A.Lanfranco & Associates Inc.
Environmental Consultants

Prepared for

METRO VANCOUVER

Metrotower III 4730 Kingsway
Burnaby, BC V5H 0C6

Annual Trace Organics Emission Report
Waste-to-Energy Facility

August 2018 Survey
Operational Certificate 107051

CERTIFICATION

The field monitoring for this survey was conducted by certified stack test technicians as required by the British Columbia Ministry of Environment (BC MOE) Field Sampling Manual.

The field crew consisted of:

Mr. S. Harrington (certified), and Mr. Jeremy Gibbs.

The report was prepared by Mr. M. Lanfranco using reporting principles and guidelines generally acceptable to Metro Vancouver (MV).

The field crew and A. Lanfranco and Associates Inc. certify that the test methods used were BC MOE/MV approved reference methods for the parameters investigated.

Mark Lanfranco, CST
President | Owner

Table of Contents

APPENDICES

TEST PROGRAM ORGANIZATION

Primary Stakeholders:	Brent Kirkpatrick and Sarah Wellman Metro Vancouver – Solid Waste Services Metrotower III - 4730 Kingsway Burnaby, B.C. Canada Email: brent.kirkpatrick@metrovancouver.org Email: sarah.wellman@metrovancouver.org
Facility Coordinator:	Stephen McKinney Facility Manager Covanta Burnaby Renewable Energy ULC 5150 Riverbend Drive Burnaby, BC Canada V3N 4V3 Email: smckinney@covanta.com
Project Manager/Sampling Contractor:	Mr. Mark L.A. Lanfranco President and Owner A. Lanfranco and Associates Inc. 101 – 9488 189 St Surrey, BC Canada V4N 4W7 Tel: (604) 881-2582 Email: mark.lanfranco@alanfranco.com
Sampling Crew:	Mr. M. Lanfranco – A. Lanfranco and Associates Inc. Mr. C. Lanfranco – A. Lanfranco and Associates Inc. Mr. S. Harrington – A. Lanfranco and Associates Inc. Mr. M. Harrington – A. Lanfranco and Associates Inc. Mr. S. Ferguson – A. Lanfranco and Associates Inc. Mr. M. Goods – A. Lanfranco and Associates Inc.

SUMMARY

The following tables present the average of triplicate test results on Unit 1 for various trace organics on August 22-24, 2018. Additional emission parameters were measured by the facilities certified continuous emission monitoring system.

Parameter		Unit 1	Limit
PCDD/PCDF	(TEQ ng/Sm^3 @ 11% O_2)	0.0013	0.08
PCDD/PCDF Mass Emission	(TEQ g/day)	2.61E-06	
PAH	(ug/Sm^3 @ 11% O_2)	0.0291	5.0
HCB	(ug/Sm^3 @ 11% O_2)	0.0023	
Total CB	(ug/Sm^3 @ 11% O_2)	0.3007	1.0
Total CP	(ug/Sm^3 @ 11% O_2)	0.0718	1.0
Total PCB	(ug/Sm^3 @ 11% O_2)	0.0011	1.0
Flowrate	(Sm^3/min)	1250	
Temperature	(^oC)	154.9	
O_2	(vol % dry)	9.8	

standard conditions of 20 deg C and 101.325 kPa (dry)

Note: PCDD/PCDF results are in nanograms per cubic meter and grams/day, PAH/HCB/CB/CP are reported in micrograms per cubic meter.

1.0 INTRODUCTION

Metro Vancouver (MV) commissioned an emissions monitoring survey at the Waste-to-Energy Facility (WTEF) in Burnaby, B.C. This report documents the results of a semi-volatile organics survey for dioxin/furan (PCDD/PCDF), polychlorinated biphenyl (PCB), polycyclic aromatic hydrocarbons (PAH), hexachlorobenzenes (HCB), chlorobenzenes (CB), and chlorophenols (CP) during normal operations at the facility.

This report includes detailed emission results, a brief outline of methods employed, equipment used, and a discussion of the survey. Supporting data is presented in the appendices section of this report.

For 2018, the individual source that was monitored is identified as Unit 1.

2.0 METHODOLOGY

All services provided by A. Lanfranco and Associates were conducted in accordance with approved reference methods as issued by:

- Metro Vancouver
- BC Ministry of Environment & Climate Change Strategy
- Environment Canada (EC)
- US Environmental Protection Agency (EPA)

2.1 Sampling and Analytical Methods

The following table lists the test methods used for the different parameters measured. The subsequent paragraphs briefly describe each method.

Parameter	**Reference Method**
Sample and Velocity traverse points	EPS 1/RM/8 A Determination of Sampling Site and Traverse Points
Velocity and flowrate	EPS 1/RM/8 B Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Gas molecular weight (O_2/CO_2)	EPS 1/RM/8 C Determination of Molecular Weight by Gas Analysis
Flue gas Moisture	EPS 1/RM/8 D Determination of Moisture Content
Dioxin/Furan (sampling)	EPS 1/RM/2 Reference Method for Source Testing - Measurement of Releases of Semi-Volatile Organic Compounds from Stationary Sources EPA Method 23 Determination of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans from Stationary Sources supporting
Dioxin/Furan (analytical)	Methodology for Organic Analysis - A Method for the Analysis of Polychlorinated Dibenzopara-Dioxins (PCDD's), Polychlorinated Dibenzofurans (PCDF's) Environment Canada, December 1989

Sampling Site and Traverse Points — Primary: EPS 1/RM/8 Method A; Supporting: EPA Method 1

This method is designed to aid in the representative measurement of pollutant emissions and/or total volumetric flow rate from a stationary source. A measurement site where the effluent stream is flowing in a known direction is selected, and the cross-section of the stack is divided into a number of equal areas. Traverse points are then located within each of these equal areas.

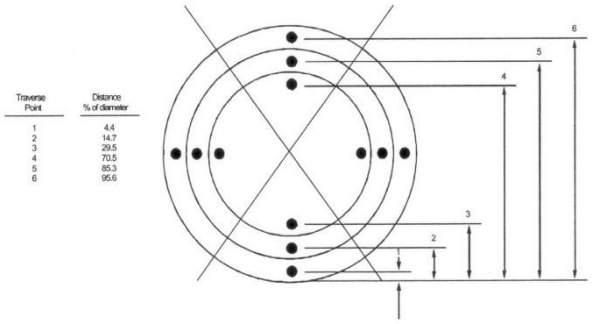


Figure 1. Example showing circular stack cross section divided into 12 equal areas, with location of traverse points.

Stack Gas Velocity and Volumetric Flow Rate

Primary: EPS 1/RM/8 Method B
Supporting: EPA Method 2

The average gas velocity in a stack or duct is determined from the gas density and from the measurement of velocity pressure with an S-type pitot tube. A standard pitot tube may be used where plugging of the tube openings due to particulate matter and/or moisture is not likely to occur. Stack gas volumetric flow rate is determined from measurements of stack gas velocity, temperature, absolute pressure, dry gas composition, moisture content, and stack diameter.

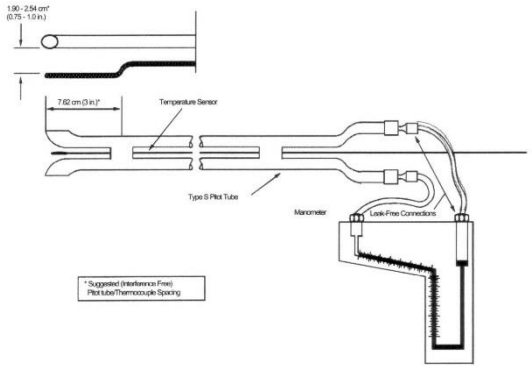


Figure 2. Type S Pitot Tube Manometer Assembly

Molecular Weight by Gas Analysis

Primary: EPS 1/RM/8 Method C
Supporting: EPA Method 3

An integrated or grab sample is extracted from a single point in the gas stream and analyzed for its components using a Fyrite analyzer, a gas chromatograph, or calibrated continuous analyzers.

Moisture Content

Primary: EPS 1/RM/8 Method D
Supporting: EPA Method 4

A gas sample is extracted from a single point in the enclosed gas stream being sampled. The moisture is condensed and its weight measured. This weight, together with the volume of gas sampled, enables the stack gas moisture content to be calculated.

Dioxins / Furans	Primary:	EPS 1/RM/2, 1/RM/3, 1/RM/23
	Supporting:	EPA Method 23

This method is applicable to the determination of emissions of polychlorinated dibenzo-para-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and other semi-volatile organic compounds from stationary sources. An integrated gas sample is isokinetically withdrawn from the stack similar to Method 5. Semi-volatile organic compounds associated with particulate matter are collected in the front half components with remaining compounds not collected by the filter, being absorbed in an Amberlite XAD-2 resin trap.

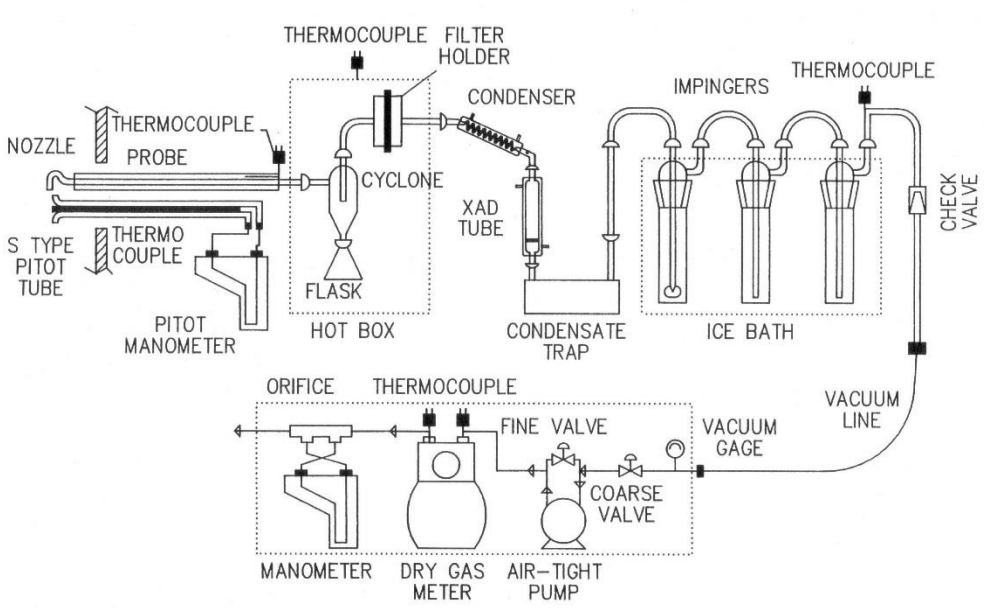


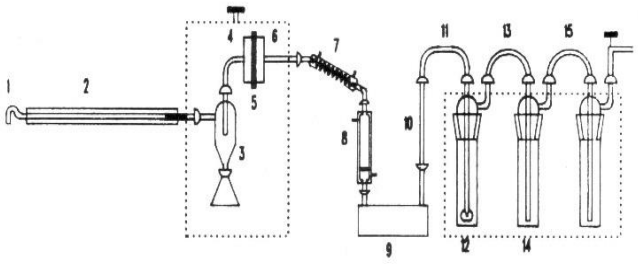
Figure 3 - Dioxin / Furan Sampling Train

Due to the sensitivity of this test method, extra care and precautions are used. All sample trains were cleaned professionally at an accredited laboratory. A solvent proof of the glassware and XAD was archived as suggested by the method.

The train was operated for duration of 240 minutes. Upon completion, it was removed to a clean area for recovery. The recovered sample consists of 6 individual components:

• Filter Rinses	• Front Half Rinses
• XAD Trap	• Soak
• Impingers	• Final Rinse

Complete sampling and recovery procedures can be supplied upon request.



Container or Sample	Component(s)	Recovery Procedure
1	1, 2, 3, 4	Wash and brush 3 times each with hexane (H) and acetone (A). Rinse 3 times each with H and A.
2	5	Remove carefully from holder. Place on pre-cleaned foil. Fold in half. Place in pre-cleaned glass petri dish.
3	6, 7	Soak 5 minutes each with H and A. Rinse 3 times each with H and A.
4	8	Cap ends and wrap in foil.
5	9, 12	Empty contents into container and rinse each 3 times with HPLC water.
6	6 to 15 except 8	Rinse 3 times each with H and A.

Mark liquid levels on all bottles.
All sample containers are pre-cleaned amber glass bottles with pre-cleaned Teflon lid liners.

Figure 4 Recovery Procedures for Semi-Volatile Organics

Samples are analyzed on a high-resolution GS/MS at Pacific Rim Laboratories Inc. of Surrey, BC. Following is a description, in very simplified terms, of the basic procedures used to process the sample train and blank train components.

Initially the sample components are separated into liquid (containers 1, 4, 5 and 6) or solid phases (containers 2 and 3) and surrogate compounds (for recovery calculations) are injected into the solid phases of the front and back half samples. Liquid and solid samples are extracted with various solvents (usually benzene), sometimes under acid conditions. Figure 5 and Figure 6 demonstrate the step by step procedures used to extract the components of interest into a solvent phase which is ready for detailed splitting and clean-up. The concentrated extracts from Figure 5 are combined and are processed per procedures detailed in Figure 6.

When each target group has been isolated, as indicated in Figure 4, the extract volumes are dried, concentrated, and analysed by GC/MS analytical instrumentation. Prior to actual analysis, all samples were spiked with a performance standard for laboratory QA/QC purposes.

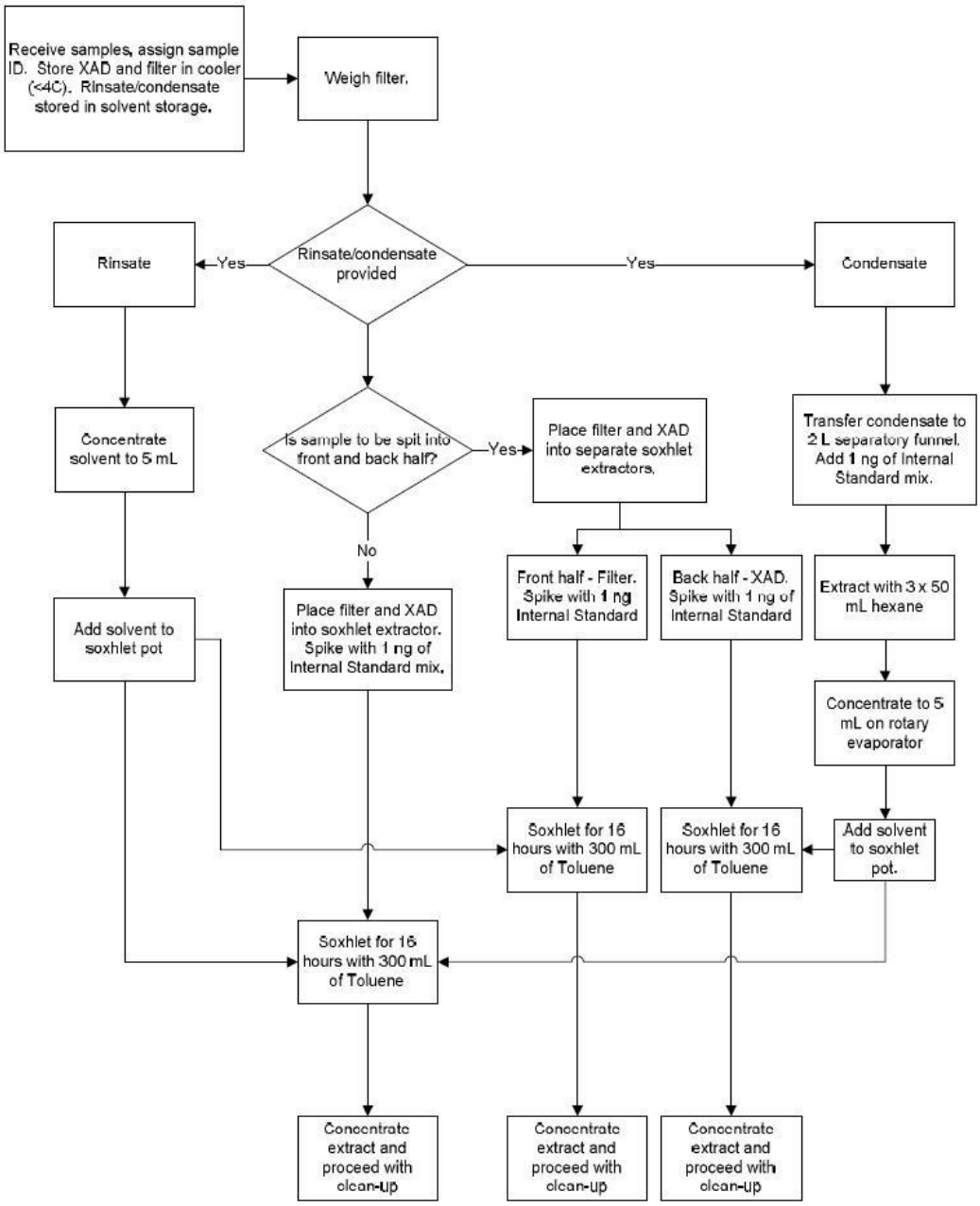


Figure 5 - Semi-Volatile Organics XAD and Filter Recovery Schematic

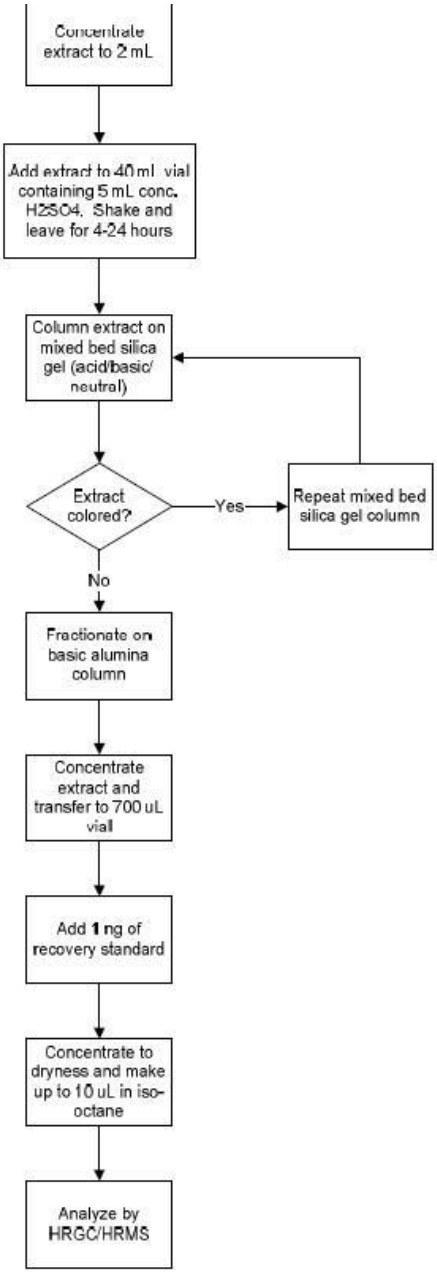


Figure 6 - Schematic of analytical methodology for dioxins and furans

2.2 Calculations

The following sections show the equations and define the variables that were used for this survey. The equations are organized in three sections. Equations 1-11 were used to calculate particulate concentration at standard conditions on a dry basis. Equations 12-26 were used to sample within the 100 ± 10% isokinetic variation and to confirm that sampling meets this isokinetic variation threshold. Equations 27-29 were used to calculate the volumetric flowrate of the stack flue gas.

