Tier 2 Non-Methane Organic Compound Test Report

Manistee County Landfill
Manistee, Michigan

December 28, 2017

Prepared for:
Harland's Sanitary Landfill / Manistee County Landfill
3890 Camp Road
Manistee, Michigan 49960

Prepared by:
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EXECUTIVE SUMMARY

Manistee County Landfill retained Air Quality Specialist, Inc. to conduct tests to measure the site-specific non-methane organic compound (NMOC) concentration at Manistee County Landfill located in Manistee, Michigan.

The purpose of the test program was to measure the site-specific NMOC concentration [40 CFR, Part 60, Subpart WWW, 60.754(a)(3)]. The NMOC concentration data was used to calculate the 5-year NMOC emission rate estimate pursuant to 60.757(b)(1) and (2) and The facility's Renewable Operating Permit (ROP) Section EULANDFILL<50, VII.4.a. and b.

AQSI conducted the fieldwork on November 2, 2017, and in accordance with the test plan, dated September 15, 2017. Mr. Andrew Secord and Mr. Jeremy Chrobak conducted the tests. Mr. Rob Dickman with Michigan Department of Environmental Quality (MDEQ) Air Quality Division reviewed the test protocol. The NMOC test results, and 5-year projected NMOC emission rate are:

	Test 1	Test 2	Test 3	Average
Average NMOC Concentration [a]	754.2	775.3	810.8	780.1
Calculated NMOC Emission Rate, 2017[b]	-	-	-	51.9
Calculated NMOC Emission Rate, 2018	-	-	-	51.2
Calculated NMOC Emission Rate, 2019	-	-	-	50.5
Calculated NMOC Emission Rate, 2020	-	-	-	49.9
Calculated NMOC Emission Rate, 2021	-	-	-	49.2

[a] parts per million (ppmv), as hexane
[b] megagrams per year (Mg/yr)

NMOC: non-methane organic compounds

1.0 INTRODUCTION

Manistee County Landfill retained Air Quality Specialist, Inc. to conduct tests to measure the site-specific non-methane organic compound (NMOC) concentration at Manistee County Landfill located in Manistee, Michigan.

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The NMOC test program followed the provisions outlined in Title 40, *Code of Federal Regulations,* Part 60, Appendix A, Method 25C, "Determination of Non-methane Organic Compounds in Landfill Gases.' AQSI performed the NMOC tests in triplicate. The samples were analyzed by Triangle Environmental Services, Inc. (TES), Hillsborough, North Carolina.

AQSI conducted the fieldwork on November 2, 2017, and in accordance with the test plan, dated September 15, 2017. Mr. Andrew Secord and Mr. Jeremy Chrobak conducted the tests. Mr. Rob Dickman with Michigan Department of Environmental Quality (MDEQ) Air Quality Division reviewed the test protocol. Mr. Bob Jozwiak, Site Manager of Manistee County Landfill provided on-site coordination.

The name, address, and telephone number of the primary contact for further information about the tests and this test report is:

Name and Title	**Company**	**Telephone**
Mr. Andrew Secord Environmental Scientist	Air Quality Specialist, Inc. 672 N. Milford Road, Suite 152 Highland, Michigan 48357	(248) 887-7565

The name, address, and telephone number of the primary contact for further information about the landfill and landfill operation is:

Name and Title	**Company**	**Telephone/Fax**
Ms. Debbi Nurmi Environmental Manager	Manistee County Landfill 3890 Camp Road Manistee, Michigan 49660	(616) 437-8408

2.0 SUMMARY OF RESULTS

On November 2, 2017, Manistee County Landfill operated the open (utility) flare at an average landfill gas flow rate of approximately 1,255 standard cubic feet per minute (scfm) as measured by the installed process flow meter, or 950 scfm as measured by Method 2. The landfill Operations and Maintenance (O&M) contractor monitored landfill gas extraction wells on November 1, 2017, for proper operation, and conducted a surface emissions monitoring (SEM) scan on the morning of November 2, 2017, prior to AQSI commencing the NMOC tests.

The test results for Manistee County Landfill was an average NMOC concentration of 780.1 parts per million (ppm), as hexane. The NMOC emission rate is projected to be 51.9 megagrams per year (Mg/yr) in 2017, as calculated by United States Environmental Protection Agency (USEPA) Landfill Gas Emissions (LandGEM) Model, Version 3.02.

Based on these results, Manistee County Landfill is required to submit a gas collection and control system (GCCS) design plan for operation of the existing gas system under NSPS. Manistee County Landfill must submit a GCCS plan within one year of the first report showing NMOC emission rates equal to or exceeding 50 Mg/yr.

