



ENVIRONMENTAL  
INFORMATION  
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## Non-Methane Organic Compound Test Report

**Manistee County Landfill**  
Manistee, Michigan

October 10, 2019

*Prepared for:*

**Harland's Sanitary Landfill / Manistee County Landfill**  
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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 per 40 CFR, Part 60, Subpart WWW, 60.754(a)(3), and to use the NMOC concentration data under 60.759(a)(3)(ii) to calculate whether nonproductive areas of the facility contribute less than 1 percent of the total NMOC emission from the landfill, and thus can be excluded from control.

EIL conducted the fieldwork on August 13, 2019, and in accordance with the test plan, dated July 3, 2019. Mr. Andrew Secord and Mr. Tyler Smith conducted the tests. Mr. Rob Dickman with Michigan Department of Environment, Great Lakes, and Energy (EGLE), Air Quality Division, reviewed the test protocol. The NMOC concentration test results and NMOC emission rates are:

	Test 1	Test 2	Test 3	Average
OH Average NMOC Concentration <sup>a</sup>	18.2	24.2	22.3	21.6
OH Calculated NMOC Emission Rate <sup>b</sup>	-	-	-	0.16
MH Average NMOC Concentration	550	563	562	558
MH Calculated NMOC Emission Rate	-	-	-	49.7
OH Percent Contribution				0.3

OH: Old Hills – Act 87/641 Header, closed phase(s) of the landfill

MH: Main Header – combined closed and active phase(s) of the landfill

NMOC: non-methane organic compounds

<sup>a</sup> parts per million (ppmv), as hexane, corrected for oxygen or nitrogen

<sup>b</sup> megagrams per year (Mg/yr)



## 1.0 INTRODUCTION

Manistee County Landfill retained Environmental Information Logistics, LLC (EIL) 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." EIL performed the NMOC tests in triplicate, on both the Act87/461 hills header, and also the main header before the utility flare blower and knockout pot. The samples were analyzed by AtmAA, Inc., Calabasas, California.

EIL conducted the fieldwork on August 13, 2019, and in accordance with the test plan, dated July 3, 2019. Mr. Andrew Secord and Mr. Tyler Smith conducted the tests. Mr. Rob Dickman with Michigan Department of Environment, Great Lakes, and Energy (EGLE), Air Quality Division, reviewed the test protocol.

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	Environmental Information Logistics, LLC 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
Mr. Justin Obermeyer Environmental Manager	Republic Services, Inc. 15550 68th Ave. Coopersville, Michigan 49404	(616) 431-6173



## 1.0 INTRODUCTION

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## 2.0 SUMMARY OF RESULTS

On August 13, 2019, Manistee County Landfill operated the utility flare at an average landfill gas flow rate of approximately 725 standard cubic feet per minute (scfm) as measured by the installed process flow meter. The flow rate from the Act 87/641 phases was approximately 60 scfm as measured by the process flow meter installed on that header.

The test results for Manistee County Landfill was an average NMOC concentration of 21.6 parts per million (ppm), as hexane, at the Act 87/641 header, and 558 ppm, as hexane, from the main header, prior to the blower and knockout pot. The NMOC emission rate from the Act 87/641 phase of the landfill is 0.16 megagrams per year (Mg/yr) in 2019, as calculated by United States Environmental Protection Agency (USEPA) Landfill Gas Emissions (LandGEM) Model, Version 3.02. The total NMOC emission rate of the entire facility is 49.7 Mg/yr, per LandGEM.

Based on these results, the Act 87/641 area contributes 0.3 percent of the total NMOC from Manistee County Landfill. Since the Act 87/641 area contributes less than 1 percent of the total NMOC emissions from the landfill, it can be excluded from control.

## 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.

Manistee County Landfill consists of three (3) discrete landfill sections: the closed Act 87 and Act 641 phases, and the current Subtitle D active phase. EIL collected NMOC samples, in triplicate, at each the closed Act 87/641 phase's common header, and the main landfill gas header inlet, prior to the utility flare blower and knockout pot.

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 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 725 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 (Table 1) obtained from both the Act 87/641 header, and the main header, on August 13, 2019, may be considered typical. The Method 3C results are consistent test-to-test, and are also consistent with those obtained by the landfill gas analyzer during the August 2019 well tuning event.