2.2.1 Contaminant Concentration Calculations

$$c = \frac{m}{V_{std}} \quad \textbf{Equation 1}$$

$$m_{part} = m_{filter} + m_{pw} \quad \textbf{Equation 2}$$

$$m_i = m_{ana,i} - m_{blank} \quad \textbf{Equation 3}$$

$$m_{HF} = \frac{20.006}{18.998}(m_F - m_{blank})/1000 \quad \textbf{Equation 4}$$

$$V_{std} = \frac{V_{std(imp)}}{35.315} \quad \textbf{Equation 5}$$

$$V_{std(imp)} = \frac{V_{samp} \times y \times P_m \times (T_{std} + 459.67)}{P_{std} \times (T_{m(ave)} + 459.67)} \quad \textbf{Equation 6}$$

$$V_{samp} = V_{final} - V_{init} \quad \textbf{Equation 7}$$

$$P_m = P_B + \frac{\Delta H_{ave}}{13.6} \quad \textbf{Equation 8}$$

$$\Delta H_{ave} = \frac{1}{n}\sum_{i=1}^{n} \Delta H_{i(act)}, where\ n = the\ number\ of\ points \quad \textbf{Equation 9}$$

$$OC = \frac{20.9 - \%O_{2c}}{20.9 - \%O_{2m}} \quad \textbf{Equation 10}$$

$$\%O_{2m} = \frac{1}{n}\sum_{i=1}^{n} \%O_{2i}, where\ n = the\ number\ of\ O_2\ measurements \quad \textbf{Equation 11}$$

Where,

c	= Contaminant concentration
m	= Contaminant mass
m_i	= Net analytical mass (mg, ng, or µg)
$m_{ana,i}$	= Analytical mass (mg, ng, or µg)
m_{blank}	= Blank analytical mass (mg, ng, or µg)
$V_{std(imp)}$	= Sample volume at standard conditions (ft^3)
V_{std}	= Sample volume at standard conditions (m^3)
V_{samp}	= Sample volume at actual conditions (ft^3)
V_{final}	= Final gas meter reading (ft^3)
V_{init}	= Initial gas meter reading (ft^3)
T_{std}	= Standard temperature (68 °F)
T_m	= Gas meter temperature (°F)
$T_{m(ave)}$	= Average gas meter temperature (°F)
P_m	= Absolute meter pressure (inches of Hg)
P_B	= Barometric pressure (inches of Hg)
ΔH_{ave}	= Average of individual point orifice pressures (inches of H_2O)
$\Delta H_{i(act)}$	= Individual recorded point orifice pressures (inches of H_2O)
OC	= Oxygen correction factor (dimensionless)
$\%O_{2c}$	= Oxygen concentration to correct to (% dry basis)
$\%O_{2m}$	= Average measured stack gas oxygen concentration (% dry basis)

Equation 1 is the general concentration calculation used for all contaminants. The contaminant mass, *m*, is the net analytic mass for the given contaminant.

The dioxins/furans and other semi-volatile organic compounds were treated slightly different. The blank results for all trace organic species are used as a Quality Assurance check and are not used to correct the analytic results. Also, according to the terms of the service agreement, individual trace organic species were reported as "non-detect" (ND) if all three tests for that species are below the detection limit. If one (or more) of the triplicate samples has a reportable value, the corresponding ND samples from the other test runs were reported at half the detection limit. For calculating of summarized results (PCDD& PCDF TEQ, Total PAHs, Total Chlorobenzenes, Total Chlorophenols, and Total PCBs) the substitution of half DL for each individual species, as detailed above, was performed prior to calculating the sums.

All results are reported in the units outlined in the service agreement. The following unit conversions were used throughout:

$$1 \text{ mg} = 10^{-3} \text{ g}$$

$$1 \text{ µg} = 10^{-6} \text{ g}$$

$$1 \text{ ng} = 10^{-9} \text{ g}$$

$$1 \text{ tonne} = 10^{6} \text{ g}$$

Oxygen corrections were applied by multiplying the result of Equation 1 by the result of Equation 10 for each individual result.

2.2.2 Isokinetic Variation Calculations

$$\Delta H_i = \frac{2.62 \times 10^7 \times c_p \times A_n \times (1 - B_{wo}) \times M_D \times (T_m + 459.67) \times \Delta p_i}{k_o \times M_w \times (T_{Stk} + 459.67)} \quad \textbf{Equation 12}$$

$$R_m = 85.49 \times c_p \times \sqrt{\Delta p_i} \times \sqrt{\frac{(T_{stk_i} + 459.67)}{M_w \times P_B}} \times 60 \times A_n \times \frac{(T_{m_i} + 459.67) \times (1 - B_{wo})}{(T_{stk_i} + 459.67) \times y} \quad \textbf{Equation 13}$$

$$A_n = \pi \left(\frac{d_n}{24}\right)^2 \quad \textbf{Equation 14}$$

$$M_w = M_D \times (1 - B_{wo}) + 18 \times B_{wo} \quad \textbf{Equation 15}$$

$$M_D = 0.44 \times \%CO_2 + 0.32 \times \%O_2 + 0.28 \times (100 - \%CO_2 - \%O_2) \quad \textbf{Equation 16}$$

$$T_{Stk} = \frac{1}{n} \sum_{i=1}^{n} T_{Stk_i}, where\ n = the\ number\ of\ points \quad \textbf{Equation 17}$$

$$B_{wo} = \frac{V_{cond}}{V_{cond} + V_{std(imp)}} \quad \textbf{Equation 18}$$

$$V_{cond} = 0.04707 \times V_{gain} \quad \textbf{Equation 19}$$

$$Iso = \frac{1}{n} \sum_{i=1}^{n} Iso_i, where\ n = the\ number\ of\ points \quad \textbf{Equation 20}$$

$$Iso_i = \frac{v_{nzi}}{v_i} \quad \textbf{Equation 21}$$

$$v_i = 85.49 \times c_p \times \sqrt{\Delta p_i} \times \sqrt{\frac{\left(T_{Stk_i} + 459.67\right)}{(P_{Stk} \times M_W)}}$$ **Equation 22**

$$v_{nzi} = \frac{(V_i - V_{i-1}) \times y \times (T_{Stk_i} + 459.67) \times (P_B + \frac{\Delta H_{i(act)}}{13.6})}{A_n \times t_i \times 60 \times (T_{m(i)} + 459.67) \times P_{stk} \times (1 - B_{wo})}$$ **Equation 23**

$$P_{stk} = P_B + \frac{P_g}{13.6}$$ **Equation 24**

$$v_{stk} = \frac{1}{n}\sum_{i=1}^{n} v_i \,, where\ n = the\ number\ of\ points$$ **Equation 25**

$$v_{nz} = \frac{1}{n}\sum_{i=1}^{n} v_{nzi} \,, where\ n = the\ number\ of\ points$$ **Equation 26**

Where,

A_n = *Nozzle area (ft^2)*
d_n = *Diameter of nozzle (inches)*
c_p = *Pitot coefficient (dimensionless)*
Δp_i = *Individual point differential pressures (inches of H_2O)*
T_{Stk} = *Average flue gas temperature (°F), second subscript i, indicates individual point measurements*
$\Delta H_{i(act)}$ = *Calculated individual point orifice pressures (inches of H_2O)*
P_g = *Stack Static pressure (inches of H_2O)*
P_{stk} = *Absolute stack pressure (inches of Hg)*
M_w = *Wet gas molecular weight (g/gmol)*
M_D = *Dry gas molecular weight (g/gmol)*
$\%CO_2$ = *Stack gas carbon dioxide concentration (% dry basis)*
$\%O_2$ = *Stack gas oxygen concentration (% dry basis)*
B_{wo} = *Stack gas water vapour, proportion by volume*
V_{cond} = *Total volume of water vapor collected, corrected to standard conditions (ft^3)*
V_{gain} = *Condensate gain of impinger contents (mL)*
P_{std} = *Standard pressure (29.92 inches of Hg)*
v_{stk} = *Average flue gas velocity (ft/sec)*
v_i = *Individual point flue gas velocity (ft/sec)*
v_{nz} = *Average velocity at nozzle(ft/sec)*
v_{nzi} = *Individual point velocity at nozzle(ft/sec)*

Iso_i = *Individual point isokinetic variation (%)*
Iso = *Average isokinetic variation (%)*
R_m = *Isokinetic sampling rate (ft^3/min)*

2.2.3 Volumetric Flowrate Calculations

$$Q_S = Q_A \times \frac{(T_{Std} + 459.67)}{(T_{Stk} + 459.67)} \times \frac{P_{Stk}}{P_{Std}}$$ **Equation 27**

$$Q_A = \frac{v_{stk} \times 60 \times A_{stk}}{35.315}$$ **Equation 28**

$$A_{stk} = \pi \left(\frac{d}{24}\right)^2$$ **Equation 29**

Where,

Q_A = *Actual flowrate (Am^3/min)*
Q_S = *Flowrate (m^3/min) at standard conditions on a dry basis*
A_{stk} = *Area of stack (ft^2)*
d = *Diameter of stack (inches)*

2.3 Quality Assurance/Quality Control (QA/QC) Techniques

QA/QC of this survey was accomplished by the following mechanisms.

1. Pre and Post-test leak checks.
2. Calibration of volume measuring and monitoring instrumentation.
3. Proofing of organic glassware and supplies.
4. Analysis of all blank solutions and materials.
5. Surrogate spiking of XAD using EPA protocols
6. Internal standard spiking and recovery analysis of organic trains to Env. Canada specs
7. Blank train sampling of leak check average volume

3.0 TEST RESULTS

Most of the results of stack emissions were calculated using a "STACK" computer program developed by A. Lanfranco and Associates for BC MOE/MV requirements.

Table 1 presents summarized trace organic results using the Hazardous Waste Regulation TEQ's, as well as additional organic species. Table 2 presents detailed PCDD/PCDF data and Table 3 presents trace organics results as a mass emission (not corrected for O_2). Detailed PAH and additional chlorinated organic species emission concentrations are presented in Table 4 and Appendix 2.

Trace organic results were recovery corrected according to surrogate recovery efficiencies determined for each organic analysis. Surrogates added and the recoveries determined are listed in the analytical data presented in the Appendices.

A stratification check was performed in 2018 and a cyclonic flow check was performed in 2006. Neither condition was present at the Unit 1 sampling location.

TABLE 1: UNIT 1 TRACE ORGANICS RESULTS TABLE

Parameter		Test 1	Test 2	Test 3	Average
Test Date		22-Aug-18	23-Aug-18	24-Aug-18	
Test Time		10:01 - 14:10	09:02 - 13:06	08:37 - 12:40	
Duration	(minutes)	240	240	240	240
PCDD & PCDF TEQ	(ng/Sm^3)	0.0009	0.0026	0.0009	0.0015
PCDD & PCDF TEQ	**(ng/Sm^3 @ 11% O_2)**	**0.0009**	**0.0022**	**0.0008**	**0.0013**
Total PAH	($\mu g/Sm^3$)	0.0287	0.0524	0.0172	0.0327
Total PAH	**($\mu g/Sm^3$ @ 11% O_2)**	**0.0262**	**0.0456**	**0.0154**	**0.0291**
Total HCB	($\mu g/Sm^3$)	0.0025	0.0030	0.0023	0.0026
Total HCB	**($\mu g/Sm^3$ @ 11% O_2)**	**0.0023**	**0.0026**	**0.0021**	**0.0023**
Total CB	($\mu g/Sm^3$)	0.4452	0.2430	0.3163	0.3348
Total CB	**($\mu g/Sm^3$ @ 11% O_2)**	**0.4070**	**0.2117**	**0.2835**	**0.3007**
Total CP	($\mu g/Sm^3$)	0.0865	0.0964	0.0584	0.0804
Total CP	**($\mu g/Sm^3$ @ 11% O_2)**	**0.0790**	**0.0839**	**0.0524**	**0.0718**
Total PCB	($\mu g/Sm^3$)	0.0021	0.0014	0.0002	0.0012
Total PCB	**($\mu g/Sm^3$ @ 11% O_2)**	**0.0019**	**0.0012**	**0.0001**	**0.0011**
Stack Temperature	(°C)	154	157	153	155
Flowrate	(Sm^3/min)	1262	1227	1261	1250
Oxygen (O_2)	(vol % dry)	10.1	9.5	9.9	9.8
Carbon Dioxide (CO_2)	(vol % dry)	10.1	10.3	10.3	10.2
Moisture	(vol %)	14.4	15.4	14.1	14.6
Isokinetic Variation	(%)	102	104	102	103

standard conditions of 20 °C and 101.325 kPa (dry)

TABLE 2 Detailed PCDD/PCDF Emission Results

		Test 1		Test 2		Test 3	
Test Date:		22-Aug-18		23-Aug-18		24-Aug-18	
Test Time:		10:01 - 14:10		09:02 - 13:06		08:37 - 12:40	
Component	**TEF**	**Analyzed** (ng)	**TEQ** (ng)	**Analyzed** (ng)	**TEQ** (ng)	**Analyzed** (ng)	**TEQ** (ng)
2378 TCDD	1.0000	0.0000	ND	0.0000	ND	0.0000	ND
12378 PCDD	0.5000	0.0020	0.0010	0.0100	0.0050	0.0020	0.0010
123478 HxCDD	0.1000	0.0000	ND	0.0000	ND	0.0000	ND
123678 HxCDD	0.1000	0.0020	0.0002	0.0170	0.0017	0.0020	0.0002
123789 HxCDD	0.1000	0.0020	0.0002	0.0020	0.0002	0.0078	0.0008
1234678 HpCDD	0.0100	0.0950	0.0010	0.1300	0.0013	0.0760	0.00076
OCDD	0.0010	0.0075	0.00001	0.2800	0.00028	0.1900	0.00019
2378 TCDF	0.1000	0.0000	ND	0.0000	ND	0.0000	ND
12378 PCDF	0.0500	0.0000	ND	0.0000	ND	0.0000	ND
23478 PCDF	0.5000	0.0000	ND	0.0000	ND	0.0000	ND
123478 HxCDF	0.1000	0.0000	ND	0.0000	ND	0.0000	ND
123678 HxCDF	0.1000	0.0100	0.0010	0.0020	0.0002	0.0020	0.0002
234678 HxCDF	0.1000	0.0020	0.0002	0.0160	0.0016	0.0020	0.0002
123789 HxCDF	0.1000	0.0000	ND	0.0000	ND	0.0000	ND
1234678 HpCDF	0.0100	0.0480	0.00048	0.0540	0.00054	0.0470	0.00047
1234789 HpCDF	0.0100	0.0020	0.0000	0.0150	0.00015	0.0020	0.00002
OCDF	0.0010	0.0075	7.5E-06	0.0430	0.000043	0.0075	7.50E-06
Summed PCDD & PCDF TEQ (ng)			**0.0041**		**0.0110**		**0.0038**
Sample Volume (dscm)			**4.3596**		**4.2967**		**4.3628**
PCDD & PCDF TEQ	**ng/dscm**		**0.00093**		**0.00256**		**0.00088**
PCDD & PCDF TEQ	**ng/dscm @ 11% O_2**		**0.00085**		**0.00223**		**0.00079**
PCDD & PCDF TEQ	**grams/day**		**0.000002**		**0.000005**		**0.000002**
Flowrate (dscm/min)			1262		1227		1261
Oxygen (Vol. %)			10.1		9.5		9.9
Carbon Dioxide (Vol. %)			10.1		10.3		10.3
Moisture (Vol. %)			14.4		15.4		14.1
Temperature (oC)			154.2		157.2		153.3
Isokinetic Variation (%)			102.3		103.6		102.4

TABLE 3: UNIT 1 TRACE ORGANICS MASS EMISSIONS RESULTS

Parameter		Test 1	Test 2	Test 3	Average
PCDD & PCDF TEQ	(g/sec)	1.96E-11	5.24E-11	1.84E-11	3.02E-11
PCDD & PCDF TEQ	(tonnes/annum)	6.19E-10	1.65E-09	5.81E-10	9.51E-10
Total PAH	(g/sec)	6.03E-07	1.10E-06	3.62E-07	6.89E-07
Total PAH	(tonnes/annum)	1.90E-05	3.47E-05	1.14E-05	2.17E-05
Total HCB	(g/sec)	5.31E-08	6.36E-08	4.82E-08	5.50E-08
Total HCB	(tonnes/annum)	1.67E-06	2.01E-06	1.52E-06	1.73E-06
Total CB	(g/sec)	9.37E-06	5.11E-06	6.65E-06	7.04E-06
Total CB	(tonnes/annum)	2.95E-04	1.61E-04	2.10E-04	2.22E-04
Total CP	(g/sec)	1.82E-06	2.03E-06	1.23E-06	1.69E-06
Total CP	(tonnes/annum)	5.74E-05	6.39E-05	3.88E-05	5.34E-05
Total PCB	(g/sec)	4.44E-08	2.99E-08	3.38E-09	2.59E-08
Total PCB	(tonnes/annum)	1.40E-06	9.42E-07	1.06E-07	8.16E-07

standard conditions of 20 °C and 101.325 kPa (dry)