3.0 SOURCE DESCRIPTION

Manistee County Landfill is a municipal solid waste landfill, and is subject to the New Source Performance Standards (NSPS) for Municipal Solid Waste (MSW) Landfills, 40 CFR 60, Subpart WWW. Manistee County Landfill operates under MDEQ-issued Renewable Operating Permit (ROP) MI-ROP-N3634-2015.

Anaerobic bacteria decompose the emplaced waste. The primary by-products of decomposition are methane (~25-45%, typical), carbon dioxide (~15-25%, typical), with the remainder balance gases nitrogen and oxygen (40-55% combined), and trace amounts of non-methane organic compounds.

Manistee County Landfill employs an active gas collection and control system, though the facility is not yet required to have such a system, to meet the requirements of Subpart WWW. Gas collection wells are installed in a grid pattern about the landfill. The wells are connected to a common header system. A blower produces a vacuum on the well field. Collected gas is routed to the utility flare for landfill gas control.

The utility flare at Manistee County Landfill has a rated capacity up to 1,200 scfm. The landfill gas flow rate to the flare was expected to be approximately 850 scfm. The average flow rate recorded from the installed process flow meter was 1,255 scfm; the average flow rate measured by AQSI was 950 scfm.

The landfill gas flow is variable, and depends on gas production in the landfill. The composition of the landfill gas varies, but the average Method 3C values obtained on November 2, 2017, may be considered 'typical:' methane, 32.9%; carbon dioxide, 12.3%; oxygen, 4.9%; and nitrogen, 45.4%.

4.0 SAMPLE AND ANALYTICAL PROCEDURES

AQSI measured landfill gas flow rate to the flare by USEPA Methods 1 and 2. AQSI measured the landfill gas composition by USEPA Method 3C. AQSI measured non-methane organic compounds (NMOC) by Method 25C. AQSI extracted an integrated canister sample, in triplicate, and had the samples analyzed for carbon dioxide, methane, nitrogen, oxygen, and NMOC.

Sample collection and analysis methods included:

Parameter	Method	Analytical Method
Landfill gas velocity and volumetric flow rate	USEPA Methods 1A & 2C	Field Data
Landfill gas composition and moisture content	USEPA Method 3C	Gas Chromatography / Thermal Conductivity Detector (GC/TCD)
NMOC concentration	USEPA Method 25C	Gas Chromatography / Flame Ionization Detector (GC/FID)

AQSI used Method 1A, *"Sample and Velocity Traverses for Stationary Sources with Small Ducts or Stacks,"* to determine the appropriate number and location of traverse points on the common gas collection header. The determination was based on dividing the stack cross-section into equal areas (one traverse point for each area) and the number of upstream and downstream stack diameters from the sample ports to the nearest flow disturbance.

AQSI used Method 2C, *"Determination of Stack Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts (Standard Pitot Tube),"* to measure velocity pressures and temperatures at each traverse point. AQSI will use a standard pitot tube, with a baseline coefficient of 0.99, positioned at each traverse point. The velocity pressure and exhaust gas temperature were measured and recorded. Velocity pressure measurements were made on a digital manometer having increments of 0.01 inch of water. Temperature measurements were made using a pyrometer with an attached thermocouple wire.

The average stack gas velocity is a function of the average velocity pressure, absolute stack gas pressure, average stack gas temperature, molecular weight of the wet stack gas, and pitot tube coefficient. The derivation of the average stack gas velocity was calculated using the equations stipulated in this test method. The actual stack gas flow rate was calculated using the average stack gas velocity and the cross-sectional area of the stack.

AQSI used Method 3C, *"Determination of Carbon Dioxide, Methane, Nitrogen, and Oxygen from Stationary Sources,"* and Method 25C *"Determination of Non-methane Organic Compounds in Landfill Gases,"* to determine the landfill gas composition and NMOC concentrations.

AQSI collected three, approximately 30-minute (minimum), integrated samples of landfill gas from the utility flare blower inlet. AQSI contracted Triangle Environmental Services, Inc. (TES), Hillsborough, North Carolina, to analyze each sample for carbon dioxide (CO_2), methane (CH_4), nitrogen (N_2), oxygen (O_2), and NMOC concentration.

TES followed the analytical procedures of Method 3C by using a gas chromatograph (GC), with appropriate separation column for the expected parameters, equipped with a thermal conductivity detector (TCD) and flame ionization detector (FID). TES notes that while Method 3C requires duplicate injection, they performed triplicate injection, as this provides better quality control.

