HEALTHY ENVIRONMENTS LTD
AIR QUALITY AND ENVIRONMENTAL SCIENTISTS

PO Box 338,
WELLINGTON 6140
Telephone (04) 970-4924
Facsimile (04) 970-4923
Mobile (0274) 424-280
healthyenviro@clear.net.nz
www.healthyenvironments.co.nz

Report date: 3 October 2016

Prepared by: L.M STRATTON BSc(Hons), Chem

Laboratory: RJ Hill Laboratories Ltd

For the Attention of:

Brian Nelson
Facilities and Service Manager
Corporate Services
New Zealand Police
The Royal New Zealand Police College
Private Bag 50906
Porirua 5024

Re: Occupational Hygiene Assessment
Exposure to Emissions from FX Ammunition
Garage Adjacent to the Upper Firing Range
at the Police College

IMPORTANT NOTICE

EXECUTIVE SUMMARY

This report presents the results and findings of an occupational hygiene assessment of airborne exposure to emissions from FX ammunition when fired in a confined space.

The highlights of this evaluation are as follows:

- Air contaminant concentrations during the simulated firing of FX ammunition in a confined space were very low.
- The officer's exposure to particulates, copper particulate and gases/aerosols/irritants was low when compared with the applicable occupational exposure limits.
- In general, the firing of FX ammunition in confined spaces does result in higher exposure to copper and other particulates from propellant/primer compared with the training ammunition used in the indoor firing ranges. Despite measuring higher airborne contaminant during the firing of FX ammunition, officers exposures would still be significantly well below applicable occupational exposure limits.
- Lead particulate was detected in the personal breathing zone of the officer during the firing of FX ammunition. His exposure to this metal during short-term firing events is significant.
- On the basis of the air sampling data the aerosol produced during firing events consists primarily of fume sized copper and lead, and other particulate from propellant/primer in the ammunition.
- No volatile organic compounds derived from the propellant and primer components in the ammunition were detected in air during the firing of FX ammunition.
- No irritant acid gases/aerosols were detected in the air during firing events.

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1.0 INRODUCTION:

Healthy Environments Ltd received a request from the facilities and service manager at New Zealand Police to carry out a health hazard evaluation of emissions from FX ammunition. The request concerned the potential occupational exposure of officers to particulates and gases/aerosols/irritants during the firing of 9-mm FX Marking Cartridges from a handgun in confined spaces.

Mr L.M Stratton BSc(Hons),Chem of Healthy Environments Ltd visited the New Zealand Royal Police College on 26th August 2016 and measured airborne levels of particulate, acid gases/aerosols, carbon monoxide (CO), and particle mass concentrations inside the garage.

The investigation has naturally been limited to its terms of reference.

Further copies of the report can be made available if required.

DISCLAIMER:

RJ Hill Laboratories Ltd is an IANZ accredited Laboratory.

Opinions and interpretations based on the test results are outside the scope of their accreditation.

Laboratory analysis reports for samples and photographs of the evaluation of an officers' exposure to emissions from FX ammunition are attached in Appendix E.

COMPANY LIABILITY FOR ADVICE GIVEN:

Healthy Environments Ltd will only accept responsibility for advice given if such advice is in writing.

2.0 BACKGROUND:

Ammunition

Historically, lead has been used in the manufacture of bullets. However, because of environmental and human health, concerns, the use of lead ammunition has declined. New Zealand police have opted to use lead-free frangible ammunition for small arms training in the indoor ranges at New Zealand Royal Police College. The frangible ammunition is considered non-toxic because lead is no longer present in the bullet or the primer. Also, the frangible bullet presents less ricochet hazard because it is designed to fragment upon impact. However, 9mm FX ammunition is used in training sessions and for close range combat situations. The bullets evaluated in this evaluation are composed of a polypropylene jacket and core made of compacted metal powder (barium sulphate).

Firing of FX Ammunition in a Confined Space

The garage was a steel/wooden structure on a concrete slab. The garage contained two rooms, one containing furniture and the other a kitchen. There were two entry doors, one on the south side of garage and the other at the west end of the building. The large garage door allowed direct entry into the room containing the furniture. The officer fired FX ammunition from the kitchen area into the room containing some furniture. Both entry doors to the garage were fully open during the simulation of firing of FX ammunition. The officer fired 20 rounds of the 9-mm FX ammunition into the lounge.