TABLE 4 Detailed PCB/PAH/CB/CP Emission Results

		Test 1	Test 2	Test 3
Test Date:		22-Aug-18	23-Aug-18	24-Aug-18
Test Time:		10:01 - 14:10	09:02 - 13:06	08:37 - 12:40
Component		**Analyzed** (ug)	**Analyzed** (ug)	**Analyzed** (ug)
Benz(a)anthracene		ND	ND	ND
Benzo(a)pyrene		ND	ND	ND
Benzo(b,j) fluoranthene		ND	ND	ND
Benzo(e)pyrene		0.005	0.005	0.010
Benzo(g,h,i)perylene		ND	ND	ND
Benzo(k)fluoranthene		ND	ND	ND
Chrysene		ND	ND	ND
Dibenz(a,j)acridine		ND	ND	ND
Dibenz(a,h)acridine		ND	ND	ND
Dibenz(a,h)anthracene		ND	ND	ND
Dibenzo(a,i)pyrene		ND	ND	ND
Fluoranthene		0.010	0.050	0.005
Indeno(1,2,3-c,d)pyrene		ND	ND	ND
Phenanthrene		0.080	0.100	0.040
Pyrene		0.020	0.050	0.010
7H-dibenzo(c,g)carbazole		ND	ND	ND
Acenaphthene		**ND**	**ND**	**ND**
Acenaphthylene		**ND**	**ND**	**ND**
Fluorene		**0.010**	**0.020**	**0.010**
Dibenzo(a,e) fluoranthene		**ND**	**ND**	**ND**
3-Methylcholanthrene		**ND**	**ND**	**ND**
5-Methylchrysene		**ND**	**ND**	**ND**
7,12-Dimethylbenz(a)anthracene		**ND**	**ND**	**ND**
Dibenzo(a,h)pyrene		**ND**	**ND**	**ND**
Dibenzo(a,e)pyrene		**ND**	**ND**	**ND**
Dibenzo(a,l)pyrene		**ND**	**ND**	**ND**
Quinoline		**ND**	**ND**	**ND**
Total CP		**0.3770**	**0.4140**	**0.2550**
Total CB		**1.9410**	**1.0440**	**1.3800**
HCB		**0.0110**	**0.0130**	**0.0100**
* ND = Less than detection limit				
PCB Total (ng)		**9.200**	**6.100**	**0.700**
Total PAH (ug)		**0.125**	**0.225**	**0.075**
Sample Volume (dscm)		**4.36**	**4.30**	**4.36**
Oxygen		10.1	9.5	9.9
PAH	**ug/dscm**	**0.0287**	**0.0524**	**0.0172**
HCB	**ug/dscm**	**0.0025**	**0.0030**	**0.0023**
CB Total	**ug/dscm**	**0.4452**	**0.2430**	**0.3163**
CP Total	**ug/dscm**	**0.0865**	**0.0964**	**0.0584**
PCB Total	**ug/dscm**	**0.0021**	**0.0014**	**0.0002**
PAH	**ug/dscm @ 11% O_2**	**0.0262**	**0.0456**	**0.0154**
HCB	**ug/dscm @ 11% O_2**	**0.0023**	**0.0026**	**0.0021**
CB Total	**ug/dscm @ 11% O_2**	**0.4070**	**0.2117**	**0.2835**
CP Total	**ug/dscm @ 11% O_2**	**0.0790**	**0.0839**	**0.0524**
PCB Total	**ug/dscm @ 11% O_2**	**0.0019**	**0.0012**	**0.0001**

4.0 DISCUSSION

The emissions monitoring for this survey was preformed during normal processing of municipal solid waste at the Waste-to-Energy facility. Three sample runs for each test parameter were conducted over three days to determine final results.

Results from this survey indicate that emissions are below the operational certificate limits for each pollutant.

Trace organics results are similar to data from 2016 and 2017; however, there was a notable decrease in PAH for 2018 and a notable increase in total CP.

Dioxin/Furan results are expressed using the International Toxic Equivalents (I-TEQ). In this report, individual species that were measured below detection limits were reported as zero or "non-detect" as long as there was no detection in any of the three test runs.

In the blank sample, no dioxin/furan congeners were detected, and minimal congeners were detected at levels only very slightly above the detection limit for PCB, PAH, CB and CP. In other words, the blank and the majority of all samples were below normal detection limits.

The QA/QC program showed very low or non-detectable levels of target contaminants in the blank sample, which used the same solid sorbent resin and clean-up solvents as those used for samples. Additionally, the proof analysis of the glassware and XAD (prior recent blanks) showed no significant PCDD/PCDF.

For all tests and the blank test, internal standard recoveries ranged from 40 to 120%.

EPA Method 23 surrogate recoveries ranged from 70 to 123% for each sample. The recovery QA/QC data is expected to meet EPA performance specifications (M23) of 70 to 130% for pre-

test spiked surrogates. The M23 spiking protocol is not required in Canada and is included in the sampling/analytical protocol for additional QA/QC and information purposes only.

There were no problems associated with sample collection or analysis. Sampling was conducted in accordance with the respective reference methods and passed all appropriate quality assurance and quality control criteria. It is therefore stated that these results are reported with a high degree of confidence and are an accurate representation of emission characteristics for the operating conditions maintained on the test dates.

APPENDIX 1

ANALYTICAL DATA

SAMPLE RECEIPT FORM / CHEMICAL ANALYSIS FORM

FILE #: PR182302

CLIENT: A. Lanfranco & Associates
Unit 101 9488 – 189 St.
Surrey, BC
V4N 4W7

Phone: (604) 881-2582
Email: mark.lanfranco@alanfranco.com

RECEIVED BY: C. Hsieh
CONDITION: Okay, 8.5°C

DATE/TIME: August 24, 2018 (3:30 p.m.)

# of Containers	Sample Type	Sample (Client Codes)	Lab Codes	Test Requested
5	XAD, filter, rinses	Blank Dioxin	PR182302	PCDD/F, PCB, PAH/HCB, CB, CP
5	XAD, filter, rinses	Run-1 – Dioxin	PR182303	PCDD/F, PCB, PAH/HCB, CB, CP
5	XAD, filter, rinses	Run-2 – Dioxin	PR182304	PCDD/F, PCB, PAH/HCB, CB, CP
5	XAD, filter, rinses	Run-3 – Dioxin	PR182305	PCDD/F, PCB, PAH/HCB, CB, CP

STORAGE: XAD and filter stored at 4°C, rinses stored at ambient temperature.

ANALYTES: HRGC/HRMS analysis for polychlorinated dibenzo(p)dioxins and dibenzofurans (PCDD/F), polychlorinated biphenyls (PCB) and polycyclic aromatic hydrocarbons (PAH).

SPECIAL INSTRUCTIONS: none

METHODOLOGY

Reference Method: PCDD/F: SOP LAB01; EPA Method 23, Environment Canada 1-RM-3
PCB: SOP LAB02F; EPA Method 1668C
PAH/CB/CP: SOP LAB03; in house

Data summarized in Data Report Attached

Report sent to: Mark Lanfranco Date: September 18, 2018

Comments: Results relate only to items tested.

Digitally signed by Patrick Pond
DN: cn=Patrick Pond, o=Pacific Rim Laboratories Inc., ou=CTO, email=Pat@pacificrimlabs.com, c=CA
Date: 2018.09.18 15:13:26 -07'00'

Patrick Pond, CTO

METHOD 23/1-RM-3 DATA REPORT

Client:	Lanfranco & Associates	**Sample Date:**	22-Aug-18
Client ID:	Run-1 – Dioxin	**Date Extracted:**	28-Aug-18
PRL ID:	PR182303	**Date Analysed:**	13-Sep-18
		Filter Wt.:	0.33 g

DIOXINS				I-TEQs		
		DL	# of	(ND=0)	(ND=½DL)	(ND=DL)
Congeners	**pg**	**pg**	**peaks**	**pg**	**pg**	**pg**
2,3,7,8-TCDD	ND	2		ND	1	2
Total TCDD	ND	2	0			
1,2,3,7,8-PeCDD	ND	4		ND	1	2
Total PeCDD	ND	4	0			
1,2,3,4,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,7,8,9-HxCDD	ND	4		ND	0.2	0.4
Total HxCDD	170	4	1			
1,2,3,4,6,7,8-HpCDD	95	4		0.95	0.95	0.95
Total HpCDD	210	4	2			
OCDD	ND	15	0	ND	0.0075	0.015
		Total Dioxin TEQ		**1.0**	**3.6**	**6.2**

FURANS				I-TEQs		
		DL	# of	(ND=0)	(ND=½DL)	(ND=DL)
Congeners	**pg**	**pg**	**peaks**	**pg**	**pg**	**pg**
2,3,7,8-TCDF	ND	2		ND	0.1	0.2
Total TCDF	ND	2	0			
1,2,3,7,8-PeCDF	ND	4		ND	0.1	0.2
2,3,4,7,8-PeCDF	ND	4		ND	1	2
Total PeCDF	ND	4	0			
1,2,3,4,7,8-HxCDF	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDF	10	4		1	1	1
1,2,3,7,8,9-HxCDF	ND	4		ND	0.2	0.4
2,3,4,6,7,8-HxCDF	ND	4		ND	0.2	0.4
Total HxCDF	95	4	2			
1,2,3,4,6,7,8-HpCDF	48	4		0.48	0.48	0.48
1,2,3,4,7,8,9-HpCDF	ND	4		ND	0.02	0.04
Total HpCDF	57	4	2			
OCDF	ND	15	0	ND	0.0075	0.015
		Total Furan TEQ		**1.5**	**3.3**	**5.1**

Total PCDD/PCDF Toxic Equivalent (pg)	**2.4**	**6.9**	**11.3**

Surrogate Recoveries (%)

$^{37}Cl_4$ -2,3,7,8-TCDD	100
$^{13}C_{12}$ -2,3,4,7,8-PeCDF	103
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDD	75
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDF	97
$^{13}C_{12}$ -1,2,3,4,7,8,9-HpCDF	89

ND - none detected

Internal Standards (%)

$^{13}C_{12}$ -2,3,7,8-TCDD	47
$^{13}C_{12}$ -1,2,3,7,8-PeCDD	55
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDD	73
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD	80
$^{13}C_{12}$ -OCDD	100
$^{13}C_{12}$ -2,3,7,8-TCDF	41
$^{13}C_{12}$ -1,2,3,7,8-PeCDF	53
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDF	72
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF	77

METHOD 23/1-RM-3 DATA REPORT

Client:	Lanfranco & Associates	**Sample Date:**	23-Aug-18
Client ID:	Run-2 – Dioxin	**Date Extracted:**	28-Aug-18
PRL ID:	PR182304	**Date Analysed:**	13-Sep-18
		Filter Wt.:	0.33 g

DIOXINS		DL	# of	I-TEQs (ND=0)	I-TEQs (ND=½DL)	I-TEQs (ND=DL)
Congeners	**pg**	**pg**	**peaks**	**pg**	**pg**	**pg**
2,3,7,8-TCDD	ND	2		ND	1	2
Total TCDD	15	2	1			
1,2,3,7,8-PeCDD	10	4		5	5	5
Total PeCDD	62	4	2			
1,2,3,4,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDD	17	4		1.7	1.7	1.7
1,2,3,7,8,9-HxCDD	ND	4		ND	0.2	0.4
Total HxCDD	280	4	2			
1,2,3,4,6,7,8-HpCDD	130	4		1.3	1.3	1.3
Total HpCDD	250	4	2			
OCDD	280	15	1	0.28	0.28	0.28
		Total Dioxin TEQ		**8.3**	**9.7**	**11.1**

FURANS		DL	# of	I-TEQs (ND=0)	I-TEQs (ND=½DL)	I-TEQs (ND=DL)
Congeners	**pg**	**pg**	**peaks**	**pg**	**pg**	**pg**
2,3,7,8-TCDF	ND	2		ND	0.1	0.2
Total TCDF	ND	2	0			
1,2,3,7,8-PeCDF	ND	4		ND	0.1	0.2
2,3,4,7,8-PeCDF	ND	4		ND	1	2
Total PeCDF	ND	4	0			
1,2,3,4,7,8-HxCDF	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDF	ND	4		ND	0.2	0.4
1,2,3,7,8,9-HxCDF	ND	4		ND	0.2	0.4
2,3,4,6,7,8-HxCDF	16	4		1.6	1.6	1.6
Total HxCDF	41	4	3			
1,2,3,4,6,7,8-HpCDF	54	4		0.54	0.54	0.54
1,2,3,4,7,8,9-HpCDF	15	4		0.15	0.15	0.15
Total HpCDF	83	4	2			
OCDF	43	15	1	0.043	0.043	0.043
		Total Furan TEQ		**2.3**	**4.1**	**5.9**
Total PCDD/PCDF Toxic Equivalent (pg)				**10.6**	**13.8**	**17.0**

Surrogate Recoveries (%)

$^{37}Cl_4$ -2,3,7,8-TCDD	98
$^{13}C_{12}$ -2,3,4,7,8-PeCDF	111
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDD	79
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDF	94
$^{13}C_{12}$ -1,2,3,4,7,8,9-HpCDF	123

ND - none detected

Internal Standards (%)

$^{13}C_{12}$ -2,3,7,8-TCDD	47
$^{13}C_{12}$ -1,2,3,7,8-PeCDD	54
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDD	68
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD	67
$^{13}C_{12}$ -OCDD	63
$^{13}C_{12}$ -2,3,7,8-TCDF	41
$^{13}C_{12}$ -1,2,3,7,8-PeCDF	51
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDF	66
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF	53

METHOD 23/1-RM-3 DATA REPORT

Client:	Lanfranco & Associates	**Sample Date:**	24-Aug-18
Client ID:	Run-3 – Dioxin	**Date Extracted:**	28-Aug-18
PRL ID:	PR182303	**Date Analysed:**	13-Sep-18
		Filter Wt.:	0.32 g

DIOXINS

Congeners	pg	DL pg	# of peaks	I-TEQs (ND=0) pg	I-TEQs (ND=½DL) pg	I-TEQs (ND=DL) pg
2,3,7,8-TCDD	ND	2		ND	1	2
Total TCDD	ND	2	0			
1,2,3,7,8-PeCDD	ND	4		ND	1	2
Total PeCDD	68	4	2			
1,2,3,4,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,7,8,9-HxCDD	7.8	4		0.78	0.78	0.78
Total HxCDD	120	4	2			
1,2,3,4,6,7,8-HpCDD	76	4		0.76	0.76	0.76
Total HpCDD	160	4	2			
OCDD	190	15	1	0.19	0.19	0.19
		Total Dioxin TEQ		**1.7**	**4.1**	**6.5**

FURANS

Congeners	pg	DL pg	# of peaks	I-TEQs (ND=0) pg	I-TEQs (ND=½DL) pg	I-TEQs (ND=DL) pg
2,3,7,8-TCDF	ND	2		ND	0.1	0.2
Total TCDF	ND	2	0			
1,2,3,7,8-PeCDF	ND	4		ND	0.1	0.2
2,3,4,7,8-PeCDF	ND	4		ND	1	2
Total PeCDF	ND	4	0			
1,2,3,4,7,8-HxCDF	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDF	ND	4		ND	0.2	0.4
1,2,3,7,8,9-HxCDF	ND	4		ND	0.2	0.4
2,3,4,6,7,8-HxCDF	ND	4		ND	0.2	0.4
Total HxCDF	ND	4	0			
1,2,3,4,6,7,8-HpCDF	47	4		0.47	0.47	0.47
1,2,3,4,7,8,9-HpCDF	ND	4		ND	0.02	0.04
Total HpCDF	55	4	2			
OCDF	ND	15	0	ND	0.0075	0.015
		Total Furan TEQ		**0.5**	**2.5**	**4.5**

Total PCDD/PCDF Toxic Equivalent (pg)	**2.2**	**6.6**	**11.1**

Surrogate Recoveries (%)

$^{37}Cl_4$ -2,3,7,8-TCDD	88
$^{13}C_{12}$ -2,3,4,7,8-PeCDF	116
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDD	70
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDF	97
$^{13}C_{12}$ -1,2,3,4,7,8,9-HpCDF	84

ND - none detected

Internal Standards (%)

$^{13}C_{12}$ -2,3,7,8-TCDD	53
$^{13}C_{12}$ -1,2,3,7,8-PeCDD	58
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDD	79
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD	70
$^{13}C_{12}$ -OCDD	69
$^{13}C_{12}$ -2,3,7,8-TCDF	42
$^{13}C_{12}$ -1,2,3,7,8-PeCDF	51
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDF	58
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF	61

DATA REPORT

Client:	Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	Run-1 – Dioxin	**Date Extracted:**	28-Aug-18
PRL ID:	PR182303	**Date Analysed:**	12-Sep-18

Dioxin-like PCBs				Surrogate
			DL	Recoveries
Chemical Name	**IUPAC #**	**ng**	**ng**	**%**
3,4,4',5-TeCB	PCB 81	ND	0.02	88
3,3',4,4'-TeCB	PCB 77	ND	0.02	88
2,3',4,4',5'-PeCB	PCB 123	ND	0.02	100
2,3',4,4',5-PeCB	PCB 118	0.15	0.02	88
2,3,4,4',5-PeCB	PCB 114	ND	0.02	92
2,3,3',4,4'-PeCB	PCB 105	ND	0.02	96
3,3',4,4',5-PeCB	PCB 126	ND	0.02	84
2,3',4,4',5,5'-HxCB	PCB 167	ND	0.02	88
2,3,3',4,4',5-HxCB	PCB 156	ND	0.02	92
2,3,3',4,4',5'-HxCB	PCB 157	ND	0.02	88
3,3',4,4',5,5'-HxCB	PCB 169	ND	0.02	72
2,3,3',4,4',5,5'-HpCB	PCB 189	ND	0.02	96
		Toxic Equivalent (WHO-TEQ)		

