BTEC Inc.

City of Warren Sewage Sludge Incinerator NOx and CO Emissions Test Report

Prepared for:

Tetra Tech, Inc.

710 Avis Drive
Ann Arbor, Michigan 48108

Project No. 049AS-353376
August 10, 2018

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
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EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by Tetra Tech Inc. (Tetra Tech) to conduct a performance test in conformance with Michigan Rule 972 "Emissions Standards For Existing Sewage Sludge Incineration Units" and 40 CFR Part 60 Subpart MMMM. The test program consisted of sampling and analysis of stack exhaust gas concentrations, and emission rates for carbon monoxide (CO) and oxides of nitrogen (NOx) from the Incinerator exhaust stack located at the City of Warren Wastewater Treatment Plant (WWTP). In addition, fugitive emissions from the Ash handling system were observed. The emissions test program was conducted on June 12, 2018.

Testing consisted of triplicate 84-minute test runs for CO and NOx, and triplicate 60-minute test runs for fugitive emissions. The emissions test program was required by MDEQ Air Quality Division Renewable Operating Permit (ROP) No. MI-ROP-B1792-2016. The results of the emission test program are summarized by Table I.

Table I
Incinerator Overall Emission Summary
Test Date: June 12, 2018

Pollutant	Emission Limit[1]	Emission Rate[1]
NOx	220 ppmv	237 ppmv
CO	3,800 ppmv	3,147 ppmv

1: All emission limits and emission rates are corrected to 7% oxygen.

1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Tetra Tech Inc. (Tetra Tech) to conduct a performance test in conformance with Michigan Rule 972 "Emissions Standards For Existing Sewage Sludge Incineration Units" and 40 CFR Part 60 Subpart MMMM. The test program consisted of sampling and analysis of stack exhaust gas concentrations, and emission rates for carbon monoxide (CO) and oxides of nitrogen (NOx) from the Incinerator exhaust stack located at the City of Warren Wastewater Treatment Plant (WWTP). In addition, fugitive emissions from the Ash handling system were observed. The emissions test program was conducted on June 12, 2018. The purpose of this report is to document the results of the test program.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (March 2018). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document. All testing was performed in accordance with BTEC test plan 049AS-353376.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on June 12, 2018 at the WWWTP in Warren, Michigan. The test program included evaluation of NOx and CO from the incinerator exhaust, and fugitive emissions from the ash handling system.

1.b Purpose of Testing

AQD issued Renewable Operating Permit No. MI-ROP-B1792-2016 to WWWTP. This permit limits emissions from the incinerator as summarized by Table 1.

Table 1
Existing Multiple Hearth Sewage Sludge Emission Limitations

Pollutant	Part 60 Subpart MMMM Limit
NOx	220 ppmV
CO	3,800 ppmV

All limits are corrected to 7% oxygen

1.c Source Description

The City of Warren owns and operates a multiple hearth sewage sludge incinerator located in Warren, Michigan. The incinerator combusts natural gas and sewage sludge, a product of secondary and tertiary waste water treatment processes, also known as biosolids. The incinerator exhaust gases are passed through a wet scrubber prior to discharge to atmosphere.

1.d Test Program Contacts

The contact for the source and test report is:

Mr. Todd Schaedig, P.E.
Facility Engineer
City of Warren Wastewater Treatment Plant
32360 Warkrop Ave.
Warren, MI 48093
586-264-2530 ext 8203

Ms. Valerie Guenther P.E.
Project Manager
Tetra Tech Inc.
710 Avis Drive, Suite 100
Ann Arbor, Michigan 48108
734-765-3984 (c) 734-213-4043 (w)

Mr. Barry P. Boulianne
Senior Project Manager
BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, MI 48073
313-449-2361

Names and affiliations for personnel who were present during the testing program are summarized by Table 2.