TES corrected the raw NMOC concentration for the presence of air; the correction increases the reported NMOC concentration.

AQSI divided the raw (corrected) NMOC concentration by six (6), to yield a NMOC-as hexane ($NMOC_{hexane}$) concentration. This $NMOC_{hexane}$ value was entered into the appropriate field in the LandGEM model used to calculate NMOC emission rate.

5.0 RESULTS AND DISCUSSION

The average NMOC concentration at the utility flare blower inlet was 4,680 parts per million (ppm), as carbon, or 780.1 ppm, as hexane. This yields a projected NMOC emission rate of 51.9 Mg/yr for 2017.

The test results demonstrate Manistee County Landfill is required to submit a GCCS design plan for operation of the existing active gas collection system for NSPS compliance within one year.

AQSI noted no deviations from the test plan and normal sample procedures; all test results appear consistent and repeatable.

AQSI quality assurance (QA) procedures included verification of sufficient evacuation of each Method 3C/25C canister, and leak check of the sample train, prior to initiation of each sample collection; the sample train passed all leak checks.

Table 1 presents the Method 3C landfill gas composition results. Table 2 presents the oxygen-corrected NMOC concentration results, and the calculated $NMOC_{hexane}$ results. Figure 1 presents a map of the existing gas collection system at Manistee County Landfill. Figure 2 presents a sketch of the utility flare blower inlet NMOC sample location. Figure 3 presents a sketch of the Method 3C/25C sample train.

Raw and calculated field sample data sheets are presented in Appendix A. The Method 3C/25C laboratory analytical report is presented in Appendix B. The LandGEM Model report is presented in Appendix C.

This report prepared by: _____
Andrew D. Secord
Environmental Scientist

This report reviewed by: _____
for Dana A. Oleniacz
President

December 28, 2017

Table 1

USEPA Method 3C Analytical Results
Utility Flare Blower Inlet
Manistee County Landfill
Manistee, Michigan
November 2, 2017

Test No.	Tank No.	CH_4 (%)	CO_2 (%)	O_2 (%)	N_2 (%)
1	N29P	33.2	12.4	5.0	46.0
2	N35	32.3	12.2	5.1	45.5
3	N354P	33.2	12.4	4.7	44.8
Averages		**32.9**	**12.3**	**4.9**	**45.4**

CH_4: Methane
CO_2: Carbon dioxide
O_2: Oxygen
N_2: Nitrogen
%: Percent-by-volume

AQS Inc.

Table 2

USEPA Method 25C Analytical Results (Corrected for Oxygen)
Utility Flare Blower Inlet
Manistee County Landfill
Manistee, Michigan
November 2, 2017

Test No.	Tank No.	NMOC (ppm)	$NMOC_{hexane}$ (ppm)
1	N29P	4,525	754.2
2	N35	4,652	775.3
3	N354P	4,865	810.8
Averages		**4,681**	**780.1**

NMOC: Non-methane organic compounds, as carbon, corrected for oxygen
$NMOC_{hexane}$: NMOC, as hexane (= NMOC / 6)
ppm: Parts-per-million, volume

AQS Inc.