3.0 AIR SAMPLING:

Task-based personal and area air samples for particulates and gases/aerosols/irritants were collected during the firing of FX ammunition. For personal air sampling a device was attached to the lapel of the officer. Area air samples were collected 1.5-metres above the floor and either side of the officer while firing the handgun. All samples collected were analyzed by an IANZ accredited laboratory using NIOSH methods and or approved variations.

One personal and area air sample for Total Suspended Particulate (TSP) was collected using a 37-mm open-faced cassette containing two pre-weighed 0.8-micrometer (µm) mixed cellulose ester (MCE) filters. The filter cassette was positioned on the lapel of the officer and then attached to a personal sampling pump operating at 2-litres per minute (Lpm). The area air sample was collected 1.5-metres above the floor and immediately on the right of the officer firing the handgun. The MCE filters in the personal and area cassette samplers were analyzed for metals. The particle mass concentrations were measured using TSI Dust Trak Model 8520 real-time aerosol photometers.

These instruments respond to particulate in the range of 0.001 to 150 milligrams per cubic metre of air (mg/m^3). One of the Dust Trak instruments was set-up to measure the size-selected particulate mass (PM) fraction corresponding to particles with size less than or equal to 10-micrometer (µm). The other Dust Trak instrument was set-up to measure the respirable mass air concentrations. The particle size cut-off in this air monitoring was 4-micrometer (µm). To carry out this measurement a 10-mm Nylon Dorr-Oliver Cyclone was used at a sampling flow rate of 2.7-litres per minute. The cyclone was attached to the air inlet of the Dust Trak instrument.

Area air concentrations of CO and NO_2 were measured using a MultiRAE real-time, data-logging gas monitor.

Charcoal and silica gel tubes were used to collect an area air sample for volatile organic compounds (VOCs) and inorganic acid gases, hydrogen bromide, hydrogen chloride, hydrogen fluoride, nitric acid, phosphoric and sulphuric acids respectively. The sorbent tubes were held in a dual tube adjustable low flow assembly that was attached to a personal sampling pump operating at a calibrated flow rate around 200-millilitres per minute (ml/min).

4.0 WORKPLACE EXPOSURE STANDARDS:

Workplace Exposure Standards (WES) for airborne hazards has been published from time to time by the Occupational Safety and Health Service of the Department of Labour. The publication in January 2002 entitled Workplace Exposure Standards has now been superseded by the June 2016 eighth edition, Workplace Exposure Standards and Biological Exposure Indices. This latest edition of the occupational exposure standards reflects the change in the governing agency from the Occupational Safety and Health Service to WorkSafe New Zealand, and the relevant content of the new Legislation, the Health and Safety at Work Act 2015 (HSWA) and Health and Safety at Work (General Risk and Workplace Management) Regulations 2016 (GRWM Regulations).

The workplace (occupational) exposure standards are intended to provide guidance for hazard evaluation and for setting target levels for control. Exposure in excess of these guideline limits requires immediate remedial action by the improvement of existing control measures or implementation of new ones. In fact, preventative interventions should be made at the "action level", which may be, one-half or one-fifth of the occupational exposure limit. A low action level for the control of hazards arising from work processes is the best assurance of meeting the goals of protection and promotion of workers' health.

The WES is defined as that airborne concentration of a substance which it is believed that nearly all workers may be exposed to day after day without developing adverse health effects.

The *time-weighted average* (*TWA*), defined as the time-weighted average concentration for a normal 8-hour workday and a 40-hour workweek which will produce no adverse health effects for nearly all workers, is usually used to determine a safe exposure level.

Some substances have recommended short-term exposure limits (*STELs*) or ceiling limits which are intended to supplement the WES criteria where there are recognised irritation and or toxic effects from brief exposures to high airborne concentrations. STELs are based on TWA concentrations over 15-minute time periods, whereas ceiling limits are concentrations which should not be exceeded even momentarily.

5.0 RESULTS AND DISCUSSION:

During the simulation of firing FX ammunition in a confined space the officer stood at an open internal entry door to a room containing furniture. He fired 20 FX rounds from a handgun into the room.

