BTEC Inc.

Engines 1 and 5
CO Destruction Efficiency
Emissions Test Summary Report

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Prepared for:

DTE Energy

DTE Putnam Facility
5660 Mertz Rd.
Mayville, Michigan

Project No. 16-4891.00
June 30, 2016

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
(248) 548-8070

EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by DTE Energy (DTE) to evaluate carbon monoxide (CO) and oxygen (O_2) concentrations from the inlet and outlet of two diesel peaker units at the DTE Putnam facility located in Mayville, Michigan. The emissions test program was conducted on June 21 and 23, 2016.

Testing of Engine 1 and Engine 5 consisted of triplicate 60-minute test runs on the inlet and outlet simultaneously at each engine. The emissions test program was required by 40 CFR Part 63 Subpart ZZZZ MACT standards. The results of the emission test program are summarized by Table I.

Table I
Overall Emission Summary
Test Date: June 21 and 23, 2016

Engine 1

Pollutant	Average Destruction Efficiency (%)	Average Emission Rate	Emission Limit
CO	79.9	29.8 ppmv[1]	70 % Destruction Efficiency or 23 ppmv[1]

1: Corrected to 15% O_2

Engine 5

Pollutant	Average Destruction Efficiency (%)	Average Emission Rate	Emission Limit
CO	73.7	21.8 ppmv[1]	70 % Destruction Efficiency or 23 ppmv[1]

1: Corrected to 15% O_2

1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by DTE Energy (DTE) to evaluate carbon monoxide (CO) and oxygen (O_2) concentrations from the inlet and outlet of two diesel peaker units at the DTE Putnam facility located in Mayville, Michigan. The emissions test program was conducted on June 21 and 23, 2016.

AQD has published a guidance document entitled "Format for Submittal of Source Emission Test Plans and Reports" (December 2013). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on June 21 and 23, 2016 at the DTE Putnam facility located in Mayville, Michigan. The test program included evaluation of CO and O_2 emissions from the inlets and outlets of Engines 1 and 5.

1.b Purpose of Testing

Compliance emission testing is required by 40 CFR Part 63 Subpart ZZZZ MACT standards. This permit limits emissions from each engine as summarized by Table 1.

Table 1
CO Emission Limitations

Facility	CO DE Emission Limit	CO Emission Limit
DTE Putnam	70%	23 ppmv @ 15% O_2

1.c Source Description

Each peaker site employs five GM Electro-Motive Division MP45, 20 cylinder, diesel fueled, 3600 horsepower compression ignition (CI) engines. The sites are used as electrical substations, which generate supplemental electrical power during peak electrical demand periods or when required for load stability. On site diesel generators, produce the electrical power supply which is sent to the electrical grid. Each unit is capable of producing approximately 2.5MW.

1.d Test Program Contacts

The contact for the source and test report is:

Mr. Thomas Snyder
Senior Engineering Technician
DESC-EMR
6100 West Warren Ave
Room H136
Detroit, MI 48210
(313) 897-0899

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
Mr. Barry Boulianne Senior Project Manager	BTEC 4949 Fernlee Ave Royal Oak, Michigan 48073	(248) 548-8072
Mr. Steve Smith Project Manager	BTEC 4949 Fernlee Ave Royal Oak, Michigan 48073	(248) 548-8072
Mr. Shane Rabideau Environmental Technician	BTEC 4949 Fernlee Ave Royal Oak, Michigan 48073	(248) 548-8072

2. Summary of Results

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

2.a Operating Data

Operating parameters used to regulate the engines include speed (RPM) and torque. Additional parameters monitored were catalyst inlet temperature (F), crank case vacuum (in. H_2O), and differential pressure across the catalyst (in. H_2O).

2.b Applicable Permit

Compliance emission testing is required by 40 CFR Part 63 Subpart ZZZZ MACT standards.

2.c Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a). CO destruction efficiency from each engine was above the 70% limit.

