting from the combustion chamber. The preheated air then enters the combustion zone, where the air temperature must be raised to the required oxidation temperature. This additional heat is provided by a burner, which is fueled by a supplemental fuel. The use of a heat exchanger to preheat the process gas stream greatly reduces the amount of supplemental fuel required.

Regenerative oxidizers (RTO) employ primary heat recovery, but operate in a periodic, repetitive cycle rather than a steady state mode. Instead of a conventional heat exchanger, RTOs use a heat recovery media as a store and release mechanism. Depending on the amount of media in a RTO, very high (approximately 95%) heat recoveries are common. Therefore, very little or no supplemental fuel is required. This type of operation is referred to as “auto-thermal”.

Process Description

UNH is proposing to install a TOX to treat the process gas streams produced during the regeneration of the activated carbon and the pressure swing adsorption (PSA) molecular sieve. The properties of the process gas streams are summarized in Table 24.

Table 24
Properties of Process Streams to Thermal Oxidizer

	Stream 1 (PSA)	Stream 2 (Act. Carbon)
CO_2	84%	70-84%
CH_4	16%	16-30%
Flow (scfm)	1403	1500
Temp. (ºF)	80	100
Other VOCs	No	Yes

Assuming the upstream total reduced sulfur (TRS) removal and VOC removal equipment are functioning properly, the PSA gas stream should be free of H_2S and VOCs. However, the waste gas stream from the regeneration of the activated carbon will be laden with VOCs and siloxanes. Therefore, a regenerative TOX is not feasible for this installation because the siloxanes would cause fouling of the media used for heat regeneration.

Although the PSA process gas stream does not contain any regulated VOCs, the current process design incorporates this stream in order to destroy the methane content. Therefore, the gas stream to the TOX will be a combination of the two streams, with a combined flow rate of approximately 2,900 scfm. The energy content of the waste gas is highly variable; therefore, landfill gas will be provided to the TOX for flame stabilization.

Proposed Equipment

UNH has not selected the manufacturer and specific configuration of the TOX. At this point, it is known that the TOX will have an approximate maximum heat input of 36 MMBtu/hr. A heat exchanger will be used to heat the gas stream, which will allow the gas stream to meet the TOX inlet requirements, and will reduce the energy requirements for the TOX operation.

A TOX is being proposed rather than a conventional enclosed flare because a flare would not achieve a similar destruction/reduction efficiency (DRE) as a TOX when considering the characteristics of the gas streams. A TOX has a larger chamber with increased turbulence and higher combustion temperature than a flare, which will allow for a higher DRE when treating the large amount of VOCs that are initially released from the regeneration of the activated carbon. A TOX will also require less supplemental fuel than an enclosed flare.

NOx and CO Control Technologies for Thermal Oxidizers

In addition to destroying the organic contaminants, an effective control system for a TOX must minimize emissions of combustion co-products such as NOx and CO. The three key factors in achieving a high DRE are temperature, residence time, and turbulence.

Low emissions burner technologies are available for thermal oxidizers, and are sometimes referred to as "high intensity spin mix" design. Combustion air is introduced to the burner throat with high velocity and spin, to promote good mixing with the fuel gas. The design of the burner allows very little of the flame to extend into the combustion chamber, enabling full use of the entire chamber volume for retention time.

Burners can also be run at stoichiometric or sub-stoichiometric ("starved air" mode) conditions to minimize NOx emissions associated with some process streams. Process gas or additional ("re-oxidation") air is introduced at the inlet of the combustion chamber to mix with the burner exhaust gas, providing oxygen to complete the destruction of the organics, and complete the conversion of CO and other combustibles. If further NOx reductions are needed, the burner adiabatic flame temperatures can be reduced with the use of flue gas recirculation (FGR), or possibly by "dilution" of the burner gases with a portion of low/no O_2-content process gas. The two critical design factors in determining the most appropriate destruction method is velocity profiles and mixing through the burner and combustion chamber.

The only post combustion control device available to control CO is an oxidation catalyst. As mentioned, the regenerated gas stream from the activated carbon will be laden with siloxanes. Based on information provided by Süd-Chemie, the oxidation catalyst is not technically feasible because the siloxanes would adhere to the catalyst preventing CO removal and requiring catalyst replacement within a very short amount of time (one to three months).

LAER/BACT Determination

A RBLC search was conducted to identify recently permitted thermal oxidizers. There were only a few entries and none of the TOXs were used for the same application as UNH is proposing. EPA's Landfill Methane Outreach Program was contacted to identify LFG facilities that have a thermal oxidizer to handle the gas streams from the regenerative processes. These facilities are identified as high BTU projects because similar to UNH, they are removing contaminants, increasing the methane concentration and therefore increasing the BTU value of the gas. Table 25 contains the facilities and pertinent information that was collected from contact with the respective state agencies.

Table 25
EPA LMOP Database: High-BTU Facilities

Landfill Name	State	Thermal oxidizer	Comments
City of Fort Smith LF	AR	No	
Johnson County LF	KS	Yes	Facility permit does not contain a NOx emissions limit for the thermal oxidizer. Did not trigger NSR. Application did not address emissions from TOX.
Westside Recycling and Disposal Facility	MI	Unable to obtain further information	
Fresh Kills LF	NY	Yes	Facility permit does not contain a NOx or CO emission limit for the thermal oxidizer. Project triggered NSR, however TOX was not reviewed for LAER.
Rumpke SLF	OH	Yes	Existing TOX installed 15-20 years ago. Application submitted to replace existing with new. Application triggered PSD. Application did not address emissions from thermal oxidizer. Permit contains lb/hr emission limits from entire processing facility.
Stony Hollow LF	OH	Yes	Landfill gas from Stony Hollow and Pinnacle Rd landfills is collected and processed by Pinnacle Gas Producers to produce high Btu gas. Not a major source and permit does not contain emissions limits for CO or NOx.
Pinnacle Rd LF	OH	See comment for Stony Hollow	See comment for Stony Hollow
Monroeville LF	PA	No	
USA Valley LF	PA	No	
McCarty Road LF	TX	Unable to obtain further information	
McCommas Bluff LF	TX		

Thermal oxidizers are widely used as a VOC control technology, and are capable of treating many different process gas streams. Due to this variance, every TOX installation is inherently unique, and designed to treat the specific process gas streams. Extensive research and discussions with multiple air agencies identified no similar sources to the proposed installation with specified NOx and CO permit limits.

None of the facilities identified in the table above employ add on control devices for NOx and CO emissions from thermal oxidizers. As mentioned previously, the application of a CO oxidation catalyst is technically infeasible. Vendors of thermal oxidizers were contacted to provide estimated NOx and CO emission rates based on the expected process streams associated with the project. As expected, the predicted emission rates varied greatly.

Based on discussions with California's BAAQMD and SCAQMD, the factor most considered when an applicant is permitting a TOX is if staged combustion will be used. Staged combustion is considered a combustion control technology designed to reduce NOx and CO emissions. As mentioned above, FGR is also a method that can be used to reduce NOx emissions. At this point, the specific NOx minimization technique will depend on the specific TOX selected for the project. The proposed TOX will operate

with good combustion controls. Oxygen levels will be monitored to control combustion and minimize NOx and CO formation.

Due to the lack of sources with a similar TOX installation, and therefore inability to determine what limits are being proposed and achieved in practice for representative units, it is reasonable for UNH to suggest a preferred vendor's emission rates as a preliminary BACT/LAER determination. Therefore, UNH proposes a NOx emission limit of 0.065 lb/MMBtu and a CO emission limit of 0.065 lb/MMBtu. UNH requests the option to discuss alternate emission rates when the particular make and model of the TOX is decided.

7.0 Summary

Table 26 summarizes the BACT/LAER determinations for the proposed project.

Table 26
Summary of BACT/LAER Determinations

Equipment	NOx	CO	PM_{10}	VOC	SOx
Two Caterpillar G3520C Reciprocating Engines[1]	0.50 gm/bhp-hr	2.75 gm/bhp-hr	0.1 gm/bhp-hr	0.7 lb/MMBtu	0.046 lb/MMBtu
One 43.6 MMBtu/hr Solar Turbines Mercury 50[2]	5 ppmvd @ 15% O_2	10 ppmvd @ 15% O_2	0.042 lb/MMBtu	0.013 lb/MMBtu	0.001 lb/MMBtu
One 36 MMBtu/hr Thermal Oxidizer[3]	0.065 lb/MMBtu	0.065 lb/MMBtu	0.042 lb/MMBtu	0.065 lb/MMBtu	0.015 lb/MMBtu
Two Utility Flares (125 MMBtu/hr and 105 MMBtu/hr)[4]	0.068 lb/MMBtu	0.370 lb/MMBtu	0.042 lb/MMBtu	0.06 lb/MMBtu	0.149 lb/MMBtu

[1]Emission limits are for each engine, based on 3-hr averaging period.
[2]Based on 3-hr averaging period.
[3]Preliminary BACT/LAER determination. Actual to be based on make/model chosen. Based on 3-hr averaging period.
[4]Emissions limits are for each flare, based on 3-hr averaging period.

Section 3
Air Dispersion Modeling Summary

University of New Hampshire
Landfill Gas to Energy Project

Section 3
Ambient Air Quality Analyses

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A. Introduction

The University of New Hampshire (UNH) is proposing to locate a landfill gas to energy (LFGTE) facility at the Waste Management Turnkey Landfill in Rochester, New Hampshire. The proposed facility will include two Caterpillar engine-generator sets, a thermal oxidizer, and two utility flares. The equipment will be fired on landfill gas. In addition to the fuel burning equipment at the Rochester project site, a Solar Mercury 50 combustion turbine is proposed to be located at UNH's existing co-generation facility on the Durham campus. The combustion turbine will operate on processed LFG that will be delivered via pipeline from the Rochester site.

The construction and installation of a LFGTE facility is defined as a major modification pursuant to the federal prevention of significant deterioration (PSD) regulations (40 CFR 52.21) based on the potential significant emissions increase of carbon monoxide and particulate matter (PM_{10}). As such, UNH is required to apply for a temporary permit under Env-A 607 of the State of New Hampshire Regulations. The PSD regulations are incorporated into the New Hampshire Code of Administrative Rules at Env-A 619.

On behalf of UNH, MacMillan & Donnelly (M&D) has prepared an application for a temporary permit for the UNH LFGTE project. Any application for a permit under the rules of 40 CFR 52.21 must contain an analysis of ambient air quality impacts for each pollutant for which it would result in a significant net emissions increase. Thus, UNH's LFGTE project is required by PSD regulations to provide an ambient air quality analysis for CO and PM_{10}.

UNH used the AERMOD program to perform ambient air quality analyses for emissions of SO_2 and NOx, in addition to CO and $PM_{10.}$ This summary report outlines the procedures and conclusions of the air quality impact analyses. The modeling analyses demonstrate that the UNH LFGTE project will meet National Ambient Air Quality Standards (NAAQS) and Increment Standards for Class I & II areas. The analyses further demonstrate that no adverse impacts on visibility, soils, and vegetation will occur. The analyses also conclude that minimal facility related growth is expected for the project area as a result of general commercial, residential, and industrial growth.

At NHARD's request, the modeling analyses evaluated the combined emissions impacts from off-site sources including Waste Management of New Hampshire's Turnkey Landfill and the Brox/Marcou Construction facility.

B. Input Parameters

1. Operating Scenarios and Load Conditions Modeled

It is anticipated that the proposed facility will be a base loaded operation running close to 100% load on a continuous basis. However, for modeling purposes, an evaluation of three operating loads (50%, 75%, and 100%) was made to assess the effects of reduced stack velocity.

Preliminary modeling was performed using the AERMOD model to evaluate ambient impacts for each of these three operating scenarios. Based on this load case analysis, with the exception of the 1-hr CO averaging period, the maximum impacts for all pollutants and averaging periods reflected 100% load condition.

2. Emission Rates

SCS Energy, the project design engineers, provided the emission rates for the stationary internal combustion engines (SICE), Mercury turbine, flares and thermal oxidizer. The emission rates for the off-site nearby sources were supplied by NHARD. The emission rates used in the modeling analysis are listed below in Table 1.

Table 1: Short-Term Emission Rates (pounds/hour)

Source	SO_2	PM_{10}	NOx	CO
UNH LFGTE SICE 1	0.25	0.5	2.5	13.5
UNH LFGTE SICE 2	0.25	0.5	2.5	13.5
UNH LFGTE Thermal Oxidizer	0.5	1.5	2.3	2.3
UNH LFGTE Supplemental Flare	18.7	5.3	8.5	46.4
UNH LFGTE Standby Flare	15.7	4.4	7.1	38.9
UNH Mercury Turbine (Durham)	0.1	1.8	0.8	1.0
UNH Existing Turbine (Durham)	13.6*	5.4*	7.9*	12.6*
Waste Management Engine 1	2.3	0.1	3.5	8.0
Waste Management Engine 2	2.3	0.1	3.5	8.0
Waste Management Engine 3	2.3	0.1	3.5	8.0
Waste Management Engine 4	2.3	0.1	3.5	8.0
Waste Management Turbine 1	12.3	0.8	8.0	8.5
Waste Management Turbine 2	12.3	0.8	8.0	8.5
Waste Management Flare 1	12.2	0.8	3.4	18.3
Waste Management Flare 2	12.2	0.8	3.4	18.3
Waste Management Flare 3	31.6	2.3	2.9	6.9
Waste Management Flare 4	6.5	0.12	1.8	9.8
Waste Management LB Boiler	0.55	0.01	0.33	0.41
Brox Industries Generator	0.66	0.70	5.29**	2.16
Brox Industries Asphalt Batch Plant	35.2	10.8	6.27**	160.0
Marcou Construction Generator	3.33	0.47	5.10**	7.01

*Short term worst case emission rate per NHDES;
**Annualized NOx emission rate per NHDES.

3. Stack Parameters

The Universal Transverse Mercator (UTM) coordinates and stack base elevations of the stacks included in the modeling analyses are listed below in Table 2 (NAD27). A site plan showing the proposed locations of the fuel burning devices associated with the UNH LFGTE project is included in Attachment A. The stack coordinates and base elevations for other nearby sources were supplied by NHARD.

Table 2: Stack Locations and Base Elevations

Source	UTM Coordinates Easting (km)	UTM Coordinates Northing (km)	Stack Base Elev. feet amsl
UNH LFGTE SICE 1	341.058	4789.821	148
UNH LFGTE SICE 2	341.062	4789.817	148
UNH LFGTE Thermal Oxidizer	341.096	4789.813	148
UNH LFGTE Supplemental Flare	340.926	4789.919	147
UNH LFGTE Standby Flare	340.952	4789.897	147
UNH Mercury Turbine (Durham)	342.481	4777.550	61
UNH Existing Turbine (Durham)	342.481	4777.556	61
Waste Management Engine 1	340.2777	4789.3128	187.7
Waste Management Engine 2	340.2811	4789.3158	187.7
Waste Management Engine 3	340.2844	4789.3192	187.7
Waste Management Engine 4	340.2878	4789.3222	187.7
Waste Management Turbine 1	340.3542	4789.2884	174
Waste Management Turbine 2	340.3579	4789.2857	174
Waste Management Flare 1	340.2698	4789.2844	185
Waste Management Flare 2	340.2792	4789.2747	185
Waste Management Flare 3	340.2576	4789.3054	186.5
Waste Management Flare 4	340.414	4789.885	270
Waste Management LB Boiler	340.2652	4789.3561	189.2
Brox Industries Generator	341.400	4787.800	183.7
Brox Industries Asphalt Batch Plant	341.38956	4787.697	182.9
Marcou Construction Generator	341.200	4787.540	173.6

SCS Energy provided the exhaust gas characteristics for the LFGTE project fuel burning equipment. NHDES provided the exhaust gas characteristics for nearby sources. The stack exhaust data used in the modeling analyses is shown in Table 3.

Table 3: Exhaust Gas Parameters

Source	Stack height (ft)	Stack diameter (ft)	Exhaust gas flow rate (acfm)	Exhaust gas temperature (F)
UNH LFGTE SICE 1	32	1.33	11,948	896
UNH LFGTE SICE 2	32	1.33	11,948	896
UNH LFGTE Thermal Oxidizer	30	4	32,830	1,280
UNH LFGTE Supplemental Flare	61.2*	6.5*	129,170**	1,832
UNH LFGTE Standby Flare	58.6*	5.9*	107,837**	1,832
UNH Mercury Turbine (Durham)	100	4.1	69,756	708
UNH Existing Turbine (Durham)	100	5.0	46,768	273
Waste Management Engine 1	27.5	0.67	6,103	819
Waste Management Engine 2	27.5	0.67	6,103	819
Waste Management Engine 3	27.5	0.67	6,103	819
Waste Management Engine 4	27.5	0.67	6,103	819
Waste Management Turbine 1	36.3	4	90,478	752
Waste Management Turbine 2	36.3	4	90,478	752
Waste Management Flare 1	38.5	3.7	42,782	1,832
Waste Management Flare 2	42.5	3.7	42,782	1,832
Waste Management Flare 3	40	12.6	203,596	1,600
Waste Management Flare 4	33.8	2.96	27,085	1,832
Waste Management LB Boiler	29.3	1.3	414	350
Brox Industries Generator	26.5	0.41	2,150	860
Brox Industries Asphalt Batch Plant	45	5.25	98,705	286
Marcou Construction Generator	14	0.67	6,927	965

**Effective release height (SCREEN3); equivalent diameter = 0.1755(heat release in MMBtu/hr).*
***Exhaust flow represents exit velocity of 65.6 ft/sec (20 meter/sec).*

4. Building Parameters

The BPIP-PRIME model was used to determine the direction-dependent building dimensions required for the AERMOD model, and to determine the formula GEP stack height. A summary of the BPIP-PRIME inputs is included in Attachment C. The BPIP-PRIME model output indicates that the proposed Engine building (20 feet above ground level) will be the GEP-controlling structure. The proposed SICE stacks represent approximately 64% of formula GEP stack height based. The building and stack dimension data for nearby sources was provided by NHARD.

5. Models and Methodologies

a. Models

The AERMOD model was used to determine combined source "NAAQS" impacts and the LFGTE's "Increment" impacts. AERMOD was developed by the American Meteorological Society/EPA regulatory Model Improvement (AERMIC) with a goal of including current planetary boundary layer concepts into a regulatory model. On September 9, 2003, EPA proposed to revise "The Guideline on Air Quality Models" by incorporating AERMOD as a new, general purpose dispersion model to replace the

existing Industrial Source Complex (ISC3) model. The ISC3 model was used as the framework for the AERMOD model. Improvements to ISC3 made in the AERMOD model include improved plume rise and buoyancy, new vertical profiles of wind, turbulence and temperature, improved treatment of terrain, improved dispersion in both the stable boundary layer and the convective boundary layer, and improved characterizing of boundary layer parameters in the meteorological pre-processing portion of the model (AERMET).

The AERMOD model was designed to support the EPA's regulatory modeling programs, thus the model's default mode of operation is the regulatory modeling options. The options include the use of stack-tip downwash and a routine for processing averages when calm winds or missing meteorological data occur. AERMOD can process runs for multiple sources, including point, volume, and area source types.

b. Model Options

The regulatory default option was used in the AERMOD model runs.

6. Meteorological Conditions

For the AERMOD modeling conducted for the LFGTE Rochester project site, five years of meteorological data, covering the period from 2000 to 2004 collected at the Concord Municipal Airport in Concord (surface data station 14745) and the Portland, Maine International Airport (upper air station #14764), was used. For the Mercury 50 turbine significant impact modeling analysis, five years of meteorological data covering the period from 2000 to 2004 collected from the former Pease Air Force Base in Portsmouth (surface data) and the Portland, Maine International Airport (upper air station #14764).

Prior to use in the AERMOD model, AERMET, a preprocessor, is run to organize and process the meteorological data and estimate the necessary boundary layer parameters for dispersion calculations in AERMOD. AERMET preprocesses the data in a three-step manner: The first stage retrieves the raw hourly surface observations and raw upper air soundings data and assesses data quality. Once the data has received quality assurance, the second stage combines the available data into 24-hour block periods and writes these data to an intermediate file. In stage three, for a given year the merged data file generates a profile file and a surface file with planetary boundary layer parameters for use in dispersion calculations by AERMOD.

The meteorological data sets used for this modeling analysis were processed and approved for use by NHARD. The meteorological data was processed using the surface characteristics for twelve 30 degree sectors defined by land use within a 3-kilometer radius centered on the collection site. Surface characteristics such as obstacles to the wind flow, the amount of moisture at the surface, and reflectivity of the surface will influence boundary layer parameter estimates. These influences are quantified through the surface albedo, Bowen ratio and roughness length (z).

7. Receptor Grid

The program generated Cartesian receptor grids consisted of 100-meter spacing in the immediate project area and 200-meter spacing out to 5 kilometers from the proposed facility. The program generated Cartesian grids were converted to discrete receptors. Additional receptors were added at 20 meter spacing along the facility's property line and in the vicinity of stacks and buildings in order to capture downwash in the near wake region.

The receptor elevations were determined in AERMAP using U.S. Geological Survey (USGS) digitized elevation model (DEM) data and the highest of nearest 4 terrain points method. Copies of the DEM data files have been previously submitted to NHDES.

8. Air Contaminants

The air quality impact analysis addressed compliance with NAAQS for SO_2, CO, NO_2 and PM_{10}, as well as the PSD Increment Standards for SO_2, NO_2 and PM_{10}. In addition, the proposed facility's impacts of regulated toxic air pollutants (RTAPs) were assessed for compliance with Env-A 1400 RTAP ambient air limits.

9. Background Air Quality

Table 4 lists background air quality values for Portsmouth that were added to the combined source impacts to assess compliance with NAAQS. The values listed below are the highest values of the three most recent years for which data was available (2003-2005).

Table 4: Background Air Quality

Pollutant	Averaging Period	Concentration ($\mu g/m^3$)
SO_2	3-hr	157
	24-hr	68
	Annual	16
PM_{10}	24-hr	42
	Annual	20
NO_2	Annual	24
CO	1-hr	2,300
	8-hr	2,300

C. Results of Modeling Analysis

1. UNH LFGTE Load Analysis

The maximum impacts for all pollutants and averaging periods resulted from 100% load, which is the load included in interactive source modeling. The Mercury 50 turbine's impacts were determined to be insignificant for all pollutants and averaging periods.

2. Combined Source NAAQS Analysis

AERMOD model runs were performed to evaluate combined impacts from UNH's LFGTE project and nearby sources as required by NHARD. The model results indicate compliance with the PM_{10}, NOx, SO_2, and CO NAAQS for all averaging periods.

Table 5 lists the maximum combined source impacts for each pollutant and averaging period, and compares the results to NAAQS after adding in background air quality values. For the 3-hour SO_2 and the 24-hour SO_2 and PM_{10}, the listed impact represents the highest second-high impact. The CO impacts listed below are the highest impacts. For the annual averaging periods, the listed impacts represent the highest overall impacts. Note that all of the annual impacts reflect simultaneous operation of all emission sources at 100% load on a continuous year-round basis. None of the proposed equipment will operate 8,760 hours per year. Consequently, actual annual impacts will be much lower.

Table 5: Summary of Maximum Impacts

Pollutant	Avg. Period	Max. Impact (ug/m^3)	Background (ug/m^3)	Total Impact (ug/m^3)	NAAQS (ug/m^3)
SO_2	3-hour	189.4	157	346.4	1300
	24-hour	88.8	68	156.8	365
	Annual	14.6	16	30.6	80
PM_{10}	24-hour	18.8	42	60.8	150
	Annual	2.6	20	22.6	50
NO_2	Annual	16.9	24	40.9	100
CO	1-hour	814.5	2,300	3,114.5	40,000
	8-hour	407.7	2,300	2,707.7	10,000

Comparison of the total impacts to the NAAQS indicates that UNH's LFGTE project will not cause or contribute to a violation of NAAQS. A summary of the maximum impacts for each pollutant for each year of the meteorological data set is contained in Attachment D.