One personal air sample was collected in the breathing zone of the officer during the simulation in the garage. The sampling time for the TSP exposure measurement was 6-minutes. Occupational Exposure Limits (OELs) for copper are presented in Table 1.

Table 1: OELs for copper in air samples (ug/m^3)

	Dusts/Mists	Copper Fume
WES (New Zealand)	1000	200
NIOSH REL	1000	100
OSHA PEL	1000	100
ACIGH TLV	1000	200

ug/m^3 = micrograms per cubic meter, WES = workplace exposure standard (eight-hour time-weighted average), NIOSH = National Institute for Occupational Safety and Health, REL = recommended exposure limit (up to 10-hours), OSHA = Occupational Safety and Health Administration, PEL = permissible exposure limit (eight-hour time-weighted average), ACIGH = American Conference of Governmental Industrial Hygienists, TLV = threshold limit value (eight-hour time-weighted average)

The personal air sample collected on the officer did not exceed any applicable occupational exposure limit for copper. The total copper concentration in the breathing zone of the officer was 5.0-ug/m^3 (Appendix A, Table 4). The area air sample collected to the right of the standing officer recorded the copper concentration at <1.7-ug/m^3 (Appendix B, Table 4).

The Total Suspended Particulate (TSP) concentration in the breathing zone of the officer was 830-ug/m^3 (Appendix A, Table 2). TSP in the context of the air sampling in the garage refers to suspended particulate matter with a particle size range 0.8 to 100-microns (0.0008 to 0.1 mm).

The TSP concentration in area air sample collected to the right of the officer firing the handgun was <2800-ug/m^3 (Appendix B, Table 2). TSP concentrations for both personal and area air samples are well below the WES of 10000-ug/m^3 (time-weighted over 8-hours). This WES is assigned to particulates not otherwise classified. Metallurgical dusts and fume have a particle size range of 0.001 to 100-microns.

The area particle mass air concentrations to the right and left of the officer firing a handgun were measured using real-time Dust Trak monitors. These instruments showed particulate levels in the air were low (Appendix C, Figures 1 to 2). The PM_{10} mass concentration during the firing of FX ammunition averaged 54.0-ug/m^3 (Appendix B, Table 7). PM_{10} refers to particulate matter with particle size less than or equal to 10-microns (0.010 mm) in size. This concentration is well below OSHA OEL of 5000-ug/m^3 as an 8-hour average. The respirable particle mass concentration averaged 3.0-ug/m^3 (Appendix B, Table 8). Respirable particulate matter as measured using the Dust Trak instrument refers to particles of size equal to or less than 4-microns (0.004 mm).

The CO concentration in the air to the right of the officer firing a handgun averaged 0.3-ppm (Appendix C, Figure 3). The graphical profile shows when firing began, the CO concentration increased steadily, peaking at around 2.0-ppm. The CO concentration did not exceed the WES time-weighted average (TWA) of 25-ppm for an 8-hour period and the WES-Ceiling limit of 400-ppm. Short-term exposure to CO in any 15-minute interval did not exceed the WES-STEL of 200-ppm. Nitrogen dioxide concentrations averaged 0.1-ppm and <0.1-ppm, both are well below the applicable OEL.

No volatile organic compounds were detected on the charcoal tube air sampling device during the firing of FX ammunition (Appendix B, Table 5). Concentrations of the acid gases hydrobromic, hydrochloric, hydrofluoric, nitric, phosphoric, and sulfuric were well below their respective OELs (Appendix B, Table 6).

6.0 VENTILATION ASSESSMENT:

During the simulation of firing FX ammunition from a handgun inside a garage there was little air movement in the area around the standing officer. The small southwest corner entry door to the garage was fully open. There was no perceptible air movement from outdoors into the room where the officer was positioned to fire into an adjoining room in the garage. The south side garage door was fully open during the simulation.

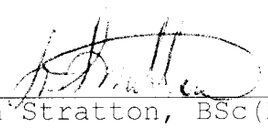
7.0 RECOMMENDATIONS:

On the basis of the findings of the Health Hazard Evaluation of an officers exposure to emissions from FX ammunition when used firing a handgun in a confined space, there are no recommended actions.