3. Source Description

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

3.a Process Description

The facility has installed engines that employ a single oxidation catalyst to reduce HAP constituents as required by the RICE MACT. Per the MACT standard, reduction of CO levels in a substitute for measurement of HAPs, and CO must be reduced by at least 70% from pre-oxidation catalyst levels. The engines have independent exhaust stacks and catalyst systems. Sampling was performed on the horizontal section of the catalyst/muffler unit up-stream of the catalyst elements (pre-catalyst) to determine CO emission rates. Simultaneously, CO testing was performed on the horizontal section of the catalyst/muffler unit down-stream of the catalyst elements (post-catalyst) in order to calculate catalyst efficiency.

3.b Process Flow Diagram

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

3.c Raw and Finished Materials

The generator engines are reciprocating compression diesel (#2 fuel oil), fired units. Fuel consumption varies with operating parameters.

3.d Process Capacity

The engines are rated at 3,600 hp. The engine testing was completed during maximum operating conditions (+/- 10% of 100% load).

3.e Process Instrumentation

Operating data collected during the testing included: load, catalyst inlet temperature (F), and crank case vacuum (in. H_2O), and differential pressure across the catalyst (in. H_2O).

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

The CO content was measured using a Teledyne Model 300EM CO gas analyzer, and the O_2 content was measured using a M&C Products PMA 100-L O_2 gas analyzer. A sample of the gas stream was drawn through an insulated stainless-steel probe with an in-line glass fiber filter to remove any particulate, a heated Teflon® sample line, and through an electronic sample conditioner to remove the moisture from the sample before it enters the analyzer. Data was recorded at 4-second intervals on a PC equipped with data acquisition software.

For analyzer calibrations, calibration gases were mixed to desired concentrations using an Environics Series 4040 Computerized Gas Dilution System. The Series 4040 consists of a single chassis with four mass flow controllers. The mass flow controllers are factory-calibrated using a primary flow standard traceable to the United State's National Institute of Standards and Technology (NIST). Each flow controller utilizes an 11-point calibration table with linear interpolation, to increase accuracy and reduce flow controller nonlinearity. A schematic of the sampling train is provided as Figure 1.

Sampling and analysis procedures utilized the following test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations (40 CFR 60, Appendix A):

- Method 3A, "*Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources*", was used to measure the O_2 concentration of the exhaust gas.

- Method 10, "*Determination of Carbon Monoxide Emissions from Stationary Sources*", was used to measure the CO concentration of the exhaust gas.

The accuracy of the gas dilution system was verified using the procedures detailed by Method 205.

4.b Recovery and Analytical Procedures

This test program did not include laboratory samples, consequently, sample recovery and analysis is not applicable to this test program.

4.c Sampling Ports

A diagram of the stack showing sampling ports in relation to upstream and downstream disturbances is included as Figures 2 and 3.

4.d Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figures 2 and 3.

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 Tables 4 and 5.

Table 3
Overall Emission Summary
Test Date: June 21 and 23, 2016

Engine 1

Pollutant	Average Destruction Efficiency (%)	Average Emission Rate	Emission Limit
CO	79.9	29.8 ppmv[1]	70 % Destruction Efficiency or 23 ppmv[1]

1: Corrected to 15% O_2

Engine 5

Pollutant	Average Destruction Efficiency (%)	Average Emission Rate	Emission Limit
CO	73.7	21.8 ppmv[1]	70 % Destruction Efficiency or 23 ppmv[1]

1: Corrected to 15% O_2

5.b Discussion of Results

The overall results of the emission test program are summarized by Table 3 (see Section 5.a). CO destruction efficiency from each engine was above the 70% limit.

5.c Sampling Procedure Variations

There were no sampling variations used during the emission compliance test program.

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 collected as part of the test program.

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

There are no laboratory results for this test program. Raw CEM data is provided electronically in Appendix D.