Table 2
Test Personnel

Name and Title	Affiliation	Telephone
Ms. Valerie Guenther Project Manager	Tetra Tech Inc. 710 Avis Drive, Suite 100 Ann Arbor, Michigan 48108	(734) 765-3984
Mr. Matthew Young Client Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(586) 744-9133
Mr. Barry Boulianne Operations Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(313) 449-2361
Mr. Mark Dziadosz Environmental Quality Analyst	MDEQ Air Quality Division	(586) 753-3745
Mr. Sebastian Kallumkal Senior Environmental Engineer	MDEQ Air Quality Division	(586) 753-3738

2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions compliance test program.

2.a Operating Data

Process data monitored during the emissions test program included sludge feed rate in wet tons per hour, pH at the venturi stage drain, water flow in gpm and differential pressure in inches of water column across the VenturiPak unit and combustion chamber temperature of hearths 4, 5, 6 & 7 in degrees Fahrenheit. Based on one year of operational experience with the new pollution controls in place Warren believes that the best representation of the combustion temperature in the incinerator is the average of hearths 4, 5, 6 and 7. This average better represents the minimum temperature that should be maintained in the incinerator during the varying sludge cake loading conditions that might be encountered during normal plant operations. The actual data that was recorded is compiled and averaged per the rule in Appendix E.

2.b Applicable Permit

The applicable permit for this emissions test program is Renewable Operating Permit (ROP) No. MI-ROP-B1792-2016.

2.c Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a). Detailed emission summaries can be found in Table 4.

3. Source Description

Sections 3.a through 3.e provide a detailed description of the process.

3.a Process Description

The City of Warren owns and operates a multiple hearth sewage sludge incinerator located in Warren, Michigan. The incinerator combusts natural gas and sewage sludge, a product of secondary and tertiary waste water treatment processes, also known as biosolids. The incinerator exhaust gases are passed through a wet scrubber prior to discharge to atmosphere.

3.b Process Flow Diagram

Due to the simplicity of the incinerator, a process flow diagram is not necessary.

3.c Raw and Finished Materials

The process combusts dewatered biosolids which is fed to the incinerator at a maximum rate of 6.5 wet tons per hour, which is equivalent to an 85% feed rate of 5.53 wet tons per hour.

3.d Process Capacity

The process combusts dewatered biosolids which is fed to the incinerator at a maximum rate of 6.5 wet tons per hour, which is equivalent to an 85% feed rate of 5.53 wet tons per hour.

3.e Process Instrumentation

Process data monitored during the emissions test program included sludge feed rate in wet tons per hour, pH at the venturi stage drain, water flow in gpm and differential pressure in inches of water column across the VenturiPak unit and combustion chamber temperature of hearths 4, 5, 6, & 7 in degrees Fahrenheit. The actual data that was recorded is compiled and averaged per the rule in Appendix E.

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

4.a Sampling Train and Field Procedures

Sampling and analytical methodologies for the emissions test program were separated into two categories as follows:

(1) Measurement of exhaust gas O_2, NOx, and CO concentration using USEPA Methods 3A/7E/10
(2) Measurement of exhaust gas fugitive emissions using USEPA Method 22

Sampling and analytical methodologies by category are summarized below.

O_2, NOx, and CO (USEPA Method 3A/7E/10)

The NOx content of the gas stream was measured using a Teledyne Model T200H NOx gas analyzer. The CO content of the gas stream was measured using a TECO 48i CO gas analyzer. The O_2 content was measured using a Servomex 4100 gas analyzer. The gas stream was drawn through a stainless-steel probe with a heated in-line filter to remove any particulate, a heated Teflon® sample line, through a refrigerated Teflon® sample conditioner to remove the moisture from the sample before it entered the gas analyzers. Data was recorded on a PC equipped with data acquisition software. Recorded NOx, CO, and O_2 concentrations were averaged and reported for the duration of each test (as drift

corrected per Method 7E). A drawing of the sampling train used for the testing program is presented as Figure 2.

In accordance with Method 7E, a 3-point (zero, mid, and high) bias check and calibration check was performed on the analyzer prior to initiating the test program. Following each test run, a 2-point (zero and mid) calibration drift check was performed. The NOx analyzer was operated at the 0-500 ppm range. The CO analyzer was operated at the 0-5000 ppm range. The O_2 analyzer was operated in the 0-25% range.