8.0. SIGN-OFF

This report has been prepared by Healthy Environments Ltd for the Facilities and Services Manager at the Royal New Zealand Police College, Papakowhai Road, Porirua. The report reflects the position of firing handguns in confined spaces with regard to airborne concentrations of emissions from FX ammunition referred to in the main body of the report.

This report is issued under the authority of



Len Stratton, BSc(Hons), Chem
Occupational Hygienist
Author
3rd October 2016

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APPENDIX A

PERSONAL AIR SAMPLING RESULTS

OFFICER FIRING FX AMMUNITION IN A GARAGE

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MONITORING RESULTS:

TABLE 1: AIR QUALITY - NEW ZEALAND ROYAL POLICE COLLEGE
PAPAKOWHAI ROAD, PORIRUA
GARAGE ADJACENT TO THE UPPER INDOOR FIRING RANGE
PERSONAL AIR SAMPLE
BREATHING ZONE OF AN OFFICER
26 AUGUST 2016

SAMPLING DETAILS*a	WEIGHT OF TOTAL SUSPENDED PARTICULATE COLLECTED ON THE SAMPLING FILTER (mg) *a
Sample DPOLFX2 Personal Air Sample, Daryl	0.06
Samples RPC4, LRPC4 Field Blanks from Upper and Lower Indoor Firing Range Assessments	<0.05

The air sampling result shows there was very little particulate matter in the breathing zone of the officer firing FX ammunition in a confined space.

a. Air Sample DPOLFX2 (Pre-weighed matched filters 4-222985)

RPC4 (Pre-weighed matched filters 4-222978)
Field Blank for Upper Indoor Range Assessment

LRPC4 (Pre-weighed matched filters 4-222984)
Field Blank for Lower Indoor Range Assessment

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MONITORING RESULTS:

TABLE 2: AIR QUALITY - NEW ZEALAND ROYAL POLICE COLLEGE
PAPAKOWHAI ROAD, PORIRUA
GARAGE ADJACENT TO THE UPPER INDOOR FIRING RANGE
PERSONAL AIR SAMPLE
BREATHING ZONE OF AN OFFICER
26 AUGUST 2016

SAMPLING DETAILS	CONCENTRATION OF TOTAL SUSPENDED PARTICULATE IN THE AIR (ug/m^3) *a
Sample DPOLFX2 Personal Air Sample, Daryl	830
WES-$TWA_{8\text{-Hour}}$ (ug/m^3) *b	**10000**

The air sample collected in the breathing zone of an officer of firing FX ammunition shows his exposure to total suspended particulate to be significantly below the New Zealand Workplace Exposure Standard for particulates not otherwise classified.

* Reference standards and guidelines established to limit worker exposure to airborne hazardous substances that are injurious to health.

a. Air Sample — DPOLFX2 (pre-weighed matched filters 4-222985) Air sample collected over a 6-minute period at a sampling rate of 2-litres per minute

b. WORKSAFE New Zealand — Workplace Exposure Standards, 8th Edition (Effective June 2016)

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MONITORING RESULTS:

TABLE 3: AIR QUALITY - NEW ZEALAND ROYAL POLICE COLLEGE
PAPAKOWHAI ROAD, PORIRUA
GARAGE ADJACENT TO THE UPPER INDOOR FIRING RANGE
PERSONAL AIR SAMPLE
BREATHING ZONE OF AN OFFICER
26 AUGUST 2016

SAMPLING DETAILS	WEIGHT OF METAL PARTICULATE COLLECTED ON THE AIR SAMPLING FILTERS (µg) *a				
	Antimony	Copper	Lead	Tin	Zinc
Sample DPOLFX1 Personal Sample Daryl	0.019	0.09	0.075	<0.03	<0.05
Sample RPC4 Field Blank	<0.010	<0.03	<0.005	<0.03	<0.05
Sample LRPC4 Field Blank	<0.010	<0.03	<0.005	<0.03	<0.05

The air sampling shows there was very little metal particulate/fume in the breathing zone of an officer firing FX ammunition in a confined space.

a. Air Sample DPOLFX2 (pre-weighed matched filters 4-222985)

RPC4 (Pre-weighed matched filters 4-222978)
Field Blank for Upper Indoor Range Assessment

LRPC4 (Pre-weighed matched filters 4-222984)
Field Blank for Lower Indoor Range Assessment