Mayville, Michigan
BTEC Project No. 16-4891.00
Sampling Dates: 6/21/2016

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	6/21/2016	6/21/2016	6/21/2016	
Test Run Time	9:50-10:54	11:08-12:08	12:23-13:23	
Inlet Oxygen Concentration (%)	11.7	11.7	11.6	**11.7**
Inlet Oxygen Concentration (%, drift corrected as per USEPA 7E)	11.9	11.8	11.8	**11.8**
Outlet Oxygen Concentration (%)	11.5	11.5	11.5	**11.5**
Outlet Oxygen Concentration (%, drift corrected as per USEPA 7E)	11.9	11.9	11.9	**11.9**
Inlet Carbon Monoxide Concentration (ppmv)	209.5	232.6	246.9	**229.7**
Inlet CO Concentration (ppmv, corrected as per USEPA 7E)	208.1	230.6	244.7	**227.8**
Inlet CO Concentration (ppmv, corrected to 15% O_2)	**136.4**	**149.8**	**158.5**	**148.2**
Outlet Carbon Monoxide Concentration (ppmv)	44.7	43.0	46.7	**44.8**
Outlet CO Concentration (ppmv, corrected as per USEPA 7E)	45.5	43.5	47.1	**45.4**
Outlet CO Concentration (ppmv, corrected to 15% O_2)	**29.9**	**28.6**	**30.8**	**29.8**
CO Destruction Efficiency (%)	**78.1**	**80.9**	**80.6**	**79.9**

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)

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

$Conc_{@15\%O2}$ = Conc * (20.9 -15)/(20.9 - $\%O_2$)

Mayville, Michigan
BTEC Project No. 16-4891.00
Sampling Dates: 6/23/2016

Parameter	Run 1	Run 2	Run 3	Average
Test Run Date	6/23/2016	6/23/2016	6/23/2016	
Test Run Time	9:40-9:43	11:01-12:01	12:19-13:19	
Inlet Oxygen Concentration (%)	12.1	12.1	12.2	**12.1**
Inlet Oxygen Concentration (%, drift corrected as per USEPA 7E)	12.4	12.4	12.4	**12.4**
Outlet Oxygen Concentration (%)	12.0	12.1	12.0	**12.0**
Outlet Oxygen Concentration (%, drift corrected as per USEPA 7E)	12.5	12.5	12.5	**12.5**
Inlet Carbon Monoxide Concentration (ppmv)	125.1	120.9	117.2	**121.0**
Inlet CO Concentration (ppmv, corrected as per USEPA 7E)	123.9	119.9	116.1	**120.0**
Inlet CO Concentration (ppmv, corrected to 15% O_2)	**85.5**	**82.7**	**80.3**	**82.8**
Outlet Carbon Monoxide Concentration (ppmv)	33.3	33.2	26.9	**31.1**
Outlet CO Concentration (ppmv, corrected as per USEPA 7E)	33.4	33.3	26.8	**31.2**
Outlet CO Concentration (ppmv, corrected to 15% O_2)	**23.3**	**23.3**	**18.7**	**21.8**
CO Destruction Efficiency (%)	**72.7**	**71.8**	**76.7**	**73.7**

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)

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

$Conc_{@15\%O2}$ = Conc * (20.9 -15)/(20.9 - $\%O_2$)