3. PSD Increment Analysis

The UNH LFGTE facility is a modification to an existing source and the emissions from the project are from new fuel burning equipment, thus they are considered to be increment-consuming devices. Table 6 summarizes Class II increment impacts, which reflect UNH LFGTE at maximum load case and all nearby increment consuming sources. As a conservative approach, no annual fuel limits were considered for increment consumption and reflect all proposed UNH LFGTE fuel burning equipment operating at 100% capacity for 8,760 hours per year.

Table 6: Summary of Maximum Increment Impacts

Pollutant	Ave. Period	Increment Impact* µg/m^3	Increment Standard µg/m^3
SO_2	3-hr	189.4	512
	24-hr	88.8	91
	annual	14.6	20
PM_{10}	24-hr	18.8	30
	annual	2.6	17
NOx	annual	16.9	25

4. Documentation of Modeling Results

Electronic copies of the AERMOD modeling files are being submitted to NHARD with this air quality modeling report. Attachment D contains summary sheets of the modeling impacts for each year and pollutant.

5. Conclusion

Based on the AERMOD modeling results, UNH's LFGTE project emissions in conjunction with other nearby emission sources will not cause or contribute to a violation of NAAQS or PSD Increment Standards.

D. Additional Air Quality Impact Analyses

The PSD regulations require that additional impact analyses be conducted to consider UNH's LFGTE project's effects on soils and vegetation and the potential impact of secondary growth.

40 CFR 52.21(o) requires a new source or major modification to provide an additional impact analysis of:

(a) The impairment to visibility, soils and vegetation that would occur as a result of the new major source and general, commercial, residential, industrial, and other growth associated with the new major source, except that an analysis of the impact on vegetation having no significant commercial or recreational value is not required;
(b) The air quality impact projected for the area as a result of the general commercial, residential, industrial, and other growth associated with the facility; and
(c) The impact, including visibility impairment, on any Class I area or integral vista.

The following subsections address each of these required impact analyses.

1. Visibility, Soils, and Vegetation Analysis

As required by 40 CFR 52.21(o), an analysis of UNH's LFGTE impacts on visibility, soils and vegetation for the project area (designated as Class II areas) was conducted.

a. Impact on Visibility

NHARD regulations limit the opacity of exhaust plumes released from stationary sources, primarily as a means of limiting the quantity of emissions released from the source. An opacity limitation also has the effect of minimizing the visual impact of the plume. Opacity can be defined as the degree of light obscuring capability of emissions of visible air contaminants, expressed as a percentage, where 100% opacity represents complete obscurity of light.

UNH will be limited by permit to an opacity limit of 20% for any continuous six-minute period in any 60-minute period during normal operations.

At the Rochester project site, UNH's LFGTE will utilize two SICEs, a thermal oxidizer, and utility flares fired on landfill gas with low sulfur content. In addition to these fuel-burning devices, a Mercury turbine fired on processed landfill gas will be installed at UNH's Durham campus Co-Gen facility. Thus, there will be little or no visible emissions from the stacks during normal operating conditions. UNH's LFGTE air permit will contain an opacity limitation that reflects the minimal opacity levels associated with combustion devices. In addition, the maximum potential emissions of SO_2 (~24 TPY), PM (~23 TPY), and NOx (~41 TPY) will be partially offset by the reduction in emissions from combusting fossil fuel at the UNH campus and WM Turnkey Landfill operations. Given the limitation on opacity and the size and design of the combustion devices, the emissions from the proposed LFGTE facility are not expected to cause visibility impairment in the project area.

b. Impact on Soils and Vegetation

To assess the facility's impacts on soils and vegetation, the EPA report entitled *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals*[1] was consulted. This report indicates that the two primary pathways of pollutants to cause adverse impacts to soils and vegetation are through deposition and direct exposure.

The EPA report also contains threshold levels for thirteen metals, in addition to fluoride, to assess the impacts of trace element deposition to soil. Analyses of the raw landfill gas at the project site do not indicate the presence of any of these elements, thus one can assume emissions from the UNH's LFGTE project would not have detrimental impacts to soils.

The remainder of the EPA screening procedure addresses the effects of direct exposure of vegetation to specific air pollutants. The sensitivity levels cited in the document represent the ambient levels at which visible damage or growth retardation may occur, or

[1] Smith, A.E., Levenson, J.B. 1980. **A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals**. EPA 450/2 81-078. Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency.

represent the observed minimum levels at which injury and mortality to plants have been reported. Air pollutants for which sensitivity levels are provided that will be emitted by the proposed UNH LFGTE SICEs, thermal oxidizer, and flares are SO_2, NO_2, and CO. The EPA screening document does include sensitivity levels for ozone (O_3), a secondary air pollutant caused by photochemical reactions of precursor species. However, none of the fuel burning equipment at the UNH LFGTE project will emit O_3 directly into the atmosphere. Thus, an assessment of the impacts of O_3 emissions from UNH's LFGTE project is not warranted.

The screening procedure calls for a comparison of the predicted cumulative air quality impacts, based on the proposed facility's emissions plus background sources, to the sensitivity levels. The screening values represent the minimum concentration at which adverse growth effects or tissue injury in exposed vegetation were reported.

EPA regulations currently do not contain significant impact levels for determining when a cumulative air quality analysis is warranted to address impacts to vegetation. However, the relatively small ambient impacts from the proposed UNH LFGTE project indicate that a cumulative air quality analysis to address vegetation impacts is not warranted. This determination is substantiated by the data in the Table 7, which provides a comparison of the facility's maximum ambient impacts with the sensitivity levels contained in the EPA report. Note that the impacts listed in Table 7 represent the highest predicted ambient concentrations for the particular averaging period and that the sensitivity levels correspond to the levels for sensitive plant species.

Table 7: Comparison of Maximum Impacts to Sensitivity Levels for Vegetation ($\mu g/m^3$)

Pollutant and Averaging Time	UNH LFGTE Impact	Sensitivity[a] Level
SO_2		
3 hour	24.5[b]	786
annual	1.5[b]	18
NO_2		
4 hour	42.0[b]	3760
8 hour	28.1[b]	3760
month	4.9[b]	564
annual	2.6[b]	100
CO		
week	99.2[c]	1,800,000

[a]The referenced EPA report contains sensitivity levels for sensitive, intermediate, and resistant species. The levels listed in the table correspond to the levels for sensitive species.
[b]This value represents UNH's maximum impact based on AERMOD results from a five year meteorological data set (2000 - 2004).
[c]This value represents UNH's maximum 24-hour CO impact, based on AERMOD results from a five year meteorological data set (2000 - 2004); maximum weekly CO impact will be substantially lower than this value.

This comparison indicates that the emissions of SO_2, NOx and CO from the proposed UNH LFGTE project are not expected to cause damage to vegetation in the project area as a result of direct exposure.

2. Growth Analysis

The proposed LFGTE facility will process LFG and deliver it via pipeline to the Durham campus for use in the existing Co-Gen facility. In addition, a Mercury turbine combusting processed landfill gas will be installed at the Durham campus. The project is not expected to induce secondary growth beyond what is currently anticipated at the campus. Furthermore, the construction work force for the UNH LFGTE project is expected to be in the range of 10 – 15 people and the operations work force will be 1 – 2 full-time equivalent employees. Thus, no secondary growth related to the work force is expected during either construction or operation of the plant.

3. Class I Area Impact Considerations

Class I areas are areas of special national or regional natural, scenic, recreational, or historic value. Lands designated as Class I Areas under the 1977 Clean Air Act Amendments are afforded the highest level of protection under PSD regulations. These lands consist of national wildernesses, parks, and wildlife refuges in existence at the time the amendments were passed. All other areas in the United States are designated as Class II or Class III. 40 CFR 52.21(p) requires the State of New Hampshire to provide written notification of any permit application for a proposed major modification with emissions that may affect a Class I area to the federal land manager. This notification includes an analysis of the source's anticipated impacts on visibility in the Class I area. The proposed UNH LFGTE project is approximately 97.4 kilometers south-southeast of the nearest point in the Presidential Range-Dry River Wilderness Area Class I area. The federal land manager for both Class I areas in New Hampshire is the United States Department of Agriculture's (USDA) Forest Service.

The Federal Land Managers AQRV Workgroup (FLAG) Phase I Report, dated December, 2000, states that the permitting authority should notify the federal land manager of all new or modified major facilities proposing to locate within 100 kilometers (62 miles) of a Class I area.

40 CFR 52.21(k) states that:

"The owner or operator of a proposed source or modification shall demonstrate that the allowable emissions increases from the proposed source or modification, in conjunction with all other applicable emission increases or reductions (including secondary emissions) would not cause or contribute to air pollution in violation of: (1) Any national ambient air quality standard in the air quality control region; or (2) Any applicable maximum allowable increases over the baseline concentration in the area."

As specified in 40 CFR 52.21(c), in areas designated as Class I or II, increases in pollutant concentration over the baseline concentration shall be limited to the following:

Pollutant	Maximum allowable increase (micrograms per cubic meter)
Class I	
Particulate matter:	
PM–10, annual arithmetic mean	4
PM–10, 24-hr maximum	8
Sulfur dioxide:	
Annual arithmetic mean	2
24-hr maximum	5
3-hr maximum	25
Nitrogen dioxide:	
Annual arithmetic mean	2.5
Class II	
Particulate matter:	
PM–10, annual arithmetic mean	17
PM–10, 24-hr maximum	30
Sulfur dioxide:	
Annual arithmetic mean	20
24-hr maximum	91
3-hr maximum	512
Nitrogen dioxide:	
Annual arithmetic mean	25

The AERMOD model was used to estimate impacts at the approximate midpoint between the proposed project location and the nearest Class I receptor. The AERMOD maximum impacts at receptors spaced 500 meters apart approximately 47 - 49 kilometers to the north of the proposed facility are summarized in Table 8. All increment consuming sources were included in the Class I impact analysis, including all UNH LFGTE devices, Waste Management Turkey Landfill devices, and UNH Co-Gen devices.

Table 8: UNH LFGTE Maximum Impacts at 49 kilometers

Pollutant & Averaging Period	**UNH LFGTE Maximum Impact (µg/m3)**	**Class I Maximum Allowable Increase (µg/m3)**	**Class I Significant Impact Level (µg/m3)***
SO_2 3-hour	5.68	25	1.0
SO_2 24-hour	0.95	5	0.2
SO_2 Annual	0.05	2	0.08
PM_{10} 24-hour	0.12	8	0.2
PM_{10} Annual	0.008	4	0.08
NOx Annual	0.03	2.5	0.08

**SILs for guidance and comparison only.*

.

The maximum impacts at the approximate midpoint to the nearest Class I boundary summarized above do not account for reductions in the operation of Waste Management fuel-burning devices that will occur as a result of LFGTE project. The impacts in Table 8

assume all proposed equipment is operating at maximum load for 8,760 hours per year, which is an overly conservative estimate. Further, combusting landfill gas also reduces or offsets pollution associated with the extraction and use of fossil fuels. The proposed UNH LFGTE project will result in a direct reduction of greenhouse gas emissions from the WM Turnkey landfill. In addition, through the capture, cleaning, and combustion of the LFG gas to generate electricity, a reduction of fossil fuel use at the UNH Co-Gen facility in Durham and its associated emissions of carbon dioxide, sulfur dioxide, nitrogen oxides, and other pollutants will occur. Based on the maximum impacts at the mid-point to the nearest Class I receptor (approximately 49 kilometers, which is typically assumed to be extent of AERMOD range) and considering the displacement of fossil fuels combustion, the operation of the LFGTE project will not adversely impact Class I air quality related values (AQRV). No further impact analysis of Class I AQRVs is warranted for this project.

4. Conclusion

The following additional impact analyses were conducted as required by PSD regulations:

- analysis of impacts on visibility, soils and vegetation;
- analysis of air quality impacts that may occur as a result of growth associated with the facility; and,
- assessment of impacts on Class I areas.

Based on the results of these analyses, no further analysis is necessary. Additionally, the air quality impacts that may occur as a result of facility-related growth will be minimal and, therefore, do not warrant quantification or further analysis. The proposed UNH LFGTE project will not have any adverse impacts on any Class I AQRVs.

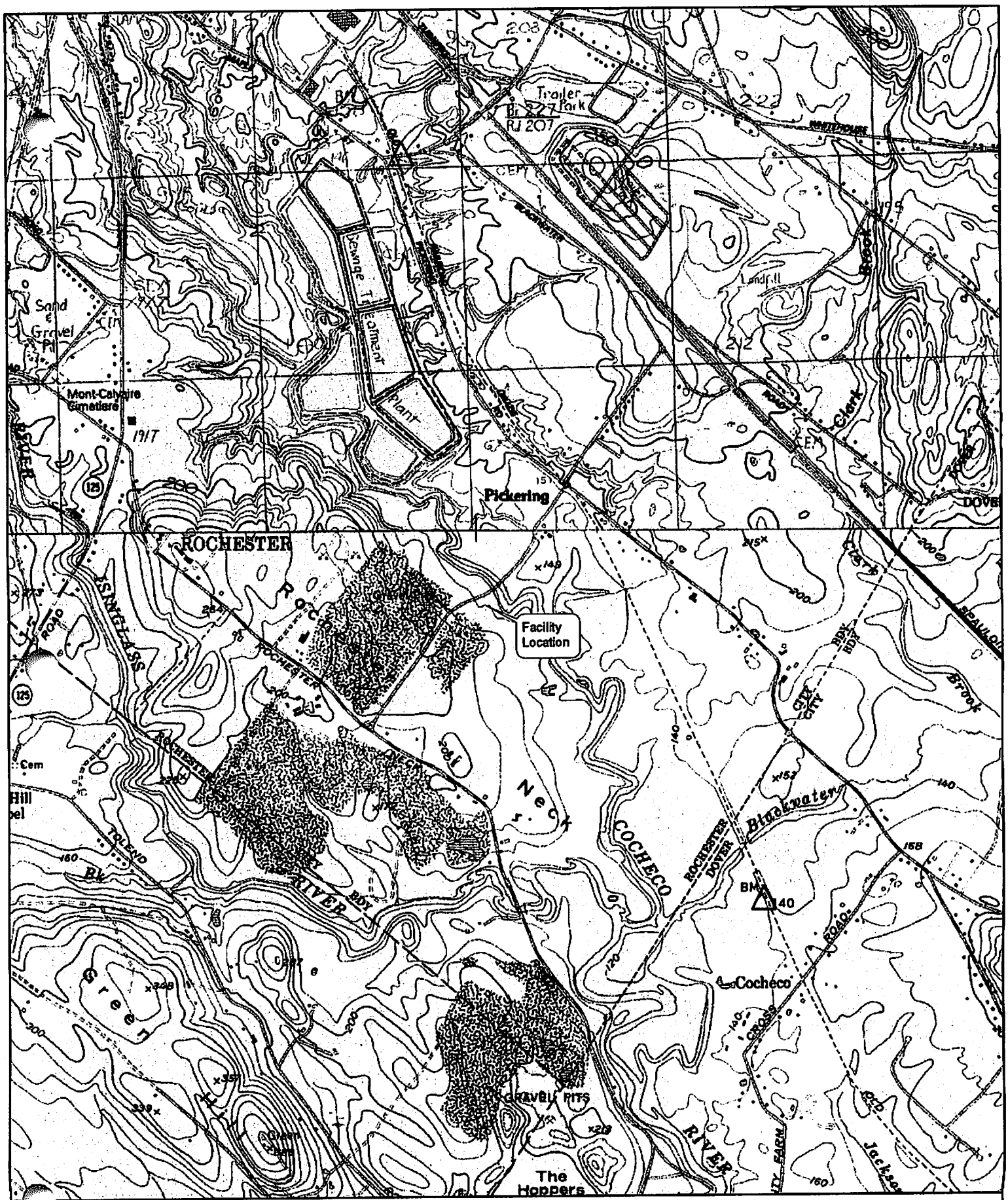
E. Env-A 1400 Compliance Demonstration

NHDES promulgated Env-A 1400, “Regulated Toxic Air Pollutants” (“RTAPS”), which require sources that emit one or more of over 700 listed RTAPS to demonstrate compliance with established Ambient Air Limits (“AAL”). The limits are applicable at and beyond the source’s property boundary. If a source can demonstrate that uncontrolled RTAP emissions comply with the AAL, a permit for the release of the RTAPs is not required. Sources unable to show compliance with the AALs without the use of controls are required to submit an application to NHARD identifying how the device or process will comply with the limits.

Due to the nature of the landfill gas, the emissions from the project’s combustion devices may include some RTAPs regulated under Env-A 1400. A compliance demonstration has been prepared using the AERMOD model and the landfill gas concentrations based on actual analysis of the gas. The ambient impacts of methane, hydrogen sulfide, and hydrogen chloride were assessed using the AERMOD model. All other RTAP impacts were estimated by pro-rating the modeled methane impacts using the ratios of molecular

weights and concentrations in landfill gas. A summary of RTAP impacts is included in Attachment D. The maximum ambient impacts listed in the summary table demonstrate that RTAP emissions from the UNH LFGTE project will not exceed ambient air limits. Modeling for air toxics was also completed for all WM Turnkey devices operating simultaneously with the UNH LFGTE project emissions.

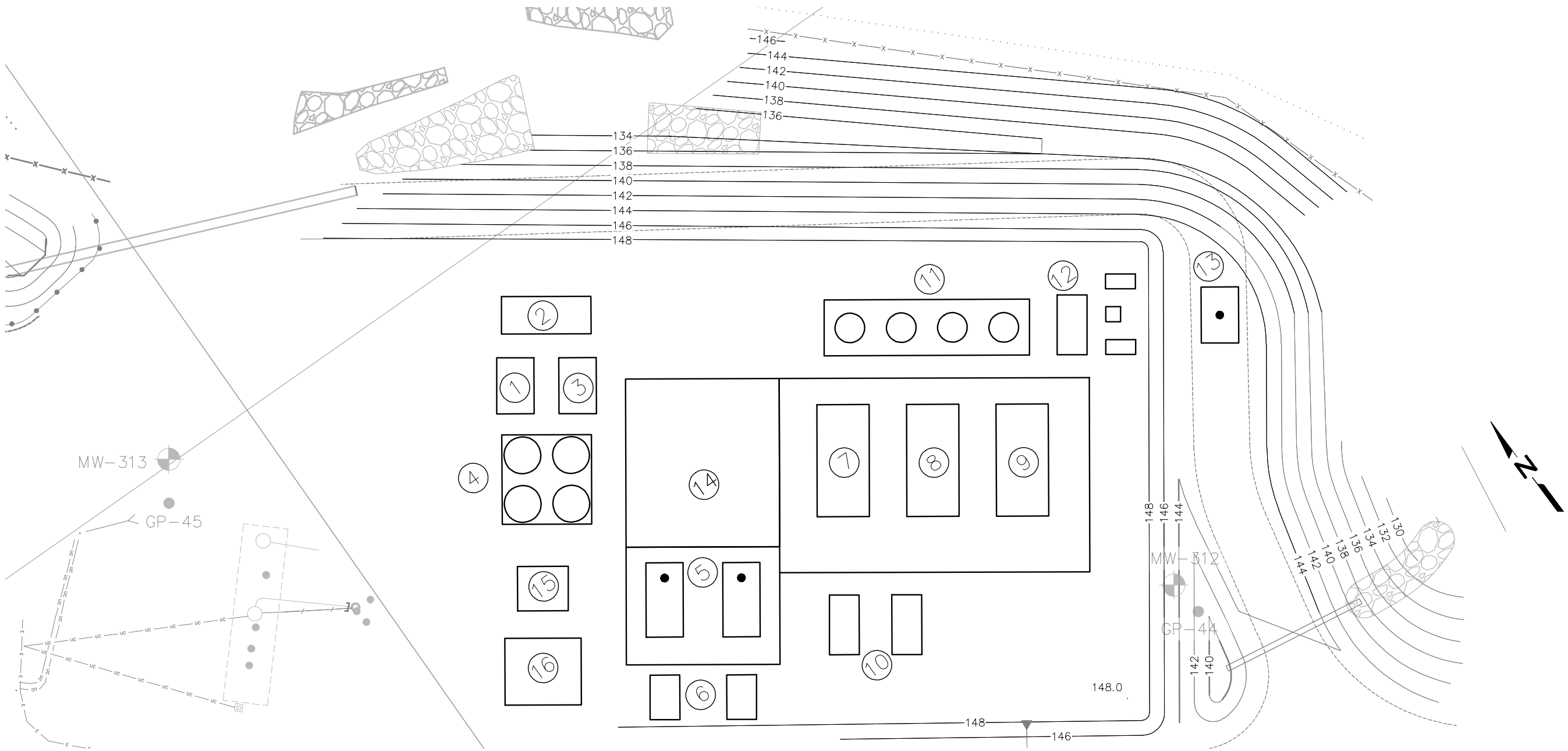
Attachment A
Facility Site Plan
Location of Facility on a USGS Topographical Map



Name: DOVER WEST
Date: 1/2/2007
Scale: 1 inch equals 2000 feet

Location: 19 0341136 E 4789863 N
Caption: UNH LFG Processing Facility
Temporary Air Permit Application
January 3, 2007

Copyright (C) 2002, Maptech, Inc.