HEALTHY ENVIRONMENTS LTD

MONITORING RESULTS:

TABLE 4: AIR QUALITY - NEW ZEALAND ROYAL POLICE COLLEGE
PAPAKOWHAI ROAD, PORIRUA
GARAGE ADJACENT TO THE UPPER INDOOR FIRING RANGE
PERSONAL AIR SAMPLE
BREATHING ZONE OF AN OFFICER
26 AUGUST 2016

SAMPLING DETAILS	CONCENTRATION OF METAL PARTICULATE IN THE AIR ($\mu g/m^3$) *a				
	Antimony	**Copper**	**Lead**	**Tin**	**Zinc**
Sample DPOLFX2 Personal Sample Daryl	0.75	5.0	5.8	<2.5	<4.2
WES-TWA$_{8\text{-Hour}}$ ($\mu g/m^3$) *b	**500**	**1000**	**100**	**2000**	**10000**

The air sample collected in the breathing zone of an officer firing FX ammunition in a confined space shows his exposure to metal particulates/fume to be significantly below the New Zealand Workplace Exposure Standards.

* Reference standards and guidelines established to limit worker exposure to airborne hazardous substances that are injurious to health.

a. Air Sample — DPOLFX2 (pre-weighed matched filters 4-222985) Air sample collected over a period of 6-minutes at a sampling rate of 2-litres per minute

b. WORKSAFE New Zealand — Workplace Exposure Standards, 8th Edition (Effective June 2016)

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APPENDIX B

AREA AIR SAMPLING RESULTS

RIGHT AND LEFT HAND SIDE OF AN OFFICER

FIRING FX AMMUNITION

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MONITORING RESULTS:

TABLE 1: AIR QUALITY - NEW ZEALAND ROYAL POLICE COLLEGE
PAPAKOWHAI ROAD, PORIRUA
GARAGE ADJACENT TO THE UPPER INDOOR FIRING RANGE
AREA AIR SAMPLE
RIGHT HAND SIDE OF THE OFFICER FIRING FX AMMUNITION
26 AUGUST 2016

SAMPLING DETAILS*a	WEIGHT OF TOTAL SUSPENDED PARTICULATE MATTER COLLECTED ON THE SAMPLING FILTER (mg) *a
Sample DPOLFX1 Area Air Sample Right hand side of the officer firing FX ammunition	<0.05
Samples RPC4, LRPC4 Field Blanks Upper and Lower Indoor Firing Range Assessments	<0.05

The air sampling result shows there was very little suspended particulate matter in the air where an officer was firing FX ammunition.

a. Air Sample DPOLFX1 (Pre-weighed matched filters 4-222976)

RPC4 (Pre-weighed matched filters 4-222978)
Field Blank for Upper Indoor Range Assessment

LRPC4 (Pre-weighed matched filters 4-222984)
Field Blank for Lower Indoor Range Assessment

HEALTHY ENVIRONMENTS LTD

MONITORING RESULTS:

TABLE 2: AIR QUALITY - NEW ZEALAND ROYAL POLICE COLLEGE
PAPAKOWHAI ROAD, PORIRUA
GARAGE ADJACENT TO THE UPPER INDOOR FIRING RANGE
AREA AIR SAMPLE
RIGHT HAND SIDE OF THE OFFICER FIRING FX AMMUNITION
26 AUGUST 2016

SAMPLING DETAILS	CONCENTRATION OF TOTAL SUSPENDED PARTICULATE MATTER IN THE AIR (ug/m^3) *a
Sample DPOLFX1 Area Air Sample Right hand side of the officer firing FX ammunition	<280
WES-TWA$_{8\text{-Hour}}$ (ug/m^3) *b	**10000 *b**

The area air sample collected close to an officer firing FX ammunition showed the concentration of total suspended particulate in the air to be significantly below the New Zealand Workplace Exposure Standard for particulates not otherwise classified.