#### 4.0 SAMPLE AND ANALYTICAL PROCEDURES

EIL measured the landfill gas composition by USEPA Method 3C. EIL measured NMOC by Method 25C. EIL extracted a canister sample, in triplicate, from both the Act 87/461 header, and the main header, 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 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)

EIL 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.

AtmAA, Inc. 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). AtmAA, Inc. corrected the raw NMOC concentration for the presence of air; the correction increases the reported NMOC concentrations.

EIL divided the raw NMOC concentration by six (6), to yield a NMOC-as hexane (NMOC<sub>hexane</sub>) concentration. This NMOC<sub>hexane</sub> value was entered into the appropriate field in the LandGEM model used to calculate NMOC emission rate. EIL used the default values in 60.759(a)(3) in LandGEM. Waste tonnages were obtained from the GCCS Design Plan, dated December 20, 2018.

#### 5.0 RESULTS AND DISCUSSION

The average NMOC concentration at the Act 87/641 header was 129 ppm, as carbon, or 21.6 ppm, as hexane. This yields a NMOC emission rate of 0.16 Mg/yr for 2019. The average NMOC concentration at the utility flare blower inlet was 3,350 ppm, as carbon, or 558.3 ppm, as hexane. This yields a NMOC emission rate of 49.7 Mg/yr for 2019.



The test results demonstrate that the Act 87/641 area contributes less than 1 percent of the total amount of NMOC emissions from Manistee County Landfill, and therefore can be excluded from control.

EIL noted deviations from the test plan and normal sample procedures; however, all test results appear consistent and repeatable. EIL intended to contract Triangle Environmental Services, Inc. (TES) to provide sample media and analysis. Unfortunately, TES suffered a catastrophic fire the week prior to the test date, and could not provide canisters, sample trains, or analysis. EIL contracted AtmAA, Inc., and informed EGLE of the proposed change. EGLE had no objection.

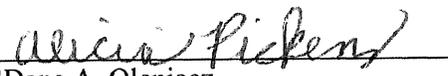
The sample trains provided by AtmAA, Inc. consisted of a critical orifice, with flow rate set at the laboratory. In the field, this arrangement would not pull sample against the vacuum in the headers. EIL ultimately bypassed the critical orifices, and was able to obtain samples. EIL notes that these samples were obtained in 10 to 15 seconds (i.e., "grab" samples) vs. the 30-minutes anticipated in the test plan. EIL considers the results valid due to test-to-test consistency and repeatability, as well as the consistency of the analytical results to the landfill gas analyzer measurements obtained during the August 2019 well field tuning events.

EIL 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<sub>hexane</sub> 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 reports are presented in Appendix C.

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Environmental Engineer

October 10, 2019



**TABLES & FIGURES**

**Table 1**

**USEPA Method 3C Analytical Results  
Act 87/641 Header (OH) and Main Header (MH) Prior to Utility Flare Blower  
Manistee County Landfill  
Manistee, Michigan  
August 13, 2019**

<b>Test No.</b>	<b>Tank No.</b>	<b>CH<sub>4</sub> (%)</b>	<b>CO<sub>2</sub> (%)</b>	<b>O<sub>2</sub> (%)</b>	<b>N<sub>2</sub> (%)</b>
OH-1	112	19.8	10.9	7.59	61.8
OH-2	115	20.2	11.1	7.52	61.9
OH-3	118	20.5	11.5	7.15	61.2
<b>OH Averages</b>		<b>20.2</b>	<b>11.2</b>	<b>7.42</b>	<b>61.6</b>
LFG Analyzer		21.1	11.8	6.0	61.1
MH-1	143	38.3	17.1	3.27	37.5
MH-2	178	38.7	17.3	2.94	36.3
MH-3	273	39.5	17.5	2.47	35.7
<b>MH Averages</b>		<b>38.8</b>	<b>17.3</b>	<b>2.89</b>	<b>36.5</b>
LFG Analyzer		40.6	17.6	2.8	39.1

OH: "Old Hills" – Act 87/641 Header.  
 MH: "Main Header" – combined closed and active phases of the landfill.  
 CH<sub>4</sub>: Methane  
 CO<sub>2</sub>: Carbon dioxide  
 O<sub>2</sub>: Oxygen  
 N<sub>2</sub>: Nitrogen  
 %: Percent-by-volume  
 LFG: Landfill gas analyzer (GEM5000, or equivalent)