INDENTIFICATION OF MAJOR PLANT COMPONENTS

1. BOOSTER BLOWER PRE-COOLER
2. BOOSTER BLOWERS
3. BOOSTER BLOWER AFTER-COOLER
4. SULFATREAT VESSELS
5. RECIPROCATING ENGINES
6. RADIATORS
7. COMPRESSION SKID
8. REFRIGERATION SKID
9. PRESSURE SWING ADSORPTION SKID
10. COMPRESSION AND REFRIGERATION AFTER-COOLERS
11. TEMPERATURE SWING ADSORPTION VESSELS
12. CO2 VACUUM BLOWER
13. THERMAL OXIDIZER
14. OFFICE/ELECTRICAL ROOM/SHOP
15. NEW 34.5 KV FUSED SWITCH
16. 2000 KV TRANSFORMER

GRAPHIC SCALE
30 20 10 0 30 60
SCALE IN FEET

NO.	REVISION	DATE

SHEET TITLE: SOURCES OF AIR EMISSIONS

PROJECT TITLE: LANDFILL GAS PROCESSING FACILITY

UNIVERSITY OF NEW HAMPSHIRE
DURHAM, NEW HAMPSHIRE

SCS ENERGY
3900 KILROY AIRPORT WAY
LONG BEACH, CA 90806
(562) 426-9544

PROJ. NO. 06206001.00 | DWN. BY: EA | ACAD FILE:
DSN. BY: BV | CHK. BY: | APP. BY:

DATE: 03/14/07

SCALE: AS SHOWN

DRAWING NO. G-100

of

N:\JOBS\2006 - JOBS\06206001.00 - Univ. of New Hampshire\Drawings\G-100 2.dwg Mar 14, 2007 - 2:28pm By: 2925dta

Attachment B
Emission Calculations

UNIVERSITY OF NEW HAMPSHIRE
LANDFILL GAS PROCESSING FACILITY
AIR EMISSIONS CALCULATIONS

	Full Output Capacity		Emission Factor		Lbs per Hour	Up Time	Capacity Factor	Tons per Year
RECIPROCATING ENGINES (CAT 3520 x 2)								
NOx	4466	bhp	0.500	g/bhp-hr	4.9	97%	100%	20.92
CO	4466	bhp	2.750	g/bhp-hr	27.1	97%	100%	115.03
VOC	4466	bhp	0.700	g/bhp-hr	6.9	97%	100%	29.28
SOx	4466	bhp	0.046	g/bhp-hr	0.5	97%	100%	1.94
Particulate	4466	bhp	0.100	g/bhp-hr	1.0	97%	100%	4.18
SUPPLEMENTAL TURBINE (Mercury 50)								
NOx	43.56	mmBtu/hr	0.018	lbs/mmBtu	0.8	97%	93%	3.17
CO	43.56	mmBtu/hr	0.022	lbs/mmBtu	1.0	97%	93%	3.80
VOC	43.56	mmBtu/hr	0.013	lbs/mmBtu	0.6	97%	93%	2.24
SOx	43.56	mmBtu/hr	0.001	lbs/mmBtu	0.1	97%	93%	0.26
Particulate	43.56	mmBtu/hr	0.042	lbs/mmBtu	1.8	97%	93%	7.25
THERMAL OXIDIZER								
NOx	35.50	mmBtu/hr	0.065	lbs/mmBtu	2.3	97%	95%	9.31
CO	35.50	mmBtu/hr	0.065	lbs/mmBtu	2.3	97%	95%	9.31
VOC	35.50	mmBtu/hr	0.060	lbs/mmBtu	2.1	97%	95%	8.60
SOx	35.50	mmBtu/hr	0.015	lbs/mmBtu	0.5	97%	95%	2.15
Particulate	35.50	mmBtu/hr	0.042	lbs/mmBtu	1.5	97%	95%	6.02
STANDBY AND SUPPLEMENTAL LFG FLARES								
Utility Flare 1 or 2 (as Supplemental)								
NOx	125.40	mmBtu/hr	0.060	lbs/mmBtu	7.5	99%	12%	3.88
CO	125.40	mmBtu/hr	0.200	lbs/mmBtu	25.1	99%	12%	12.94
VOC	125.40	mmBtu/hr	0.060	lbs/mmBtu	7.5	99%	12%	3.88
SOx	125.40	mmBtu/hr	0.149	lbs/mmBtu	18.7	99%	12%	9.64
Particulate	125.40	mmBtu/hr	0.042	lbs/mmBtu	5.3	99%	12%	2.72
Utility Flare 1 (as Standby)								
NOx	125.40	mmBtu/hr	0.060	lbs/mmBtu	7.5	7%	100%	2.31
CO	125.40	mmBtu/hr	0.200	lbs/mmBtu	25.1	7%	100%	7.69
VOC	125.40	mmBtu/hr	0.060	lbs/mmBtu	7.5	7%	100%	2.31
SOx	125.40	mmBtu/hr	0.149	lbs/mmBtu	18.7	7%	100%	5.73
Particulate	125.40	mmBtu/hr	0.042	lbs/mmBtu	5.3	7%	100%	1.61
Utility Flare 2 (as Standby)								
NOx	105.06	mmBtu/hr	0.060	lbs/mmBtu	6.3	7%	100%	1.93
CO	105.06	mmBtu/hr	0.200	lbs/mmBtu	21.0	7%	100%	6.44
VOC	105.06	mmBtu/hr	0.060	lbs/mmBtu	6.3	7%	100%	1.93
SOx	105.06	mmBtu/hr	0.149	lbs/mmBtu	15.7	7%	100%	4.80
Particulate	105.06	mmBtu/hr	0.042	lbs/mmBtu	4.4	7%	100%	1.35

GRAND TOTAL	
NOx	41.52
CO	155.22
VOC	48.24
SOx	24.52
Particulate	23.14

Attachment C
BPIP-Prime Inputs

BEE-Line Software Version: 9.95

Input File - unhlfgcrit.PRW
Input File - unhlfgcrit.PIP
Output File - unhlfgcrit.TAB
Output File - unhlfgcrit.SUM
Output File - unhlfgcrit.SO

BPIP (Dated: 04274)

DATE : 03/15/2007
TIME : 03:26:40 PM
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BPIP PROCESSING INFORMATION:
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The P flag has been set for preparing downwash related data for a model run utilizing the PRIME algorithm.

Inputs entered in METERS will be converted to meters using a conversion factor of 1.0000. Output will be in meters.

The UTMP variable is set to UTMY. The input is assumed to be in UTM coordinates. BPIP will move the UTM origin to the first pair of UTM coordinates read. The UTM coordinates of the new origin will be subtracted from all the other UTM coordinates entered to form this new local coordinate system.

Plant north is set to 0.00 degrees with respect to True North.

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PRELIMINARY* GEP STACK HEIGHT RESULTS TABLE
(Output Units: meters)

Stack Name	Stack Height	Stack-Building Base Elevation Differences	GEP** EQN1	Preliminary* GEP Stack Height Value
SICE1	9.75	0.00	20.04	65.00
SICE2	9.75	0.00	20.04	65.00
THERMOX	9.14	0.00	15.24	65.00
SUPFLR	18.65	N/A	0.00	65.00
STBBYFLR	17.87	N/A	0.00	65.00
ENGINE1	8.38	-0.49	20.15	65.00
ENGINE2	8.38	-0.49	20.15	65.00
ENGINE3	8.38	-0.49	20.15	65.00
ENGINE4	8.38	-0.49	20.15	65.00
TURBINE1	11.06	0.02	18.27	65.00
TURBINE2	11.06	0.02	18.27	65.00
FL1/100	11.73	-0.82	17.58	65.00
FLR2/100	12.95	N/A	0.00	65.00
FLR3/100	12.19	-0.85	20.51	65.00
FLR4100	10.31	N/A	0.00	65.00
LBOILER	8.93	-0.03	19.69	65.00
BROXGEN	8.08	0.00	9.91	65.00
ASPHALT	13.72	1.50	38.63	65.00
MARCGEN	4.27	0.01	9.13	65.00

* Results are based on Determinants 1 & 2 on pages 1 & 2 of the GEP Technical Support Document. Determinant 3 may be investigated for additional stack height credit. Final values result after Determinant 3 has been taken into consideration.

** Results were derived from Equation 1 on page 6 of GEP Technical Support Document. Values have been adjusted for any stack-building base elevation differences.

Note: Criteria for determining stack heights for modeling emission limitations for a source can be found in Table 3.1 of the GEP Technical Support Document.

BPIP (Dated: 04274)

DATE : 03/15/2007
TIME : 03:26:40 PM

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BPIP output is in meters

SO	BUILDHGT	SICE1	8.23	8.23	8.23	6.10	6.10	6.10
SO	BUILDHGT	SICE1	6.10	6.10	6.10	6.10	6.10	6.10
SO	BUILDHGT	SICE1	8.23	8.23	8.23	8.23	8.23	8.23
SO	BUILDHGT	SICE1	8.23	8.23	8.23	6.10	6.10	6.10
SO	BUILDHGT	SICE1	6.71	6.71	6.71	6.10	6.10	6.10
SO	BUILDHGT	SICE1	8.23	8.23	8.23	8.23	8.23	8.23
SO	BUILDWID	SICE1	7.66	7.35	6.91	31.66	33.14	33.61
SO	BUILDWID	SICE1	33.07	31.51	29.00	25.61	21.44	20.37
SO	BUILDWID	SICE1	6.59	7.11	7.51	7.76	7.87	7.84
SO	BUILDWID	SICE1	7.66	7.35	6.91	31.66	33.14	33.61
SO	BUILDWID	SICE1	8.33	7.17	6.74	25.61	21.44	20.37
SO	BUILDWID	SICE1	6.59	7.11	7.51	7.76	7.87	7.84
SO	BUILDLEN	SICE1	7.63	7.28	6.81	20.01	25.07	29.36
SO	BUILDLEN	SICE1	32.76	35.16	36.50	36.73	35.84	33.86
SO	BUILDLEN	SICE1	6.74	7.23	7.61	7.83	7.90	7.84
SO	BUILDLEN	SICE1	7.63	7.28	6.81	20.01	25.07	29.36
SO	BUILDLEN	SICE1	6.05	6.79	7.84	36.73	35.84	33.86
SO	BUILDLEN	SICE1	6.74	7.23	7.61	7.83	7.90	7.84
SO	XBADJ	SICE1	5.57	4.97	4.18	-6.22	-6.54	-6.67
SO	XBADJ	SICE1	-6.58	-6.30	-5.83	-5.18	-4.37	-3.43
SO	XBADJ	SICE1	-11.19	-12.42	-13.31	-13.85	-14.00	-13.79
SO	XBADJ	SICE1	-13.20	-12.25	-10.98	-13.79	-18.52	-22.69
SO	XBADJ	SICE1	-25.86	-28.97	-27.09	-31.55	-31.47	-30.43
SO	XBADJ	SICE1	4.45	5.18	5.71	6.02	6.10	5.95
SO	YBADJ	SICE1	3.70	5.25	6.64	-12.99	-11.52	-9.70
SO	YBADJ	SICE1	-7.59	-5.24	-2.73	-0.14	2.45	3.09
SO	YBADJ	SICE1	6.18	4.72	3.13	1.43	-0.30	-2.03
SO	YBADJ	SICE1	-3.70	-5.25	-6.64	12.99	11.52	9.70
SO	YBADJ	SICE1	5.00	3.68	-3.12	0.14	-2.45	-3.09
SO	YBADJ	SICE1	-6.18	-4.72	-3.13	-1.43	0.30	2.03

SO	BUILDHGT	SICE2	6.10	6.10	6.10	6.10	6.10	6.10
SO	BUILDHGT	SICE2	6.10	6.10	6.10	6.10	6.10	6.10
SO	BUILDHGT	SICE2	8.23	8.23	8.23	8.23	8.23	8.23
SO	BUILDHGT	SICE2	6.10	6.10	6.10	6.10	6.71	6.71
SO	BUILDHGT	SICE2	6.71	6.71	6.71	6.10	6.10	6.10
SO	BUILDHGT	SICE2	8.23	8.23	8.23	8.23	8.23	8.23
SO	BUILDWID	SICE2	36.73	35.84	33.86	31.66	33.14	33.61
SO	BUILDWID	SICE2	33.07	31.51	29.00	25.61	21.44	20.37
SO	BUILDWID	SICE2	6.59	7.11	7.51	7.76	7.87	7.84
SO	BUILDWID	SICE2	36.73	35.84	33.86	31.66	9.19	8.36
SO	BUILDWID	SICE2	7.85	7.17	6.74	25.61	21.44	20.37
SO	BUILDWID	SICE2	6.59	7.11	7.51	7.76	7.87	7.84
SO	BUILDLEN	SICE2	25.61	21.44	20.37	20.01	25.07	29.36
SO	BUILDLEN	SICE2	32.76	35.16	36.50	36.73	35.84	33.86
SO	BUILDLEN	SICE2	6.74	7.23	7.61	7.83	7.90	7.84
SO	BUILDLEN	SICE2	25.61	21.44	20.37	20.01	3.80	4.90
SO	BUILDLEN	SICE2	5.90	6.79	7.84	36.73	35.84	33.86
SO	BUILDLEN	SICE2	6.74	7.23	7.61	7.83	7.90	7.84
SO	XBADJ	SICE2	-10.25	-6.35	-6.02	-6.02	-7.22	-8.20
SO	XBADJ	SICE2	-8.93	-9.40	-9.57	-9.45	-9.05	-8.37
SO	XBADJ	SICE2	-16.24	-17.43	-18.13	-18.32	-18.01	-17.19

SO	XBADJ	SICE2	-15.36	-15.09	-14.35	-13.99	-20.97	-23.68
SO	XBADJ	SICE2	-25.14	-25.87	-23.35	-27.27	-26.79	-25.49
SO	XBADJ	SICE2	9.50	10.19	10.52	10.49	10.10	9.35
SO	YBADJ	SICE2	-8.91	-8.87	-8.56	-7.94	-6.51	-4.88
SO	YBADJ	SICE2	-3.11	-1.24	0.67	2.56	4.37	4.17
SO	YBADJ	SICE2	6.38	4.05	1.59	-0.92	-3.40	-5.77
SO	YBADJ	SICE2	8.91	8.87	8.56	7.94	7.49	7.39
SO	YBADJ	SICE2	3.59	-0.32	-6.52	-2.56	-4.37	-4.17
SO	YBADJ	SICE2	-6.38	-4.05	-1.59	0.92	3.40	5.77
SO	BUILDHGT	THERMOX	6.10	6.10	6.10	6.10	6.10	6.10
SO	BUILDHGT	THERMOX	6.10	6.10	6.10	6.10	6.10	6.10
SO	BUILDHGT	THERMOX	6.10	6.10	6.10	6.10	6.10	6.10
SO	BUILDHGT	THERMOX	6.10	6.10	6.10	6.10	6.10	6.10
SO	BUILDHGT	THERMOX	6.10	6.10	6.10	6.10	6.10	6.10
SO	BUILDHGT	THERMOX	6.10	6.10	6.10	6.10	6.10	6.10
SO	BUILDWID	THERMOX	47.82	48.42	47.59	45.60	33.14	33.61
SO	BUILDWID	THERMOX	33.07	31.51	29.00	25.61	21.44	20.37
SO	BUILDWID	THERMOX	24.63	28.19	38.23	42.02	44.54	45.82
SO	BUILDWID	THERMOX	47.82	48.42	47.59	45.60	33.14	33.61
SO	BUILDWID	THERMOX	33.07	31.51	29.00	25.61	21.44	20.37
SO	BUILDWID	THERMOX	24.63	28.19	38.23	42.02	44.54	45.82
SO	BUILDLEN	THERMOX	26.14	21.44	23.11	27.31	25.07	29.36
SO	BUILDLEN	THERMOX	32.76	35.16	36.50	36.73	35.84	33.86
SO	BUILDLEN	THERMOX	31.66	33.14	39.82	37.97	35.00	31.02
SO	BUILDLEN	THERMOX	26.14	21.44	23.11	27.31	25.07	29.36
SO	BUILDLEN	THERMOX	32.76	35.16	36.50	36.73	35.84	33.86
SO	BUILDLEN	THERMOX	31.66	33.14	39.82	37.97	35.00	31.02
SO	XBADJ	THERMOX	-12.86	-14.83	-20.10	-25.28	-31.07	-35.92
SO	XBADJ	THERMOX	-39.68	-42.23	-43.50	-43.45	-42.07	-39.42
SO	XBADJ	THERMOX	-36.02	-34.42	-37.98	-33.06	-27.18	-20.52
SO	XBADJ	THERMOX	-13.28	-6.62	-3.01	-2.03	6.01	6.56
SO	XBADJ	THERMOX	6.92	7.07	7.00	6.72	6.24	5.56
SO	XBADJ	THERMOX	4.36	1.28	-1.84	-4.91	-7.82	-10.50
SO	YBADJ	THERMOX	21.88	22.42	22.29	21.58	17.85	14.96
SO	YBADJ	THERMOX	11.63	7.93	4.00	-0.05	-4.11	-9.91
SO	YBADJ	THERMOX	-12.97	-16.98	-16.81	-18.67	-19.96	-20.71
SO	YBADJ	THERMOX	-21.88	-22.42	-22.29	-21.58	-17.85	-14.96
SO	YBADJ	THERMOX	-11.63	-7.93	-4.00	0.05	4.11	9.91
SO	YBADJ	THERMOX	12.97	16.98	16.81	18.67	19.96	20.71
SO	BUILDHGT	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00

SO	YBADJ	SUPFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	STBBYFLR	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	ENGINE1	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDHGT	ENGINE1	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDHGT	ENGINE1	7.86	7.86	7.86	7.86	7.86	6.71
SO	BUILDHGT	ENGINE1	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDHGT	ENGINE1	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDHGT	ENGINE1	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDWID	ENGINE1	30.35	26.17	21.20	15.58	11.68	16.52
SO	BUILDWID	ENGINE1	20.85	24.55	28.10	31.63	34.20	35.74
SO	BUILDWID	ENGINE1	27.87	25.38	27.63	29.18	29.84	33.60
SO	BUILDWID	ENGINE1	30.35	26.17	21.20	15.58	11.68	16.52
SO	BUILDWID	ENGINE1	20.85	24.55	28.10	31.63	34.20	35.74
SO	BUILDWID	ENGINE1	36.18	35.90	37.00	36.98	35.83	33.60
SO	BUILDLEN	ENGINE1	31.63	34.20	35.74	36.18	35.90	37.00
SO	BUILDLEN	ENGINE1	36.98	35.83	33.60	30.35	26.17	21.20
SO	BUILDLEN	ENGINE1	20.10	16.56	20.71	24.24	27.03	28.10
SO	BUILDLEN	ENGINE1	31.63	34.20	35.74	36.18	35.90	37.00
SO	BUILDLEN	ENGINE1	36.98	35.83	33.60	30.35	26.17	21.20
SO	BUILDLEN	ENGINE1	15.58	11.68	16.52	20.85	24.55	28.10
SO	XBADJ	ENGINE1	-5.76	-7.05	-8.12	-8.95	-9.54	-10.72
SO	XBADJ	ENGINE1	-11.57	-12.07	-12.20	-11.96	-11.36	-10.42
SO	XBADJ	ENGINE1	-54.41	-54.93	-57.88	-59.08	-58.48	-23.80
SO	XBADJ	ENGINE1	-25.87	-27.15	-27.61	-27.23	-26.36	-26.28
SO	XBADJ	ENGINE1	-25.41	-23.77	-21.40	-18.38	-14.81	-10.78
SO	XBADJ	ENGINE1	-6.43	-2.45	-2.90	-3.27	-3.54	-4.30
SO	YBADJ	ENGINE1	-3.21	-1.72	-0.18	1.36	3.39	5.35
SO	YBADJ	ENGINE1	7.15	8.73	9.75	10.05	10.05	9.74
SO	YBADJ	ENGINE1	17.08	9.12	0.88	-7.38	-15.43	4.60
SO	YBADJ	ENGINE1	3.21	1.72	0.18	-1.36	-3.39	-5.35
SO	YBADJ	ENGINE1	-7.15	-8.73	-9.75	-10.05	-10.05	-9.74
SO	YBADJ	ENGINE1	-9.14	-8.41	-7.78	-6.92	-5.85	-4.60
SO	BUILDHGT	ENGINE2	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDHGT	ENGINE2	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDHGT	ENGINE2	7.86	7.86	7.86	7.86	6.71	6.71
SO	BUILDHGT	ENGINE2	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDHGT	ENGINE2	6.71	6.71	6.71	6.71	6.71	6.71

SO	BUILDHGT	ENGINE2	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDWID	ENGINE2	30.35	26.17	21.20	15.58	11.68	16.52
SO	BUILDWID	ENGINE2	20.85	24.55	28.10	31.63	34.20	35.74
SO	BUILDWID	ENGINE2	27.87	25.38	27.63	29.18	35.83	33.60
SO	BUILDWID	ENGINE2	30.35	26.17	21.20	15.58	11.68	16.52
SO	BUILDWID	ENGINE2	20.85	24.55	28.10	31.63	34.20	35.74
SO	BUILDWID	ENGINE2	36.18	35.90	37.00	36.98	35.83	33.60
SO	BUILDLEN	ENGINE2	31.63	34.20	35.74	36.18	35.90	37.00
SO	BUILDLEN	ENGINE2	36.98	35.83	33.60	30.35	26.17	21.20
SO	BUILDLEN	ENGINE2	20.10	16.56	20.71	24.24	24.55	28.10
SO	BUILDLEN	ENGINE2	31.63	34.20	35.74	36.18	35.90	37.00
SO	BUILDLEN	ENGINE2	36.98	35.83	33.60	30.35	26.17	21.20
SO	BUILDLEN	ENGINE2	15.58	11.68	16.52	20.85	24.55	28.10
SO	XBADJ	ENGINE2	-9.31	-11.03	-12.42	-13.43	-14.07	-15.16
SO	XBADJ	ENGINE2	-15.79	-15.94	-15.60	-14.79	-13.53	-11.86
SO	XBADJ	ENGINE2	-55.09	-54.82	-56.99	-57.42	-18.64	-20.80
SO	XBADJ	ENGINE2	-22.32	-23.17	-23.31	-22.75	-21.82	-21.84
SO	XBADJ	ENGINE2	-21.19	-19.90	-18.00	-15.56	-12.64	-9.34
SO	XBADJ	ENGINE2	-5.75	-2.56	-3.80	-4.93	-5.90	-7.30
SO	YBADJ	ENGINE2	-0.38	0.45	1.26	2.04	3.28	4.46
SO	YBADJ	ENGINE2	5.50	6.37	6.75	6.51	6.07	5.45
SO	YBADJ	ENGINE2	12.60	4.59	-3.56	-11.61	1.98	1.20
SO	YBADJ	ENGINE2	0.38	-0.45	-1.26	-2.04	-3.28	-4.46
SO	YBADJ	ENGINE2	-5.50	-6.37	-6.75	-6.51	-6.07	-5.45
SO	YBADJ	ENGINE2	-4.66	-3.88	-3.34	-2.70	-1.98	-1.20
SO	BUILDHGT	ENGINE3	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDHGT	ENGINE3	6.71	6.71	6.71	6.71	6.71	7.86
SO	BUILDHGT	ENGINE3	7.86	7.86	7.86	7.86	6.71	6.71
SO	BUILDHGT	ENGINE3	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDHGT	ENGINE3	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDHGT	ENGINE3	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDWID	ENGINE3	30.35	26.17	21.20	15.58	11.68	16.52
SO	BUILDWID	ENGINE3	20.85	24.55	28.10	31.63	34.20	29.51
SO	BUILDWID	ENGINE3	27.87	25.38	27.63	29.18	35.83	33.60
SO	BUILDWID	ENGINE3	30.35	26.17	21.20	15.58	11.68	16.52
SO	BUILDWID	ENGINE3	20.85	24.55	28.10	31.63	34.20	35.74
SO	BUILDWID	ENGINE3	36.18	35.90	37.00	36.98	35.83	33.60
SO	BUILDLEN	ENGINE3	31.63	34.20	35.74	36.18	35.90	37.00
SO	BUILDLEN	ENGINE3	36.98	35.83	33.60	30.35	26.17	23.63
SO	BUILDLEN	ENGINE3	20.10	16.56	20.71	24.24	24.55	28.10
SO	BUILDLEN	ENGINE3	31.63	34.20	35.74	36.18	35.90	37.00
SO	BUILDLEN	ENGINE3	36.98	35.83	33.60	30.35	26.17	21.20
SO	BUILDLEN	ENGINE3	15.58	11.68	16.52	20.85	24.55	28.10
SO	XBADJ	ENGINE3	-13.23	-15.36	-17.02	-18.16	-18.78	-19.72
SO	XBADJ	ENGINE3	-20.05	-19.78	-18.90	-17.45	-15.47	-55.14
SO	XBADJ	ENGINE3	-55.43	-54.33	-55.69	-55.36	-15.87	-17.40
SO	XBADJ	ENGINE3	-18.40	-18.85	-18.72	-18.02	-17.11	-17.28
SO	XBADJ	ENGINE3	-16.93	-16.06	-14.70	-12.90	-10.70	-8.18
SO	XBADJ	ENGINE3	-5.41	-3.04	-5.10	-6.99	-8.68	-10.70
SO	YBADJ	ENGINE3	2.28	2.38	2.42	2.38	2.80	3.16
SO	YBADJ	ENGINE3	3.43	3.59	3.35	2.59	1.75	15.63
SO	YBADJ	ENGINE3	7.87	-0.13	-8.12	-15.87	-1.86	-2.10
SO	YBADJ	ENGINE3	-2.28	-2.38	-2.42	-2.38	-2.80	-3.16
SO	YBADJ	ENGINE3	-3.43	-3.59	-3.35	-2.59	-1.75	-0.85
SO	YBADJ	ENGINE3	0.07	0.84	1.22	1.56	1.86	2.10
SO	BUILDHGT	ENGINE4	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDHGT	ENGINE4	6.71	6.71	6.71	6.71	7.86	7.86
SO	BUILDHGT	ENGINE4	7.86	7.86	7.86	6.71	6.71	6.71
SO	BUILDHGT	ENGINE4	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDHGT	ENGINE4	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDHGT	ENGINE4	6.71	6.71	6.71	6.71	6.71	6.71
SO	BUILDWID	ENGINE4	30.35	26.17	21.20	15.58	11.68	16.52
SO	BUILDWID	ENGINE4	20.85	24.55	28.10	31.63	30.26	29.51
SO	BUILDWID	ENGINE4	27.87	25.38	27.63	36.98	35.83	33.60
SO	BUILDWID	ENGINE4	30.35	26.17	21.20	15.58	11.68	16.52
SO	BUILDWID	ENGINE4	20.85	24.55	28.10	31.63	34.20	35.74
SO	BUILDWID	ENGINE4	36.18	35.90	37.00	36.98	35.83	33.60
SO	BUILDLEN	ENGINE4	31.63	34.20	35.74	36.18	35.90	37.00