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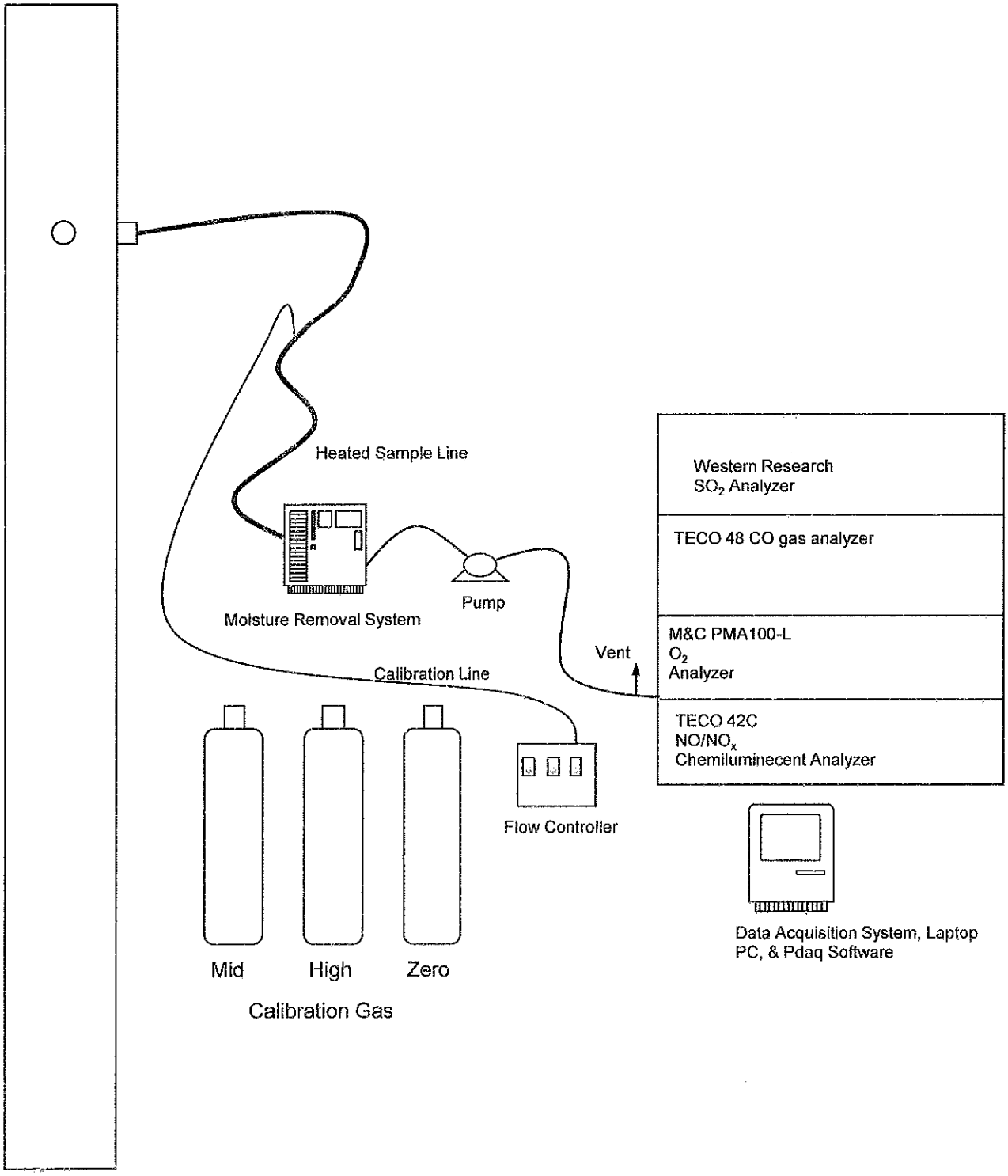

Figure No. 1

Site:	Sampling Date:	
USEPA Method 3A and 10 DTE Putnam Mayville, Michigan	June 21 and 23, 2016	BT Environmental Consulting Inc. 4949 Fernlee Avenue Royal Oak, MI 48073

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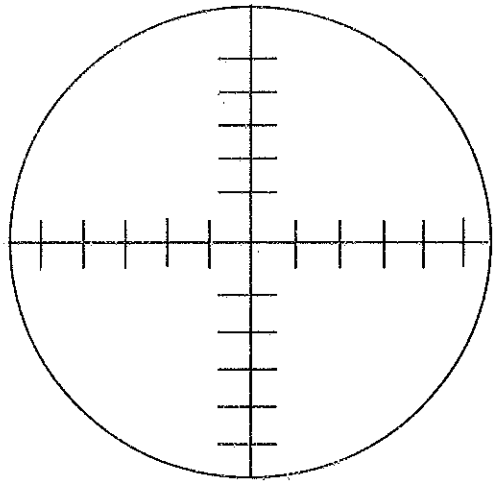
diameter = 35"