WHO-TEQs (2005)	
(ND=0)	(ND=DL)
ng	ng
ND	6.00E-06
ND	2.00E-06
ND	6.00E-07
4.37E-06	4.37E-06
ND	6.00E-07
ND	6.00E-07
ND	2.00E-03
ND	6.00E-07
ND	6.00E-07
ND	6.00E-07
ND	6.00E-04
ND	6.00E-07
4.37E-06	2.62E-03

Total PCB		
		DL
Homologs	**ng**	**ng**
Monochlorobiphenyls	0.74	0.05
Dichlorobiphenyls	6.67	0.05
Trichlorobiphenyls	1.30	0.05
Tetrachlorobiphenyls	0.29	0.05
Pentachlorobiphenyls	0.15	0.05
Hexachlorobiphenyls	ND	0.05
Heptachlorobiphenyls	ND	0.05
Octachlorobiphenyls	ND	0.05
Nonachlorobiphenyls	ND	0.05
Decachlorobiphenyl	ND	0.05
Total PCB	9.2	

ND - none detected

Surrogate Recoveries		
Chemical Name	**IUPAC #**	**%**
13C12-2-MoCB	1L	60
13C12-4,4'-DiCB	15L	56
13C12-2,2',6'-TrCB	19L	56
13C12-3,4,4'-TrCB	37L	140
13C12-2,2',6,6'-TeCB	54L	68
13C12-2,2',4,6,6'-PeCB	104L	80
13C12-2,2',4,4',6,6'-HxCB	155L	56
13C12-2,2',3,4',5,6,6'-HpCB	188L	80
13C12-2,2',3,3',5,5',6,6'-OcCB	202L	64
13C12-2,3,3',4,4',5,5',6-OcCB	205L	76
13C12-2,2',3,3',4,4',5,5',6-NoCB	206L	80
13C12-DeCB	209L	60

DATA REPORT

Client:	Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	Run-2 – Dioxin	**Date Extracted:**	28-Aug-18
PRL ID:	PR182304	**Date Analysed:**	12-Sep-18

Dioxin-like PCBs				Surrogate	WHO-TEQs (2005)	
			DL	Recoveries	(ND=0)	(ND=DL)
Chemical Name	**IUPAC #**	**ng**	**ng**	**%**	**ng**	**ng**
3,4,4',5-TeCB	PCB 81	ND	0.02	68	ND	6.00E-06
3,3',4,4'-TeCB	PCB 77	ND	0.02	64	ND	2.00E-06
2,3',4,4',5'-PeCB	PCB 123	ND	0.02	80	ND	6.00E-07
2,3',4,4',5-PeCB	PCB 118	ND	0.02	76	ND	6.00E-07
2,3,4,4',5-PeCB	PCB 114	ND	0.02	76	ND	6.00E-07
2,3,3',4,4'-PeCB	PCB 105	ND	0.02	72	ND	6.00E-07
3,3',4,4',5-PeCB	PCB 126	ND	0.02	68	ND	2.00E-03
2,3',4,4',5,5'-HxCB	PCB 167	ND	0.02	68	ND	6.00E-07
2,3,3',4,4',5-HxCB	PCB 156	ND	0.02	80	ND	6.00E-07
2,3,3',4,4',5'-HxCB	PCB 157	ND	0.02	72	ND	6.00E-07
3,3',4,4',5,5'-HxCB	PCB 169	ND	0.02	64	ND	6.00E-04
2,3,3',4,4',5,5'-HpCB	PCB 189	ND	0.02	96	ND	6.00E-07
		Toxic Equivalent (WHO-TEQ)			0.00E+00	2.61E-03

Total PCB		
		DL
Homologs	**ng**	**ng**
Monochlorobiphenyls	0.53	0.05
Dichlorobiphenyls	5.1	0.05
Trichlorobiphenyls	0.45	0.05
Tetrachlorobiphenyls	ND	0.05
Pentachlorobiphenyls	ND	0.05
Hexachlorobiphenyls	ND	0.05
Heptachlorobiphenyls	ND	0.05
Octachlorobiphenyls	ND	0.05
Nonachlorobiphenyls	ND	0.05
Decachlorobiphenyl	ND	0.05
Total PCB	6.1	

ND - none detected

Surrogate Recoveries		
Chemical Name	**IUPAC #**	**%**
13C12-2-MoCB	1L	64
13C12-4,4'-DiCB	15L	56
13C12-2,2',6'-TrCB	19L	56
13C12-3,4,4'-TrCB	37L	128
13C12-2,2',6,6'-TeCB	54L	64
13C12-2,2',4,6,6'-PeCB	104L	68
13C12-2,2',4,4',6,6'-HxCB	155L	48
13C12-2,2',3,4',5,6,6'-HpCB	188L	56
13C12-2,2',3,3',5,5',6,6'-OcCB	202L	52
13C12-2,3,3',4,4',5,5',6-OcCB	205L	84
13C12-2,2',3,3',4,4',5,5',6-NoCB	206L	72
13C12-DeCB	209L	64

DATA REPORT

Client:	Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	Run-3 – Dioxin	**Date Extracted:**	28-Aug-18
PRL ID:	PR182305	**Date Analysed:**	12-Sep-18

Dioxin-like PCBs				Surrogate Recoveries
			DL	
Chemical Name	**IUPAC #**	**ng**	**ng**	**%**
3,4,4',5-TeCB	PCB 81	ND	0.02	76
3,3',4,4'-TeCB	PCB 77	ND	0.02	76
2,3',4,4',5'-PeCB	PCB 123	ND	0.02	84
2,3',4,4',5-PeCB	PCB 118	ND	0.02	88
2,3,4,4',5-PeCB	PCB 114	ND	0.02	92
2,3,3',4,4'-PeCB	PCB 105	ND	0.02	92
3,3',4,4',5-PeCB	PCB 126	0.040	0.02	88
2,3',4,4',5,5'-HxCB	PCB 167	ND	0.02	84
2,3,3',4,4',5-HxCB	PCB 156	ND	0.02	100
2,3,3',4,4',5'-HxCB	PCB 157	ND	0.02	96
3,3',4,4',5,5'-HxCB	PCB 169	ND	0.02	80
2,3,3',4,4',5,5'-HpCB	PCB 189	ND	0.02	92
		Toxic Equivalent (WHO-TEQ)		

WHO-TEQs (2005)	
(ND=0)	**(ND=DL)**
ng	**ng**
ND	6.00E-06
ND	2.00E-06
ND	6.00E-07
ND	6.00E-07
ND	6.00E-07
ND	6.00E-07
4.05E-03	4.05E-03
ND	6.00E-07
ND	6.00E-07
ND	6.00E-07
ND	6.00E-04
ND	6.00E-07
4.05E-03	4.66E-03

Total PCB		
		DL
Homologs	**ng**	**ng**
Monochlorobiphenyls	0.3	0.05
Dichlorobiphenyls	ND	0.05
Trichlorobiphenyls	0.33	0.05
Tetrachlorobiphenyls	0.05	0.05
Pentachlorobiphenyls	ND	0.05
Hexachlorobiphenyls	ND	0.05
Heptachlorobiphenyls	ND	0.05
Octachlorobiphenyls	ND	0.05
Nonachlorobiphenyls	ND	0.05
Decachlorobiphenyl	ND	0.05
Total PCB	0.7	

ND - none detected

Surrogate Recoveries		
Chemical Name	**IUPAC #**	**%**
13C12-2-MoCB	1L	72
13C12-4,4'-DiCB	15L	60
13C12-2,2',6'-TrCB	19L	56
13C12-3,4,4'-TrCB	37L	108
13C12-2,2',6,6'-TeCB	54L	64
13C12-2,2',4,6,6'-PeCB	104L	64
13C12-2,2',4,4',6,6'-HxCB	155L	60
13C12-2,2',3,4',5,6,6'-HpCB	188L	76
13C12-2,2',3,3',5,5',6,6'-OcCB	202L	72
13C12-2,3,3',4,4',5,5',6-OcCB	205L	80
13C12-2,2',3,3',4,4',5,5',6-NoCB	206L	56
13C12-DeCB	209L	64

DATA REPORT

Client: Lanfranco & Associates
Contact: Mark Lanfranco
Project: MetroVancouver WTE

Date Extracted: 28-Aug-18
Date Analysed: 12-Sep-18

	Client ID:	Blank Dioxin	Run-1 – Dioxin	Run-2 – Dioxin	Run-3 – Dioxin		BLANK
	PRL ID:	PR182302	PR182303	PR182304	PR182305		PH180668B
NPRI PAH	**DL**						
	µg	µg	µg	µg	µg		µg
Acenaphthylene	0.05	ND	ND	ND	ND		ND
Acenaphthene	0.05	ND	ND	ND	ND		ND
Fluorene	0.02	ND	ND	0.02	ND		ND
Phenanthrene	0.02	ND	0.08	0.10	0.04		ND
Fluoranthene	0.01	ND	0.01	0.05	ND		ND
Pyrene	0.01	ND	0.02	0.05	0.01		ND
Benz(a)anthracene	0.02	ND	ND	ND	ND		ND
Chrysene	0.02	ND	ND	ND	ND		ND
Benzo(b)fluoranthene	0.01	ND	ND	ND	ND		ND
Benzo(k)fluoranthene	0.01	ND	ND	ND	ND		ND
Benzo(a)pyrene	0.01	ND	ND	ND	ND		ND
Indeno(1,2,3-cd)pyrene	0.01	ND	ND	ND	ND		ND
Dibenz(a,h)anthracene	0.01	ND	ND	ND	ND		ND
Benzo(ghi)perylene	0.01	ND	ND	ND	ND		ND
1-Nitropyrene	0.05	ND	ND	ND	ND		ND
5-Methylchrysene	0.05	ND	ND	ND	ND		ND
7,12-Dimethylbenz(a)anthr	0.05	ND	ND	ND	ND		ND
3-Methylcholanthrene	0.05	ND	ND	ND	ND		ND
Benzo(e)pyrene	0.01	ND	ND	ND	0.01		ND
Perylene	0.05	ND	ND	ND	ND		ND
Dibenz(a,h)acridine	0.05	ND	ND	ND	ND		ND
Dibenz(a,j)acridine	0.05	ND	ND	ND	ND		ND
7H-Dibenzo(c,g)carbazole	0.05	ND	ND	ND	ND		ND
Dibenzo(a,e)fluoranthene	0.05	ND	ND	ND	ND		ND
Dibenzo(a,e)pyrene	0.05	ND	ND	ND	ND		ND
Dibenzo(a,h)pyrene	0.05	ND	ND	ND	ND		ND
Dibenzo(a,l)pyrene	0.05	ND	ND	ND	ND		ND
Dibenzo(a,i)pyrene	0.05	ND	ND	ND	ND		ND
Quinoline	0.05	ND	ND	ND	ND		ND
Other PAH							
Naphthalene	0.05	2.3	1	0.66	0.52		ND
Anthracene	0.05	ND	ND	ND	ND		ND
Surrogate Recoveries (%)							
d8-Naphthalene		68	68	76	72		72
d10-Acenaphthylene		60	72	76	76		48
d10-Acenaphthene		60	64	72	68		60
d10-Fluorene		88	100	108	100		72
d10-Phenanthrene		104	92	100	96		100
d10-Fluoranthene		92	84	88	96		88
d10-Pyrene		92	84	88	88		92
d12-Chrysene		88	84	104	100		92
d12-Benzo(b)fluoranthene		104	96	104	100		100
d12-Benzo(a)pyrene		96	100	108	100		88
d14-Dibenz(a,h)anthracene		108	124	140	128		128

ND - none detected

DATA REPORT

Client: Lanfranco & Associates
Contact: Mark Lanfranco

Date Extracted: 28-Aug-18
Date Analysed: 12-Sep-18

	Client ID:	Blank Dioxin	Run-1 – Dioxin	Run-2 – Dioxin	Run-3 – Dioxin		BLANK
	PRL ID:	PR182302	PR182303	PR182304	PR182305		
Compound	**DL µg**	**µg**	**µg**	**µg**	**µg**		**µg**
Trichlorobenzenes	0.05	ND	1.47	0.684	1.04		ND
Tetrachlorobenzenes	0.05	ND	0.396	0.290	0.27		ND
Pentachlorobenzene	0.05	ND	0.064	0.057	0.06		ND
Hexachlorobenzene	0.01	ND	0.011	0.013	0.01		ND
Surrogate Recoveries (%)							
13C6-Tetrachlorobenzene		64	144	124	136		64
13C6-Pentachlorobenzene		72	152	160	140		84
13C6-Hexachlorobenzene		76	128	164	136		132

Compound	**DL µg**	**µg**	**µg**	**µg**	**µg**		**µg**
Trichlorophenols	0.05	ND	0.210	0.163	0.112		ND
Tetrachlorophenols	0.05	ND	ND	ND	ND		ND
Pentachlorophenol	0.05	ND	0.167	0.251	0.143		ND
Surrogate Recoveries (%)							
13C6-Trichlorophenol		48	96	108	84		68
13C6-Tetrachlorophenol		60	76	108	84		80
13C6-Pentachlorophenol		20	68	100	80		36

ND - none detected

APPENDIX 2

QA/QC RESULTS

METHOD 23/1-RM-3 DATA REPORT

Client:	Lanfranco & Associates	**Sample Date:**	22-Aug-18
Client ID:	Blank Dioxin	**Date Extracted:**	28-Aug-18
PRL ID:	PR182302	**Date Analysed:**	13-Sep-18
		Filter Wt.:	0.32 g

DIOXINS				I-TEQs		
		DL	# of	(ND=0)	(ND=½DL)	(ND=DL)
Congeners	**pg**	**pg**	**peaks**	**pg**	**pg**	**pg**
2,3,7,8-TCDD	ND	2		ND	1	2
Total TCDD	ND	2	0			
1,2,3,7,8-PeCDD	ND	4		ND	1	2
Total PeCDD	ND	4	0			
1,2,3,4,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,7,8,9-HxCDD	ND	4		ND	0.2	0.4
Total HxCDD	ND	4	0			
1,2,3,4,6,7,8-HpCDD	ND	4		ND	0.02	0.04
Total HpCDD	ND	4	0			
OCDD	ND	15	0	ND	0.0075	0.015
		Total Dioxin TEQ		**0.0**	**2.6**	**5.3**

FURANS				I-TEQs		
		DL	# of	(ND=0)	(ND=½DL)	(ND=DL)
Congeners	**pg**	**pg**	**peaks**	**pg**	**pg**	**pg**
2,3,7,8-TCDF	ND	2		ND	0.1	0.2
Total TCDF	ND	2	0			
1,2,3,7,8-PeCDF	ND	4		ND	0.1	0.2
2,3,4,7,8-PeCDF	ND	4		ND	1	2
Total PeCDF	ND	4	0			
1,2,3,4,7,8-HxCDF	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDF	ND	4		ND	0.2	0.4
1,2,3,7,8,9-HxCDF	ND	4		ND	0.2	0.4
2,3,4,6,7,8-HxCDF	ND	4		ND	0.2	0.4
Total HxCDF	ND	4	0			
1,2,3,4,6,7,8-HpCDF	ND	4		ND	0.02	0.04
1,2,3,4,7,8,9-HpCDF	ND	4		ND	0.02	0.04
Total HpCDF	ND	4	0			
OCDF	ND	15	0	ND	0.0075	0.015
		Total Furan TEQ		**0.0**	**2.0**	**4.1**

Total PCDD/PCDF Toxic Equivalent (pg)			
		0.0	**4.7**	**9.4**

Surrogate Recoveries (%)

$^{37}Cl_4$ -2,3,7,8-TCDD	88
$^{13}C_{12}$ -2,3,4,7,8-PeCDF	103
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDD	82
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDF	89
$^{13}C_{12}$ -1,2,3,4,7,8,9-HpCDF	88

ND - none detected

Internal Standards (%)

$^{13}C_{12}$ -2,3,7,8-TCDD	53
$^{13}C_{12}$ -1,2,3,7,8-PeCDD	58
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDD	77
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD	74
$^{13}C_{12}$ -OCDD	59
$^{13}C_{12}$ -2,3,7,8-TCDF	43
$^{13}C_{12}$ -1,2,3,7,8-PeCDF	58
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDF	76
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF	76

METHOD 23/1-RM-3 DATA REPORT

Client:	Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	BLANK	**Date Extracted:**	28-Aug-18
PRL ID:	DF180668B	**Date Analysed:**	13-Sep-18

DIOXINS		DL	# of	I-TEQs (ND=0)	I-TEQs (ND=½DL)	I-TEQs (ND=DL)
Congeners	**pg**	**pg**	**peaks**	**pg**	**pg**	**pg**
2,3,7,8-TCDD	ND	2		ND	1	2
Total TCDD	ND	2	0			
1,2,3,7,8-PeCDD	ND	4		ND	1	2
Total PeCDD	ND	4	0			
1,2,3,4,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDD	ND	4		ND	0.2	0.4
1,2,3,7,8,9-HxCDD	ND	4		ND	0.2	0.4
Total HxCDD	ND	4	0			
1,2,3,4,6,7,8-HpCDD	ND	4		ND	0.02	0.04
Total HpCDD	ND	4	0			
OCDD	ND	15	0	ND	0.0075	0.015
		Total Dioxin TEQ		**0.0**	**2.6**	**5.3**