SO	BUILDLEN	ENGINE4	36.98	35.83	33.60	30.35	26.45	23.63
SO	BUILDLEN	ENGINE4	20.10	16.56	20.71	20.85	24.55	28.10
SO	BUILDLEN	ENGINE4	31.63	34.20	35.74	36.18	35.90	37.00
SO	BUILDLEN	ENGINE4	36.98	35.83	33.60	30.35	26.17	21.20
SO	BUILDLEN	ENGINE4	15.58	11.68	16.52	20.85	24.55	28.10
SO	XBADJ	ENGINE4	-16.77	-19.34	-21.31	-22.64	-23.32	-24.16
SO	XBADJ	ENGINE4	-24.27	-23.65	-22.30	-20.28	-55.34	-56.58
SO	XBADJ	ENGINE4	-56.11	-54.22	-54.79	-12.20	-13.50	-14.40
SO	XBADJ	ENGINE4	-14.86	-14.87	-14.42	-13.54	-12.58	-12.84
SO	XBADJ	ENGINE4	-12.70	-12.19	-11.30	-10.07	-8.53	-6.74
SO	XBADJ	ENGINE4	-4.74	-3.16	-5.99	-8.65	-11.04	-13.70
SO	YBADJ	ENGINE4	5.10	4.55	3.86	3.06	2.68	2.26
SO	YBADJ	ENGINE4	1.77	1.23	0.35	-0.96	18.94	11.34
SO	YBADJ	ENGINE4	3.39	-4.66	-12.57	-5.78	-5.73	-5.50
SO	YBADJ	ENGINE4	-5.10	-4.55	-3.86	-3.06	-2.68	-2.26
SO	YBADJ	ENGINE4	-1.77	-1.23	-0.35	0.96	2.24	3.45
SO	YBADJ	ENGINE4	4.55	5.37	5.66	5.78	5.73	5.50
SO	BUILDHGT	TURBINE1	7.32	7.32	7.32	7.32	7.32	7.32
SO	BUILDHGT	TURBINE1	7.32	7.32	7.32	7.32	7.32	7.32
SO	BUILDHGT	TURBINE1	7.32	7.32	7.32	7.32	7.32	7.32
SO	BUILDHGT	TURBINE1	7.32	7.32	7.32	7.32	7.32	7.32
SO	BUILDHGT	TURBINE1	7.32	7.32	7.32	7.32	7.32	7.32
SO	BUILDHGT	TURBINE1	7.32	7.32	7.32	7.32	7.32	7.32
SO	BUILDWID	TURBINE1	40.75	41.56	41.12	39.42	40.38	41.30
SO	BUILDWID	TURBINE1	40.96	39.38	36.60	32.71	27.83	22.10
SO	BUILDWID	TURBINE1	15.70	19.88	25.92	31.17	35.47	38.70
SO	BUILDWID	TURBINE1	40.75	41.56	41.12	39.42	40.38	41.30
SO	BUILDWID	TURBINE1	40.96	39.38	36.60	32.71	27.83	22.10
SO	BUILDWID	TURBINE1	15.70	19.88	25.92	31.17	35.47	38.70
SO	BUILDLEN	TURBINE1	32.71	27.83	22.10	15.70	19.88	25.92
SO	BUILDLEN	TURBINE1	31.17	35.47	38.70	40.75	41.56	41.12
SO	BUILDLEN	TURBINE1	39.42	40.38	41.30	40.96	39.38	36.60
SO	BUILDLEN	TURBINE1	32.71	27.83	22.10	15.70	19.88	25.92
SO	BUILDLEN	TURBINE1	31.17	35.47	38.70	40.75	41.56	41.12
SO	BUILDLEN	TURBINE1	39.42	40.38	41.30	40.96	39.38	36.60
SO	XBADJ	TURBINE1	-23.58	-21.74	-19.24	-16.16	-18.15	-20.79
SO	XBADJ	TURBINE1	-22.80	-24.12	-24.70	-24.53	-23.62	-21.99
SO	XBADJ	TURBINE1	-19.69	-18.69	-17.76	-16.28	-14.31	-11.90
SO	XBADJ	TURBINE1	-9.13	-6.09	-2.86	0.46	-1.73	-5.12
SO	XBADJ	TURBINE1	-8.37	-11.36	-14.00	-16.22	-17.94	-19.12
SO	XBADJ	TURBINE1	-19.72	-21.69	-23.54	-24.68	-25.07	-24.70
SO	YBADJ	TURBINE1	4.16	2.84	1.43	-0.02	-1.50	-2.89
SO	YBADJ	TURBINE1	-4.20	-5.38	-6.40	-7.22	-7.83	-8.19
SO	YBADJ	TURBINE1	-8.31	-8.21	-7.83	-7.22	-6.38	-5.35
SO	YBADJ	TURBINE1	-4.16	-2.84	-1.43	0.02	1.50	2.89
SO	YBADJ	TURBINE1	4.20	5.38	6.40	7.22	7.83	8.19
SO	YBADJ	TURBINE1	8.31	8.21	7.83	7.22	6.38	5.35
SO	BUILDHGT	TURBINE2	7.32	7.32	7.32	7.32	7.32	7.32
SO	BUILDHGT	TURBINE2	7.32	7.32	7.32	7.32	7.32	7.32
SO	BUILDHGT	TURBINE2	7.32	7.32	7.32	7.32	7.32	7.32
SO	BUILDHGT	TURBINE2	7.32	7.32	7.32	7.32	7.32	7.32
SO	BUILDHGT	TURBINE2	7.32	7.32	7.32	7.32	7.32	7.32
SO	BUILDHGT	TURBINE2	7.32	7.32	7.32	7.32	7.32	7.32
SO	BUILDWID	TURBINE2	40.75	41.56	41.12	39.42	40.38	41.30
SO	BUILDWID	TURBINE2	40.96	39.38	36.60	32.71	27.83	22.10
SO	BUILDWID	TURBINE2	15.70	19.88	25.92	31.17	35.47	38.70
SO	BUILDWID	TURBINE2	40.75	41.56	41.12	39.42	40.38	41.30
SO	BUILDWID	TURBINE2	40.96	39.38	36.60	32.71	27.83	22.10
SO	BUILDWID	TURBINE2	15.70	19.88	25.92	31.17	35.47	38.70
SO	BUILDLEN	TURBINE2	32.71	27.83	22.10	15.70	19.88	25.92
SO	BUILDLEN	TURBINE2	31.17	35.47	38.70	40.75	41.56	41.12
SO	BUILDLEN	TURBINE2	39.42	40.38	41.30	40.96	39.38	36.60
SO	BUILDLEN	TURBINE2	32.71	27.83	22.10	15.70	19.88	25.92
SO	BUILDLEN	TURBINE2	31.17	35.47	38.70	40.75	41.56	41.12
SO	BUILDLEN	TURBINE2	39.42	40.38	41.30	40.96	39.38	36.60
SO	XBADJ	TURBINE2	-21.56	-20.47	-18.75	-16.47	-19.25	-22.65
SO	XBADJ	TURBINE2	-25.35	-27.29	-28.40	-28.65	-28.02	-26.55
SO	XBADJ	TURBINE2	-24.26	-23.14	-21.94	-20.08	-17.61	-14.60

SO	XBADJ	TURBINE2	-11.15	-7.36	-3.34	0.77	-0.63	-3.27
SO	XBADJ	TURBINE2	-5.81	-8.18	-10.30	-12.11	-13.54	-14.57
SO	XBADJ	TURBINE2	-15.15	-17.24	-19.35	-20.88	-21.77	-22.00
SO	YBADJ	TURBINE2	8.27	7.24	5.99	4.55	2.95	1.30
SO	YBADJ	TURBINE2	-0.40	-2.08	-3.70	-5.21	-6.56	-7.70
SO	YBADJ	TURBINE2	-8.62	-9.31	-9.69	-9.77	-9.56	-9.05
SO	YBADJ	TURBINE2	-8.27	-7.24	-5.99	-4.55	-2.95	-1.30
SO	YBADJ	TURBINE2	0.40	2.08	3.70	5.21	6.56	7.70
SO	YBADJ	TURBINE2	8.62	9.31	9.69	9.77	9.56	9.05
SO	BUILDHGT	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FL1/100	0.00	0.00	0.00	0.00	6.71	6.71
SO	BUILDHGT	FL1/100	6.71	6.71	6.71	0.00	0.00	0.00
SO	BUILDHGT	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FL1/100	0.00	0.00	0.00	0.00	35.83	33.60
SO	BUILDWID	FL1/100	30.35	26.17	21.20	0.00	0.00	0.00
SO	BUILDWID	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FL1/100	0.00	0.00	0.00	0.00	24.55	28.10
SO	BUILDLEN	FL1/100	31.63	34.20	35.74	0.00	0.00	0.00
SO	BUILDLEN	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FL1/100	0.00	0.00	0.00	0.00	-47.60	-52.20
SO	XBADJ	FL1/100	-55.21	-56.54	-56.16	0.00	0.00	0.00
SO	XBADJ	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FL1/100	0.00	0.00	0.00	0.00	18.56	12.50
SO	YBADJ	FL1/100	6.06	-0.57	-7.17	0.00	0.00	0.00
SO	YBADJ	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FL1/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00

SO	YBADJ	FLR2/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FLR3/100	0.00	0.00	6.71	6.71	6.71	6.71
SO	BUILDHGT	FLR3/100	6.71	6.71	6.71	0.00	0.00	0.00
SO	BUILDHGT	FLR3/100	0.00	0.00	0.00	7.86	7.86	7.86
SO	BUILDHGT	FLR3/100	7.86	0.00	6.71	6.71	6.71	6.71
SO	BUILDHGT	FLR3/100	6.71	6.71	6.71	0.00	0.00	0.00
SO	BUILDHGT	FLR3/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FLR3/100	0.00	0.00	21.20	15.58	11.68	16.52
SO	BUILDWID	FLR3/100	20.85	24.55	28.10	0.00	0.00	0.00
SO	BUILDWID	FLR3/100	0.00	0.00	0.00	29.18	29.84	29.60
SO	BUILDWID	FLR3/100	28.46	0.00	21.20	15.58	11.68	16.52
SO	BUILDWID	FLR3/100	20.85	24.55	28.10	0.00	0.00	0.00
SO	BUILDWID	FLR3/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FLR3/100	0.00	0.00	35.74	36.18	35.90	37.00
SO	BUILDLEN	FLR3/100	36.98	35.83	33.60	0.00	0.00	0.00
SO	BUILDLEN	FLR3/100	0.00	0.00	0.00	24.24	27.03	29.00
SO	BUILDLEN	FLR3/100	30.09	0.00	35.74	36.18	35.90	37.00
SO	BUILDLEN	FLR3/100	36.98	35.83	33.60	0.00	0.00	0.00
SO	BUILDLEN	FLR3/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FLR3/100	0.00	0.00	8.33	9.64	10.62	10.39
SO	XBADJ	FLR3/100	9.85	9.01	7.90	0.00	0.00	0.00
SO	XBADJ	FLR3/100	0.00	0.00	0.00	-59.16	-62.27	-63.50
SO	XBADJ	FLR3/100	-62.80	0.00	-44.07	-45.82	-46.51	-47.39
SO	XBADJ	FLR3/100	-46.83	-44.85	-41.50	0.00	0.00	0.00
SO	XBADJ	FLR3/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FLR3/100	0.00	0.00	-13.89	-9.28	-3.86	1.71
SO	YBADJ	FLR3/100	7.23	12.53	17.15	0.00	0.00	0.00
SO	YBADJ	FLR3/100	0.00	0.00	0.00	14.03	5.65	-2.90
SO	YBADJ	FLR3/100	-11.36	0.00	13.89	9.28	3.86	-1.71
SO	YBADJ	FLR3/100	-7.23	-12.53	-17.15	0.00	0.00	0.00
SO	YBADJ	FLR3/100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDWID	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDLEN	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	XBADJ	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	YBADJ	FLR4100	0.00	0.00	0.00	0.00	0.00	0.00
SO	BUILDHGT	LBOILER	7.86	7.86	7.86	7.86	7.86	7.86
SO	BUILDHGT	LBOILER	7.86	7.86	7.86	7.86	7.86	7.86
SO	BUILDHGT	LBOILER	7.86	7.86	7.86	7.86	7.86	7.86
SO	BUILDHGT	LBOILER	7.86	7.86	7.86	7.86	7.86	7.86
SO	BUILDHGT	LBOILER	7.86	7.86	7.86	7.86	7.86	7.86

SO	BUILDHGT	LBOILER	7.86	7.86	7.86	7.86	7.86	7.86
SO	BUILDWID	LBOILER	28.46	26.45	23.63	20.10	16.56	20.71
SO	BUILDWID	LBOILER	24.24	27.03	29.00	30.09	30.26	29.51
SO	BUILDWID	LBOILER	27.87	25.38	27.63	29.18	29.84	29.60
SO	BUILDWID	LBOILER	28.46	26.45	23.63	20.10	16.56	20.71
SO	BUILDWID	LBOILER	24.24	27.03	29.00	30.09	30.26	29.51
SO	BUILDWID	LBOILER	27.87	25.38	27.63	29.18	29.84	29.60
SO	BUILDLEN	LBOILER	30.09	30.26	29.51	27.87	25.38	27.63
SO	BUILDLEN	LBOILER	29.18	29.84	29.60	28.46	26.45	23.63
SO	BUILDLEN	LBOILER	20.10	16.56	20.71	24.24	27.03	29.00
SO	BUILDLEN	LBOILER	30.09	30.26	29.51	27.87	25.38	27.63
SO	BUILDLEN	LBOILER	29.18	29.84	29.60	28.46	26.45	23.63
SO	BUILDLEN	LBOILER	20.10	16.56	20.71	24.24	27.03	29.00
SO	XBADJ	LBOILER	-18.54	-20.32	-21.48	-21.99	-21.83	-23.76
SO	XBADJ	LBOILER	-25.04	-25.56	-25.30	-24.27	-22.51	-20.06
SO	XBADJ	LBOILER	-17.00	-13.73	-14.14	-14.11	-13.66	-12.80
SO	XBADJ	LBOILER	-11.55	-9.94	-8.04	-5.88	-3.55	-3.87
SO	XBADJ	LBOILER	-4.14	-4.29	-4.30	-4.18	-3.94	-3.57
SO	XBADJ	LBOILER	-3.10	-2.83	-6.58	-10.13	-13.37	-16.20
SO	YBADJ	LBOILER	10.05	9.29	8.24	6.95	5.45	3.78
SO	YBADJ	LBOILER	1.99	0.15	-1.70	-3.50	-5.19	-6.72
SO	YBADJ	LBOILER	-8.05	-9.14	-9.94	-10.45	-10.64	-10.50
SO	YBADJ	LBOILER	-10.05	-9.29	-8.24	-6.95	-5.45	-3.78
SO	YBADJ	LBOILER	-1.99	-0.15	1.70	3.50	5.19	6.72
SO	YBADJ	LBOILER	8.05	9.14	9.94	10.45	10.64	10.50
SO	BUILDHGT	BROXGEN	3.96	3.96	3.96	3.96	3.96	3.96
SO	BUILDHGT	BROXGEN	3.96	3.96	3.96	3.96	3.96	3.96
SO	BUILDHGT	BROXGEN	3.96	3.96	3.96	3.96	3.96	3.96
SO	BUILDHGT	BROXGEN	3.96	3.96	3.96	3.96	3.96	3.96
SO	BUILDHGT	BROXGEN	3.96	3.96	3.96	3.96	3.96	3.96
SO	BUILDHGT	BROXGEN	3.96	3.96	3.96	3.96	3.96	3.96
SO	BUILDWID	BROXGEN	12.00	11.29	10.24	8.87	7.24	5.39
SO	BUILDWID	BROXGEN	3.37	3.04	5.10	7.00	8.69	10.12
SO	BUILDWID	BROXGEN	11.23	12.01	12.42	12.46	12.31	12.34
SO	BUILDWID	BROXGEN	12.00	11.29	10.24	8.87	7.24	5.39
SO	BUILDWID	BROXGEN	3.37	3.04	5.10	7.00	8.69	10.12
SO	BUILDWID	BROXGEN	11.23	12.01	12.42	12.46	12.31	12.34
SO	BUILDLEN	BROXGEN	7.00	8.69	10.12	11.23	12.01	12.42
SO	BUILDLEN	BROXGEN	12.46	12.31	12.34	12.00	11.29	10.24
SO	BUILDLEN	BROXGEN	8.87	7.24	5.39	3.37	3.04	5.10
SO	BUILDLEN	BROXGEN	7.00	8.69	10.12	11.23	12.01	12.42
SO	BUILDLEN	BROXGEN	12.46	12.31	12.34	12.00	11.29	10.24
SO	BUILDLEN	BROXGEN	8.87	7.24	5.39	3.37	3.04	5.10
SO	XBADJ	BROXGEN	-1.80	-2.65	-3.42	-4.08	-4.62	-5.02
SO	XBADJ	BROXGEN	-5.27	-5.46	-5.72	-5.81	-5.72	-5.45
SO	XBADJ	BROXGEN	-5.02	-4.44	-3.73	-2.90	-3.07	-4.20
SO	XBADJ	BROXGEN	-5.20	-6.04	-6.70	-7.15	-7.39	-7.40
SO	XBADJ	BROXGEN	-7.19	-6.85	-6.62	-6.19	-5.57	-4.78
SO	XBADJ	BROXGEN	-3.85	-2.80	-1.66	-0.48	0.03	-0.90
SO	YBADJ	BROXGEN	-0.19	0.07	0.34	0.59	0.82	1.03
SO	YBADJ	BROXGEN	1.21	1.55	1.65	1.70	1.69	1.64
SO	YBADJ	BROXGEN	1.53	1.38	1.19	0.96	0.69	0.45
SO	YBADJ	BROXGEN	0.19	-0.07	-0.34	-0.59	-0.82	-1.03
SO	YBADJ	BROXGEN	-1.21	-1.55	-1.65	-1.70	-1.69	-1.64
SO	YBADJ	BROXGEN	-1.53	-1.38	-1.19	-0.96	-0.69	-0.45
SO	BUILDHGT	ASPHALT	9.60	9.60	9.60	9.60	9.60	9.60
SO	BUILDHGT	ASPHALT	9.60	9.60	9.60	9.60	9.60	9.60
SO	BUILDHGT	ASPHALT	9.60	9.60	9.60	9.60	9.60	9.60
SO	BUILDHGT	ASPHALT	9.60	9.60	9.60	9.60	9.60	9.60
SO	BUILDHGT	ASPHALT	9.60	9.60	9.60	9.60	9.60	22.71
SO	BUILDHGT	ASPHALT	22.71	22.71	9.60	9.60	9.60	9.60
SO	BUILDWID	ASPHALT	9.47	8.34	6.97	5.38	3.69	5.43
SO	BUILDWID	ASPHALT	7.01	8.38	9.50	10.33	10.84	11.03
SO	BUILDWID	ASPHALT	10.88	10.44	10.87	11.01	10.82	10.30
SO	BUILDWID	ASPHALT	9.47	8.34	6.97	5.38	3.69	5.43
SO	BUILDWID	ASPHALT	7.01	8.38	9.50	10.33	10.84	11.62
SO	BUILDWID	ASPHALT	11.18	10.38	10.87	11.01	10.82	10.30
SO	BUILDLEN	ASPHALT	10.33	10.84	11.03	10.88	10.44	10.87

SO	BUILDLEN	ASPHALT	11.01	10.82	10.30	9.47	8.34	6.97
SO	BUILDLEN	ASPHALT	5.38	3.69	5.43	7.01	8.38	9.50
SO	BUILDLEN	ASPHALT	10.33	10.84	11.03	10.88	10.44	10.87
SO	BUILDLEN	ASPHALT	11.01	10.82	10.30	9.47	8.34	8.62
SO	BUILDLEN	ASPHALT	7.13	5.52	5.43	7.01	8.38	9.50
SO	XBADJ	ASPHALT	-1.39	-0.73	-0.06	0.62	1.24	1.22
SO	XBADJ	ASPHALT	1.17	1.07	0.95	0.80	0.62	0.42
SO	XBADJ	ASPHALT	0.21	0.00	-2.02	-3.99	-5.83	-7.50
SO	XBADJ	ASPHALT	-8.94	-10.11	-10.97	-11.50	-11.68	-12.09
SO	XBADJ	ASPHALT	-12.18	-11.90	-11.25	-10.26	-8.96	-39.63
SO	XBADJ	ASPHALT	-39.43	-38.08	-3.41	-3.03	-2.55	-2.00
SO	YBADJ	ASPHALT	-5.53	-4.79	-3.91	-2.91	-1.84	-0.69
SO	YBADJ	ASPHALT	0.48	1.64	2.75	3.78	4.69	5.46
SO	YBADJ	ASPHALT	6.06	6.46	6.66	6.67	6.48	6.10
SO	YBADJ	ASPHALT	5.53	4.79	3.91	2.91	1.84	0.69
SO	YBADJ	ASPHALT	-0.48	-1.64	-2.75	-3.78	-4.69	6.22
SO	YBADJ	ASPHALT	-0.01	-6.23	-6.66	-6.67	-6.48	-6.10

SO	BUILDHGT	MARCGEN	3.66	3.66	3.66	3.66	3.66	3.66
SO	BUILDHGT	MARCGEN	3.66	3.66	3.66	3.66	3.66	3.66
SO	BUILDHGT	MARCGEN	3.66	3.66	3.66	3.66	3.66	3.66
SO	BUILDHGT	MARCGEN	3.66	3.66	3.66	3.66	3.66	3.66
SO	BUILDHGT	MARCGEN	3.66	3.66	3.66	3.66	3.66	3.66
SO	BUILDHGT	MARCGEN	3.66	3.66	3.66	3.66	3.66	3.66
SO	BUILDWID	MARCGEN	4.48	6.43	8.18	9.68	10.89	11.77
SO	BUILDWID	MARCGEN	12.29	12.43	12.20	12.43	12.29	11.77
SO	BUILDWID	MARCGEN	10.89	9.68	8.18	6.43	4.48	2.40
SO	BUILDWID	MARCGEN	4.48	6.43	8.18	9.68	10.89	11.77
SO	BUILDWID	MARCGEN	12.29	12.43	12.20	12.43	12.29	11.77
SO	BUILDWID	MARCGEN	10.89	9.68	8.18	6.43	4.48	2.40
SO	BUILDLEN	MARCGEN	12.43	12.29	11.77	10.89	9.68	8.18
SO	BUILDLEN	MARCGEN	6.43	4.48	2.40	4.48	6.43	8.18
SO	BUILDLEN	MARCGEN	9.68	10.89	11.77	12.29	12.43	12.20
SO	BUILDLEN	MARCGEN	12.43	12.29	11.77	10.89	9.68	8.18
SO	BUILDLEN	MARCGEN	6.43	4.48	2.40	4.48	6.43	8.18
SO	BUILDLEN	MARCGEN	9.68	10.89	11.77	12.29	12.43	12.20
SO	XBADJ	MARCGEN	-4.62	-4.59	-4.43	-4.13	-3.70	-3.17
SO	XBADJ	MARCGEN	-2.54	-1.83	-1.06	-2.38	-3.63	-4.77
SO	XBADJ	MARCGEN	-5.76	-6.58	-7.20	-7.60	-7.77	-7.70
SO	XBADJ	MARCGEN	-7.82	-7.69	-7.34	-6.76	-5.98	-5.01
SO	XBADJ	MARCGEN	-3.89	-2.66	-1.34	-2.10	-2.80	-3.41
SO	XBADJ	MARCGEN	-3.92	-4.31	-4.57	-4.69	-4.66	-4.50
SO	YBADJ	MARCGEN	0.14	0.42	0.68	0.92	1.14	1.32
SO	YBADJ	MARCGEN	1.46	1.55	1.60	1.60	1.55	1.46
SO	YBADJ	MARCGEN	1.32	1.14	0.92	0.68	0.42	0.14
SO	YBADJ	MARCGEN	-0.14	-0.42	-0.68	-0.92	-1.14	-1.32
SO	YBADJ	MARCGEN	-1.46	-1.55	-1.60	-1.60	-1.55	-1.46
SO	YBADJ	MARCGEN	-1.32	-1.14	-0.92	-0.68	-0.42	-0.14