Table 2

USEPA Method 25C Analytical Results  
Act 87/461 Header (OH) and Utility Flare Blower Inlet (MH)  
Manistee County Landfill  
Manistee, Michigan  
August 13, 2019

Test No.	Tank No.	NMOC (ppm)	NMOC <sub>hexane</sub> (ppm)
1	112	109	18.2
2	115	145	24.2
3	118	134	22.3
<b>OH Averages</b>		<b>129</b>	<b>21.6</b>
1	143	3,300	550.0
2	178	3,380	563.3
3	273	3,370	562.7
<b>MH Averages</b>		<b>3,350</b>	<b>558.3</b>

OH: "Old Hills" – Act 87/641 Header – closed phase(s) of the landfill.

MH: "Main Header" – combined closed and active phases of the landfill.

NMOC: Non-methane organic compounds, as carbon, corrected for oxygen.

NMOC<sub>hexane</sub>: NMOC, as hexane (= NMOC / 6).

ppm: Parts-per-million, volume.



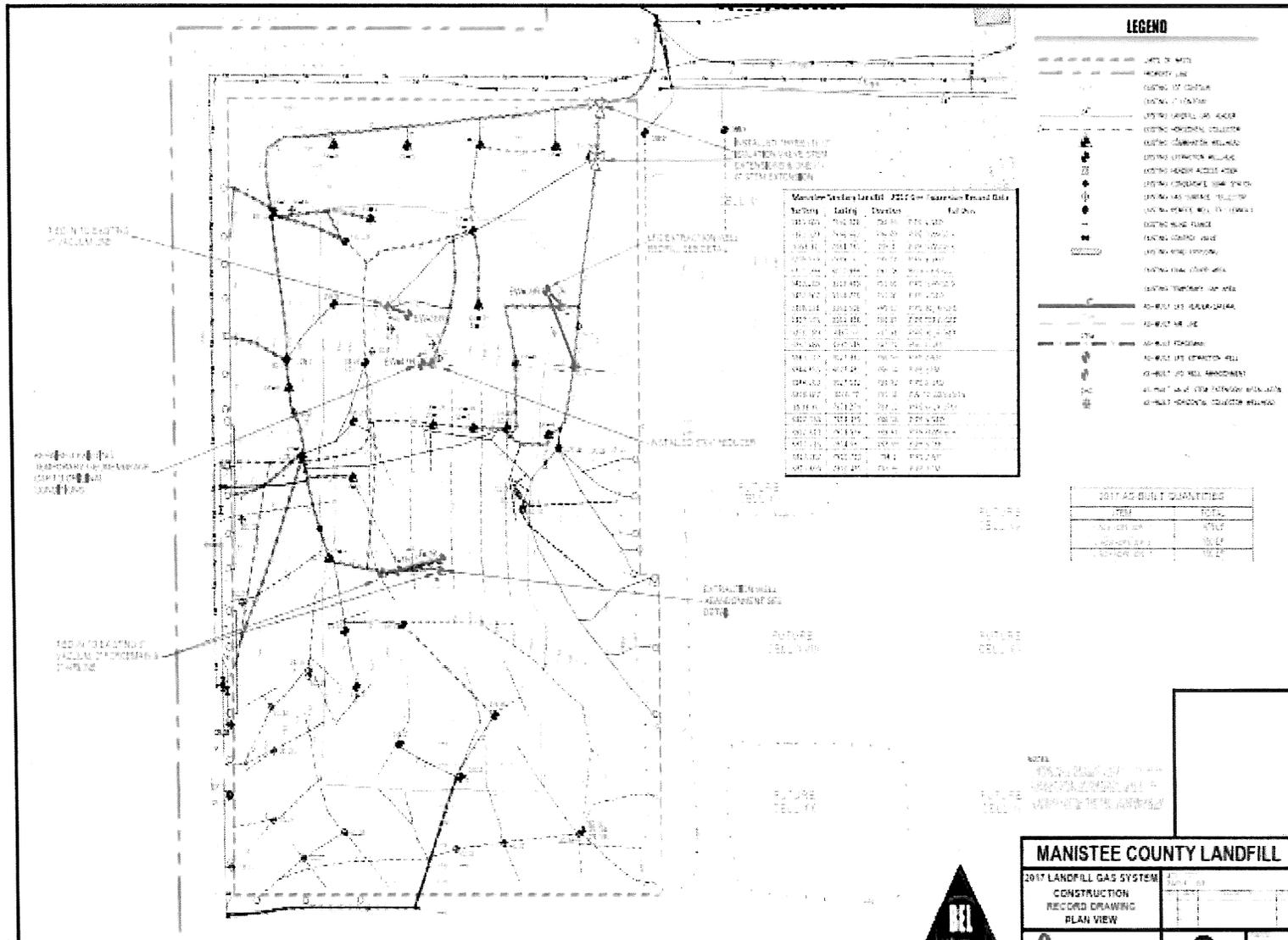