FURANS		DL	# of	I-TEQs (ND=0)	I-TEQs (ND=½DL)	I-TEQs (ND=DL)
Congeners	**pg**	**pg**	**peaks**	**pg**	**pg**	**pg**
2,3,7,8-TCDF	ND	2		ND	0.1	0.2
Total TCDF	ND	2	0			
1,2,3,7,8-PeCDF	ND	4		ND	0.1	0.2
2,3,4,7,8-PeCDF	ND	4		ND	1	2
Total PeCDF	ND	4	0			
1,2,3,4,7,8-HxCDF	ND	4		ND	0.2	0.4
1,2,3,6,7,8-HxCDF	ND	4		ND	0.2	0.4
1,2,3,7,8,9-HxCDF	ND	4		ND	0.2	0.4
2,3,4,6,7,8-HxCDF	ND	4		ND	0.2	0.4
Total HxCDF	ND	4	0			
1,2,3,4,6,7,8-HpCDF	ND	4		ND	0.02	0.04
1,2,3,4,7,8,9-HpCDF	ND	4		ND	0.02	0.04
Total HpCDF	ND	4	0			
OCDF	ND	15	0	ND	0.0075	0.015
		Total Furan TEQ		**0.0**	**2.0**	**4.1**

Total PCDD/PCDF Toxic Equivalent (pg)	**0.0**	**4.7**	**9.4**

Internal Standards (%)

$^{13}C_{12}$ -2,3,7,8-TCDD	46
$^{13}C_{12}$ -1,2,3,7,8-PeCDD	57
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDD	67
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD	70
$^{13}C_{12}$ -OCDD	120
$^{13}C_{12}$ -2,3,7,8-TCDF	41
$^{13}C_{12}$ -1,2,3,7,8-PeCDF	57
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDF	69
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF	72

ND - none detected

QC REPORT - SPIKE

Client:	Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	MATRIX SPIKE	**Date Extracted:**	28-Aug-18
PRL ID:	DF180669S	**Date Analysed:**	13-Sep-18

DIOXINS			Acceptable Recovery		Pass/Fail	Int. Std Recoveries
	LOF	Recovery	Min	Max		
Congeners	pg	%	%	%		%
2,3,7,8-TCDD	200	86	80	120	Pass	50
1,2,3,7,8-PeCDD	200	102	80	120	Pass	63
1,2,3,4,7,8-HxCDD	400	80	80	120	Pass	-
1,2,3,6,7,8-HxCDD	400	113	80	120	Pass	74
1,2,3,7,8,9-HxCDD	400	99	80	120	Pass	-
1,2,3,4,6,7,8-HpCDD	400	120	80	120	Pass	94
OCDD	1000	116	80	120	Pass	92

FURANS			Acceptable Recovery		Pass/Fail	Int. Std Recoveries
	LOF	Recovery	Min	Max		
Congeners	pg	%	%	%		%
2,3,7,8-TCDF	200	86	80	120	Pass	42
1,2,3,7,8-PeCDF	200	105	80	120	Pass	63
2,3,4,7,8-PeCDF	200	83	80	120	Pass	-
1,2,3,4,7,8-HxCDF	400	93	80	120	Pass	-
1,2,3,6,7,8-HxCDF	400	107	80	120	Pass	80
1,2,3,7,8,9-HxCDF	400	85	80	120	Pass	-
2,3,4,6,7,8-HxCDF	400	85	80	120	Pass	-
1,2,3,4,6,7,8-HpCDF	400	94	80	120	Pass	91
1,2,3,4,7,8,9-HpCDF	400	83	80	120	Pass	-
OCDF	1000	82	80	120	Pass	-

LOF - Level of Fortification

DATA REPORT

Client:	Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	**Blank Dioxin**	**Date Extracted:**	28-Aug-18
PRL ID:	PR182302	**Date Analysed:**	12-Sep-18

Dioxin-like PCBs				**Surrogate**
			DL	**Recoveries**
Chemical Name	**IUPAC #**	**ng**	**ng**	**%**
3,4,4',5-TeCB	PCB 81	ND	0.02	72
3,3',4,4'-TeCB	PCB 77	ND	0.02	76
2,3',4,4',5'-PeCB	PCB 123	ND	0.02	80
2,3',4,4',5-PeCB	PCB 118	ND	0.02	72
2,3,4,4',5-PeCB	PCB 114	ND	0.02	72
2,3,3',4,4'-PeCB	PCB 105	ND	0.02	84
3,3',4,4',5-PeCB	PCB 126	ND	0.02	76
2,3',4,4',5,5'-HxCB	PCB 167	ND	0.02	84
2,3,3',4,4',5-HxCB	PCB 156	ND	0.02	92
2,3,3',4,4',5'-HxCB	PCB 157	ND	0.02	92
3,3',4,4',5,5'-HxCB	PCB 169	ND	0.02	72
2,3,3',4,4',5,5'-HpCB	PCB 189	ND	0.02	92
		Toxic Equivalent (WHO-TEQ)		

WHO-TEQs (2005)	
(ND=0)	**(ND=DL)**
ng	**ng**
ND	6.00E-06
ND	2.00E-06
ND	6.00E-07
ND	6.00E-07
ND	6.00E-07
ND	6.00E-07
ND	2.00E-03
ND	6.00E-07
ND	6.00E-07
ND	6.00E-07
ND	6.00E-04
ND	6.00E-07
0.00E+00	2.61E-03

Total PCB		
		DL
Homologs	**ng**	**ng**
Monochlorobiphenyls	ND	0.05
Dichlorobiphenyls	6.88	0.05
Trichlorobiphenyls	0.28	0.05
Tetrachlorobiphenyls	0.07	0.05
Pentachlorobiphenyls	ND	0.05
Hexachlorobiphenyls	ND	0.05
Heptachlorobiphenyls	ND	0.05
Octachlorobiphenyls	ND	0.05
Nonachlorobiphenyls	ND	0.05
Decachlorobiphenyl	ND	0.05
Total PCB	7.24	

ND - none detected

Surrogate Recoveries		
Chemical Name	**IUPAC #**	**%**
13C12-2-MoCB	1L	60
13C12-4,4'-DiCB	15L	56
13C12-2,2',6'-TrCB	19L	68
13C12-3,4,4'-TrCB	37L	112
13C12-2,2',6,6'-TeCB	54L	72
13C12-2,2',4,6,6'-PeCB	104L	72
13C12-2,2',4,4',6,6'-HxCB	155L	68
13C12-2,2',3,4',5,6,6'-HpCB	188L	76
13C12-2,2',3,3',5,5',6,6'-OcCB	202L	92
13C12-2,3,3',4,4',5,5',6-OcCB	205L	84
13C12-2,2',3,3',4,4',5,5',6-NoCB	206L	72
13C12-DeCB	209L	88

DATA REPORT

Client:	Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	BLANK	**Date Extracted:**	28-Aug-18
PRL ID:	PC180668B	**Date Analysed:**	13-Sep-18

Dioxin-like PCBs				Surrogate Recoveries	WHO-TEQs (2005) (ND=0)	WHO-TEQs (2005) (ND=DL)
			DL			
Chemical Name	**IUPAC #**	**ng**	**ng**	**%**	**ng**	**ng**
3,4,4',5-TeCB	PCB 81	ND	0.02	64	ND	6.00E-06
3,3',4,4'-TeCB	PCB 77	ND	0.02	64	ND	2.00E-06
2,3',4,4',5'-PeCB	PCB 123	ND	0.02	80	ND	6.00E-07
2,3',4,4',5-PeCB	PCB 118	ND	0.02	76	ND	6.00E-07
2,3,4,4',5-PeCB	PCB 114	ND	0.02	80	ND	6.00E-07
2,3,3',4,4'-PeCB	PCB 105	ND	0.02	76	ND	6.00E-07
3,3',4,4',5-PeCB	PCB 126	ND	0.02	76	ND	2.00E-03
2,3',4,4',5,5'-HxCB	PCB 167	ND	0.02	76	ND	6.00E-07
2,3,3',4,4',5-HxCB	PCB 156	ND	0.02	76	ND	6.00E-07
2,3,3',4,4',5'-HxCB	PCB 157	ND	0.02	72	ND	6.00E-07
3,3',4,4',5,5'-HxCB	PCB 169	ND	0.02	68	ND	6.00E-04
2,3,3',4,4',5,5'-HpCB	PCB 189	ND	0.02	84	ND	6.00E-07
		Toxic Equivalent (WHO-TEQ)			0.00E+00	2.61E-03

Total PCB		
		DL
Homologs	**ng**	**ng**
Monochlorobiphenyls	ND	0.05
Dichlorobiphenyls	0.21	0.05
Trichlorobiphenyls	ND	0.05
Tetrachlorobiphenyls	ND	0.05
Pentachlorobiphenyls	ND	0.05
Hexachlorobiphenyls	ND	0.05
Heptachlorobiphenyls	ND	0.05
Octachlorobiphenyls	ND	0.05
Nonachlorobiphenyls	ND	0.05
Decachlorobiphenyl	ND	0.05
Total PCB	0.21	

ND - none detected

Surrogate Recoveries		
Chemical Name	**IUPAC #**	**%**
13C12-2-MoCB	1L	52
13C12-4,4'-DiCB	15L	44
13C12-2,2',6'-TrCB	19L	52
13C12-3,4,4'-TrCB	37L	92
13C12-2,2',6,6'-TeCB	54L	60
13C12-2,2',4,6,6'-PeCB	104L	60
13C12-2,2',4,4',6,6'-HxCB	155L	64
13C12-2,2',3,4',5,6,6'-HpCB	188L	68
13C12-2,2',3,3',5,5',6,6'-OcCB	202L	76
13C12-2,3,3',4,4',5,5',6-OcCB	205L	76
13C12-2,2',3,3',4,4',5,5',6-NoCB	206L	72
13C12-DeCB	209L	64

QC REPORT - SPIKE

Client:	Lanfranco & Associates	**Contact:**	Mark Lanfranco
Client ID:	SPIKE	**Date Extracted:**	28-Aug-18
PRL ID:	PC180669S	**Date Analysed:**	14-Sep-18

Dioxin-like PCBs			Acceptable Recovery		Pass/Fail
	LOF	Recovery	Min	Max	
Chemical Name	ng	%	%	%	
3,4,4',5-TeCB (81)	1	126	50	150	Pass
3,3',4,4'-TeCB (77)	1	92	50	150	Pass
2,3',4,4',5'-PeCB (123)	1	104	50	150	Pass
2,3',4,4',5-PeCB (118)	1	118	50	150	Pass
2,3,4,4',5-PeCB (114)	1	96	50	150	Pass
2,3,3',4,4'-PeCB (105)	1	102	50	150	Pass
3,3',4,4',5-PeCB (126)	1	109	50	150	Pass
2,3',4,4',5,5'-HxCB (167)	1	73	50	150	Pass
2,3,3',4,4',5-HxCB (156)	1	99	50	150	Pass
2,3,3',4,4',5'-HxCB (157)	1	96	50	150	Pass
3,3',4,4',5,5'-HxCB (169)	1	103	50	150	Pass
2,3,3',4,4',5,5'-HpCB (189)	1	85	50	150	Pass

Surrogate Recoveries
%
56
56
68
60
68
72
68
76
68
72
64
92

Total PCB			Acceptable Recovery		Pass/Fail
	LOF	Recovery	Min	Max	
Homologs	ng	%	%	%	
Monochlorobiphenyls	2	100			
Dichlorobiphenyls	4	96			
Trichlorobiphenyls	6	61			
Tetrachlorobiphenyls	12	109			
Pentachlorobiphenyls	13	106			
Hexachlorobiphenyls	15	91			
Heptachlorobiphenyls	11	104			
Octachlorobiphenyls	6	91			
Nonachlorobiphenyls	2	95			
Decachlorobiphenyl	1	122			
Total PCB	72	97	50	150	Pass

LOF - Level of Fortification

DATA REPORT

Client: Lanfranco & Associates
Contact: Mark Lanfranco
Project: MetroVancouver WTE

Date Extracted: 28-Aug-18
Date Analysed: 12-Sep-18

Client ID: SPIKE
PRL ID: PH180669S

NPRI PAH

	µg/g	LOF	Recovery	Acceptable	Pass/Fail
Acenaphthene	0.94	1	94%	50-150%	pass
Acenaphthylene	0.98	1	98%	50-150%	pass
Benz(a)anthracene	0.74	1	74%	50-150%	pass
Benzo(a)pyrene	0.93	1	93%	50-150%	pass
Benzo(b)fluoranthene	0.81	1	81%	50-150%	pass
Benzo(ghi)perylene	0.81	1	81%	50-150%	pass
Benzo(k)fluoranthene	0.89	1	89%	50-150%	pass
Chrysene	0.92	1	92%	50-150%	pass
Dibenz(a,h)anthracene	0.81	1	81%	50-150%	pass
Fluoranthene	0.78	1	78%	50-150%	pass
Fluorene	0.92	1	92%	50-150%	pass
Indeno(1,2,3-cd)pyrene	0.82	1	82%	50-150%	pass
Phenanthrene	1.18	1	118%	50-150%	pass
Pyrene	0.73	1	73%	50-150%	pass
Dibenz(a,h)acridine	0.78	1	78%		
Dibenz(a,j)acridine	1.12	1	112%		
7H-Dibenzo(c,g)carbazole	0.77	1	77%		
Dibenzo(a,e)fluoranthene	1.00	1	100%		
Dibenzo(a,h)pyrene	1.39	1	139%		
Dibenzo(a,e)pyrene	0.97	1	97%		
Dibenzo(a,i)pyrene	1.37	1	137%		
Dibenzo(a,l)pyrene	1.20	1	120%		
7,12-Dimethylbenz(a)anthracene	0.94	1	94%		
3-Methylcholanthrene	0.90	1	90%		
5-Methylchrysene	1.18	1	118%		
1-Nitropyrene	1.18	1	118%		
Perylene	1.22	1	122%		
Other PAH					
Naphthalene	0.98	1	98%	50-150%	pass

Form Name: DOC23 Data Report PAH 22-Mar-08 DGH

QC REPORT - SPIKE

Client: Lanfranco & Associates
Contact: Mark Lanfranco

Date Extracted: 28-Aug-18
Date Analysed: 12-Sep-18

Client ID: SPIKE
PRL ID: CB180669S

Compound	LOF µg	µg	Recovery
Trichlorobenzenes	2.0	1.78	89%
Tetrachlorobenzenes	3.0	3.24	108%
Pentachlorobenzene	1.0	1.11	111%
Hexachlorobenzene	1.0	1.39	139%
Trichlorophenols	5.0	6.02	120%
Tetrachlorophenols	5.0	5.50	110%
Pentachlorophenol	5.0	6.01	120%

LOF - level of fortification

Acronyms used in reporting dioxins and furans:

TCDD = Tetrachlorodibenzo-*p*-dioxin
PeCDD = Pentachlorodibenzo-*p*-dioxin
HxCDD = Hexachlorodibenzo-*p*-dioxin
HpCDD = Heptachlorodibenzo-*p*-dioxin
OCDD = Octachlorodibenzo-*p*-dioxin

TCDF = Tetrachlorodibenzofuran
PeCDF = Pentachlorodibenzofuran
HxCDF = Hexachlorodibenzofuran
HpCDF = Heptachlorodibenzofuran
OCDF = Octachlorodibenzofuran

Acceptable recoveries for surrogates	**EPA Method 23**	
	Min (%)	**Max (%)**
$^{37}Cl_4$ -2,3,7,8-TCDD	70	130
$^{13}C_{12}$ -2,3,4,7,8-PeCDF	70	130
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDD	70	130
$^{13}C_{12}$ -1,2,3,4,7,8-HxCDF	70	130
$^{13}C_{12}$ -1,2,3,4,7,8,9-HpCDF	70	130

Acceptable recoveries for Internal Standards

	EPA Method 23		**Env. Can. 1-RM-3**	
	Min (%)	**Max (%)**	**Min (%)**	**Max (%)**
$^{13}C_{12}$ -2,3,7,8-TCDD	40	130	40	130
$^{13}C_{12}$ -1,2,3,7,8-PeCDD	40	130	40	130
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDD	40	130	40	130
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDD	25	130	40	130
$^{13}C_{12}$ -OCDD	25	130	40	130
$^{13}C_{12}$ -2,3,7,8-TCDF	40	130	40	130
$^{13}C_{12}$ -1,2,3,7,8-PeCDF	40	130		
$^{13}C_{12}$ -1,2,3,6,7,8-HxCDF	40	130		
$^{13}C_{12}$ -1,2,3,4,6,7,8-HpCDF	25	130		

Acronyms used in reporting Polychlorinated Biphenyls (PCBs)

MoCB = Monochlorobiphenyl
DiCB = Dichlorobiphenyl
TrCB = Trichlorobiphenyl
TeCB = Tetrachlorobiphenyl
PeCB = Pentachlorobiphenyl
HxCB = Hexachlorobiphenyl
HpCB = Heptachlorobiphenyl
OcCB = Octachlorobiphenyl
NoCB = Nonachlorobiphenyl
DeCB = Decachlorobiphenyl