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File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Groups	Rec.
UNHLFGCrit_04_NOX.USF	*NOX*	*ANNUAL*	*ALL*	*1ST*	*16.9392*	*340303.8*	*4789438*	*57.65*	*5*	*3423*
UNHLFGCrit_04_NOX.USF	NOX	ANNUAL	TURNKEY	1ST	16.51211	340303.8	4789438	57.65	5	3423
UNHLFGCrit_02_NOX.USF	NOX	ANNUAL	ALL	1ST	16.00935	340315.6	4789422	57.68	5	3423
UNHLFGCrit_02_NOX.USF	NOX	ANNUAL	TURNKEY	1ST	15.6204	340315.6	4789422	57.68	5	3423
UNHLFGCrit_03_NOX.USF	NOX	ANNUAL	ALL	1ST	15.31463	340278	4789468	58.33	5	3423
UNHLFGCrit_03_NOX.USF	NOX	ANNUAL	TURNKEY	1ST	14.90974	340278	4789468	58.33	5	3423
UNHLFGCrit_00_NOX.USF	NOX	ANNUAL	ALL	1ST	13.37913	340303.8	4789438	57.65	5	3423
UNHLFGCrit_00_NOX.USF	NOX	ANNUAL	TURNKEY	1ST	13.00784	340303.8	4789438	57.65	5	3423
UNHLFGCrit_01_NOX.USF	NOX	ANNUAL	ALL	1ST	12.79976	340278	4789468	58.33	5	3423
UNHLFGCrit_01_NOX.USF	NOX	ANNUAL	TURNKEY	1ST	12.30017	340278	4789468	58.33	5	3423
UNHLFGCrit_00_NOX.USF	NOX	ANNUAL	BROX	1ST	6.19132	341488	4787602	56	5	3423
UNHLFGCrit_04_NOX.USF	NOX	ANNUAL	BROX	1ST	5.90114	341488	4787602	56	5	3423
UNHLFGCrit_00_NOX.USF	NOX	ANNUAL	MARCOU	1ST	5.67968	341288	4787402	52	5	3423
UNHLFGCrit_04_NOX.USF	NOX	ANNUAL	MARCOU	1ST	5.38355	341288	4787402	52	5	3423
UNHLFGCrit_02_NOX.USF	NOX	ANNUAL	BROX	1ST	5.38199	341488	4787802	49	5	3423
UNHLFGCrit_03_NOX.USF	NOX	ANNUAL	BROX	1ST	5.32715	341488	4787802	49	5	3423
UNHLFGCrit_01_NOX.USF	NOX	ANNUAL	BROX	1ST	4.43825	341488	4787602	56	5	3423
UNHLFGCrit_02_NOX.USF	NOX	ANNUAL	MARCOU	1ST	4.31485	341288	4787402	52	5	3423
UNHLFGCrit_03_NOX.USF	NOX	ANNUAL	MARCOU	1ST	4.2205	341288	4787402	52	5	3423
UNHLFGCrit_01_NOX.USF	NOX	ANNUAL	MARCOU	1ST	3.77381	341288	4787402	52	5	3423
UNHLFGCrit_00_NOX.USF	NOX	ANNUAL	UNHLFG	1ST	2.13012	341343	4789644	37.93	5	3423
UNHLFGCrit_03_NOX.USF	NOX	ANNUAL	UNHLFG	1ST	1.99065	341343	4789644	37.93	5	3423
UNHLFGCrit_04_NOX.USF	NOX	ANNUAL	UNHLFG	1ST	1.82969	341343	4789644	37.93	5	3423
UNHLFGCrit_02_NOX.USF	NOX	ANNUAL	UNHLFG	1ST	1.80962	341343	4789644	37.93	5	3423
UNHLFGCrit_01_NOX.USF	NOX	ANNUAL	UNHLFG	1ST	1.37171	341343	4789644	37.93	5	3423
UNHLFGCrit_00_PM.USF	*PM*	*24-HR*	*ALL*	*1ST*	*18.79456*	*341488*	*4787602*	*56*	*5*	*3423*
UNHLFGCrit_00_PM.USF	PM	24-HR	BROX	1ST	18.52467	341488	4787602	56	5	3423
UNHLFGCrit_03_PM.USF	PM	24-HR	ALL	1ST	15.57273	341488	4787602	56	5	3423
UNHLFGCrit_03_PM.USF	PM	24-HR	BROX	1ST	15.44291	341488	4787602	56	5	3423
UNHLFGCrit_00_PM.USF	PM	24-HR	ALL	2ND	15.05937	341488	4787602	56	5	3423
UNHLFGCrit_04_PM.USF	PM	24-HR	ALL	1ST	14.79376	341488	4787602	56	5	3423
UNHLFGCrit_00_PM.USF	PM	24-HR	BROX	2ND	14.75454	341488	4787602	56	5	3423
UNHLFGCrit_04_PM.USF	PM	24-HR	BROX	1ST	14.44819	341488	4787602	56	5	3423
UNHLFGCrit_03_PM.USF	PM	24-HR	ALL	2ND	13.14743	341488	4787602	56	5	3423

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File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Groups	Rec.
UNHLFGCrit_01_PM.USF	PM	24-HR	ALL	1ST	12.86068	341488	4787602	56	5	3423
UNHLFGCrit_03_PM.USF	PM	24-HR	BROX	2ND	12.73592	341488	4787602	56	5	3423
UNHLFGCrit_01_PM.USF	PM	24-HR	BROX	1ST	12.63095	341488	4787602	56	5	3423
UNHLFGCrit_01_PM.USF	PM	24-HR	ALL	2ND	12.44371	341488	4787602	56	5	3423
UNHLFGCrit_01_PM.USF	PM	24-HR	BROX	2ND	12.05958	341488	4787602	56	5	3423
UNHLFGCrit_02_PM.USF	PM	24-HR	ALL	1ST	11.86399	341488	4787602	56	5	3423
UNHLFGCrit_02_PM.USF	PM	24-HR	BROX	1ST	11.47607	341488	4787602	56	5	3423
UNHLFGCrit_04_PM.USF	PM	24-HR	ALL	2ND	10.90375	341488	4787602	56	5	3423
UNHLFGCrit_02_PM.USF	PM	24-HR	ALL	2ND	10.79472	341488	4787602	56	5	3423
UNHLFGCrit_04_PM.USF	PM	24-HR	BROX	2ND	10.54727	341488	4787602	56	5	3423
UNHLFGCrit_02_PM.USF	PM	24-HR	BROX	2ND	10.43065	341488	4787602	56	5	3423
UNHLFGCrit_03_PM.USF	PM	24-HR	UNHLFG	1ST	6.11196	341343	4789644	37.93	5	3423
UNHLFGCrit_03_PM.USF	PM	24-HR	UNHLFG	2ND	6.08166	341343	4789644	37.93	5	3423
UNHLFGCrit_03_PM.USF	PM	24-HR	TURNKEY	1ST	5.25143	340446.6	4789307	56.41	5	3423
UNHLFGCrit_02_PM.USF	PM	24-HR	UNHLFG	1ST	5.04011	341297.6	4789819	33.42	5	3423
UNHLFGCrit_02_PM.USF	PM	24-HR	TURNKEY	1ST	5.03008	340494.4	4789274	53.97	5	3423
UNHLFGCrit_03_PM.USF	PM	24-HR	TURNKEY	2ND	4.9491	340462.5	4789296	55.49	5	3423
UNHLFGCrit_04_PM.USF	PM	24-HR	TURNKEY	1ST	4.83983	340494.4	4789274	53.97	5	3423
UNHLFGCrit_04_PM.USF	PM	24-HR	UNHLFG	1ST	4.69996	341311.4	4789808	33.59	5	3423
UNHLFGCrit_00_PM.USF	PM	24-HR	UNHLFG	1ST	4.6367	341269.9	4789841	33.64	5	3423
UNHLFGCrit_00_PM.USF	PM	24-HR	UNHLFG	2ND	4.58069	341343	4789644	37.93	5	3423
UNHLFGCrit_00_PM.USF	PM	24-HR	TURNKEY	1ST	4.57796	340315.6	4789422	57.68	5	3423
UNHLFGCrit_01_PM.USF	PM	24-HR	UNHLFG	1ST	4.18505	341256	4789851	33.86	5	3423
UNHLFGCrit_02_PM.USF	PM	24-HR	UNHLFG	2ND	4.17203	341102	4789940	35.48	5	3423
UNHLFGCrit_04_PM.USF	PM	24-HR	UNHLFG	2ND	4.16581	341095.5	4789956	35.46	5	3423
UNHLFGCrit_00_PM.USF	PM	24-HR	TURNKEY	2ND	4.04695	340446.6	4789307	56.41	5	3423
UNHLFGCrit_04_PM.USF	PM	24-HR	TURNKEY	2ND	3.77431	340292	4789454	56.81	5	3423
UNHLFGCrit_02_PM.USF	PM	24-HR	TURNKEY	2ND	3.53993	340264	4789482	58.52	5	3423
UNHLFGCrit_01_PM.USF	PM	24-HR	UNHLFG	2ND	3.48367	341297.6	4789819	33.42	5	3423
UNHLFGCrit_01_PM.USF	PM	24-HR	TURNKEY	1ST	3.45432	340462.5	4789296	55.49	5	3423
UNHLFGCrit_01_PM.USF	PM	24-HR	TURNKEY	2ND	3.0808	340510.3	4789263	54.22	5	3423
UNHLFGCrit_03_PM.USF	PM	24-HR	MARCOU	1ST	2.34156	341288	4787402	52	5	3423
UNHLFGCrit_00_PM.USF	PM	24-HR	MARCOU	1ST	2.15563	341288	4787402	52	5	3423
UNHLFGCrit_04_PM.USF	PM	24-HR	MARCOU	1ST	2.15117	341288	4787602	56	5	3423
UNHLFGCrit_04_PM.USF	PM	24-HR	MARCOU	2ND	2.06024	341288	4787402	52	5	3423
UNHLFGCrit_00_PM.USF	PM	24-HR	MARCOU	2ND	1.92413	341288	4787402	52	5	3423

University of New Hampshire Landfill Gas to Energy Project
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File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Groups	Rec.
UNHLFGCrit_01_PM.USF	PM	24-HR	MARCOU	1ST	1.86606	341288	4787402	52	5	3423
UNHLFGCrit_02_PM.USF	PM	24-HR	MARCOU	1ST	1.76125	341288	4787402	52	5	3423
UNHLFGCrit_03_PM.USF	PM	24-HR	MARCOU	2ND	1.72635	341288	4787402	52	5	3423
UNHLFGCrit_02_PM.USF	PM	24-HR	MARCOU	2ND	1.69167	341288	4787402	52	5	3423
UNHLFGCrit_01_PM.USF	PM	24-HR	MARCOU	2ND	1.68367	341288	4787402	52	5	3423
UNHLFGCrit_00_PM.USF	*PM*	*ANNUAL*	*ALL*	*1ST*	*2.61875*	*341488*	*4787602*	*56*	*5*	*3423*
UNHLFGCrit_00_PM.USF	PM	ANNUAL	BROX	1ST	2.4127	341488	4787602	56	5	3423
UNHLFGCrit_04_PM.USF	PM	ANNUAL	ALL	1ST	2.36522	341488	4787602	56	5	3423
UNHLFGCrit_03_PM.USF	PM	ANNUAL	ALL	1ST	2.17938	341488	4787602	56	5	3423
UNHLFGCrit_04_PM.USF	PM	ANNUAL	BROX	1ST	2.16988	341488	4787602	56	5	3423
UNHLFGCrit_02_PM.USF	PM	ANNUAL	ALL	1ST	2.0133	341488	4787602	56	5	3423
UNHLFGCrit_03_PM.USF	PM	ANNUAL	BROX	1ST	2.00364	341488	4787602	56	5	3423
UNHLFGCrit_02_PM.USF	PM	ANNUAL	BROX	1ST	1.82753	341488	4787602	56	5	3423
UNHLFGCrit_01_PM.USF	PM	ANNUAL	ALL	1ST	1.70178	341488	4787602	56	5	3423
UNHLFGCrit_01_PM.USF	PM	ANNUAL	BROX	1ST	1.54712	341488	4787602	56	5	3423
UNHLFGCrit_00_PM.USF	PM	ANNUAL	UNHLFG	1ST	0.85066	341343	4789644	37.93	5	3423
UNHLFGCrit_03_PM.USF	PM	ANNUAL	UNHLFG	1ST	0.79913	341343	4789644	37.93	5	3423
UNHLFGCrit_04_PM.USF	PM	ANNUAL	UNHLFG	1ST	0.73252	341343	4789644	37.93	5	3423
UNHLFGCrit_02_PM.USF	PM	ANNUAL	UNHLFG	1ST	0.72272	341343	4789644	37.93	5	3423
UNHLFGCrit_04_PM.USF	PM	ANNUAL	TURNKEY	1ST	0.61618	340303.8	4789438	57.65	5	3423
UNHLFGCrit_03_PM.USF	PM	ANNUAL	TURNKEY	1ST	0.56449	340278	4789468	58.33	5	3423
UNHLFGCrit_02_PM.USF	PM	ANNUAL	TURNKEY	1ST	0.56218	340315.6	4789422	57.68	5	3423
UNHLFGCrit_01_PM.USF	PM	ANNUAL	UNHLFG	1ST	0.54459	341343	4789644	37.93	5	3423
UNHLFGCrit_00_PM.USF	PM	ANNUAL	MARCOU	1ST	0.52342	341288	4787402	52	5	3423
UNHLFGCrit_00_PM.USF	PM	ANNUAL	TURNKEY	1ST	0.50513	340303.8	4789438	57.65	5	3423
UNHLFGCrit_04_PM.USF	PM	ANNUAL	MARCOU	1ST	0.49613	341288	4787402	52	5	3423
UNHLFGCrit_01_PM.USF	PM	ANNUAL	TURNKEY	1ST	0.43403	340278	4789468	58.33	5	3423
UNHLFGCrit_02_PM.USF	PM	ANNUAL	MARCOU	1ST	0.39764	341288	4787402	52	5	3423
UNHLFGCrit_03_PM.USF	PM	ANNUAL	MARCOU	1ST	0.38895	341288	4787402	52	5	3423
UNHLFGCrit_01_PM.USF	PM	ANNUAL	MARCOU	1ST	0.34778	341288	4787402	52	5	3423

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File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Groups	Rec.
UNHLFGCrit_04_SO2.USF	*SO2*	*24-HR*	*ALL*	*1ST*	*88.84399*	*340278*	*4789468*	*58.33*	*5*	*3423*
UNHLFGCrit_03_SO2.USF	SO2	24-HR	ALL	1ST	88.57065	340446.6	4789307	56.41	5	3423
UNHLFGCrit_03_SO2.USF	SO2	24-HR	TURNKEY	1ST	88.30549	340446.6	4789307	56.41	5	3423
UNHLFGCrit_04_SO2.USF	SO2	24-HR	TURNKEY	1ST	88.26933	340278	4789468	58.33	5	3423
UNHLFGCrit_02_SO2.USF	SO2	24-HR	ALL	1ST	84.40657	340250	4789497	60.06	5	3423
UNHLFGCrit_02_SO2.USF	SO2	24-HR	TURNKEY	1ST	84.07307	340303.8	4789438	57.65	5	3423
UNHLFGCrit_00_SO2.USF	SO2	24-HR	ALL	1ST	82.93138	340315.6	4789422	57.68	5	3423
UNHLFGCrit_00_SO2.USF	SO2	24-HR	TURNKEY	1ST	82.80519	340315.6	4789422	57.68	5	3423
UNHLFGCrit_03_SO2.USF	SO2	24-HR	ALL	2ND	82.26539	340462.5	4789296	55.49	5	3423
UNHLFGCrit_03_SO2.USF	SO2	24-HR	TURNKEY	2ND	81.99334	340462.5	4789296	55.49	5	3423
UNHLFGCrit_00_SO2.USF	SO2	24-HR	ALL	2ND	81.08722	340315.6	4789422	57.68	5	3423
UNHLFGCrit_00_SO2.USF	SO2	24-HR	TURNKEY	2ND	80.53131	340315.6	4789422	57.68	5	3423
UNHLFGCrit_02_SO2.USF	SO2	24-HR	ALL	2ND	80.44626	340303.8	4789438	57.65	5	3423
UNHLFGCrit_02_SO2.USF	SO2	24-HR	TURNKEY	2ND	80.40287	340303.8	4789438	57.65	5	3423
UNHLFGCrit_04_SO2.USF	SO2	24-HR	ALL	2ND	77.39285	340278	4789468	58.33	5	3423
UNHLFGCrit_04_SO2.USF	SO2	24-HR	TURNKEY	2ND	77.08106	340278	4789468	58.33	5	3423
UNHLFGCrit_01_SO2.USF	SO2	24-HR	ALL	1ST	71.85085	340278	4789468	58.33	5	3423
UNHLFGCrit_01_SO2.USF	SO2	24-HR	TURNKEY	1ST	71.21451	340278	4789468	58.33	5	3423
UNHLFGCrit_01_SO2.USF	SO2	24-HR	ALL	2ND	64.96803	340264	4789482	58.52	5	3423
UNHLFGCrit_01_SO2.USF	SO2	24-HR	TURNKEY	2ND	64.34463	340264	4789482	58.52	5	3423
UNHLFGCrit_00_SO2.USF	SO2	24-HR	BROX	1ST	58.04788	341488	4787602	56	5	3423
UNHLFGCrit_03_SO2.USF	SO2	24-HR	BROX	1ST	49.35518	341488	4787602	56	5	3423
UNHLFGCrit_00_SO2.USF	SO2	24-HR	BROX	2ND	45.62647	341488	4787602	56	5	3423
UNHLFGCrit_04_SO2.USF	SO2	24-HR	BROX	1ST	44.16504	341488	4787602	56	5	3423
UNHLFGCrit_01_SO2.USF	SO2	24-HR	BROX	1ST	39.13675	341488	4787602	56	5	3423
UNHLFGCrit_03_SO2.USF	SO2	24-HR	BROX	2ND	37.6529	341488	4787602	56	5	3423
UNHLFGCrit_01_SO2.USF	SO2	24-HR	BROX	2ND	36.56311	341488	4787602	56	5	3423
UNHLFGCrit_02_SO2.USF	SO2	24-HR	BROX	1ST	34.81081	341488	4787602	56	5	3423
UNHLFGCrit_02_SO2.USF	SO2	24-HR	BROX	2ND	33.03505	341488	4787602	56	5	3423
UNHLFGCrit_04_SO2.USF	SO2	24-HR	BROX	2ND	31.65061	341488	4787602	56	5	3423
UNHLFGCrit_03_SO2.USF	SO2	24-HR	MARCOU	1ST	16.59023	341288	4787402	52	5	3423
UNHLFGCrit_00_SO2.USF	SO2	24-HR	MARCOU	1ST	15.27286	341288	4787402	52	5	3423
UNHLFGCrit_04_SO2.USF	SO2	24-HR	MARCOU	1ST	15.2413	341288	4787602	56	5	3423
UNHLFGCrit_04_SO2.USF	SO2	24-HR	MARCOU	2ND	14.59703	341288	4787402	52	5	3423
UNHLFGCrit_03_SO2.USF	SO2	24-HR	UNHLFG	1ST	14.14445	341343	4789644	37.93	5	3423

University of New Hampshire Landfill Gas to Energy Project
AERMOD Maximum Impacts - Combined Source NAAQS Modeling

File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Groups	Rec.
UNHLFGCrit_00_SO2.USF	SO2	24-HR	MARCOU	2ND	13.6327	341288	4787402	52	5	3423
UNHLFGCrit_03_SO2.USF	SO2	24-HR	UNHLFG	2ND	13.52433	341343	4789644	37.93	5	3423
UNHLFGCrit_01_SO2.USF	SO2	24-HR	MARCOU	1ST	13.22127	341288	4787402	52	5	3423
UNHLFGCrit_02_SO2.USF	SO2	24-HR	MARCOU	1ST	12.47865	341288	4787402	52	5	3423
UNHLFGCrit_03_SO2.USF	SO2	24-HR	MARCOU	2ND	12.23139	341288	4787402	52	5	3423
UNHLFGCrit_02_SO2.USF	SO2	24-HR	MARCOU	2ND	11.98563	341288	4787402	52	5	3423
UNHLFGCrit_01_SO2.USF	SO2	24-HR	MARCOU	2ND	11.92899	341288	4787402	52	5	3423
UNHLFGCrit_02_SO2.USF	SO2	24-HR	UNHLFG	1ST	11.25613	341283.7	4789830	33.12	5	3423
UNHLFGCrit_04_SO2.USF	SO2	24-HR	UNHLFG	1ST	10.96717	341297.6	4789819	33.42	5	3423
UNHLFGCrit_00_SO2.USF	SO2	24-HR	UNHLFG	1ST	10.37944	341343	4789644	37.93	5	3423
UNHLFGCrit_00_SO2.USF	SO2	24-HR	UNHLFG	2ND	10.01816	341343	4789644	37.93	5	3423
UNHLFGCrit_01_SO2.USF	SO2	24-HR	UNHLFG	1ST	8.49131	341343	4789644	37.93	5	3423
UNHLFGCrit_02_SO2.USF	SO2	24-HR	UNHLFG	2ND	8.14859	341343	4789644	37.93	5	3423
UNHLFGCrit_01_SO2.USF	SO2	24-HR	UNHLFG	2ND	7.33854	341343	4789644	37.93	5	3423
UNHLFGCrit_04_SO2.USF	SO2	24-HR	UNHLFG	2ND	6.89515	341343	4789644	37.93	5	3423
UNHLFGCrit_00_SO2.USF	*SO2*	*3-HR*	*ALL*	*1ST*	*189.3851*	*340315.6*	*4789422*	*57.68*	*5*	*3423*
UNHLFGCrit_00_SO2.USF	SO2	3-HR	TURNKEY	1ST	189.2864	340315.6	4789422	57.68	5	3423
UNHLFGCrit_00_SO2.USF	SO2	3-HR	ALL	2ND	183.9768	340315.6	4789422	57.68	5	3423
UNHLFGCrit_00_SO2.USF	SO2	3-HR	TURNKEY	2ND	183.9286	340315.6	4789422	57.68	5	3423
UNHLFGCrit_02_SO2.USF	SO2	3-HR	ALL	1ST	177.6807	340250	4789497	60.06	5	3423
UNHLFGCrit_02_SO2.USF	SO2	3-HR	TURNKEY	1ST	177.042	340250	4789497	60.06	5	3423
UNHLFGCrit_03_SO2.USF	SO2	3-HR	ALL	1ST	168.8001	340462.5	4789296	55.49	5	3423
UNHLFGCrit_03_SO2.USF	SO2	3-HR	TURNKEY	1ST	168.7092	340462.5	4789296	55.49	5	3423
UNHLFGCrit_01_SO2.USF	SO2	3-HR	ALL	1ST	168.1716	340446.6	4789307	56.41	5	3423
UNHLFGCrit_01_SO2.USF	SO2	3-HR	TURNKEY	1ST	168.1037	340446.6	4789307	56.41	5	3423
UNHLFGCrit_03_SO2.USF	SO2	3-HR	ALL	2ND	160.9621	340446.6	4789307	56.41	5	3423
UNHLFGCrit_03_SO2.USF	SO2	3-HR	TURNKEY	2ND	160.8738	340446.6	4789307	56.41	5	3423
UNHLFGCrit_04_SO2.USF	SO2	3-HR	ALL	1ST	157.1912	340292	4789454	56.81	5	3423
UNHLFGCrit_04_SO2.USF	SO2	3-HR	TURNKEY	1ST	157.0326	340292	4789454	56.81	5	3423
UNHLFGCrit_02_SO2.USF	SO2	3-HR	ALL	2ND	150.5141	340264	4789482	58.52	5	3423
UNHLFGCrit_02_SO2.USF	SO2	3-HR	TURNKEY	2ND	150.0576	340264	4789482	58.52	5	3423
UNHLFGCrit_04_SO2.USF	SO2	3-HR	ALL	2ND	149.6886	340303.8	4789438	57.65	5	3423
UNHLFGCrit_04_SO2.USF	SO2	3-HR	TURNKEY	2ND	149.5453	340303.8	4789438	57.65	5	3423
UNHLFGCrit_01_SO2.USF	SO2	3-HR	ALL	2ND	140.1155	340327.4	4789406	58.11	5	3423
UNHLFGCrit_01_SO2.USF	SO2	3-HR	TURNKEY	2ND	140.0817	340327.4	4789406	58.11	5	3423