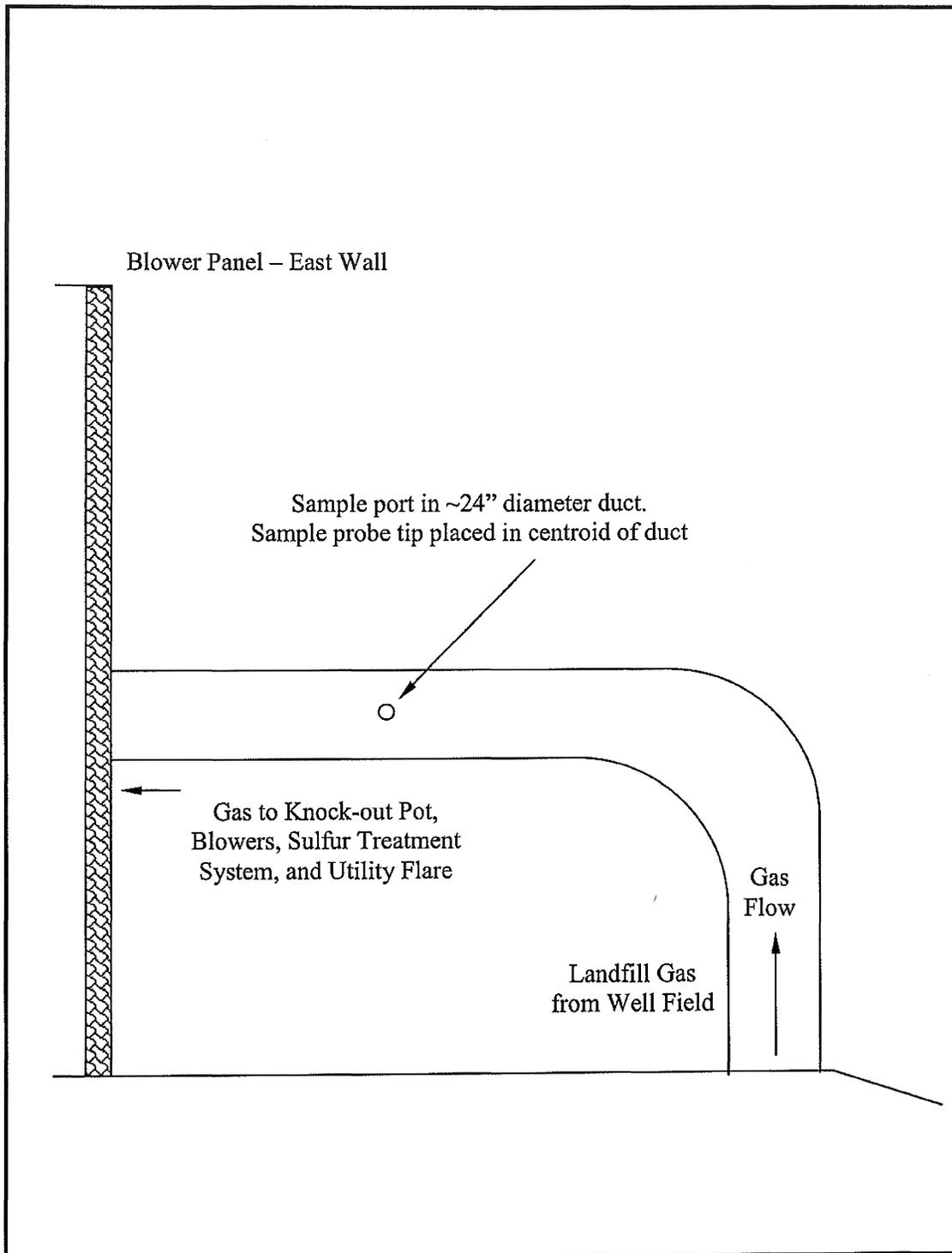
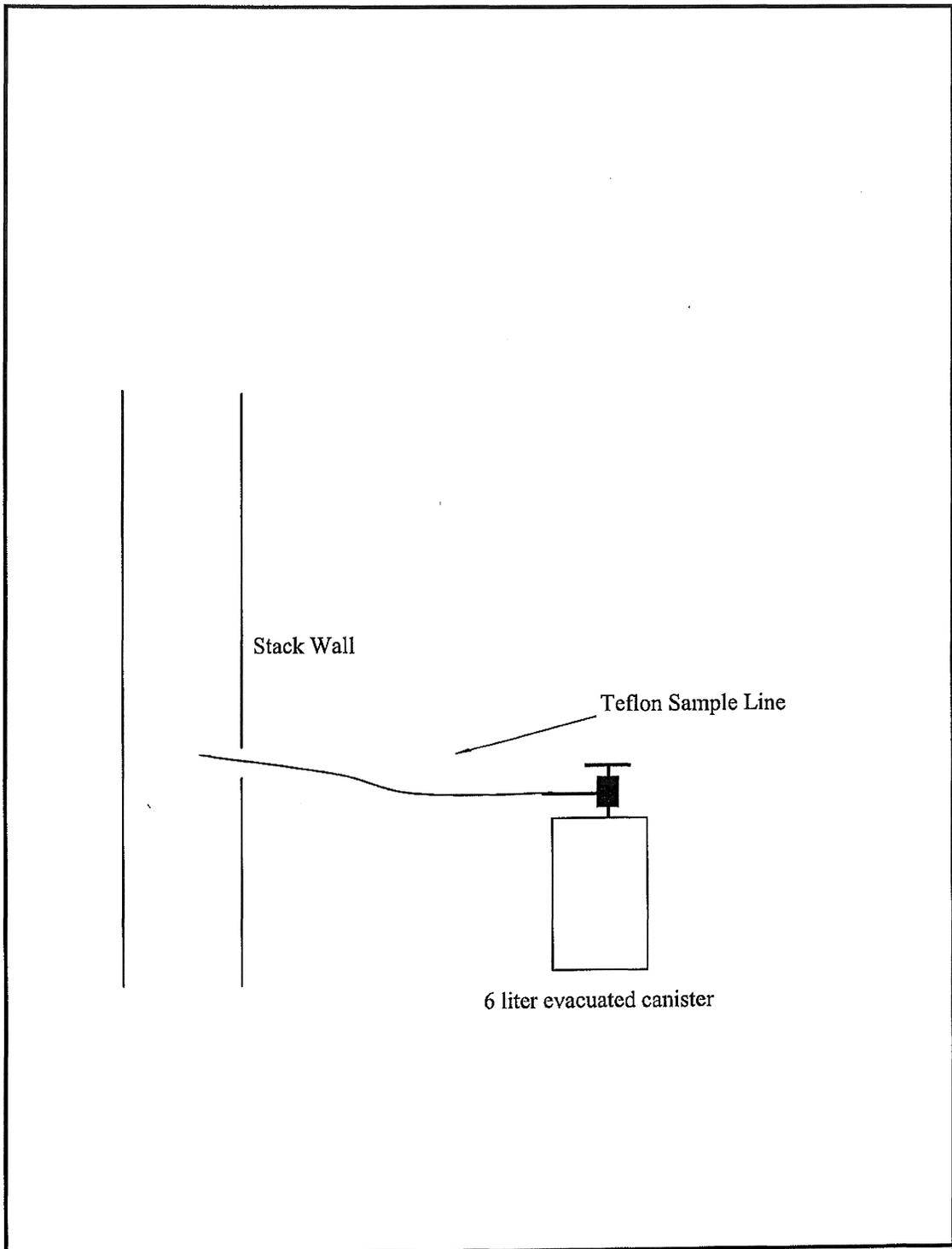


Figure 1: Manistee County Landfill Gas Collection System – General Arrangement



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

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 August 13, 2019



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

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