Fugitive Emissions (USEPA Method 22)

40 CFR 60, Appendix A, Method 22, *"Visual Determination of Fugitive Emissions from Stationary Sources"* was used to measure opacity at the ash handling system. Triplicate test runs of 60 minutes were conducted.

No emissions were observed during the testing. Hand written opacity sheets are included in Appendix A.

4.b Recovery and Analytical Procedures

Descriptions of the recovery procedures are provided in section 4.a for each sampling method.

4.c Sampling Ports

A diagram of the stack showing sampling ports in relation to upstream and downstream disturbances is included as Figure 1.

4.d Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figure 1.

5. Test Results and Discussion

Sections 5.a through 5.k provide a summary of the test results.

5.a Results Tabulation

The overall results of the emissions test program are summarized by Table 3. Detailed results for the emissions test program are summarized by Table 4.

Table 3
Incinerator Overall Emission Summary
Test Date: June 12, 2018

Pollutant	Emission Limit[1]	Emission Rate[1]
NOx	220 ppmv	237 ppmv
CO	3,800 ppmv	3,146 ppmv

1: All emission limits and emission rates are corrected to 7% oxygen.

5.b Discussion of Results

Results are discussed in City of Warren notice of exceedance to MDEQ dated June 19. 2018. See Appendix F.

5.c Sampling Procedure Variations

None.

5.d Process or Control Device Upsets

No upset conditions occurred during testing.

5.e Control Device Maintenance

There was no control equipment maintenance performed during the emissions test program.

5.f Re-Test

The emissions test program was not a re-test.

5.g Audit Sample Analyses

No audit samples were required for the testing.

5.h Calibration Sheets

Relevant equipment calibration documents are provided in Appendix B.

5.i Sample Calculations

Sample calculations are provided in Appendix C.

5.j Field Data Sheets

Field documents relevant to the emissions test program are presented in Appendix A.

5.k Laboratory Data

Raw CEM data is provided electronically in Appendix D.

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MEASUREMENT UNCERTAINTY STATEMENT

Both qualitative and quantitative factors contribute to field measurement uncertainty and should be taken into consideration when interpreting the results contained within this report. Whenever possible, Montrose Air Quality Services, LLC, (MAQS) personnel reduce the impact of these uncertainty factors through the use of approved and validated test methods. In addition, MAQS personnel perform routine instrument and equipment calibrations and ensure that the calibration standards, instruments, and equipment used during test events meet, at a minimum, test method specifications as well as the specifications of our Quality Manual and ASTM D 7036-04. The limitations of the various methods, instruments, equipment, and materials utilized during this test have been reasonably considered, but the ultimate impact of the cumulative uncertainty of this project is not fully identified within the results of this report.

Limitations

All testing performed was done in conformance to the ASTM D7036-04 standard. The information and opinions rendered in this report are exclusively for use by Tetra Tech. BTEC will not distribute or publish this report without Tetra Techs's consent except as required by law or court order. BTEC accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

This report was prepared by: _____
Matt Young
Client Project Manager

This report was reviewed by: _____
Brandon Chase
QA/QC Manager

Table 4
Incinerator
NOx and CO Emission Rates
WWTP
Warren, Michigan
BTEC Project No. 049AS-353376
Sampling Dates: 6/12/2018

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	6/12/2018	6/12/2018	6/12/2018	
Test Run Time	9:17-10:41	11:41-13:05	13:19-14:43	
Oxygen Concentration (%)	12.2	12.1	10.8	**11.7**
Oxygen Concentration (%, drift corrected as per USEPA 7E)	12.4	12.1	10.8	**11.8**
Outlet Oxides of Nitrogen Concentration (ppmv)	150.5	154.8	145.2	**150.2**
Outlet NOx Concentration (ppmv, corrected as per USEPA 7E)	153.7	158.5	150.2	**154.1**
Outlet NOx Concentration (ppmv, corrected to 7% O_2)	**252.5**	**251.8**	**207.0**	**237.1**
Outlet Carbon Monoxide Concentration (ppmv)	1753.5	2325.4	1971.1	**2016.7**
Outlet CO Concentration (ppmv, corrected as per USEPA 7E)	1777.9	2364.7	2004.7	**2049.1**
Outlet CO Concentration (ppmv, corrected to 7% O_2)	**2920.2**	**3756.0**	**2763.2**	**3146.5**