* Reference standards and guidelines established to limit worker exposure to airborne hazardous substances that are injurious to health.

a. Air Sample — DPOLFX1 (pre-weighed matched filters 4-222976) Air sample collected over a 9-minute period at a sampling rate of 2-litres per minute

b. WORKSAFE New Zealand — Workplace Exposure Standards, 8th Edition (Effective June 2016)

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MONITORING RESULTS:

TABLE 3: AIR QUALITY - NEW ZEALAND ROYAL POLICE COLLEGE
PAPAKOWHAI ROAD, PORIRUA
GARAGE ADJACENT TO THE UPPER INDOOR FIRING RANGE
AREA AIR SAMPLE
RIGHT HAND SIDE OF THE OFFICER FIRING FX AMMUNITION
26 AUGUST 2016

SAMPLING DETAILS	WEIGHT OF METAL PARTICULATE COLLECTED ON THE AIR SAMPLING FILTER (µg) *a				
	Antimony	Copper	Lead	Tin	Zinc
Sample DPOLFX1 Area Air Sample Right hand side of the officer firing FX ammunition	0.027	<0.03	0.097	<0.03	<0.05
Sample RPC4 Field Blank	<0.010	<0.03	<0.005	<0.03	<0.05
Sample LRPC4 Field Blank	<0.010	<0.03	<0.005	<0.03	<0.05

The air sampling results show there was very little metal particulate/fume in the air where an officer was firing FX ammunition.

a. Air Sample DPOLFX1 (pre-weighed matched filters 4-222976)

RPC4 (Pre-weighed matched filters 4-222978)
Field Blank for Upper Indoor Range Assessment

LRPC4 (Pre-weighed matched filters 4-222984)
Field Blank for Lower Indoor Range Assessment

HEALTHY ENVIRONMENTS LTD

MONITORING RESULTS:

TABLE 4: AIR QUALITY - NEW ZEALAND ROYAL POLICE COLLEGE
PAPAKOWHAI ROAD, PORIRUA
GARAGE ADJACENT TO THE UPPER INDOOR FIRING RANGE
AREA AIR SAMPLE
RIGHT HAND SIDE OF THE OFFICER FIRING FX AMMUNITION
26 AUGUST 2016

SAMPLING DETAILS	CONCENTRATION OF METAL PARTICULATE/FUME IN THE AIR ($\mu g/m^3$) *a				
	Antimony	**Copper**	**Lead**	**Tin**	**Zinc**
Sample DPOLFX1 Area Air Sample Right hand side of the officer firing FX ammunition	0.94	<1.7	5.1	<1.7	<2.8
WES-TWA$_{8\text{-Hour}}$ ($\mu g/m^3$) *b	**500**	**1000**	**100**	**2000**	**10000**

The area air sample collected close to an officer firing FX ammunition showed the concentration of metal particulate/ fume in the air to be significantly below the New Zealand Workplace Exposure Standards.

* Reference standards and guidelines established to limit worker exposure to airborne hazardous substances that are injurious to health.

a. Air Sample — DPOLFX1 (pre-weighed matched filters 4-222976) Air sample collected over a period of 9-minutes at a sampling rate of 2-litres per minute

b. WORKSAFE New Zealand — Workplace Exposure Standards, 8th Edition (Effective June 2016)

MONITORING RESULTS:

Area Sampling - Volatile Organic Compounds

The area sample VFX1 was collected on the left hand side of an officer firing FX ammunition in a garage. Air was drawn through a charcoal tube over a period of 9-minutes at a sampling rate of 188.3-ml/minute. The charcoal sorbent tube has been analyzed in accordance with NIOSH standard methods. The results are presented below in Table 5.

TABLE 5: VOLATILE ORGANIC COMPOUNDS IN THE AIR

Sampling Location	**Sampling Time (mins)**	**Concentration of Volatile Organic Compounds in the Air (mg/m^3)**
Sample VFX1 Area Air Sample Left hand side of an officer firing FX ammunition	9	No target volatile organic compounds detected above their detection limit. There were no unidentified peaks in the GC-MS Total Ion Chromatogram for the analysed sample.

* Reference standards and guidelines established to limit workers exposure to airborne hazardous substances that are injurious to health.

MONITORING RESULTS:

Personal Sampling – Inorganic Acidic Gases

The area sample VFX2 was collected on the left hand side of an officer firing FX ammunition in a garage. Air was drawn through a silica gel sorbent tube over a period of 9-minutes at a sampling rate of 186.2-ml/minute. The silica gel tube has been analyzed in accordance with NIOSH standard methods. The results are presented below in Table 6.