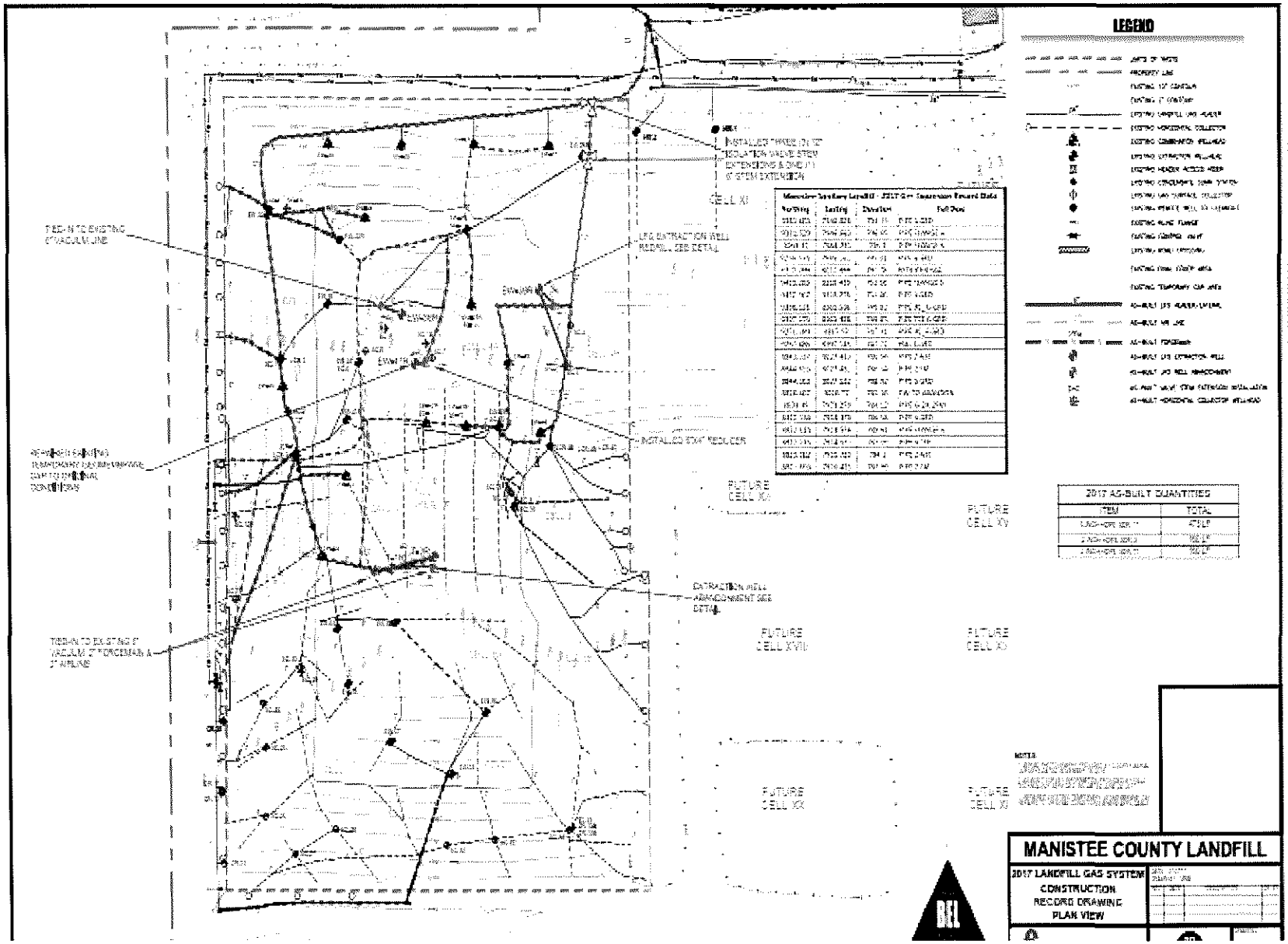

Figure 1: Manistee County Landfill Gas Collection System – General Arrangement

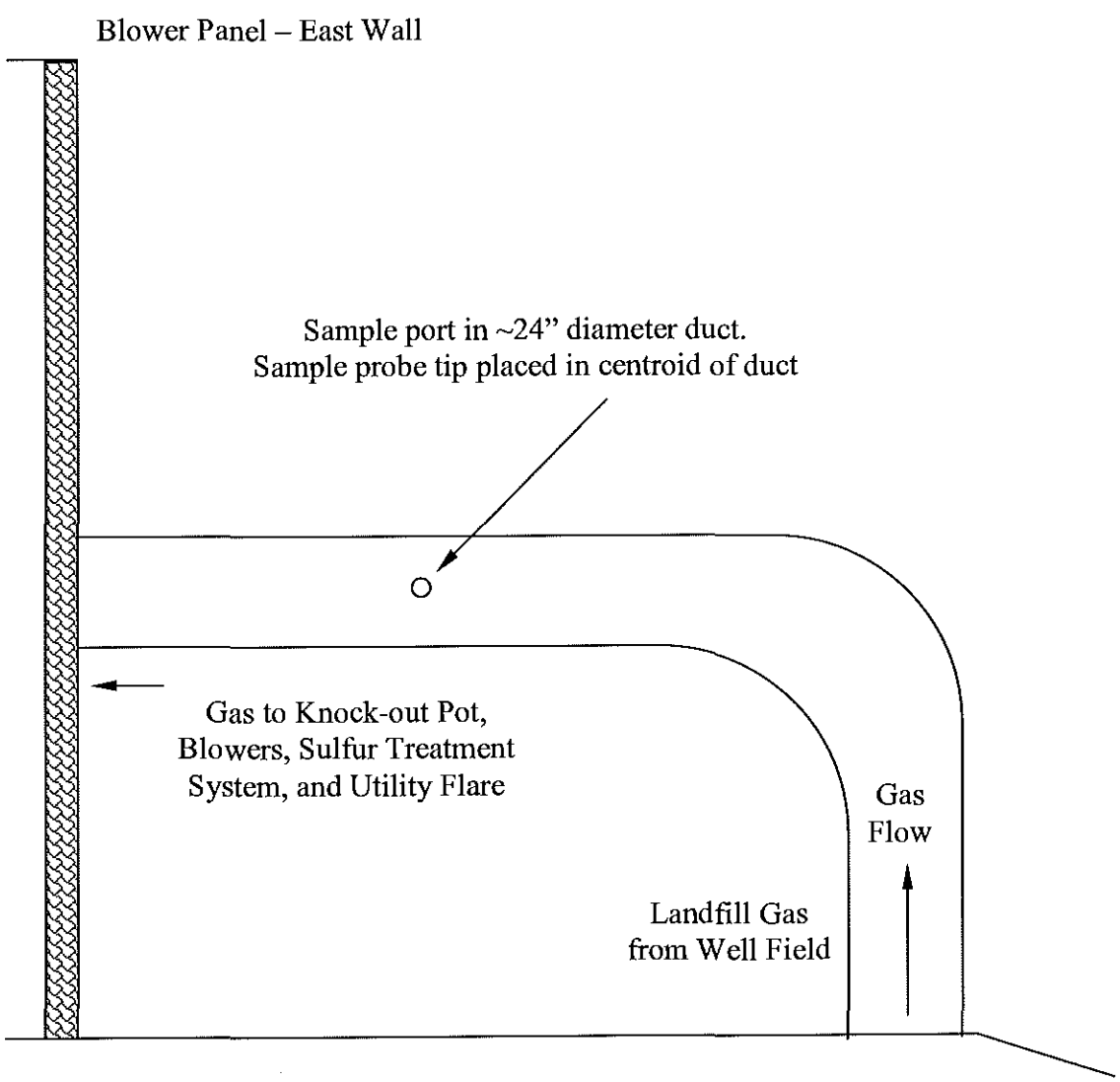

Figure 2
NMOC sample port and probe tip location, utility flare blower inlet at Manistee County Landfill in Manistee, Michigan.