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File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Groups	Rec.
UNHLFGCrit_03_SO2.USF	SO2	3-HR	BROX	1ST	95.82688	341488	4787602	56	5	3423
UNHLFGCrit_03_SO2.USF	SO2	3-HR	BROX	2ND	94.84265	341488	4787602	56	5	3423
UNHLFGCrit_00_SO2.USF	SO2	3-HR	BROX	1ST	94.73489	341488	4787602	56	5	3423
UNHLFGCrit_00_SO2.USF	SO2	3-HR	BROX	2ND	91.60114	341488	4787602	56	5	3423
UNHLFGCrit_04_SO2.USF	SO2	3-HR	BROX	1ST	90.14323	341488	4787602	56	5	3423
UNHLFGCrit_01_SO2.USF	SO2	3-HR	BROX	1ST	86.381	341488	4787602	56	5	3423
UNHLFGCrit_02_SO2.USF	SO2	3-HR	BROX	1ST	86.37295	341488	4787602	56	5	3423
UNHLFGCrit_04_SO2.USF	SO2	3-HR	BROX	2ND	84.88511	341488	4787602	56	5	3423
UNHLFGCrit_01_SO2.USF	SO2	3-HR	BROX	2ND	83.41684	341488	4787602	56	5	3423
UNHLFGCrit_02_SO2.USF	SO2	3-HR	BROX	2ND	83.10542	341488	4787602	56	5	3423
UNHLFGCrit_04_SO2.USF	SO2	3-HR	MARCOU	1ST	41.10723	341288	4787602	56	5	3423
UNHLFGCrit_03_SO2.USF	SO2	3-HR	MARCOU	1ST	36.91451	341288	4787602	56	5	3423
UNHLFGCrit_03_SO2.USF	SO2	3-HR	MARCOU	2ND	33.06678	341088	4787602	62	5	3423
UNHLFGCrit_02_SO2.USF	SO2	3-HR	MARCOU	1ST	31.24439	341288	4787602	56	5	3423
UNHLFGCrit_00_SO2.USF	SO2	3-HR	MARCOU	1ST	31.00693	341088	4787602	62	5	3423
UNHLFGCrit_02_SO2.USF	SO2	3-HR	MARCOU	2ND	30.21137	341288	4787602	56	5	3423
UNHLFGCrit_04_SO2.USF	SO2	3-HR	MARCOU	2ND	28.79505	341088	4787602	62	5	3423
UNHLFGCrit_00_SO2.USF	SO2	3-HR	MARCOU	2ND	27.91313	341288	4787602	56	5	3423
UNHLFGCrit_01_SO2.USF	SO2	3-HR	MARCOU	1ST	27.57852	341288	4787602	56	5	3423
UNHLFGCrit_01_SO2.USF	SO2	3-HR	MARCOU	2ND	27.16159	341288	4787602	56	5	3423
UNHLFGCrit_03_SO2.USF	SO2	3-HR	UNHLFG	1ST	24.84615	341256	4789851	33.86	5	3423
UNHLFGCrit_02_SO2.USF	SO2	3-HR	UNHLFG	1ST	24.44454	341269.9	4789841	33.64	5	3423
UNHLFGCrit_03_SO2.USF	SO2	3-HR	UNHLFG	2ND	23.77949	341254.5	4789869	33.68	5	3423
UNHLFGCrit_00_SO2.USF	SO2	3-HR	UNHLFG	1ST	23.43608	341247	4789958	40.11	5	3423
UNHLFGCrit_00_SO2.USF	SO2	3-HR	UNHLFG	2ND	22.18998	341248.5	4789940	37.49	5	3423
UNHLFGCrit_01_SO2.USF	SO2	3-HR	UNHLFG	1ST	21.19496	341253	4789887	34.08	5	3423
UNHLFGCrit_04_SO2.USF	SO2	3-HR	UNHLFG	1ST	20.93471	341297.6	4789819	33.42	5	3423
UNHLFGCrit_04_SO2.USF	SO2	3-HR	UNHLFG	2ND	19.2372	341339.1	4789787	33.52	5	3423
UNHLFGCrit_02_SO2.USF	SO2	3-HR	UNHLFG	2ND	18.89488	341343	4789644	37.93	5	3423
UNHLFGCrit_01_SO2.USF	SO2	3-HR	UNHLFG	2ND	17.60045	341343	4789644	37.93	5	3423

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File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Groups	Rec.
UNHLFGCrit_04_SO2.USF	*SO2*	*ANNUAL*	*ALL*	*1ST*	*14.5936*	*340278*	*4789468*	*58.33*	*5*	*3423*
UNHLFGCrit_04_SO2.USF	SO2	ANNUAL	TURNKEY	1ST	14.25708	340278	4789468	58.33	5	3423
UNHLFGCrit_02_SO2.USF	SO2	ANNUAL	ALL	1ST	13.78197	340303.8	4789438	57.65	5	3423
UNHLFGCrit_03_SO2.USF	SO2	ANNUAL	ALL	1ST	13.58329	340278	4789468	58.33	5	3423
UNHLFGCrit_02_SO2.USF	SO2	ANNUAL	TURNKEY	1ST	13.49576	340303.8	4789438	57.65	5	3423
UNHLFGCrit_03_SO2.USF	SO2	ANNUAL	TURNKEY	1ST	13.24664	340278	4789468	58.33	5	3423
UNHLFGCrit_00_SO2.USF	SO2	ANNUAL	ALL	1ST	11.90548	340303.8	4789438	57.65	5	3423
UNHLFGCrit_00_SO2.USF	SO2	ANNUAL	TURNKEY	1ST	11.60228	340303.8	4789438	57.65	5	3423
UNHLFGCrit_01_SO2.USF	SO2	ANNUAL	ALL	1ST	11.24111	340278	4789468	58.33	5	3423
UNHLFGCrit_01_SO2.USF	SO2	ANNUAL	TURNKEY	1ST	10.90369	340278	4789468	58.33	5	3423
UNHLFGCrit_00_SO2.USF	SO2	ANNUAL	BROX	1ST	6.2732	341488	4787602	56	5	3423
UNHLFGCrit_04_SO2.USF	SO2	ANNUAL	BROX	1ST	5.53131	341488	4787602	56	5	3423
UNHLFGCrit_03_SO2.USF	SO2	ANNUAL	BROX	1ST	5.23749	341488	4787602	56	5	3423
UNHLFGCrit_02_SO2.USF	SO2	ANNUAL	BROX	1ST	4.64772	341488	4787602	56	5	3423
UNHLFGCrit_01_SO2.USF	SO2	ANNUAL	BROX	1ST	3.86723	341488	4787602	56	5	3423
UNHLFGCrit_00_SO2.USF	SO2	ANNUAL	MARCOU	1ST	3.7085	341288	4787402	52	5	3423
UNHLFGCrit_04_SO2.USF	SO2	ANNUAL	MARCOU	1ST	3.51515	341288	4787402	52	5	3423
UNHLFGCrit_02_SO2.USF	SO2	ANNUAL	MARCOU	1ST	2.81734	341288	4787402	52	5	3423
UNHLFGCrit_03_SO2.USF	SO2	ANNUAL	MARCOU	1ST	2.75573	341288	4787402	52	5	3423
UNHLFGCrit_01_SO2.USF	SO2	ANNUAL	MARCOU	1ST	2.46408	341288	4787402	52	5	3423
UNHLFGCrit_00_SO2.USF	SO2	ANNUAL	UNHLFG	1ST	1.5086	341343	4789644	37.93	5	3423
UNHLFGCrit_03_SO2.USF	SO2	ANNUAL	UNHLFG	1ST	1.47322	341343	4789644	37.93	5	3423
UNHLFGCrit_04_SO2.USF	SO2	ANNUAL	UNHLFG	1ST	1.31332	341343	4789644	37.93	5	3423
UNHLFGCrit_02_SO2.USF	SO2	ANNUAL	UNHLFG	1ST	1.30767	341343	4789644	37.93	5	3423
UNHLFGCrit_01_SO2.USF	SO2	ANNUAL	UNHLFG	1ST	0.97922	341343	4789644	37.93	5	3423

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File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Groups	Rec.
UNHLFGCrit_03_CO.USF	*CO*	*1-HR*	*ALL*	*1ST*	*814.5494*	*340414.7*	*4789330*	*59.37*	*5*	*3423*
UNHLFGCrit_03_CO.USF	CO	1-HR	TURNKEY	1ST	814.532	340414.7	4789330	59.37	5	3423
UNHLFGCrit_02_CO.USF	CO	1-HR	ALL	1ST	794.1856	340414.7	4789330	59.37	5	3423
UNHLFGCrit_02_CO.USF	CO	1-HR	TURNKEY	1ST	794.1692	340414.7	4789330	59.37	5	3423
UNHLFGCrit_04_CO.USF	CO	1-HR	ALL	1ST	785.9363	340278	4789468	58.33	5	3423
UNHLFGCrit_04_CO.USF	CO	1-HR	TURNKEY	1ST	785.9189	340278	4789468	58.33	5	3423
UNHLFGCrit_04_CO.USF	CO	1-HR	ALL	2ND	782.8297	340278	4789468	58.33	5	3423
UNHLFGCrit_04_CO.USF	CO	1-HR	TURNKEY	2ND	782.813	340278	4789468	58.33	5	3423
UNHLFGCrit_03_CO.USF	CO	1-HR	ALL	2ND	780.2863	340264	4789482	58.52	5	3423
UNHLFGCrit_03_CO.USF	CO	1-HR	TURNKEY	2ND	780.2697	340264	4789482	58.52	5	3423
UNHLFGCrit_02_CO.USF	CO	1-HR	ALL	2ND	770.6626	340278	4789468	58.33	5	3423
UNHLFGCrit_02_CO.USF	CO	1-HR	TURNKEY	2ND	770.6448	340278	4789468	58.33	5	3423
UNHLFGCrit_00_CO.USF	CO	1-HR	ALL	1ST	765.1265	340264	4789482	58.52	5	3423
UNHLFGCrit_00_CO.USF	CO	1-HR	TURNKEY	1ST	765.11	340264	4789482	58.52	5	3423
UNHLFGCrit_01_CO.USF	CO	1-HR	ALL	1ST	763.6208	340264	4789482	58.52	5	3423
UNHLFGCrit_01_CO.USF	CO	1-HR	TURNKEY	1ST	763.6033	340264	4789482	58.52	5	3423
UNHLFGCrit_01_CO.USF	CO	1-HR	ALL	2ND	756.8155	340264	4789482	58.52	5	3423
UNHLFGCrit_01_CO.USF	CO	1-HR	TURNKEY	2ND	756.7974	340264	4789482	58.52	5	3423
UNHLFGCrit_00_CO.USF	CO	1-HR	ALL	2ND	746.991	340264	4789482	58.52	5	3423
UNHLFGCrit_00_CO.USF	CO	1-HR	TURNKEY	2ND	746.9742	340264	4789482	58.52	5	3423
UNHLFGCrit_01_CO.USF	CO	1-HR	BROX	1ST	467.5725	341488	4787602	56	5	3423
UNHLFGCrit_03_CO.USF	CO	1-HR	BROX	1ST	462.6392	341488	4787602	56	5	3423
UNHLFGCrit_01_CO.USF	CO	1-HR	BROX	2ND	457.3562	341488	4787602	56	5	3423
UNHLFGCrit_03_CO.USF	CO	1-HR	BROX	2ND	456.9808	341488	4787602	56	5	3423
UNHLFGCrit_02_CO.USF	CO	1-HR	BROX	1ST	455.6271	341488	4787602	56	5	3423
UNHLFGCrit_02_CO.USF	CO	1-HR	BROX	2ND	453.7541	341488	4787602	56	5	3423
UNHLFGCrit_04_CO.USF	CO	1-HR	BROX	1ST	451.9385	341488	4787602	56	5	3423
UNHLFGCrit_04_CO.USF	CO	1-HR	BROX	2ND	451.4605	341488	4787602	56	5	3423
UNHLFGCrit_00_CO.USF	CO	1-HR	BROX	1ST	451.0886	341488	4787602	56	5	3423
UNHLFGCrit_00_CO.USF	CO	1-HR	BROX	2ND	442.1107	341488	4787602	56	5	3423
UNHLFGCrit_01_CO.USF	CO	1-HR	UNHLFG	1ST	216.7563	341115	4789907	35.65	5	3423
UNHLFGCrit_02_CO.USF	CO	1-HR	UNHLFG	1ST	209.2257	341115	4789907	35.65	5	3423
UNHLFGCrit_02_CO.USF	CO	1-HR	UNHLFG	2ND	208.7727	341115	4789907	35.65	5	3423
UNHLFGCrit_04_CO.USF	CO	1-HR	UNHLFG	1ST	206.8632	341115	4789907	35.65	5	3423
UNHLFGCrit_04_CO.USF	CO	1-HR	UNHLFG	2ND	203.5589	341115	4789907	35.65	5	3423
UNHLFGCrit_00_CO.USF	CO	1-HR	UNHLFG	1ST	200.8039	341115	4789907	35.65	5	3423

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File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Groups	Rec.
UNHLFGCrit_00_CO.USF	CO	1-HR	UNHLFG	2ND	200.6629	341115	4789907	35.65	5	3423
UNHLFGCrit_01_CO.USF	CO	1-HR	UNHLFG	2ND	198.4085	341115	4789907	35.65	5	3423
UNHLFGCrit_03_CO.USF	CO	1-HR	UNHLFG	1ST	195.7872	341133.3	4789911	35.4	5	3423
UNHLFGCrit_03_CO.USF	CO	1-HR	UNHLFG	2ND	195.2555	341133.3	4789911	35.4	5	3423
UNHLFGCrit_02_CO.USF	CO	1-HR	MARCOU	1ST	104.5813	341288	4787602	56	5	3423
UNHLFGCrit_00_CO.USF	CO	1-HR	MARCOU	1ST	103.07	341288	4787602	56	5	3423
UNHLFGCrit_04_CO.USF	CO	1-HR	MARCOU	1ST	102.7253	341288	4787602	56	5	3423
UNHLFGCrit_04_CO.USF	CO	1-HR	MARCOU	2ND	102.5234	341288	4787602	56	5	3423
UNHLFGCrit_03_CO.USF	CO	1-HR	MARCOU	1ST	102.248	341288	4787602	56	5	3423
UNHLFGCrit_02_CO.USF	CO	1-HR	MARCOU	2ND	100.6273	341288	4787602	56	5	3423
UNHLFGCrit_03_CO.USF	CO	1-HR	MARCOU	2ND	98.43373	341288	4787602	56	5	3423
UNHLFGCrit_00_CO.USF	CO	1-HR	MARCOU	2ND	98.09513	341288	4787602	56	5	3423
UNHLFGCrit_01_CO.USF	CO	1-HR	MARCOU	1ST	88.24057	341288	4787602	56	5	3423
UNHLFGCrit_01_CO.USF	CO	1-HR	MARCOU	2ND	85.36212	341288	4787602	56	5	3423
UNHLFGCrit_04_CO.USF	*CO*	*8-HR*	*ALL*	*1ST*	*407.6702*	*340315.6*	*4789422*	*57.68*	*5*	*3423*
UNHLFGCrit_04_CO.USF	CO	8-HR	TURNKEY	1ST	407.4213	340315.6	4789422	57.68	5	3423
UNHLFGCrit_03_CO.USF	CO	8-HR	ALL	1ST	400.2265	341488	4787602	56	5	3423
UNHLFGCrit_03_CO.USF	CO	8-HR	BROX	1ST	397.427	341488	4787602	56	5	3423
UNHLFGCrit_02_CO.USF	CO	8-HR	ALL	1ST	373.588	340339.2	4789390	58.35	5	3423
UNHLFGCrit_02_CO.USF	CO	8-HR	TURNKEY	1ST	373.313	340339.2	4789390	58.35	5	3423
UNHLFGCrit_00_CO.USF	CO	8-HR	ALL	1ST	368.5054	341488	4787602	56	5	3423
UNHLFGCrit_00_CO.USF	CO	8-HR	ALL	2ND	367.7969	341488	4787602	56	5	3423
UNHLFGCrit_00_CO.USF	CO	8-HR	BROX	1ST	365.2993	341488	4787602	56	5	3423
UNHLFGCrit_00_CO.USF	CO	8-HR	BROX	2ND	364.9045	341488	4787602	56	5	3423
UNHLFGCrit_00_CO.USF	CO	8-HR	TURNKEY	1ST	357.6072	340315.6	4789422	57.68	5	3423
UNHLFGCrit_04_CO.USF	CO	8-HR	ALL	2ND	350.9834	340315.6	4789422	57.68	5	3423
UNHLFGCrit_04_CO.USF	CO	8-HR	TURNKEY	2ND	350.7262	340315.6	4789422	57.68	5	3423
UNHLFGCrit_02_CO.USF	CO	8-HR	ALL	2ND	344.3134	340339.2	4789390	58.35	5	3423
UNHLFGCrit_02_CO.USF	CO	8-HR	TURNKEY	2ND	344.1187	340339.2	4789390	58.35	5	3423
UNHLFGCrit_04_CO.USF	CO	8-HR	BROX	1ST	337.8524	341488	4787602	56	5	3423
UNHLFGCrit_03_CO.USF	CO	8-HR	ALL	2ND	332.7102	341488	4787602	56	5	3423
UNHLFGCrit_03_CO.USF	CO	8-HR	TURNKEY	1ST	331.2004	340264	4789482	58.52	5	3423
UNHLFGCrit_03_CO.USF	CO	8-HR	BROX	2ND	328.1699	341488	4787602	56	5	3423
UNHLFGCrit_01_CO.USF	CO	8-HR	ALL	1ST	323.8946	340382.9	4789352	60.26	5	3423
UNHLFGCrit_01_CO.USF	CO	8-HR	TURNKEY	1ST	323.642	340382.9	4789352	60.26	5	3423

University of New Hampshire Landfill Gas to Energy Project
AERMOD Maximum Impacts - Combined Source NAAQS Modeling

File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Groups	Rec.
UNHLFGCrit_00_CO.USF	CO	8-HR	TURNKEY	2ND	318.0225	340315.6	4789422	57.68	5	3423
UNHLFGCrit_01_CO.USF	CO	8-HR	ALL	2ND	314.833	340339.2	4789390	58.35	5	3423
UNHLFGCrit_01_CO.USF	CO	8-HR	TURNKEY	2ND	314.6327	340339.2	4789390	58.35	5	3423
UNHLFGCrit_03_CO.USF	CO	8-HR	TURNKEY	2ND	313.409	340264	4789482	58.52	5	3423
UNHLFGCrit_01_CO.USF	CO	8-HR	BROX	1ST	311.3782	341488	4787602	56	5	3423
UNHLFGCrit_02_CO.USF	CO	8-HR	BROX	1ST	306.1177	341488	4787602	56	5	3423
UNHLFGCrit_01_CO.USF	CO	8-HR	BROX	2ND	287.0375	341488	4787602	56	5	3423
UNHLFGCrit_04_CO.USF	CO	8-HR	BROX	2ND	275.1142	341488	4787602	56	5	3423
UNHLFGCrit_02_CO.USF	CO	8-HR	BROX	2ND	257.0577	341488	4787602	56	5	3423
UNHLFGCrit_02_CO.USF	CO	8-HR	UNHLFG	1ST	128.2404	341133.3	4789911	35.4	5	3423
UNHLFGCrit_00_CO.USF	CO	8-HR	UNHLFG	1ST	121.1548	341133.3	4789911	35.4	5	3423
UNHLFGCrit_01_CO.USF	CO	8-HR	UNHLFG	1ST	121.0621	341133.3	4789911	35.4	5	3423
UNHLFGCrit_02_CO.USF	CO	8-HR	UNHLFG	2ND	117.6171	341115	4789907	35.65	5	3423
UNHLFGCrit_04_CO.USF	CO	8-HR	UNHLFG	1ST	116.2289	341133.3	4789911	35.4	5	3423
UNHLFGCrit_01_CO.USF	CO	8-HR	UNHLFG	2ND	114.4077	341133.3	4789911	35.4	5	3423
UNHLFGCrit_00_CO.USF	CO	8-HR	UNHLFG	2ND	109.5888	341133.3	4789911	35.4	5	3423
UNHLFGCrit_03_CO.USF	CO	8-HR	UNHLFG	1ST	105.6513	341256	4789851	33.86	5	3423
UNHLFGCrit_04_CO.USF	CO	8-HR	UNHLFG	2ND	104.4735	341170	4789918	35.41	5	3423
UNHLFGCrit_03_CO.USF	CO	8-HR	UNHLFG	2ND	90.93191	341256	4789851	33.86	5	3423
UNHLFGCrit_04_CO.USF	CO	8-HR	MARCOU	1ST	63.22369	341288	4787602	56	5	3423
UNHLFGCrit_03_CO.USF	CO	8-HR	MARCOU	1ST	54.2603	341288	4787602	56	5	3423
UNHLFGCrit_02_CO.USF	CO	8-HR	MARCOU	1ST	50.78513	341288	4787602	56	5	3423
UNHLFGCrit_03_CO.USF	CO	8-HR	MARCOU	2ND	47.99595	341288	4787602	56	5	3423
UNHLFGCrit_00_CO.USF	CO	8-HR	MARCOU	1ST	46.24505	341288	4787402	52	5	3423
UNHLFGCrit_02_CO.USF	CO	8-HR	MARCOU	2ND	43.38824	341288	4787602	56	5	3423
UNHLFGCrit_04_CO.USF	CO	8-HR	MARCOU	2ND	42.05566	341288	4787402	52	5	3423
UNHLFGCrit_00_CO.USF	CO	8-HR	MARCOU	2ND	40.93082	341288	4787402	52	5	3423
UNHLFGCrit_01_CO.USF	CO	8-HR	MARCOU	1ST	39.95045	341288	4787402	52	5	3423
UNHLFGCrit_01_CO.USF	CO	8-HR	MARCOU	2ND	38.58887	341288	4787402	52	5	3423