O_2 Correction			
Co	0.23	0.10	0.04
Cma	9.95	9.95	9.95
Cm	9.81	9.92	9.92

NOx Correction			
Co	1.91	4.49	7.31
Cma	249.3	249.3	249.3
Cm	242.92	240.88	236.23

CO Correction			
Co	-12.92	-12.18	-2.95
Cma	2490	2490	2490
Cm	2460.99	2449.29	2449.03

scfm = standard cubic feet per minute
dscfm = dry standard cubic feet per minute
ppmv = parts per million on a volume-to-volume basis
lb/hr = pounds per hour
MW = molecular weight (CO = 28.01, NOx = 46.01, SO_2 = 64.05, C_3H_8 = 44.10, carbon = 12.01)
24.14 = molar volume of air at standard conditions (70°F, 29.92" Hg)
35.31 = ft^3 per m^3
453600 = mg per lb

Equations
lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * ***dcfm*** * 60
$Conc_{@7\%O2}$ = Conc * (20.9 -7)/(20.9 - $\%O_2$)

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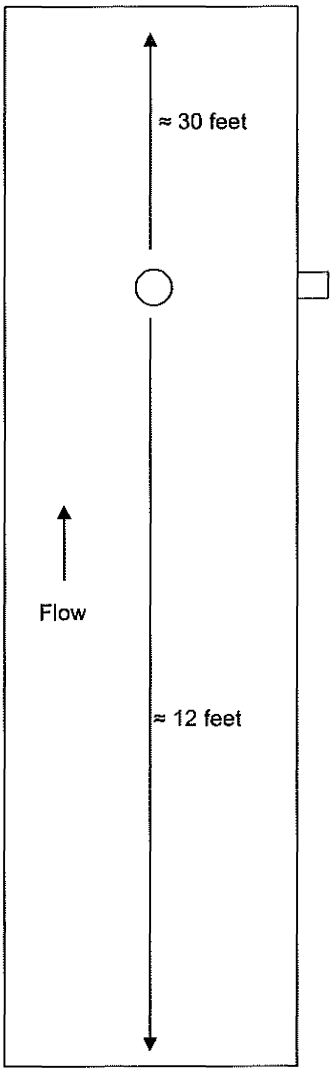
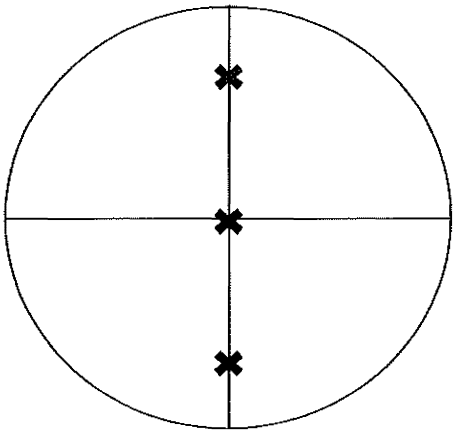
diameter = 47.75 inches





Not to Scale

Points	Distance "
1	8.0
2	23.9
3	39.8

Figure No. 1

Site: **Incinerator Exhaust** **WWTP** **Warren, Michigan**	**Sampling Date:** **June 12, 2018**	**BT Environmental Consulting, Inc.** **4949 Fernlee Avenue** **Royal Oak, Michigan 48073**