Air Quality Specialist, Inc.
November 2, 2017

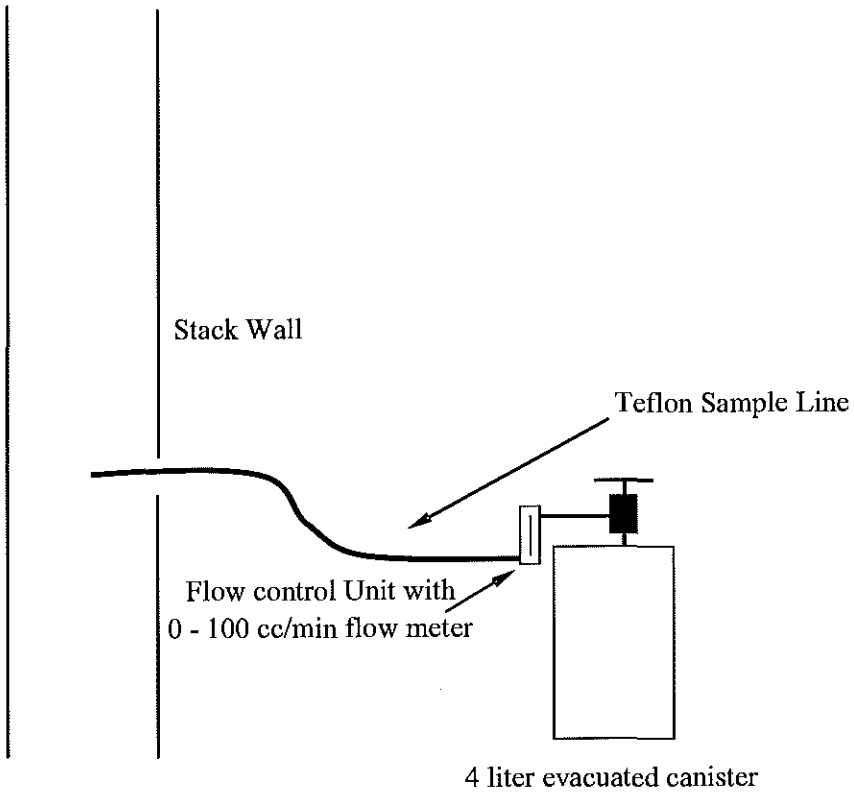

Figure 3
USEPA Method 3C/25C sample train, utility flare blower inlet duct, at Manistee County Landfill in Manistee, Michigan.

Air Quality Specialist, Inc.
November 2, 2017