University of New Hampshire Landfill Gas to Energy Project
AERMOD Maximum Impacts - ~49 Kilometers North of Facility

Model	File	Pol	Average	Group	Conc.	East(X)	North(Y)	Elev	Groups	Rec.
AERMOD	**UNHLFG_CL1NOxAN_01_NOX.USF**	**NOX**	**ANNUAL**	**ALL**	**0.02987**	**339588**	**4838302**	**146**	**1**	**500**
AERMOD	UNHLFG_CL1NOxAN_02_NOX.USF	NOX	ANNUAL	ALL	0.02467	332088	4837302	152	1	500
AERMOD	UNHLFG_CL1NOxAN_03_NOX.USF	NOX	ANNUAL	ALL	0.02158	332588	4836802	152	1	500
AERMOD	UNHLFG_CL1NOxAN_04_NOX.USF	NOX	ANNUAL	ALL	0.02128	332088	4837302	152	1	500
AERMOD	UNHLFG_CL1NOxAN_00_NOX.USF	NOX	ANNUAL	ALL	0.01722	332588	4836802	152	1	500
AERMOD	**UNHLFG_CL1PMST_00_PM.USF**	**PM**	**24-HR**	**ALL**	**0.12236**	**353588**	**4837802**	**148**	**1**	**500**
AERMOD	UNHLFG_CL1PMST_01_PM.USF	PM	24-HR	ALL	0.11539	333088	4838302	152	1	500
AERMOD	UNHLFG_CL1PMST_02_PM.USF	PM	24-HR	ALL	0.11313	332088	4838302	152	1	500
AERMOD	UNHLFG_CL1PMST_03_PM.USF	PM	24-HR	ALL	0.11285	331588	4836302	182	1	500
AERMOD	UNHLFG_CL1PMST_01_PM.USF	PM	24-HR	ALL	0.10786	339588	4838302	146	1	500
AERMOD	UNHLFG_CL1PMST_04_PM.USF	PM	24-HR	ALL	0.09564	330588	4837302	188	1	500
AERMOD	UNHLFG_CL1PMST_02_PM.USF	PM	24-HR	ALL	0.09325	332588	4836802	152	1	500
AERMOD	UNHLFG_CL1PMST_04_PM.USF	PM	24-HR	ALL	0.07491	333088	4838302	152	1	500
AERMOD	UNHLFG_CL1PMST_03_PM.USF	PM	24-HR	ALL	0.07427	333088	4838302	152	1	500
AERMOD	UNHLFG_CL1PMST_00_PM.USF	PM	24-HR	ALL	0.05686	343588	4837302	152	1	500
AERMOD	**UNHLFG_CL1PMAN_01_PM.USF**	**PM**	**ANNUAL**	**ALL**	**0.00792**	**339588**	**4838302**	**146**	**1**	**500**
AERMOD	UNHLFG_CL1PMAN_02_PM.USF	PM	ANNUAL	ALL	0.00651	332588	4836802	152	1	500
AERMOD	UNHLFG_CL1PMAN_03_PM.USF	PM	ANNUAL	ALL	0.00579	333088	4838302	152	1	500
AERMOD	UNHLFG_CL1PMAN_04_PM.USF	PM	ANNUAL	ALL	0.00575	332088	4837302	152	1	500
AERMOD	UNHLFG_CL1PMAN_00_PM.USF	PM	ANNUAL	ALL	0.00459	332588	4836802	152	1	500
AERMOD	**UNHLFG_CL1SO2ST_00_SO2.USF**	**SO2**	**24-HR**	**ALL**	**0.94829**	**353588**	**4837802**	**148**	**1**	**500**
AERMOD	UNHLFG_CL1SO2ST_01_SO2.USF	SO2	24-HR	ALL	0.87769	348588	4836302	131	1	500
AERMOD	UNHLFG_CL1SO2ST_02_SO2.USF	SO2	24-HR	ALL	0.82786	332088	4837302	152	1	500
AERMOD	UNHLFG_CL1SO2ST_03_SO2.USF	SO2	24-HR	ALL	0.80622	331588	4836302	182	1	500
AERMOD	UNHLFG_CL1SO2ST_01_SO2.USF	SO2	24-HR	ALL	0.77293	347588	4836802	143	1	500
AERMOD	UNHLFG_CL1SO2ST_04_SO2.USF	SO2	24-HR	ALL	0.72563	330088	4838302	188	1	500
AERMOD	UNHLFG_CL1SO2ST_02_SO2.USF	SO2	24-HR	ALL	0.71639	332088	4837302	152	1	500
AERMOD	UNHLFG_CL1SO2ST_04_SO2.USF	SO2	24-HR	ALL	0.57799	333088	4838302	152	1	500
AERMOD	UNHLFG_CL1SO2ST_03_SO2.USF	SO2	24-HR	ALL	0.52545	334088	4838302	170	1	500
AERMOD	UNHLFG_CL1SO2ST_00_SO2.USF	SO2	24-HR	ALL	0.41214	317588	4836302	164	1	500

University of New Hampshire Landfill Gas to Energy Project
AERMOD Maximum Impacts - ~49 Kilometers North of Facility

Model	File	Pol	Average	Group	Conc.	East(X)	North(Y)	Elev	Groups	Rec.
AERMOD	**UNHLFG_CL1SO2ST_00_SO2.USF**	**SO2**	**3-HR**	**ALL**	**5.68629**	**353588**	**4837802**	**148**	**1**	**500**
AERMOD	UNHLFG_CL1SO2ST_01_SO2.USF	SO2	3-HR	ALL	4.71587	340088	4838302	146	1	500
AERMOD	UNHLFG_CL1SO2ST_02_SO2.USF	SO2	3-HR	ALL	4.55469	332088	4837302	152	1	500
AERMOD	UNHLFG_CL1SO2ST_03_SO2.USF	SO2	3-HR	ALL	3.85153	331088	4836302	187	1	500
AERMOD	UNHLFG_CL1SO2ST_02_SO2.USF	SO2	3-HR	ALL	3.44869	332088	4838302	152	1	500
AERMOD	UNHLFG_CL1SO2ST_04_SO2.USF	SO2	3-HR	ALL	3.11465	333088	4838302	152	1	500
AERMOD	UNHLFG_CL1SO2ST_01_SO2.USF	SO2	3-HR	ALL	3.03542	342088	4837302	154	1	500
AERMOD	UNHLFG_CL1SO2ST_03_SO2.USF	SO2	3-HR	ALL	2.82495	333088	4838302	152	1	500
AERMOD	UNHLFG_CL1SO2ST_00_SO2.USF	SO2	3-HR	ALL	2.66563	348088	4836802	139	1	500
AERMOD	UNHLFG_CL1SO2ST_04_SO2.USF	SO2	3-HR	ALL	2.49539	341588	4837802	149	1	500
AERMOD	**UNHLFG_CL1SO2AN_01_SO2.USF**	**SO2**	**ANNUAL**	**ALL**	**0.0546**	**339588**	**4838302**	**146**	**1**	**500**
AERMOD	UNHLFG_CL1SO2AN_02_SO2.USF	SO2	ANNUAL	ALL	0.04444	332088	4837302	152	1	500
AERMOD	UNHLFG_CL1SO2AN_03_SO2.USF	SO2	ANNUAL	ALL	0.03931	333088	4838302	152	1	500
AERMOD	UNHLFG_CL1SO2AN_04_SO2.USF	SO2	ANNUAL	ALL	0.03869	332088	4837302	152	1	500
AERMOD	UNHLFG_CL1SO2AN_00_SO2.USF	SO2	ANNUAL	ALL	0.03107	332588	4836802	152	1	500

University of New Hampshire Landfill Gas to Energy Project
AERMOD Maximum Impacts - Sensitivity Level Comparison

File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Groups	Rec.
UNHLFGSENS_01_CO.USF	CO	24-HR	ALL	1ST	99.20452	341115	4789907	35.65	1	3423
UNHLFGSENS_04_CO.USF	CO	24-HR	ALL	1ST	96.55933	341115	4789907	35.65	1	3423
UNHLFGSENS_02_CO.USF	CO	24-HR	ALL	1ST	87.88073	341115	4789907	35.65	1	3423
UNHLFGSENS_02_CO.USF	CO	24-HR	ALL	2ND	85.70312	341133.3	4789911	35.4	1	3423
UNHLFGSENS_03_CO.USF	CO	24-HR	ALL	1ST	83.52518	341115	4789907	35.65	1	3423
UNHLFGSENS_01_CO.USF	CO	24-HR	ALL	2ND	82.58979	341115	4789907	35.65	1	3423
UNHLFGSENS_00_CO.USF	CO	24-HR	ALL	1ST	81.01102	341256	4789851	33.86	1	3423
UNHLFGSENS_04_CO.USF	CO	24-HR	ALL	2ND	79.54844	341115	4789907	35.65	1	3423
UNHLFGSENS_00_CO.USF	CO	24-HR	ALL	2ND	74.15144	341115	4789907	35.65	1	3423
UNHLFGSENS_03_CO.USF	CO	24-HR	ALL	2ND	65.22842	341256	4789851	33.86	1	3423
UNHLFGSENS_02_NOX.USF	NOX	4-HR	ALL	1ST	41.99986	341256	4789851	33.86	1	3423
UNHLFGSENS_00_NOX.USF	NOX	4-HR	ALL	1ST	39.35755	341253	4789887	34.08	1	3423
UNHLFGSENS_00_NOX.USF	NOX	4-HR	ALL	2ND	36.20877	341115	4789907	35.65	1	3423
UNHLFGSENS_01_NOX.USF	NOX	4-HR	ALL	1ST	33.86734	341115	4789907	35.65	1	3423
UNHLFGSENS_04_NOX.USF	NOX	4-HR	ALL	1ST	33.55261	341102	4789940	35.48	1	3423
UNHLFGSENS_02_NOX.USF	NOX	4-HR	ALL	2ND	32.0088	341115	4789907	35.65	1	3423
UNHLFGSENS_01_NOX.USF	NOX	4-HR	ALL	2ND	30.35018	341133.3	4789911	35.4	1	3423
UNHLFGSENS_04_NOX.USF	NOX	4-HR	ALL	2ND	29.99276	341133.3	4789911	35.4	1	3423
UNHLFGSENS_03_NOX.USF	NOX	4-HR	ALL	1ST	28.79272	341269.9	4789841	33.64	1	3423
UNHLFGSENS_03_NOX.USF	NOX	4-HR	ALL	2ND	27.82351	341256	4789851	33.86	1	3423
UNHLFGSENS_02_NOX.USF	NOX	8-HR	ALL	1ST	28.12262	341133.3	4789911	35.4	1	3423
UNHLFGSENS_00_NOX.USF	NOX	8-HR	ALL	1ST	27.10731	341115	4789907	35.65	1	3423
UNHLFGSENS_02_NOX.USF	NOX	8-HR	ALL	2ND	26.58893	341133.3	4789911	35.4	1	3423
UNHLFGSENS_00_NOX.USF	NOX	8-HR	ALL	2ND	26.46932	341115	4789907	35.65	1	3423
UNHLFGSENS_01_NOX.USF	NOX	8-HR	ALL	1ST	26.1398	341133.3	4789911	35.4	1	3423
UNHLFGSENS_01_NOX.USF	NOX	8-HR	ALL	2ND	26.11579	341133.3	4789911	35.4	1	3423
UNHLFGSENS_04_NOX.USF	NOX	8-HR	ALL	1ST	25.86472	341133.3	4789911	35.4	1	3423
UNHLFGSENS_04_NOX.USF	NOX	8-HR	ALL	2ND	24.07311	341115	4789907	35.65	1	3423
UNHLFGSENS_03_NOX.USF	NOX	8-HR	ALL	1ST	22.63792	341115	4789907	35.65	1	3423
UNHLFGSENS_03_NOX.USF	NOX	8-HR	ALL	2ND	20.30834	341115	4789907	35.65	1	3423

University of New Hampshire Landfill Gas to Energy Project
AERMOD Maximum Impacts - Sensitivity Level Comparison

File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Groups	Rec.
UNHLFGSENS_02_NOX.USF	NOX	ANNUAL	ALL	1ST	2.63847	341115	4789907	35.65	1	3423
UNHLFGSENS_04_NOX.USF	NOX	ANNUAL	ALL	1ST	2.45023	341115	4789907	35.65	1	3423
UNHLFGSENS_00_NOX.USF	NOX	ANNUAL	ALL	1ST	2.2365	341343	4789644	37.93	1	3423
UNHLFGSENS_03_NOX.USF	NOX	ANNUAL	ALL	1ST	2.18099	341115	4789907	35.65	1	3423
UNHLFGSENS_01_NOX.USF	NOX	ANNUAL	ALL	1ST	1.74702	341115	4789907	35.65	1	3423
UNHLFGSENS_04_NOX.USF	NOX	MONTH	ALL	1ST	4.94841	341343	4789644	37.93	1	3423
UNHLFGSENS_03_NOX.USF	NOX	MONTH	ALL	1ST	4.24233	341115	4789907	35.65	1	3423
UNHLFGSENS_00_NOX.USF	NOX	MONTH	ALL	1ST	3.77848	341343	4789644	37.93	1	3423
UNHLFGSENS_04_NOX.USF	NOX	MONTH	ALL	2ND	3.70691	341108.5	4789923	35.55	1	3423
UNHLFGSENS_00_NOX.USF	NOX	MONTH	ALL	2ND	3.63874	341343	4789644	37.93	1	3423
UNHLFGSENS_01_NOX.USF	NOX	MONTH	ALL	1ST	3.62589	341343	4789644	37.93	1	3423
UNHLFGSENS_02_NOX.USF	NOX	MONTH	ALL	1ST	3.58497	341115	4789907	35.65	1	3423
UNHLFGSENS_02_NOX.USF	NOX	MONTH	ALL	2ND	3.51785	341115	4789907	35.65	1	3423
UNHLFGSENS_03_NOX.USF	NOX	MONTH	ALL	2ND	3.1007	341343	4789644	37.93	1	3423
UNHLFGSENS_01_NOX.USF	NOX	MONTH	ALL	2ND	2.59773	341115	4789907	35.65	1	3423
UNHLFGSENS_03_SO2.USF	SO2	3-HR	ALL	1ST	24.47947	341288	4790002	44	1	3423
UNHLFGSENS_02_SO2.USF	SO2	3-HR	ALL	1ST	24.25661	341269.9	4789841	33.64	1	3423
UNHLFGSENS_03_SO2.USF	SO2	3-HR	ALL	2ND	23.56177	341254.5	4789869	33.68	1	3423
UNHLFGSENS_00_SO2.USF	SO2	3-HR	ALL	1ST	23.19875	341247	4789958	40.11	1	3423
UNHLFGSENS_00_SO2.USF	SO2	3-HR	ALL	2ND	21.83832	341248.5	4789940	37.49	1	3423
UNHLFGSENS_01_SO2.USF	SO2	3-HR	ALL	1ST	21.13165	341253	4789887	34.08	1	3423
UNHLFGSENS_04_SO2.USF	SO2	3-HR	ALL	1ST	20.94012	341297.6	4789819	33.42	1	3423
UNHLFGSENS_04_SO2.USF	SO2	3-HR	ALL	2ND	19.14758	341339.1	4789787	33.52	1	3423
UNHLFGSENS_02_SO2.USF	SO2	3-HR	ALL	2ND	18.89553	341352.5	4789656	37.29	1	3423
UNHLFGSENS_01_SO2.USF	SO2	3-HR	ALL	2ND	17.60171	341343	4789644	37.93	1	3423
UNHLFGSENS_00_SO2.USF	SO2	ANNUAL	ALL	1ST	1.52112	341343	4789644	37.93	1	3423
UNHLFGSENS_03_SO2.USF	SO2	ANNUAL	ALL	1ST	1.48682	341343	4789644	37.93	1	3423
UNHLFGSENS_04_SO2.USF	SO2	ANNUAL	ALL	1ST	1.32632	341343	4789644	37.93	1	3423
UNHLFGSENS_02_SO2.USF	SO2	ANNUAL	ALL	1ST	1.31998	341343	4789644	37.93	1	3423
UNHLFGSENS_01_SO2.USF	SO2	ANNUAL	ALL	1ST	0.99128	341343	4789644	37.93	1	3423

University of New Hampshire Landfill Gas to Energy Project
AERMOD Maximum Impacts - Env-A 1400 RTAP Results

File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Sources	Rec.
UNHLFGTox_02_H2S.USF	**H2S**	**24-HR**	**ALL**	**1ST**	**15.56769**	**339688**	**4789402**	**74**	**19**	**3423**
UNHLFGTox_02_H2S.USF	**H2S**	**24-HR**	**TURNKEY**	**1ST**	**15.56693**	**339688**	**4789402**	**74**	**19**	**3423**
UNHLFGTox_01_H2S.USF	H2S	24-HR	ALL	1ST	7.54919	339688	4789402	74	19	3423
UNHLFGTox_01_H2S.USF	H2S	24-HR	TURNKEY	1ST	7.54852	339688	4789402	74	19	3423
UNHLFGTox_03_H2S.USF	H2S	24-HR	ALL	1ST	7.06457	339688	4789402	74	19	3423
UNHLFGTox_03_H2S.USF	H2S	24-HR	TURNKEY	1ST	7.06436	339688	4789402	74	19	3423
UNHLFGTox_02_H2S.USF	H2S	24-HR	ALL	2ND	7.02769	339688	4789402	74	19	3423
UNHLFGTox_02_H2S.USF	H2S	24-HR	TURNKEY	2ND	7.02734	339688	4789402	74	19	3423
UNHLFGTox_03_H2S.USF	H2S	24-HR	ALL	2ND	6.28202	339688	4789402	74	19	3423
UNHLFGTox_03_H2S.USF	H2S	24-HR	TURNKEY	2ND	6.2806	339688	4789402	74	19	3423
UNHLFGTox_00_H2S.USF	H2S	24-HR	ALL	1ST	5.24691	339790.2	4790308	73.61	19	3423
UNHLFGTox_00_H2S.USF	H2S	24-HR	TURNKEY	1ST	5.24678	339790.2	4790308	73.61	19	3423
UNHLFGTox_01_H2S.USF	H2S	24-HR	ALL	2ND	3.41733	340291.1	4789477	55.66	19	3423
UNHLFGTox_01_H2S.USF	H2S	24-HR	TURNKEY	2ND	3.41588	340291.1	4789477	55.66	19	3423
UNHLFGTox_00_H2S.USF	H2S	24-HR	ALL	2ND	3.40841	339688	4789402	74	19	3423
UNHLFGTox_00_H2S.USF	H2S	24-HR	TURNKEY	2ND	3.40707	339688	4789402	74	19	3423
UNHLFGTox_04_H2S.USF	H2S	24-HR	ALL	1ST	3.11025	340291.1	4789477	55.66	19	3423
UNHLFGTox_04_H2S.USF	H2S	24-HR	TURNKEY	1ST	3.1066	340291.1	4789477	55.66	19	3423
UNHLFGTox_04_H2S.USF	H2S	24-HR	ALL	2ND	2.69912	340351	4789374	58.91	19	3423
UNHLFGTox_04_H2S.USF	H2S	24-HR	TURNKEY	2ND	2.6961	340338.8	4789417	56.72	19	3423
UNHLFGTox_03_H2S.USF	**H2S**	**24-HR**	**UNH**	**1ST**	**0.06934**	**341343**	**4789644**	**37.93**	**19**	**3423**
UNHLFGTox_03_H2S.USF	H2S	24-HR	UNH	2ND	0.06679	341343	4789644	37.93	19	3423
UNHLFGTox_02_H2S.USF	H2S	24-HR	UNH	1ST	0.05499	341297.6	4789819	33.42	19	3423
UNHLFGTox_04_H2S.USF	H2S	24-HR	UNH	1ST	0.05252	341297.6	4789819	33.42	19	3423
UNHLFGTox_00_H2S.USF	H2S	24-HR	UNH	1ST	0.05161	341343	4789644	37.93	19	3423
UNHLFGTox_00_H2S.USF	H2S	24-HR	UNH	2ND	0.04975	341343	4789644	37.93	19	3423
UNHLFGTox_01_H2S.USF	H2S	24-HR	UNH	1ST	0.04166	341343	4789644	37.93	19	3423
UNHLFGTox_02_H2S.USF	H2S	24-HR	UNH	2ND	0.0414	341343	4789644	37.93	19	3423
UNHLFGTox_01_H2S.USF	H2S	24-HR	UNH	2ND	0.03686	341343	4789644	37.93	19	3423
UNHLFGTox_04_H2S.USF	H2S	24-HR	UNH	2ND	0.0345	341343	4789644	37.93	19	3423
UNHLFGTox_00_H2S.USF	**H2S**	**ANNUAL**	**ALL**	**1ST**	**0.79917**	**340647.3**	**4789201**	**52.61**	**19**	**3423**
UNHLFGTox_00_H2S.USF	**H2S**	**ANNUAL**	**TURNKEY**	**1ST**	**0.79859**	**340647.3**	**4789201**	**52.61**	**19**	**3423**
UNHLFGTox_01_H2S.USF	H2S	ANNUAL	ALL	1ST	0.78314	340548.5	4789259	53.75	19	3423
UNHLFGTox_01_H2S.USF	H2S	ANNUAL	TURNKEY	1ST	0.78249	340548.5	4789259	53.75	19	3423
UNHLFGTox_04_H2S.USF	H2S	ANNUAL	ALL	1ST	0.78089	340662.7	4789193	52.87	19	3423
UNHLFGTox_04_H2S.USF	H2S	ANNUAL	TURNKEY	1ST	0.78017	340662.7	4789193	52.87	19	3423