Acceptable recoveries for PCB Internal Standards - EPA 1668C

Chemical Name	IUPAC #	Min	Max
$^{13}C_{12}$-2-MoCB	1L	5	145
$^{13}C_{12}$-4-MoCB	3L	5	145
$^{13}C_{12}$-2,2'-DiCB	4L	5	145
$^{13}C_{12}$-4,4'-DiCB	15L	5	145
$^{13}C_{12}$-2,2',6'-TrCB	19L	5	145
$^{13}C_{12}$-3,4,4'-TrCB	37L	5	145
$^{13}C_{12}$-2,2',6,6'-TeCB	54L	5	145
$^{13}C_{12}$-3,4,4',5-TeCB	81L	10	145
$^{13}C_{12}$-3,3',4,4'-TeCB	77L	10	145
$^{13}C_{12}$-2,2',4,6,6'-PeCB	104L	10	145
$^{13}C_{12}$-2',3,4,4',5-PeCB	123L	10	145
$^{13}C_{12}$-2,3',4,4',5-PeCB	118L	10	145
$^{13}C_{12}$-2,3,4,4',5-PeCB	114L	10	145
$^{13}C_{12}$-2,3,3',4,4'-PeCB	105L	10	145
$^{13}C_{12}$-3,3',4,4',5-PeCB	126L	10	145
$^{13}C_{12}$-2,2',4,4',6,6'-HxCB	155L	10	145
$^{13}C_{12}$-2,3',4,4',5,5'-HxCB	167L	10	145
$^{13}C_{12}$-2,3,3',4,4',5-HxCB	156L	10	145
$^{13}C_{12}$-2,3,3',4,4',5'-HxCB	157L	10	145
$^{13}C_{12}$-3,3',4,4',5,5'-HxCB	169L	10	145
$^{13}C_{12}$-2,2',3,4',5,6,6'-HpCB	188L	10	145
$^{13}C_{12}$-2,3,3',4,4',5,5'-HpCB	189L	10	145
$^{13}C_{12}$-2,2',3,3',5,5',6,6'-OcCB	202L	10	145
$^{13}C_{12}$-2,3,3',4,4',5,5',6-OcCB	205L	10	145
$^{13}C_{12}$-2,2',3,3',4',5,5',6,6'-NoCB	208L	10	145
$^{13}C_{12}$-2,2',3,3',4,4',5,5',6-NoCB	206L	10	145
$^{13}C_{12}$-DeCB	209L	10	145
$^{13}C_{12}$-2,4,4'-TrCB	28L	5	145
$^{13}C_{12}$-2,3,3',5,5'-PeCB	111L	10	145
$^{13}C_{12}$-2,2',3,3',5,5',6-HpCB	178L	10	145

Acceptable recoveries for Polycyclic Aromatic Hydrocarbon Standards in Environmental Samples

	Surrogate Recovery	
	Min (%)	**Max (%)**
Naphthalene-d8	0	135
Biphenyl-d10	15	135
Acenaphthene-d10	15	135
Fluorene-d10	30	135
Phenanthrene-d10	30	135
Fluoranthene-d10	30	135
Pyrene-d10	30	135
Chrysene-d12	30	150
Benzo(b)fluoranthene-d12	30	150
Benzo(a)pyrene-d12	15	150
Dibenz(a,h)anthracene-d14	30	150

APPENDIX 3

COMPUTER OUTPUTS OF MEASURED AND CALCULATED DATA

Client:	Metro Vancouver	**Date:**	22-Aug-18
Jobsite:	WTE (Burnaby, BC)	**Run:**	1 PCDD-PCDF
Source:	Unit 1	**Run Time:**	10:01 - 14:10

Dioxin Concentration:	**0.9**	**pg/dscm**	0.0004	gr/dscf
	0.5	**pg/dscm**	0.0002	gr/Acf
	0.9	pg/dscm (@ 11% O2)	0.0004	gr/dscf (@ 11% O2)

Emission Rate: see D/F data Table 2

Sample Gas Volume:	4.3596	dscm	153.961	dscf
Total Sample Time:	240.0	minutes		
Average Isokineticity:	102.3	%		

Flue Gas Characteristics

Moisture:	14.36	%		
Temperature	154.2	oC	309.6	oF
Flow	1262.1	dscm/min	44572	dscf/min
	21.04	dscm/sec	742.9	dscf/sec
	2261.6	Acm/min	79867	Acf/min
Velocity	14.798	m/sec	48.55	f/sec
Gas Analysis	10.07	% O2	10.06	% CO2
	30.012	Mol. Wt (g/gmole) Dry	28.288	Mol. Wt (g/gmole) Wet

*** Standard Conditions:** Metric: 20 deg C, 101.325 kPa
Imperial: 68 deg F, 29.92 in.Hg

Client:	Metro Vancouver	**Date:**	22-Aug-18
Jobsite:	WTE (Burnaby, BC)	**Run:**	1 PCDD-PCDF
Source:	Unit 1	**Run Time:**	10:01 - 14:10

Control Unit (Y)	0.9997
Nozzle Diameter (in.)	0.2660
Pitot Factor	0.8489
Baro. Press. (in. Hg)	29.86
Static Press. (in. H2O)	-19.50
Stack Height (ft)	30
Stack Diameter (in.)	70.9
Stack Area (sq.ft.)	27.417
Minutes Per Reading	5.0
Minutes Per Point	10.0

Gas Analysis (Vol. %):

	CO2	O2
Trav 1	9.92	10.12
Trav 2	10.20	10.02
Average =	**10.06**	**10.07**

Condensate Collection:

Impinger 1 (grams)	512.0
Impinger 2 (grams)	19.0
Impinger 3 (grams)	4.0
Impinger 4 (grams)	13.4
Total Gain (grams)	**548.4**

Collection:

Filter (grams)	**0.0000**
Washings (grams)	**0.0000**
Impinger (grams)	**0.0000**
D/F TEQ (ng)	**0.0041**

Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Dry Gas Temperature Inlet (oF)	Outlet (oF)	Stack (oF)	Wall Dist. (in.)	Isokin. (%)
		0.0	827.008							
1	1	5.0	830.550	0.550	1.55	78	78	305	1.5	102.0
		10.0	834.130	0.560	1.57	78	78	306	1.5	102.3
	2	15.0	837.310	0.440	1.25	79	79	307	4.7	102.3
		20.0	840.560	0.460	1.29	79	79	307	4.7	102.3
	3	25.0	843.780	0.450	1.27	80	80	307	8.4	102.2
		30.0	846.950	0.440	1.24	80	80	307	8.4	101.8
	4	35.0	850.260	0.470	1.33	81	81	307	12.5	102.7
		40.0	853.600	0.480	1.36	82	82	307	12.5	102.3
	5	45.0	857.120	0.530	1.50	83	83	307	17.7	102.5
		50.0	860.680	0.550	1.56	84	84	307	17.7	101.6
	6	55.0	864.260	0.550	1.56	85	85	308	25.2	102.0
		60.0	867.820	0.540	1.54	86	86	309	25.2	102.3
	7	65.0	871.520	0.580	1.65	88	88	310	45.6	102.3
		70.0	875.300	0.600	1.71	88	88	310	45.6	102.7
	8	75.0	878.990	0.570	1.64	90	90	310	53.2	102.5
		80.0	882.650	0.560	1.60	90	90	310	53.2	102.6
	9	85.0	886.220	0.530	1.54	90	90	309	58.3	102.7
		90.0	889.720	0.510	1.46	90	90	309	58.3	102.7
	10	95.0	893.050	0.460	1.32	91	91	309	62.5	102.6
		100.0	896.310	0.440	1.27	92	92	309	62.5	102.5
	11	105.0	899.500	0.420	1.21	92	92	310	66.1	102.7
		110.0	902.640	0.410	1.18	92	92	311	66.1	102.4
	12	115.0	905.750	0.400	1.15	92	92	311	69.4	102.7
		120.0	908.920	0.420	1.21	92	92	310	69.4	102.1
		0.0	908.920							
2	1	5.0	911.860	0.360	1.05	91	91	309	1.5	102.4
		10.0	914.870	0.380	1.10	92	92	309	1.5	101.8
	2	15.0	917.810	0.360	1.03	94	94	313	4.7	102.1
		20.0	920.750	0.360	1.03	94	94	312	4.7	102.0
	3	25.0	923.610	0.340	0.98	95	95	313	8.4	102.0
		30.0	926.470	0.340	0.98	94	94	311	8.4	102.0
	4	35.0	929.370	0.350	1.00	94	94	312	12.5	102.0

		40.0	932.320	0.360	1.04	95	95	311	12.5	102.1
	5	45.0	935.220	0.350	1.01	95	95	312	17.7	101.8
		50.0	938.160	0.360	1.03	95	95	312	17.7	101.8
	6	55.0	941.220	0.390	1.12	95	95	313	25.2	101.9
		60.0	944.320	0.400	1.15	95	95	313	25.2	101.9
	7	65.0	947.610	0.450	1.29	95	95	312	45.6	102.0
		70.0	950.920	0.450	1.30	95	95	309	45.6	102.4
	8	75.0	954.630	0.570	1.66	95	95	310	53.2	102.1
		80.0	958.420	0.590	1.71	95	95	309	53.2	102.5
	9	85.0	962.400	0.650	1.90	96	96	308	58.3	102.3
		90.0	966.480	0.680	1.97	96	96	308	58.3	102.6
	10	95.0	970.130	0.550	1.59	96	96	312	62.5	102.2
		100.0	973.840	0.570	1.65	96	96	311	62.5	102.0
	11	105.0	977.140	0.450	1.30	96	96	311	66.1	102.0
		110.0	980.500	0.460	1.33	96	96	311	66.1	102.8
	12	115.0	983.920	0.480	1.39	96	96	310	69.4	102.3
		120.0	987.340	0.480	1.39	96	96	310	69.4	102.3
			Average:	0.472	1.353	90.4	90.4	309.6		102.3

Client:	Metro Vancouver	**Date:**	23-Aug-18
Jobsite:	WTE (Burnaby, BC)	**Run:**	2 PCDD-PCDF
Source:	Unit 1	**Run Time:**	09:02 - 13:06

Dioxin Concentration:	**2.56**	**pg/dscm**	0.0011	gr/dscf
	1.4	**pg/dscm**	0.0006	gr/Acf
	2.23	pg/dscm (@ 11% O2)	0.0010	gr/dscf (@ 11% O2)

Emission Rate: see D/F data Table 2

Sample Gas Volume:	4.2967	dscm	151.738	dscf
Total Sample Time:	240.0	minutes		
Average Isokineticity:	103.6	%		

Flue Gas Characteristics

Moisture:	15.45	%		
Temperature	157.2	oC	314.9	oF
Flow	1227.2	dscm/min	43339	dscf/min
	20.45	dscm/sec	722.3	dscf/sec
	2235.3	Acm/min	78940	Acf/min
Velocity	14.627	m/sec	47.99	f/sec
Gas Analysis	9.54	% O2	10.26	% CO2
	30.023	Mol. Wt (g/gmole) Dry	28.166	Mol. Wt (g/gmole) Wet

*** Standard Conditions:** Metric: 20 deg C, 101.325 kPa
Imperial: 68 deg F, 29.92 in.Hg

Client:	Metro Vancouver	**Date:**	23-Aug-18
Jobsite:	WTE (Burnaby, BC)	**Run:**	2 PCDD-PCDF
Source:	Unit 1	**Run Time:**	09:02 - 13:06

Control Unit (Y)	0.9997
Nozzle Diameter (in.)	0.2660
Pitot Factor	0.8489
Baro. Press. (in. Hg)	29.95
Static Press. (in. H2O)	-19.50
Stack Height (ft)	30
Stack Diameter (in.)	70.9
Stack Area (sq.ft.)	27.417
Minutes Per Reading	5.0
Minutes Per Point	10.0

Gas Analysis (Vol. %):

	CO2	O2
Trav 1	10.10	9.85
Trav 2	10.42	9.22
Average =	**10.26**	**9.54**

Condensate Collection:

Impinger 1 (grams)	565.0
Impinger 2 (grams)	7.0
Impinger 3 (grams)	4.0
Impinger 4 (grams)	12.9
Total Gain (grams)	**588.9**

Collection:

Filter (grams)	**0.0000**
Washings (grams)	**0.0000**
Impinger (grams)	**0.0000**
D/F TEQ (ng)	**0.0110**

Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Dry Gas Temperature Inlet (oF)	Outlet (oF)	Stack (oF)	Wall Dist. (in.)	Isokin. (%)
		0.0	988.610							
1	1	5.0	991.820	0.470	1.20	69	69	316	1.5	103.6
		10.0	994.990	0.460	1.17	69	69	318	1.5	103.6
	2	15.0	998.090	0.440	1.12	69	69	318	4.7	103.5
		20.0	1001.150	0.430	1.09	69	69	318	4.7	103.4
	3	25.0	1004.260	0.440	1.13	70	70	314	8.4	103.4
		30.0	1007.400	0.450	1.19	70	70	314	8.4	103.3
	4	35.0	1010.620	0.460	1.22	71	71	313	12.5	104.5
		40.0	1013.860	0.470	1.22	71	71	312	12.5	103.9
	5	45.0	1016.910	0.420	1.22	73	73	312	17.7	103.1
		50.0	1019.930	0.410	1.10	74	74	311	17.7	103.0
	6	55.0	1023.300	0.510	1.36	74	74	313	25.2	103.3
		60.0	1026.770	0.540	1.44	74	74	313	25.2	103.4
	7	65.0	1030.280	0.550	1.47	75	75	313	45.6	103.4
		70.0	1033.770	0.540	1.45	75	75	313	45.6	103.8
	8	75.0	1037.250	0.540	1.44	75	75	315	53.2	103.6
		80.0	1040.790	0.560	1.49	75	75	316	53.2	103.6
	9	85.0	1044.230	0.530	1.42	76	76	317	58.3	103.3
		90.0	1047.660	0.520	1.39	76	76	317	58.3	104.0
	10	95.0	1050.950	0.480	1.28	76	76	318	62.5	103.9
		100.0	1054.310	0.500	1.33	76	76	319	62.5	104.0
	11	105.0	1057.540	0.460	1.23	77	77	318	66.1	104.0
		110.0	1060.700	0.440	1.17	77	77	318	66.1	104.0
	12	115.0	1063.770	0.420	1.12	76	76	318	69.4	103.6
		120.0	1066.730	0.390	1.04	76	76	318	69.4	103.6
								.		
		0.0	1066.730							
2	1	5.0	1069.350	0.310	0.86	77	77	320	1.5	102.8
		10.0	1072.020	0.320	0.85	77	77	320	1.5	103.1
	2	15.0	1074.660	0.310	0.82	77	77	320	4.7	103.5
		20.0	1077.260	0.300	0.80	77	77	319	4.7	103.6
	3	25.0	1079.680	0.260	0.69	78	78	317	8.4	103.2
		30.0	1082.160	0.270	0.72	78	78	317	8.4	103.8
	4	35.0	1085.100	0.380	1.02	76	76	316	12.5	104.1
		40.0	1087.950	0.360	0.96	76	76	316	12.5	103.7

	5	45.0	1090.720	0.340	0.91	77	77	316	17.7	103.5
		50.0	1093.500	0.340	0.91	77	77	316	17.7	103.9
	6	55.0	1096.120	0.300	0.80	77	77	315	25.2	104.1
		60.0	1098.900	0.340	0.91	77	77	315	25.2	103.8
	7	65.0	1102.510	0.570	1.53	78	78	314	45.6	104.0
		70.0	1106.210	0.600	1.61	78	78	313	45.6	103.8
	8	75.0	1109.840	0.580	1.56	77	77	313	53.2	103.8
		80.0	1113.420	0.570	1.54	77	77	313	53.2	103.3
	9	85.0	1116.820	0.510	1.37	77	77	310	58.3	103.4
		90.0	1120.190	0.500	1.35	77	77	308	58.3	103.4
	10	95.0	1123.800	0.570	1.54	77	77	309	62.5	103.9
		100.0	1127.440	0.590	1.60	77	77	309	62.5	102.9
	11	105.0	1131.170	0.610	1.65	77	77	310	66.1	103.8
		110.0	1134.960	0.630	1.70	77	77	310	66.1	103.8
	12	115.0	1138.460	0.540	1.45	77	77	313	69.4	103.7
		120.0	1141.870	0.510	1.37	77	77	313	69.4	103.9
			Average:	0.459	1.225	75.3	75.3	314.9		103.6

Client:	Metro Vancouver	**Date:**	24-Aug-18
Jobsite:	WTE (Burnaby, BC)	**Run:**	3 - PCDD-PCDF
Source:	Unit 1	**Run Time:**	08:37 - 12:40

Dioxin Concentration:	**0.9**	**pg/dscm**	0.0004	gr/dscf
	0.5	pg/Acm	0.0002	gr/Acf
	0.8	pg/dscm (@ 11% O2)	0.0003	gr/dscf (@ 11% O2)

Emission Rate: see D/F data Table 2

Sample Gas Volume:	4.3628	dscm	154.072	dscf
Total Sample Time:	240.0	minutes		
Average Isokineticity:	102.4	%		

Flue Gas Characteristics

Moisture:	14.10	%		
Temperature	153.3	oC	307.9	oF
Flow	1261.1	dscm/min	44535	dscf/min
	21.02	dscm/sec	742.2	dscf/sec
	2240.8	Acm/min	79133	Acf/min
Velocity	14.662	m/sec	48.10	f/sec
Gas Analysis	9.86	% O2	10.29	% CO2
	30.041	Mol. Wt (g/gmole) Dry	28.343	Mol. Wt (g/gmole) Wet

*** Standard Conditions:** Metric: 20 deg C, 101.325 kPa
Imperial: 68 deg F, 29.92 in.Hg

Client:	Metro Vancouver	**Date:**	24-Aug-18
Jobsite:	WTE (Burnaby, BC)	**Run:**	3 - PCDD-PCDF
Source:	Unit 1	**Run Time:**	08:37 - 12:40

Control Unit (Y)	0.9997
Nozzle Diameter (in.)	0.2660
Pitot Factor	0.8489
Baro. Press. (in. Hg)	29.95
Static Press. (in. H2O)	-19.50
Stack Height (ft)	30
Stack Diameter (in.)	70.9
Stack Area (sq.ft.)	27.417
Minutes Per Reading	5.0
Minutes Per Point	10.0

Gas Analysis (Vol. %):

	CO2	O2
Trav 1	10.00	10.18
Trav 2	10.58	9.53
Average =	**10.29**	**9.86**

Condensate Collection:

Impinger 1 (grams)	510.0
Impinger 2 (grams)	12.0
Impinger 3 (grams)	2.0
Impinger 4 (grams)	13.4
Total Gain (grams)	**537.4**

Collection:

Filter (grams)	**0.0000**
Washings (grams)	**0.0000**
Impinger (grams)	**0.0000**
D/F TEQ (ng)	**0.0038**