Points	Distance "
1	1.1
2	3.7
3	6.8
4	11.3
5	23.7
6	28.2
7	31.3
8	33.9



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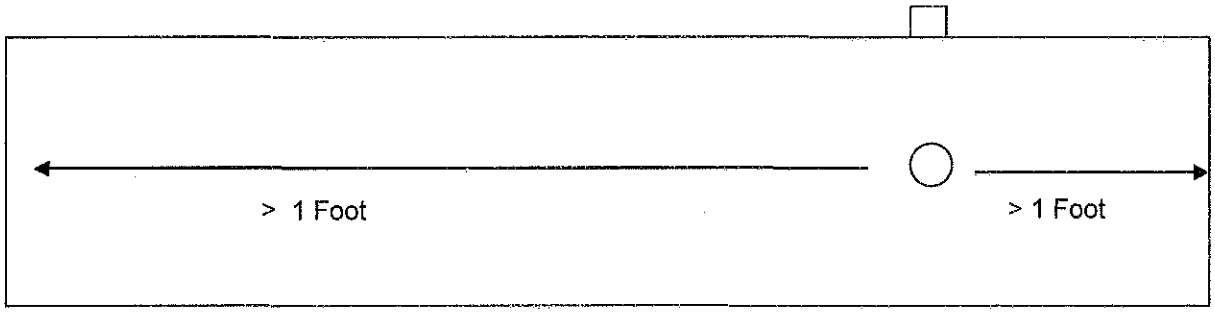


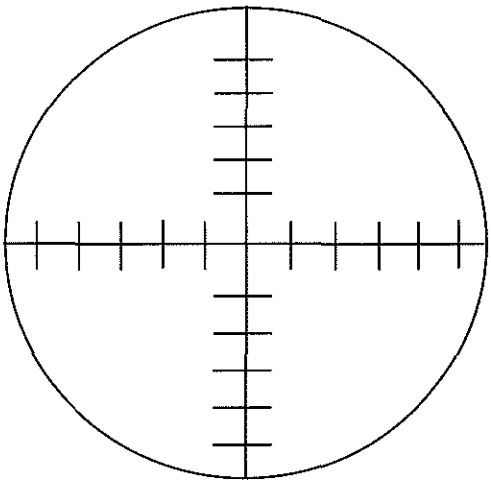
Figure No. 2

Site:	Sampling Date:	BT Environmental Consulting, Inc.
Engine 1 and 5 Inlet DTE Putnam Mayville, Michigan	June 21 and 23, 2016	4949 Fernlee Royal Oak, Michigan

BTEC Inc.

diameter = 21"

Points	Distance "
1	0.7
2	2.2
3	4.1
4	6.8
5	14.2
6	16.9
7	18.8
8	20.3



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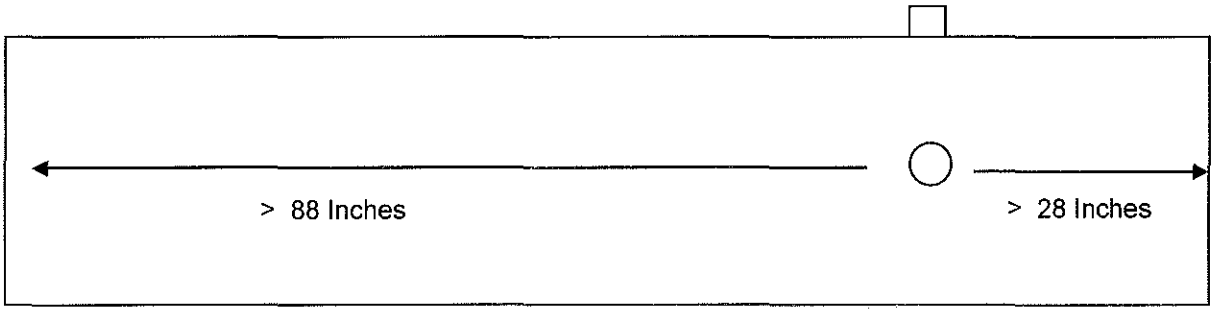

Figure No. 3

Site: **Engine 1 and 5 Outlet** **DTE Putnam** **Mayville, Michigan**	**Sampling Date:** **June 21 and 23, 2016**	**BT Environmental Consulting, Inc.** **4949 Fernlee** **Royal Oak, Michigan**