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File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Sources	Rec.
UNHLFGTox_02_H2S.USF	H2S	ANNUAL	ALL	1ST	0.75264	340632	4789209	53.03	19	3423
UNHLFGTox_02_H2S.USF	H2S	ANNUAL	TURNKEY	1ST	0.75204	340632	4789209	53.03	19	3423
UNHLFGTox_03_H2S.USF	H2S	ANNUAL	ALL	1ST	0.73266	340662.7	4789193	52.87	19	3423
UNHLFGTox_03_H2S.USF	H2S	ANNUAL	TURNKEY	1ST	0.73193	340662.7	4789193	52.87	19	3423
UNHLFGTox_00_H2S.USF	**H2S**	**ANNUAL**	**UNH**	**1ST**	**0.00786**	**341343**	**4789644**	**37.93**	**19**	**3423**
UNHLFGTox_03_H2S.USF	H2S	ANNUAL	UNH	1ST	0.00755	341343	4789644	37.93	19	3423
UNHLFGTox_04_H2S.USF	H2S	ANNUAL	UNH	1ST	0.00681	341343	4789644	37.93	19	3423
UNHLFGTox_02_H2S.USF	H2S	ANNUAL	UNH	1ST	0.00675	341343	4789644	37.93	19	3423
UNHLFGTox_01_H2S.USF	H2S	ANNUAL	UNH	1ST	0.00505	341343	4789644	37.93	19	3423
UNHLFGTox_03_HCL.USF	**HCL**	**24-HR**	**ALL**	**1ST**	**1.61002**	**340446.6**	**4789307**	**56.41**	**16**	**3423**
UNHLFGTox_03_HCL.USF	**HCL**	**24-HR**	**TURNKEY**	**1ST**	**1.60815**	**340446.6**	**4789307**	**56.41**	**16**	**3423**
UNHLFGTox_04_HCL.USF	HCL	24-HR	ALL	1ST	1.58311	340278	4789468	58.33	16	3423
UNHLFGTox_04_HCL.USF	HCL	24-HR	TURNKEY	1ST	1.58202	340278	4789468	58.33	16	3423
UNHLFGTox_02_HCL.USF	HCL	24-HR	ALL	1ST	1.51383	340303.8	4789438	57.65	16	3423
UNHLFGTox_02_HCL.USF	HCL	24-HR	TURNKEY	1ST	1.51267	340303.8	4789438	57.65	16	3423
UNHLFGTox_03_HCL.USF	HCL	24-HR	ALL	2ND	1.50072	340462.5	4789296	55.49	16	3423
UNHLFGTox_03_HCL.USF	HCL	24-HR	TURNKEY	2ND	1.4988	340462.5	4789296	55.49	16	3423
UNHLFGTox_00_HCL.USF	HCL	24-HR	ALL	1ST	1.48968	340315.6	4789422	57.68	16	3423
UNHLFGTox_00_HCL.USF	HCL	24-HR	TURNKEY	1ST	1.48838	340315.6	4789422	57.68	16	3423
UNHLFGTox_00_HCL.USF	HCL	24-HR	ALL	2ND	1.45821	340315.6	4789422	57.68	16	3423
UNHLFGTox_00_HCL.USF	HCL	24-HR	TURNKEY	2ND	1.44068	340315.6	4789422	57.68	16	3423
UNHLFGTox_02_HCL.USF	HCL	24-HR	ALL	2ND	1.43772	340303.8	4789438	57.65	16	3423
UNHLFGTox_02_HCL.USF	HCL	24-HR	TURNKEY	2ND	1.437	340303.8	4789438	57.65	16	3423
UNHLFGTox_04_HCL.USF	HCL	24-HR	ALL	2ND	1.37902	340278	4789468	58.33	16	3423
UNHLFGTox_04_HCL.USF	HCL	24-HR	TURNKEY	2ND	1.3779	340278	4789468	58.33	16	3423
UNHLFGTox_01_HCL.USF	HCL	24-HR	ALL	1ST	1.274	340278	4789468	58.33	16	3423
UNHLFGTox_01_HCL.USF	HCL	24-HR	TURNKEY	1ST	1.27314	340278	4789468	58.33	16	3423
UNHLFGTox_01_HCL.USF	HCL	24-HR	ALL	2ND	1.14995	340264	4789482	58.52	16	3423
UNHLFGTox_01_HCL.USF	HCL	24-HR	TURNKEY	2ND	1.14911	340264	4789482	58.52	16	3423
UNHLFGTox_00_HCL.USF	**HCL**	**24-HR**	**UNH**	**1ST**	**0.6555**	**341115**	**4789907**	**35.65**	**16**	**3423**
UNHLFGTox_02_HCL.USF	HCL	24-HR	UNH	1ST	0.64518	341095.5	4789956	35.46	16	3423
UNHLFGTox_04_HCL.USF	HCL	24-HR	UNH	1ST	0.61848	341108.5	4789923	35.55	16	3423
UNHLFGTox_03_HCL.USF	HCL	24-HR	UNH	1ST	0.58911	341343	4789644	37.93	16	3423
UNHLFGTox_04_HCL.USF	HCL	24-HR	UNH	2ND	0.58196	341102	4789940	35.48	16	3423
UNHLFGTox_03_HCL.USF	HCL	24-HR	UNH	2ND	0.57916	341343	4789644	37.93	16	3423
UNHLFGTox_02_HCL.USF	HCL	24-HR	UNH	2ND	0.56911	341102	4789940	35.48	16	3423

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File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Sources	Rec.
UNHLFGTox_00_HCL.USF	HCL	24-HR	UNH	2ND	0.54828	341108.5	4789923	35.55	16	3423
UNHLFGTox_01_HCL.USF	HCL	24-HR	UNH	1ST	0.46058	341256	4789851	33.86	16	3423
UNHLFGTox_01_HCL.USF	HCL	24-HR	UNH	2ND	0.38984	341102	4789940	35.48	16	3423
UNHLFGTox_04_HCL.USF	**HCL**	**ANNUAL**	**ALL**	**1ST**	**0.26109**	**340278**	**4789468**	**58.33**	**16**	**3423**
UNHLFGTox_04_HCL.USF	**HCL**	**ANNUAL**	**TURNKEY**	**1ST**	**0.2553**	**340278**	**4789468**	**58.33**	**16**	**3423**
UNHLFGTox_02_HCL.USF	HCL	ANNUAL	ALL	1ST	0.24678	340303.8	4789438	57.65	16	3423
UNHLFGTox_03_HCL.USF	HCL	ANNUAL	ALL	1ST	0.24217	340278	4789468	58.33	16	3423
UNHLFGTox_02_HCL.USF	HCL	ANNUAL	TURNKEY	1ST	0.24169	340303.8	4789438	57.65	16	3423
UNHLFGTox_03_HCL.USF	HCL	ANNUAL	TURNKEY	1ST	0.23741	340278	4789468	58.33	16	3423
UNHLFGTox_00_HCL.USF	HCL	ANNUAL	ALL	1ST	0.21416	340303.8	4789438	57.65	16	3423
UNHLFGTox_00_HCL.USF	HCL	ANNUAL	TURNKEY	1ST	0.20818	340303.8	4789438	57.65	16	3423
UNHLFGTox_01_HCL.USF	HCL	ANNUAL	ALL	1ST	0.19996	340278	4789468	58.33	16	3423
UNHLFGTox_01_HCL.USF	HCL	ANNUAL	TURNKEY	1ST	0.19485	340278	4789468	58.33	16	3423
UNHLFGTox_00_HCL.USF	**HCL**	**ANNUAL**	**UNH**	**1ST**	**0.08821**	**341343**	**4789644**	**37.93**	**16**	**3423**
UNHLFGTox_03_HCL.USF	HCL	ANNUAL	UNH	1ST	0.08126	341343	4789644	37.93	16	3423
UNHLFGTox_04_HCL.USF	HCL	ANNUAL	UNH	1ST	0.07558	341343	4789644	37.93	16	3423
UNHLFGTox_02_HCL.USF	HCL	ANNUAL	UNH	1ST	0.07411	341343	4789644	37.93	16	3423
UNHLFGTox_01_HCL.USF	HCL	ANNUAL	UNH	1ST	0.05591	341343	4789644	37.93	16	3423
UNHLFGTox_02_METHANE.	**METHANE**	**24-HR**	**ALL**	**1ST**	**6535.775**	**339688**	**4789402**	**74**	**19**	**3423**
UNHLFGTox_02_METHANE.	**METHANE**	**24-HR**	**TURNKEY**	**1ST**	**6535.582**	**339688**	**4789402**	**74**	**19**	**3423**
UNHLFGTox_01_METHANE.	METHANE	24-HR	ALL	1ST	3310.173	339688	4789402	74	19	3423
UNHLFGTox_01_METHANE.	METHANE	24-HR	TURNKEY	1ST	3310.015	339688	4789402	74	19	3423
UNHLFGTox_03_METHANE.	METHANE	24-HR	ALL	1ST	2926.979	339688	4789402	74	19	3423
UNHLFGTox_03_METHANE.	METHANE	24-HR	TURNKEY	1ST	2926.936	339688	4789402	74	19	3423
UNHLFGTox_00_METHANE.	METHANE	24-HR	ALL	1ST	2353.621	339888	4788202	72	19	3423
UNHLFGTox_00_METHANE.	METHANE	24-HR	TURNKEY	1ST	2353.611	339888	4788202	72	19	3423
UNHLFGTox_04_METHANE.	METHANE	24-HR	ALL	1ST	1297.208	340291.1	4789477	55.66	19	3423
UNHLFGTox_04_METHANE.	METHANE	24-HR	TURNKEY	1ST	1296.665	340291.1	4789477	55.66	19	3423
UNHLFGTox_00_METHANE.	**METHANE**	**24-HR**	**UNH**	**1ST**	**9.58047**	**341115**	**4789907**	**35.65**	**19**	**3423**
UNHLFGTox_02_METHANE.	METHANE	24-HR	UNH	1ST	9.34428	341095.5	4789956	35.46	19	3423
UNHLFGTox_04_METHANE.	METHANE	24-HR	UNH	1ST	8.95724	341108.5	4789923	35.55	19	3423
UNHLFGTox_03_METHANE.	METHANE	24-HR	UNH	1ST	8.56816	341343	4789644	37.93	19	3423
UNHLFGTox_01_METHANE.	METHANE	24-HR	UNH	1ST	6.60307	341256	4789851	33.86	19	3423
UNHLFGTox_01_METHANE.	**METHANE**	**ANNUAL**	**ALL**	**1ST**	**372.6506**	**340288**	**4789502**	**57**	**19**	**3423**
UNHLFGTox_01_METHANE.	**METHANE**	**ANNUAL**	**TURNKEY**	**1ST**	**372.5902**	**340288**	**4789502**	**57**	**19**	**3423**
UNHLFGTox_00_METHANE.	METHANE	ANNUAL	ALL	1ST	359.8849	340548.5	4789259	53.75	19	3423

University of New Hampshire Landfill Gas to Energy Project
AERMOD Maximum Impacts - Env-A 1400 RTAP Results

File	Pol	Average	Group	Rank	Conc.	East(X)	North(Y)	Elev	Sources	Rec.
UNHLFGTox_00_METHANE.	METHANE	ANNUAL	TURNKEY	1ST	359.805	340548.5	4789259	53.75	19	3423
UNHLFGTox_04_METHANE.	METHANE	ANNUAL	ALL	1ST	353.4845	340548.5	4789259	53.75	19	3423
UNHLFGTox_04_METHANE.	METHANE	ANNUAL	TURNKEY	1ST	353.382	340548.5	4789259	53.75	19	3423
UNHLFGTox_02_METHANE.	METHANE	ANNUAL	ALL	1ST	342.7612	340548.5	4789259	53.75	19	3423
UNHLFGTox_02_METHANE.	METHANE	ANNUAL	TURNKEY	1ST	342.6817	340548.5	4789259	53.75	19	3423
UNHLFGTox_03_METHANE.	METHANE	ANNUAL	ALL	1ST	331.9065	340548.5	4789259	53.75	19	3423
UNHLFGTox_03_METHANE.	METHANE	ANNUAL	TURNKEY	1ST	331.8155	340548.5	4789259	53.75	19	3423
UNHLFGTox_00_METHANE.	**METHANE**	**ANNUAL**	**UNH**	**1ST**	**1.27736**	**341343**	**4789644**	**37.93**	**19**	**3423**
UNHLFGTox_03_METHANE.	METHANE	ANNUAL	UNH	1ST	1.17649	341343	4789644	37.93	19	3423
UNHLFGTox_04_METHANE.	METHANE	ANNUAL	UNH	1ST	1.09461	341343	4789644	37.93	19	3423
UNHLFGTox_02_METHANE.	METHANE	ANNUAL	UNH	1ST	1.07288	341343	4789644	37.93	19	3423
UNHLFGTox_01_METHANE.	METHANE	ANNUAL	UNH	1ST	0.80901	341343	4789644	37.93	19	3423

UNH Landfill Gas Project Env-A 1400 Toxics Modeling Results Worksheet

Impacts for UNH LFGTE Devices Only

Date: 3/23/2007

Methane conc. in landfill gas = 516000 ppm
molecular weight = 16

	24-hr	Annual
Maximum modeled methane concentrations (μg/m³):	**9.5805**	**1.2774**

CAS Number	Compound	mol. weight	Conc. in Landfill Gas (ppm)	24-hr Conc. (μg/m³)	24-hr AAL (μg/m³)	Annual Conc. (μg/m³)	Annual AAL (μg/m³)	Pass/Fail
7783-6-4	**Hydrogen sulfide**	**34.07**	**482.30**	**0.06934**	**50**	**0.00786**	**2**	**Pass**
71-55-6	Methyl chloroform (1,1,1-Trichloroethane)	133.42	0.48	0.00007	6821	0.00001	4548	Pass
79-34-5	1,1,2,2-Tetrachloroethane	167.85	1.11	0.00022	25	0.00003	16	Pass
75-34-3	1,1-Dichloroethane (Ethylidene chloride)	98.95	2.35	0.00027	2037	0.00004	1358	Pass
75-35-4	1,1-Dichloroethylene (Vinylidene chloride)	96.94	0.70	0.00008	200	0.00001	200	Pass
107-6-2	Ethylene dichloride (1,2-Dichloroethane)	98.96	0.41	0.00005	143	0.00001	95	Pass
78-87-5	1,2-Dichloropropane (Propylene dichloride)	112.98	0.18	0.00002	1745	0.00000	4	Pass
107-13-1	Acrylonitrile	53.06	6.33	0.00039	15	0.00005	2	Pass
106-97-8	Butane	58.12	5.03	0.00034	35374	0.00005	23582	Pass
56-23-5	Carbon tetrachloride	153.84	0.004	0.00000	111	0.00000	74	Pass
108-90-7	Chlorobenzene	112.56	0.46	0.00006	231	0.00001	154	Pass
75-45-6	Chlorodifluoromethane (Freon 22)	67.47	1.30	0.00010	50000	0.00001	50000	Pass
75-0-3	Chloroethane (Ethyl chloride)	64.52	1.25	0.00009	10000	0.00001	10000	Pass
67-66-3	Chloroform (Trichloromethane)	119.39	0.03	0.00000	175	0.00000	117	Pass
74-87-3	Chloromethane (Methyl chloride)	50.49	1.21	0.00007	368	0.00001	245	Pass
106-46-7	p-Dichlorobenzene (1,4-Dichlorobenzene)	147	0.33	0.00006	800	0.00001	800	Pass
75-70-8	Dichlorodifluoromethane (Freon 12)	120.91	15.70	0.00220	73661	0.00029	49107	Pass
75-43-3	Dichlorofluoromethane (Freon 21)	102.92	2.62	0.00031	211	0.00004	141	Pass
75-9-2	Methylene Chloride (Dichloromethane)	84.94	14.30	0.00141	621	0.00019	414	Pass
100-41-4	Ethyl benzene	106.16	5.01	0.00062	1000	0.00008	1000	Pass
110-54-3	Hexane (n-Hexane)	86.17	6.57	0.00066	885	0.00009	200	Pass
109-66-0	Pentane (all isomers)	72.15	3.29	0.00028	36875	0.00004	17560	Pass
127-18-4	Perchloroethylene (PCE, Tetrachloroethylene)	165.83	3.73	0.00072	607	0.00010	405	Pass
75-69-4	CFC-11 (Trichlorofluoromethane, Freon 11, Flourotric	137.38	0.76	0.00012	28270	0.00002	18846	Pass
79-1-6	Trichloroethylene	131.4	2.82	0.00043	961	0.00006	640	Pass
540-59-0	1,2-Dichloroethylene	96.94	2.84	0.00032	16521	0.00004	7867	Pass
75-1-4	Chloroethylene (Vinyl chloride)	62.5	7.34	0.00053	9.3	0.00007	6.2	Pass
1330-20-7	Xylene (all isomers)	106.16	13.19	0.00162	1550	0.00022	100	Pass
71-43-2	Benzene	78.11	11.10	0.00101	5.7	0.00013	3.8	Pass
108-88-3	Toluene	92.13	42.00	0.00449	671	0.00060	400	Pass
67-63-0	Isopropyl alcohol (2-Propanol)	60.11	50.10	0.00349	1757	0.00047	1171	Pass
67-64-1	Acetone (2-Propanone)	58.08	16.30	0.00110	4243	0.00015	2829	Pass
75-15-0	Carbon disulfide	76.13	0.72	0.00006	700	0.00001	700	Pass
64-17-5	Ethanol	46.08	27.20	0.00145	9457	0.00019	6304	Pass
75-8-1	Ethyl mercaptan (Ethanithiol)	62.13	2.28	0.00016	9.2	0.00002	4.4	Pass
106-93-4	Ethylene dibromide (1,2-Dibromoethane)	187.88	0.001	0.0000002	0.05	0.00000003	0.05	Pass
7439-97-6	Mercury aryl cmpds.	200.61	0.000292	0.00000	0.36	0.00000	0.3	Pass
78-93-3	Methyl ethyl ketone (MEK)	72.11	21.20	0.00177	5000	0.00024	5000	Pass
108-10-1	Methyl isobutyl ketone (MIBK, 4-Methyl-2-pentanone)	100.16	1.87	0.00022	3000	0.00003	3000	Pass
74-93-1	Methyl mercaptan (Methanethiol)	48.11	4.00	0.00022	4.9	0.00003	3.3	Pass
156-59-2	cis-1,2-Dichloroethylene (cis)	96.94	0.79	0.00009	16521	0.00001	7867	Pass
100-42-5	Styrene, monomer	104.2	0.61	0.00007	1000	0.00001	1000	Pass
108-67-8	1,3,5-Trimethylbenzene (as Trimethylbenzene)	120.19	0.34	0.00005	619	0.00001	412	Pass
95-63-6	1,2,4-Trimethylbenzene (as Trimethylbenzene)	120.19	0.59	0.00008	619	0.00001	412	Pass
7647-1-0	**Hydrogen chloride**	**36.46**	**25.00**	**0.65550**	**20**	**0.08821**	**20**	**Pass**
0-00-0	**Aliphatic Hydrocarbon Gases:Alkanes C1 - C4**	**16**	**516000**	**9.580**	**35374**	**1.277**	**23582**	**Pass**

Notes:
Methane, hydrogen sulfide and hydrogen chloride (shown in bold) were modeled explicitly. Results for other RTAPs were scaled from the methane impacts using the ratios of molecular weights and concentrations in landfill gas.

Listed concentrations for highlighted compounds are based on site-specific data; all others are based on published data (AP-42).

UNH Landfill Gas Project Env-A 1400 Toxics Modeling Results Worksheet

Impacts for UNH LFGTE and all Turnkey Landfill Devices

Date: 3/23/2007

Methane conc. in landfill gas = 516000 ppm
molecular weight = 16

	24-hr	Annual
Maximum modeled methane concentrations (μg/m³):	6535.7750	372.6506

CAS Number	Compound	mol. weight	Conc. in Landfill Gas (ppm)	24-hr Conc. (μg/m³)	24-hr AAL (μg/m³)	Annual Conc. (μg/m³)	Annual AAL (μg/m³)	Pass/Fail
7783-6-4	**Hydrogen sulfide**	**34.07**	**482.30**	**15.5677**	**50**	**0.79917**	**2**	**Pass**
71-55-6	Methyl chloroform (1,1,1-Trichloroethane)	133.42	0.48	0.05070	6821	0.00289	4548	Pass
79-34-5	1,1,2,2-Tetrachloroethane	167.85	1.11	0.14749	25	0.00841	16	Pass
75-34-3	1,1-Dichloroethane (Ethylidene chloride)	98.95	2.35	0.18408	2037	0.01050	1358	Pass
75-35-4	1,1-Dichloroethylene (Vinylidene chloride)	96.94	0.70	0.05372	200	0.00306	200	Pass
107-6-2	Ethylene dichloride (1,2-Dichloroethane)	98.96	0.41	0.03212	143	0.00183	95	Pass
78-87-5	1,2-Dichloropropane (Propylene dichloride)	112.98	0.18	0.01610	1745	0.00092	4	Pass
107-13-1	Acrylonitrile	53.06	6.33	0.26589	15	0.01516	2	Pass
106-97-8	Butane	58.12	5.03	0.23143	35374	0.01320	23582	Pass
56-23-5	Carbon tetrachloride	153.84	0.004	0.00049	111	0.00003	74	Pass
108-90-7	Chlorobenzene	112.56	0.46	0.04099	231	0.00234	154	Pass
75-45-6	Chlorodifluoromethane (Freon 22)	67.47	1.30	0.06944	50000	0.00396	50000	Pass
75-0-3	Chloroethane (Ethyl chloride)	64.52	1.25	0.06385	10000	0.00364	10000	Pass
67-66-3	Chloroform (Trichloromethane)	119.39	0.03	0.00284	175	0.00016	117	Pass
74-87-3	Chloromethane (Methyl chloride)	50.49	1.21	0.04836	368	0.00276	245	Pass
106-46-7	p-Dichlorobenzene (1,4-Dichlorobenzene)	147	0.33	0.03840	800	0.00219	800	Pass
75-70-8	Dichlorodifluoromethane (Freon 12)	120.91	15.70	1.50276	73661	0.08568	49107	Pass
75-43-3	Dichlorofluoromethane (Freon 21)	102.92	2.62	0.21347	211	0.01217	141	Pass
75-9-2	Methylene Chloride (Dichloromethane)	84.94	14.30	0.96156	621	0.05483	414	Pass
100-41-4	Ethyl benzene	106.16	5.01	0.42104	1000	0.02401	1000	Pass
110-54-3	Hexane (n-Hexane)	86.17	6.57	0.44818	885	0.02555	200	Pass
109-66-0	Pentane (all isomers)	72.15	3.29	0.18791	36875	0.01071	17560	Pass
127-18-4	Perchloroethylene (PCE, Tetrachloroethylene)	165.83	3.73	0.48967	607	0.02792	405	Pass
75-69-4	CFC-11 (Trichlorofluoromethane, Freon 11, Flourotric	137.38	0.76	0.08265	28270	0.00471	18846	Pass
79-1-6	Trichloroethylene	131.4	2.82	0.29334	961	0.01673	640	Pass
540-59-0	1,2-Dichloroethylene	96.94	2.84	0.21795	16521	0.01243	7867	Pass
75-1-4	Chloroethylene (Vinyl chloride)	62.5	7.34	0.36316	9.3	0.02071	6.2	Pass
1330-20-7	Xylene (all isomers)	106.16	13.19	1.10849	1550	0.06320	100	Pass
71-43-2	Benzene	78.11	11.10	0.68637	5.7	0.03913	3.8	Pass
108-88-3	Toluene	92.13	42.00	3.06322	671	0.17466	400	Pass
67-63-0	Isopropyl alcohol (2-Propanol)	60.11	50.10	2.38403	1757	0.13593	1171	Pass
67-64-1	Acetone (2-Propanone)	58.08	16.30	0.74945	4243	0.04273	2829	Pass
75-15-0	Carbon disulfide	76.13	0.72	0.04339	700	0.00247	700	Pass
64-17-5	Ethanol	46.08	27.20	0.99222	9457	0.05657	6304	Pass
75-8-1	Ethyl mercaptan (Ethanithiol)	62.13	2.28	0.11214	9.2	0.00639	4.4	Pass
106-93-4	Ethylene dibromide (1,2-Dibromoethane)	187.88	0.001	0.0001487	0.05	0.00000848	0.05	Pass
7439-97-6	Mercury aryl cmpds.	200.61	0.000292	0.00005	0.36	0.00000	0.3	Pass
78-93-3	Methyl ethyl ketone (MEK)	72.11	21.20	1.21020	5000	0.06900	5000	Pass
108-10-1	Methyl isobutyl ketone (MIBK, 4-Methyl-2-pentanone)	100.16	1.87	0.14827	3000	0.00845	3000	Pass
74-93-1	Methyl mercaptan (Methanethiol)	48.11	4.00	0.15234	4.9	0.00869	3.3	Pass
156-59-2	cis-1,2-Dichloroethylene (cis)	96.94	0.79	0.06063	16521	0.00346	7867	Pass
100-42-5	Styrene, monomer	104.2	0.61	0.05032	1000	0.00287	1000	Pass
108-67-8	1,3,5-Trimethylbenzene (as Trimethylbenzene)	120.19	0.34	0.03235	619	0.00184	412	Pass
95-63-6	1,2,4-Trimethylbenzene (as Trimethylbenzene)	120.19	0.59	0.05614	619	0.00320	412	Pass
7647-1-0	**Hydrogen chloride**	**36.46**	**25.00**	**1.61002**	**20**	**0.26109**	**20**	**Pass**
0-00-0	**Aliphatic Hydrocarbon Gases:Alkanes C1 - C4**	**16**	**516000.00**	**6535.775**	**35374**	**372.651**	**23582**	**Pass**

Notes:
Methane, hydrogen sulfide and hydrogen chloride (shown in bold) were modeled explicitly. Results for other RTAPs were scaled from the methane impacts using the ratios of molecular weights and concentrations in landfill gas.

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