Traverse	Point	Time (min.)	Dry Gas Meter (ft3)	Pitot ^P (in. H2O)	Orifice ^H (in. H2O)	Dry Gas Temperature Inlet (oF)	Outlet (oF)	Stack (oF)	Wall Dist. (in.)	Isokin. (%)
		0.0	142.136							
1	1	5.0	145.320	0.460	1.23	67	67	305	1.5	102.3
		10.0	148.350	0.420	1.12	67	67	307	1.5	101.9
	2	15.0	151.400	0.420	1.12	67	67	308	4.7	102.7
		20.0	154.490	0.430	1.14	67	67	308	4.7	102.8
	3	25.0	157.650	0.450	1.20	68	68	306	8.4	102.5
		30.0	160.840	0.460	1.23	68	68	307	8.4	102.4
	4	35.0	163.880	0.410	1.10	69	69	305	12.5	103.0
		40.0	166.870	0.400	1.07	70	70	305	12.5	102.4
	5	45.0	170.150	0.480	1.28	71	71	306	17.7	102.4
		50.0	173.480	0.500	1.35	71	71	307	17.7	102.0
	6	55.0	176.800	0.490	1.31	71	71	308	25.2	102.7
		60.0	180.250	0.530	1.42	71	71	308	25.2	102.7
	7	65.0	183.710	0.540	1.45	71	71	308	45.6	102.0
		70.0	187.130	0.520	1.39	71	71	307	45.6	102.7
	8	75.0	190.790	0.600	1.60	73	73	310	53.2	102.2
		80.0	194.390	0.580	1.55	74	74	311	53.2	102.1
	9	85.0	197.530	0.440	1.18	74	74	310	58.3	102.1
		90.0	200.860	0.490	1.31	74	74	309	58.3	102.5
	10	95.0	204.160	0.480	1.30	75	75	309	62.5	102.5
		100.0	207.420	0.470	1.27	75	75	309	62.5	102.3
	11	105.0	210.800	0.500	1.35	75	75	308	66.1	102.8
		110.0	214.140	0.490	1.32	75	75	308	66.1	102.6
	12	115.0	217.230	0.420	1.13	76	76	308	69.4	102.3
		120.0	220.210	0.390	1.05	76	76	308	69.4	102.3
		0.0	220.210							
2	1	5.0	223.200	0.390	1.05	76	76	308	1.5	102.7
		10.0	226.060	0.360	0.97	76	76	307	1.5	102.1
	2	15.0	228.870	0.350	0.94	76	76	308	4.7	101.8
		20.0	231.650	0.340	0.92	76	76	308	4.7	102.2
	3	25.0	234.350	0.320	0.86	76	76	306	8.4	102.2
		30.0	237.150	0.340	0.92	76	76	306	8.4	102.8
	4	35.0	240.020	0.360	0.98	76	76	306	12.5	102.4
		40.0	242.710	0.320	0.86	77	77	308	12.5	101.8

	5	45.0	245.510	0.340	0.92	77	77	309	17.7	102.8
		50.0	248.370	0.360	0.98	77	77	308	17.7	102.0
	6	55.0	251.220	0.350	0.95	78	78	307	25.2	102.8
		60.0	254.020	0.340	0.92	78	78	307	25.2	102.5
	7	65.0	257.550	0.540	1.47	78	78	308	45.6	102.8
		70.0	261.130	0.560	1.52	78	78	308	45.6	102.3
	8	75.0	264.770	0.580	1.57	78	78	309	53.2	102.3
		80.0	268.320	0.550	1.50	78	78	309	53.2	102.5
	9	85.0	271.940	0.570	1.54	78	78	308	58.3	102.6
		90.0	275.660	0.600	1.63	79	79	309	58.3	102.6
	10	95.0	279.520	0.650	1.76	79	79	309	62.5	102.4
		100.0	283.320	0.630	1.71	79	79	309	62.5	102.3
	11	105.0	287.100	0.620	1.68	79	79	309	66.1	102.6
		110.0	290.940	0.640	1.75	79	79	310	66.1	102.7
	12	115.0	294.270	0.490	1.33	80	80	310	69.4	101.5
		120.0	297.540	0.460	1.25	80	80	309	69.4	102.8
			Average:	0.467	1.259	74.6	74.6	307.9		102.4

APPENDIX 4

FIELD DATA SHEETS

Initial L.C. Vol. = 0.36
Final L.C. Vol = 0.18
S.H.

A. Lanfranco and Associates Inc.

CLIENT	M.V. WTE	NOZZLE DIAMETER, IN.	0.2660
SOURCE	Unit - 1	PROBE	7-C Cp 0.9489
PARAMETER / RUN No	1 PCDD/PCDF	PORT LENGTH	
DATE	August 22/18	STATIC PRESSURE, IN. H2O	-19.5
OPERATOR:	S.H. J.C.	STACK DIAMETER	70.90
CONTROL UNIT	AG-15 Y 0.9997	STACK HEIGHT	
	ΔH@ 1.71		
BAROMETRIC PRESSURE, IN. Hg	29.86	INITIAL LEAK TEST	0.002 @ 15"
ASSUMED MOISTURE, Bw	15%	FINAL LEAK TEST	0.002 @ 15"

IMPINGER VOLUMES	INITIAL (mL)	FINAL (mL)	TOTAL GAIN (mL)
Imp. #1	0	519	512
Imp. #2	100	119	19
Imp. #3	0	4	4
Imp. #4	200		
Imp. #5			
Imp. #6			
Upstream Diameters			
Downstream Diameters			

Point	Clock Time	Dry Gas Meter ft³	Pitot ΔP IN. H_2O	Orifice ΔH IN. H_2O	Temperature °F: Dry Gas Outlet	Stack	Probe	Box	Impinger Exit	Pump Vac. IN. Hg	Fyrites Testo-1: CO_2 Vol. %	O_2 Vol. %	XAD
1	10:01	827.008	0.53	1.55	78	305	239	240	58	7	10.0	9.7	56
1		834.13	0.56	1.57	78	306			58	7			53
2		837.31	0.44	1.25	79	307	250	256	57	7			55
2		840.56	0.46	1.29	79	307			57	7			52
3		843.78	0.45	1.27	80	307	252	255	57	7	10.0	10.3	52
3		846.95	0.44	1.24	80	307			57	7			52
4		850.26	0.47	1.33	81	307	250	250	57	7			50
4		853.60	0.48	1.36	82	307			57	7			50
5		857.12	0.53	1.50	83	307	250	251	57	7	10.0	10.2	50
5		860.68	0.55	1.56	84	307			57	7			50
6		864.26	0.53	1.56	85	308	251	251	58	7			51
6		867.82	0.54	1.54	86	309			58	7			51
7		871.32	0.58	1.65	88	310	252	250	57	8	10.0	10.4	51
7		874.80	0.60	1.71	88	310			57	8			51
8		878.99	0.57	1.64	90	310	248	251	57	8			49
8		882.65	0.56	1.60	90	310			57	8			49
9		886.22	0.53	1.57	90	309	249	251	58	9	10.0	10.1	51
9		889.72	0.51	1.46	90	309			57	9			51
10		893.05	0.46	1.32	91	309	249	251	58	9			52
10		896.31	0.44	1.27	92	309			58	9			52
11		899.50	0.42	1.21	92	310	248	250	58	9	9.5	10.0	52
11		902.64	0.41	1.18	93	311			58	9			52
12		905.75	0.40	1.15	92	311	249	250	58	8			53
12	1	908.92	0.42	1.21	92	310			56	8			53
							256	260					

SH-

A. Lanfranco and Associates Inc.

CLIENT	M.V. WTE				NOZZLE	DIAMETER, IN.	0.2660			IMPINGER	INITIAL	FINAL	TOTAL GAIN				
SOURCE	Unit #1				PROBE		7-C	Cp	0.8489	VOLUMES	(mL)	(mL)	(mL)				
PARAMETER / RUN No	1, Contd		PCDD/PCDF		PORT LENGTH					Imp. #1	0						
DATE	August 22/18				STATIC PRESSURE, IN. H2O		-19.5			Imp. #2	100						
OPERATOR:					STACK DIAMETER		70.9			Imp. #3	0						
CONTROL UNIT			AHBY 0.9997		STACK HEIGHT					Imp. #4	200						
			ΔH@							Imp. #5							
BAROMETRIC PRESSURE, IN. Hg			29.86		INITIAL LEAK TEST		0.002 @ 15"			Imp. #6							
ASSUMED MOISTURE, Bw			15%		FINAL LEAK TEST		0.002 @ 15			Upstream Diameters							
										Downstream Diameters							

Point	Clock Time	Dry Gas Meter ft³	Pitot ΔP IN. H_2O	Orifice ΔH IN. H_2O	Temperature °F					Pump Vac. IN. Hg	Fyrites		XAD	
					Dry Gas Outlet	Stack	Probe	Box	Impinger Exit		CO_2 Vol. %	O_2 Vol. %		
		908.92												
1		911.86	0.36	1.03	91	309	249	250	57	8	10.0	10.2	52	
1		914.87	0.38	1.10	92	309			57	8			52	
2		917.91	0.36	1.03	94	313	250	251	57	8			53	
2		920.75	0.36	1.03	94	312			57	8			53	
3		923.61	0.34	.98	95	313	250	251	57	8	10.0	10.1	54	
3		926.47	0.34	.98	94	311			57	8			53	
4		929.37	0.33	1.00	94	312	251	250	57	8			54	
4		932.32	0.36	1.04	95	311			57	8			54	
5		935.22	0.35	1.01	95	312	250	250	57	8	10.1	10.6	54	
5		938.16	0.36	1.03	95	312			57	8			53	
6		941.22	0.40	1.12	95	313	250	251	56	8.5			53	
6		944.32	0.40	1.15	95	313			56	8			54	
7		947.61	0.45	1.29	95	312	250	251	57	9.5	10.5	9.7	53	
7		950.92	0.45	1.30	95	309			57	8.5			53	
8		954.03	0.57	1.66	95	310	251	248	57	8			53	
8		958.42	0.59	1.71	96	309			57	9			53	
9		962.40	0.63	1.90	96	308	251	248	56	9	10.5	9.7	53	
9		966.48	0.68	1.97	96	308			58	9			51	
10		970.13	0.55	1.59	96	312	250	250	58	8.5			54	
10		973.84	0.57	1.65	96	311			58	8.5			54	
11		977.14	0.45	1.30	96	311	250	251	58	8	10.2	9.8	53	
11		980.50	0.46	1.33	96	311			58	8			56	
12		983.92	0.44	1.39	96	310	250	251	58	8			56	
12	14:10	987.34	0.45	1.39	96	310			58	8			56	
													58	

A. Lanfranco and Associates Inc.

Initial L.C. Vol=0.21
Final L.C Vol=0.18

S.H.

CLIENT	M.V. WTE				NOZZLE	DIAMETER, IN.	0.2660			IMPINGER	INITIAL	FINAL	TOTAL GAIN				
SOURCE	Unit -1				PROBE	7-C	Cp	0.8489		VOLUMES	(mL)	(mL)	(mL)				
PARAMETER / RUN No	2	PCDD/PCDF								Imp. #1	0	563	563				
DATE	Aug. 23/18				PORT LENGTH					Imp. #2	100	107	7				
OPERATOR:					STATIC PRESSURE, IN. H2O			-19.5		Imp. #3	0						
CONTROL UNIT	AH-15	Y	0.9997		STACK DIAMETER	70.90				Imp. #4	200						
		ΔH@			STACK HEIGHT					Imp. #5							
										Imp. #6							
BAROMETRIC PRESSURE, IN. Hg	29.95				INITIAL LEAK TEST	0.002 @ 15"				Upstream Diameters							
ASSUMED MOISTURE, Bw	15%				FINAL LEAK TEST	0.002 @ 15"				Downstream Diameters							

Point	Clock Time	Dry Gas Meter ft³	Pitot ΔP IN. H_2O	Orifice ΔH IN. H_2O	Temperature °F					Pump Vac. IN. Hg	Fyrites Testo-1				
					Dry Gas Outlet	Stack	Probe	Box	Impinger Exit		CO_2 Vol. %	O_2 Vol. %	XAD		
1	09:02	988.61	0.47	1.20	69	316	251	244	57	6	10.0	10.0	49		
1		994.99	0.46	1.17	69	318			57	6			49		
2		998.09	0.44	1.12	69	318	250	250	57	6			49		
2		1001.15	0.43	1.09	69	318			57	6			49		
3		1004.26	0.44	1.13	70	314	251	250	57	6	10.0	9.8	46		
3		1007.46	0.45	1.19	70	314			57	6			46		
4		1010.69	0.46	1.22	71	313	250	250	57	7			46		
4		1013.86	0.47	1.25	71	312			57	7			46		
5		1016.91	0.42	1.17	73	312	250	250	57	7.5	10.0	10.0	47		
5		1019.93	0.41	1.10	74	311			57	7			48		
6		1023.30	0.51	1.36	74	313	250	252	57	7			48		
6		1026.77	0.54	1.44	74	313			57	7			48		
7		1030.28	0.55	1.47	75	313	250	250	57	7	10.1	9.8	50		
7		1033.77	0.54	1.45	75	313			57	7			51		
8		1037.23	0.54	1.44	75	313	250	250	58	8			51		
8		1040.79	0.56	1.49	75	316			58	8			51		
9		1044.23	0.53	1.42	76	317	250	250	58	9	10.5	9.4	51		
9		1047.66	0.52	1.39	76	317			58	9			51		
10		1050.95	0.48	1.28	76	318	250	248	58	9			61		
10		1054.31	0.50	1.33	76	319			58	9			61		
11		1057.54	0.46	1.23	77	318	250	249	58	9	10.0	10.1	51		
11		1060.70	0.44	1.17	77	318			58	9			52		
12		1063.77	0.42	1.12	76	318	251	250	58	8			52		
12		1066.73	0.39	1.04	76	318							52		

A. Lanfranco and Associates Inc.

CLIENT	M.V WTE				NOZZLE	DIAMETER, IN. 0.2660				IMPINGER	INITIAL	FINAL	TOTAL GAIN					
SOURCE	Vault -1				PROBE	7-C Cp 0.8489				VOLUMES	(mL)	(mL)	(mL)					
PARAMETER / RUN No	Inlet RCRA/RAP									Imp. #1	0	565	565					
DATE	Aug. 23/18				PORT LENGTH					Imp. #2	100	107	7					
OPERATOR:					STATIC PRESSURE, IN. H2O	~19.5				Imp. #3	0	4	4					
CONTROL UNIT	RU-15 Y 0.9997				STACK DIAMETER	70.9				Imp. #4	200							
	ΔH@ 1.65				STACK HEIGHT					Imp. #5								
BAROMETRIC PRESSURE, IN. Hg	29.93									Imp. #6								
ASSUMED MOISTURE, Bw	15%				INITIAL LEAK TEST	0.002 @ 15"				Upstream Diameters								
					FINAL LEAK TEST	0.002 @ 15"				Downstream Diameters								

Point	Clock Time	Dry Gas Meter ft³	Pitot ΔP IN. H_2O	Orifice ΔH IN. H_2O	Temperature °F					Pump Vac. IN. Hg	Fyrites Leak -1		
					Dry Gas Outlet	Stack	Probe	Box	Impinger Exit		CO_2 Vol. %	O_2 Vol. %	XAD
		1066.73											
1		1069.35	0.31	0.86	77	320	251	251	54	8	10.0	9.7	54
1		1072.02	0.32	0.83	77	320			54	8			53
2		1074.660	0.31	0.82	77	320	251	251	54	8			53
2		1077.260	0.30	0.80	77	319			53	8			54
3		1079.680	0.26	0.69	78	317	250	250	50	8	10.5	9.2	54
3		1082.160	0.27	0.72	78	317			51	8			51
4		1085.100	0.38	1.02	76	316	250	250	52	8			50
4		1087.950	0.36	0.96	76	316			52	8			50
5		1090.770	0.34	0.91	77	316	251	250	52	8	10.5	9.2	51
5		1093.560	0.34	0.91	77	316			53	8			51
6		1096.110	0.30	0.80	77	313	250	250	50	7			51
6		1098.900	0.34	0.91	77	313			52	7			51
7		1102.510	0.57	1.53	78	314	250	251	52	7	10.5	9.0	52
7		1106.210	0.60	1.61	78	313			52	8			52
8		1109.840	0.58	1.56	77	313	249	251	52	8			51
8		1113.470	0.57	1.54	77	313			53	8			51
9		1116.82	0.51	1.37	77	310	252	250	58	9	10.0	9.4	54
9		1120.19	0.50	1.35	77	308			59	9			53
10		1123.80	0.57	1.54	77	309	250	250	59	9			53
10		1127.44	0.59	1.60	77	309			58	8			54
11		1131.170	0.61	1.65	77	310	251	249	58	9	11.0	8.8	54
11		1134.960	0.63	1.70	77	310			58	9			54
12		1138.460	0.54	1.45	77	313	249	248	59	9			54
12	13:06	1141.870	0.51	1.37	77	313			54	9			54

S.H.

Initial L.C. Vol. = 0.1
Final L.C. Vol = 0.16

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S-H.