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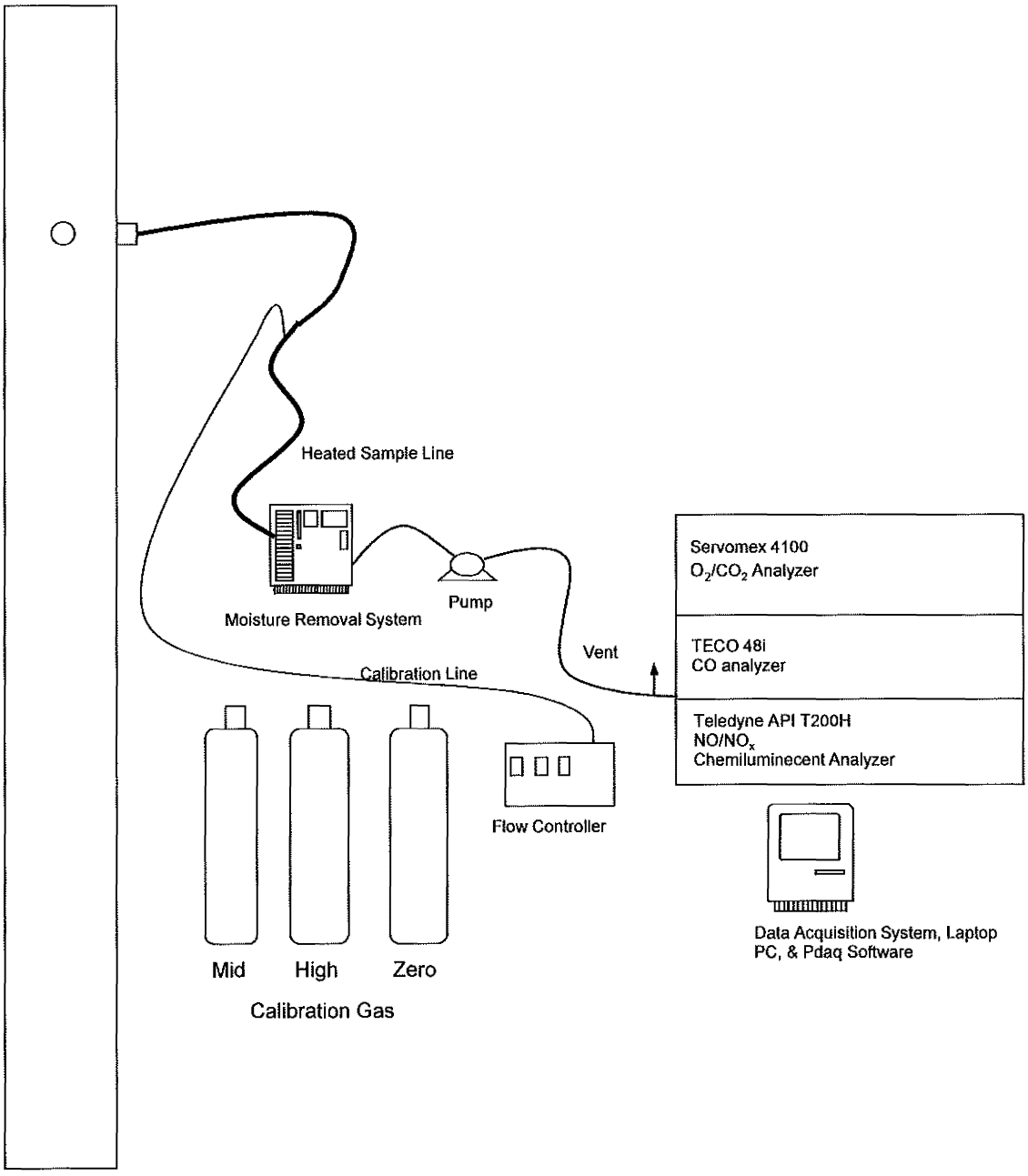

Figure No. 2

Site:	Sampling Date:	
USEPA Method 3A, 7E, and 10 WWTP Warren, Michigan	June 12, 2018	BT Environmental Consulting Inc. 4949 Fernlee Avenue Royal Oak, MI 48073