CLIENT	M. V. WTE				NOZZLE	DIAMETER, IN	0.2660		IMPINGER	INITIAL	FINAL	TOTAL GAIN				
SOURCE	Unit-1				PROBE	7-C	Cp	0.8489	VOLUMES	(mL)	(mL)	(mL)				
PARAMETER / RUN No	3	PCDD/PCDF							Imp. #1	0	541	541.0				
DATE	Aug. 24/18				PORT LENGTH				Imp. #2	100	112	12				
OPERATOR:					STATIC PRESSURE, IN. H2O		-19.5		Imp. #3	0	2	2				
CONTROL UNIT	AU-15	Y	0.9997		STACK DIAMETER		70.9		Imp. #4	200						
		ΔH@			STACK HEIGHT				Imp. #5							
BAROMETRIC PRESSURE, IN. Hg	29.95								Imp. #6							
ASSUMED MOISTURE, Bw	15 %				INITIAL LEAK TEST	0.002	@	15"	Upstream Diameters							
					FINAL LEAK TEST	0.002	@	15"	Downstream Diameters							

Point	Clock Time	Dry Gas Meter ft³	Pitot ΔP IN. H_2O	Orifice ΔH IN. H_2O	Temperature °F					Pump Vac. IN. Hg	Fyrites		XAD	
					Dry Gas Outlet	Stack	Probe	Box	Impinger Exit		CO_2 Vol. %	O_2 Vol. %		
1	08:37	142.136	0.46	1.23	67	303	253	251	56	6	10.0	10.2	43	
1		145.37	0.42	1.18	67	307			56	6			42	
2		151.40	0.42	1.12	67	308	251	250	56	6			42	
2		154.49	0.43	1.14	67	308			56	6			42	
3		157.65	0.43	1.20	68	306	250	250	56	6	10.5	9.5	40	
3		160.84	0.46	1.23	68	307			56	6			40	
4		163.88	0.41	1.10	69	305	250	250	56	7			40	
4		166.87	0.40	1.07	70	303			57	7			40	
5		170.15	0.48	1.28	71	306	250	248	57	7	9.5	11.0	39	
5		173.48	0.50	1.35	71	307			57	7			39	
6		176.80	0.49	1.31	71	308	251	250	57	7			39	
6		180.23	0.53	1.42	71	306			57	8			39	
7		183.71	0.54	1.45	71	308	252	250	57	8	9.5	11.0	39	
7		187.13	0.52	1.39	71	307			57	8			40	
8		190.79	0.60	1.60	73	310	250	250	57	8			40	
8		194.35	0.58	1.55	74	311			57	8			42	
9		197.53	0.44	1.19	74	310	250	250	57	8	10.0	10.1	43	
9		200.86	0.49	1.31	74	309			57	8			44	
10		204.16	0.48	1.30	75	309	250	251	57	8			44	
10		207.42	0.47	1.27	75	309			58	8			44	
11		210.80	0.50	1.35	75	308	252	250	58	9	10.5	9.3	46	
11		214.14	0.49	1.32	75	308			58	9			46	
12		217.23	0.42	1.13	76	308	252	248	58	9			46	
12		220.21	0.39	1.05	76	308			58	9			46	

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S.H.

CLIENT	M. V. WTE	NOZZLE DIAMETER, IN.	0.2260
SOURCE	Unit-1	PROBE Cp	0.8489
PARAMETER / RUN No	3 contd PCDD/PCDF	PORT LENGTH	
DATE	Aug. 24/18	STATIC PRESSURE, IN. H2O	-19.5
OPERATOR:		STACK DIAMETER	70.9
CONTROL UNIT	Y 0.9997	STACK HEIGHT	
	ΔH@		
BAROMETRIC PRESSURE, IN. Hg	29.95	INITIAL LEAK TEST	0.002 @ 15"
ASSUMED MOISTURE, Bw	15%	FINAL LEAK TEST	0.002 @ 15"

IMPINGER VOLUMES	INITIAL (mL)	FINAL (mL)	TOTAL GAIN (mL)
Imp. #1	0		
Imp. #2	100		
Imp. #3	0		
Imp. #4	200		
Imp. #5			
Imp. #6			
Upstream Diameters			
Downstream Diameters			

Point	Clock Time	Dry Gas Meter ft^3	Pitot ΔP IN. H_2O	Orifice ΔH IN. H_2O	Temperature °F Dry Gas Outlet	Stack	Probe	Box	Impinger Exit	Pump Vac. IN. Hg	Fyrites CO_2 Vol. %	O_2 Vol. %	XAD	
		220.21												
1		223.20	0.39	1.05	76	308	246	252	57	8	10.5	9.5	44	
1		226.06	0.36	0.97	76	307			57	8			45	
2		228.87	0.35	0.94	76	308	248	251	57	8			45	
2		231.65	0.34	0.92	76	308			57	8			45	
3		234.33	0.32	0.86	76	306	250	251	57	8	11.0	9.2	42	
3		237.15	0.34	0.92	76	306			57	8			42	
4		240.02	0.36	0.98	76	306	251	252	57	8			42	
4		242.77	0.32	0.86	77	308			58	8			42	
5		245.51	0.34	0.92	77	309	250	252	58	8	10.0	10.4	43	
5		248.37	0.36	0.98	77	308			58	8			43	
6		251.22	0.35	0.95	78	307	250	252	58	8			42	
6		254.02	0.34	0.92	78	307			58	8			44	
7		257.55	0.54	1.47	78	307	252	252	58	8	11.0	8.9	45	
7		261.13	0.56	1.52	78	308			58	8			45	
8		264.77	0.58	1.57	78	309	252	251	58	9			45	
8		268.32	0.55	1.50	78	309			58	9			45	
9		271.94	0.57	1.54	78	308	250	250	58	9	10.5	9.6	46	
9		275.66	0.60	1.63	79	309			59	9			46	
10		279.52	0.65	1.76	79	309	252	248	59	9			46	
10		283.32	0.63	1.71	79	309			59	9			45	
11		287.10	0.62	1.68	79	309	252	247	59	9	10.5	9.6	45	
11		290.84	0.64	1.75	79	310			58	9			45	
12		294.27	0.49	1.33	80	310	250	248	58	9			45	
12	12:40	297.54	0.46	1.25	80	309	X		58	9			45	

APPENDIX 5

CALIBRATION DATA and

CERTIFICATION

A.Lanfranco & Associates inc.

EPA Method 5

Meter Box Calibration

English Meter Box Units, English K' Factor

Model #: AU 15

Serial #: 0028SPC-081915-1

Date: 9-Jul-18

Barometric Pressure: 30.05 (in. Hg)

Theoretical Critical Vacuum: 14.17 (in. Hg)

!!!!!!!!!
!IMPORTANT For valid test results, the Actual Vacuum should be 1 to 2 in. Hg greater than the Theoretical Critical Vacuum shown above.
!IMPORTANT The Critical Orifice Coefficient, K', must be entered in English units, (ft)^3*(deg R)^0.5/((in.Hg)*(min)).
!!!!!!!!!

DRY GAS METER READINGS									CRITICAL ORIFICE READINGS					
dH (in H2O)	Time (min)	Volume Initial (cu ft)	Volume Final (cu ft)	Volume Total (cu ft)	Initial Temps. Inlet (deg F)	Initial Temps. Outlet (deg F)	Final Temps. Inlet (deg F)	Final Temps. Outlet (deg F)	Orifice Serial# (number)	K' Orifice Coefficient (see above)	Actual Vacuum (in Hg)	Ambient Temperature Initial (deg F)	Ambient Temperature Final (deg F)	Ambient Temperature Average (deg F)
3.50	14.00	479.000	493.900	**14.900**	76.0	76.0	77.0	77.0	73	0.8185	18.2	77.0	77.0	**77.0**
1.85	15.00	494.200	505.917	**11.717**	77.0	77.0	78.0	78.0	63	0.5956	20.8	77.0	81.0	**79.0**
1.12	16.00	506.000	515.730	**9.730**	78.0	78.0	80.0	80.0	55	0.4606	22.2	79.0	81.0	**80.0**
0.63	18.00	516.000	524.338	**8.338**	79.0	79.0	79.0	79.0	48	0.3560	23.2	80.0	82.0	**81.0**
0.30	15.00	524.400	529.141	**4.741**	79.0	79.0	80.0	80.0	40	0.2408	25.0	82.0	82.0	**82.0**

**********RESULTS**********

DRY GAS METER		ORIFICE			DRY GAS METER		ORIFICE			
VOLUME CORRECTED Vm(std) (cu ft)	VOLUME CORRECTED Vm(std) (liters)	VOLUME CORRECTED Vcr(std) (cu ft)	VOLUME CORRECTED Vcr(std) (liters)	VOLUME NOMINAL Vcr (cu ft)	CALIBRATION FACTOR Y Value (number)	CALIBRATION FACTOR Y Variation (number)	CALIBRATION FACTOR dH@ Value (in H2O)	CALIBRATION FACTOR dH@ Value (mm H2O)	CALIBRATION FACTOR dH@ Variation (in H2O)	Ko (value)
14.848	420.5	14.859	420.8	15.053	1.001	0.001	1.727	43.87	0.014	0.727
11.608	328.7	11.564	327.5	11.758	0.996	-0.003	1.727	43.88	0.014	0.732
9.595	271.7	9.530	269.9	9.708	0.993	-0.006	1.747	44.38	0.034	0.731
8.213	232.6	8.279	234.5	8.449	1.008	0.008	1.648	41.86	-0.065	0.742
4.662	132.0	4.662	132.0	4.767	1.000	0.000	1.717	43.61	0.004	0.733
				Average Y----->	**0.9997**		**Average dH@----->**	**1.713**	**43.5**	**Average Ko----->**	**0.733**

TEMPERATURE CALIBRATION

Calibration Standard -----> Omega Model CL23A S/N:T-218768

Reference Temperature Set-Point (deg F)	Temperature Device Reading (deg F)	Results Variation (degF)	Results Percent of Absolute
32	32	0	0.00%
100	100	0	0.00%
300	300	0	0.00%
500	500	0	0.00%
1000	1000	0	0.00%

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +-0.02.
For Orifice Calibration Factor dH@, the orifice differential pressure in inches of H20 that equates to 0.75 cfm of air at 68 F and 29.92 inches of Hg, acceptable tolerance of individual values from the average is +-0.2.
For Temperature Devicee, the reading must be within 1.5% of certified calibration standard (absolute temperature) to be acceptable.

Calibrated by: Mat Harrington

Signature: Shaun Harrington

Date: July 9, 2018

BAROMETER CALIBRATION FORM

Device	Cal Date	Pbar Env Canada (kPa)	Pbar Env Canada (inches of Hg)	Device (inches of Hg) Reading	Device (inches of Hg) Elevation Corrected	Difference (Env Can - Elv Corr)
LA	July 17, 2018	101.6	30.01	29.90	29.97	0.04
DS	July 17, 2018	101.6	30.01	29.91	29.98	0.03
CL	July 17, 2018	101.6	30.01	29.89	29.96	0.05
ML	July 17, 2018	101.6	30.01	29.90	29.97	0.04
MH	July 17, 2018	101.6	30.01	29.91	29.98	0.03
SH	July 17, 2018	101.6	30.01	29.91	29.98	0.03
JB	July 17, 2018	101.6	30.01	29.97	30.04	-0.03
SF	July 17, 2018	101.6	30.01	29.99	30.06	-0.05
JG	July 17, 2018	101.6	30.01	29.89	29.96	0.05
SB	July 17, 2018	101.6	30.01	29.89	29.96	0.05

Calibrated by: Daryl Sampson Signature: _____ Date: July 17, 2018

Performance Specification is

Device Corrected for Elevation must be +/- 0.1 " Hg of ENV CANADA SEA-LEVEL Pbar

Enter Environment canada Pressure from their website for Vancouver (link below)
and the reading from your barometer on the ground floor of the office.

http://www.weatheroffice.gc.ca/city/pages/bc-74_metric_e.html

A. LANFRANCO and ASSOCIATES INC.

ENVIRONMENTAL CONSULTANTS

GLASS NOZZLE DIAMETER CALIBRATION FORM

Calibrated by: Michael Goods
Date: June 22, 2018
Signature:

Nozzle I.D.	d1 (inch)	d2 (inch)	d3 (inch)	difference (inch)	average dia. (inch)	average area (ft^2)
A	0.1250	0.1240	0.1245	0.0010	0.1245	0.0000845
G-165	0.1640	0.1655	0.1660	0.0020	0.1652	0.0001488
P-20	0.1855	0.1865	0.1835	0.0030	0.1852	0.0001870
J	0.1880	0.1880	0.1880	0.0000	0.1880	0.0001928
E	0.1880	0.1895	0.1882	0.0015	0.1886	0.0001939
P-13	0.2070	0.2080	0.2075	0.0010	0.2075	0.0002348
L	0.2112	0.2120	0.2105	0.0015	0.2112	0.0002434
G-215	0.2160	0.2150	0.2130	0.0030	0.2147	0.0002513
Q	0.2190	0.2170	0.2185	0.0020	0.2182	0.0002596
V-07	0.2430	0.2460	0.2450	0.0030	0.2447	0.0003265
G-250	0.2480	0.2500	0.2555	0.0075	0.2512	0.0003441
P	0.2580	0.2570	0.2575	0.0010	0.2575	0.0003616
P-2	0.2790	0.2780	0.2790	0.0010	0.2787	0.0004235
G-280	0.2850	0.2840	0.2850	0.0010	0.2847	0.0004420
G-306	0.3060	0.3060	0.3065	0.0005	0.3062	0.0005113
V-06	0.3200	0.3210	0.3210	0.0010	0.3207	0.0005608
G-337	0.3380	0.3355	0.3365	0.0025	0.3367	0.0006182
P-27	0.3390	0.3380	0.3390	0.0010	0.3387	0.0006256
G-343	0.3430	0.3440	0.3435	0.0010	0.3435	0.0006435
P-9	0.3650	0.3640	0.3655	0.0015	0.3648	0.0007260
G-368	0.3685	0.3665	0.3690	0.0025	0.3680	0.0007386
G-372	0.3710	0.3730	0.3740	0.0030	0.3727	0.0007575
I	0.3785	0.3785	0.3785	0.0000	0.3785	0.0007814
O	0.3910	0.3915	0.3905	0.0010	0.3910	0.0008338
P-14	0.3910	0.3935	0.3920	0.0025	0.3922	0.0008388
P-17	0.4070	0.4075	0.4065	0.0010	0.4070	0.0009035
C	0.4255	0.4225	0.4235	0.0030	0.4238	0.0009798
#21	0.4305	0.4325	0.4315	0.0020	0.4315	0.0010155
G-434	0.4345	0.4335	0.4350	0.0015	0.4343	0.0010289
G-437	0.4340	0.4350	0.4360	0.0020	0.4350	0.0010321
G-468	0.4680	0.4670	0.4680	0.0010	0.4677	0.0011929
P-29	0.4650	0.4650	0.4660	0.0010	0.4653	0.0011810
P-7	0.4965	0.4940	0.4930	0.0035	0.4945	0.0013337
B	0.5015	0.5030	0.5025	0.0015	0.5023	0.0013763
G-540	0.5405	0.5400	0.5405	0.0005	0.5403	0.0015924
MV-248	0.2485	0.2490	0.2485	0.0005	0.2487	0.0003373
MV-248	0.2660	0.2650	0.2670	0.0020	0.2660	0.0003859
MV-280	0.2800	0.2795	0.2810	0.0015	0.2802	0.0004281
MV-02	0.3040	0.3070	0.3040	0.0030	0.3050	0.0005074
MV-01	0.3050	0.3060	0.3070	0.0020	0.3060	0.0005107

Where:

(a) D1, D2, D3 = three different nozzle diameters; each diameter must be measured to within (0.025mm) 0.001 in.

(b) Difference = maximum difference between any two diameters; must be less than or equal to (0.1mm) 0.004 in.

(c) Average = average of D1, D2 and D3

Pitot Tube Calibration

Date: 11-Jul-18
Pbar (in.Hg): 29.69

Temp (R): 530
Dn (in.): 0.25

Pitot ID: **7A**

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
0.290	0.400	35.8	0.8430	0.0006
0.360	0.500	39.9	0.8400	0.0035
0.460	0.640	45.1	0.8393	0.0042
0.570	0.790	50.2	0.8409	0.0026
0.700	0.940	55.6	0.8543	0.0108
		Average :	0.8435	0.0043

Pitot ID:

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
		0.0	#DIV/0!	#DIV/0!
		0.0	#DIV/0!	#DIV/0!
		0.0	#DIV/0!	#DIV/0!
		0.0	#DIV/0!	#DIV/0!
		0.0	#DIV/0!	#DIV/0!
		Average :	#DIV/0!	#DIV/0!

Pitot ID: **7B**

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
0.120	0.160	23.0	0.8574	0.0111
0.260	0.370	33.9	0.8299	0.0164
0.410	0.550	42.6	0.8548	0.0085
0.530	0.740	48.4	0.8378	0.0085
0.640	0.865	53.2	0.8516	0.0053
		Average :	0.8463	0.0099

Pitot ID:

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
		0.0	#DIV/0!	#DIV/0!
		0.0	#DIV/0!	#DIV/0!
		0.0	#DIV/0!	#DIV/0!
		0.0	#DIV/0!	#DIV/0!
		0.0	#DIV/0!	#DIV/0!
		Average :	#DIV/0!	#DIV/0!

Pitot ID: **7 AL GVRD**

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
0.290	0.400	35.8	0.8430	0.0041
0.350	0.480	39.3	0.8454	0.0065
0.470	0.670	45.6	0.8292	0.0097
0.600	0.840	51.5	0.8367	0.0021
0.720	1.000	56.4	0.8400	0.0012
		Average :	0.8388	0.0047

Pitot ID:

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
		Average :		

Pitot ID: **7C**

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
0.260	0.360	33.9	0.8413	0.0076
0.320	0.440	37.6	0.8443	0.0046
0.400	0.550	42.0	0.8443	0.0046
0.510	0.680	47.5	0.8574	0.0084
0.660	0.880	54.0	0.8574	0.0084
		Average :	0.8489	0.0068

Pitot ID:

Reference Pitot (in H2O)	S-Type Pitot (in H2O)	Air Velocity (ft/s)	Pitot Coeff. Cp	Deviation (absolute)
		Average :		

* Average absolute deviation must not exceed 0.01.

Calibrated by: Jeremy Gibbs

Signature:

Date: July 11, 2018

BRITISH COLUMBIA INSTITUTE OF TECHNOLOGY

BCIT

Shawn Harrington

has met the requirements of

Stack Testing for Pollutants

(CHSC 7760)

School of Process, Energy and Natural Resources
Chemical Sciences Program

Endorsed by:

Greater Vancouver Regional District

Environment Canada / Environnement Canada

Province of British Columbia
Ministry of Environment, Lands and Parks

Marsh Hemekey, Dean
School of Process, Energy and Natural Resources

JUNE 21, 2001
Dated