TABLE 6: INORGANIC ACIDIC GASES IN THE AIR

Sampling Location	**Sampling Time (mins)**	**Concentration of Inorganic Acidic Gases in the Air (mg/m^3)** *b		
		Hydrogen Bromide	**Hydrogen Chloride**	**Hydrogen Fluoride (as fluoride)**
Sample VFX2 Area Air Sample Left hand side of an officer firing FX ammunition	9	<0.3	0.04	<0.31
WES-TWA (8-hour) *a		**C(9.9)** *c	**C(7.5)** *c	**2.5**
		Nitric Acid	**Phosphoric Acid**	**Sulphuric Acid**
		<0.30	<3.1	<3.1
WES-TWA (8-hour) *a		**31**	**1**	**1**

* Reference standards and guidelines established to limit workers exposure to airborne hazardous substances that are injurious to health.

a. Worksafe New Zealand — Workplace Exposure Standards, 8th Edition (Effective June 2016)

b. Air Sampling Result — Airborne contaminant concentrations reported in the table above are expressed as a Time-Weighted Average (TWA) over the sampling period of 9-minutes.

c. Workplace Exposure Standards — 'C' designates a ceiling limit concentration to limit exposure to this hazardous substance.

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MONITORING RESULTS:

TABLE 7: AIR QUALITY - NEW ZEALAND ROYAL POLICE COLLEGE
PAPAKOWHAI ROAD, PORIRUA
GARAGE ADJACENT TO THE UPPER INDOOR FIRING RANGE
AREA AIR SAMPLE
LEFT HAND SIDE OF AND OFFICER FIRING FX AMMUNITION
26 AUGUST 2016

	Air Quality Parameter*a		Workplace Exposure Guideline*b	
	PM_{10} Concentration in the Air (ug/m^3)			
Sampling Period	Average	Peak	No Concern	Concern
10.48 - 10.54	54.0	381.0	--	5000

The concentration of PM_{10} in the air is very low when compared with an 8-hour TWA health-based exposure guideline for workplaces (occupational).

* Reference standards and guidelines established to limit worker exposure to airborne hazardous substances that are injurious to health.

a. PM_{10} Particulate matter with particle size equal to or less than 10-microns

b. OSHA Regulations Standards - 29 CFR

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MONITORING RESULTS:

TABLE 8: AIR QUALITY - NEW ZEALAND ROYAL POLICE COLLEGE
PAPAKOWHAI ROAD, PORIRUA
GARAGE ADJACENT TO THE UPPER INDOOR FIRING RANGE
AREA AIR SAMPLE
RIGHT HAND SIDE OF AN OFFICER FIRING FX AMMUNITION
26 AUGUST 2016

	Air Quality Parameter		Workplace Exposure Guideline*a	
	Respirable Particulate Matter Concentration in the Air (ug/m^3)			
Sampling Period	Average	Peak	No Concern	Concern
10.49 -10.57	3.0	11.0	--	3000

The concentration of RSP in the air is very low when compared with an 8-hour TWA Workplace Exposure Standard for workplaces (occupational).

* Reference standards and guidelines established to limit worker exposure to airborne hazardous substances that are injurious to health.

b. Exposure Standard The workplace exposure standard refers to respirable particulate matter that is otherwise not classified

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MONITORING RESULTS:

TABLE 9 AIR QUALITY - NEW ZEALAND ROYAL POLICE COLLEGE
PAPAKOWHAI ROAD, PORIRUA
GARAGE ADJACENT TO THE UPPER INDOOR FIRING RANGE
AREA AIR SAMPLE
RIGHT HAND SIDE OF AN OFFICER FIRING FX AMMUNITION
26 AUGUST 2016

Air Sampling Period	AIR QUALITY PARAMETER		WORKPLACE EXPOSURE STANDARD*a	
	Carbon Monoxide (ppm)			
	Average	Peak Level	No Concern	Concern
10.35 - 10.59	0.3	2.0	--	25
	Nitrogen Dioxide (ppm)			
10.35 - 10.59	<0.1	0.1	---	3

The concentration of carbon monoxide and nitrogen dioxide gases in the air is well below the 8-hour Workplace Exposure Standards for these hazardous substances.

* Reference standards and guidelines established to limit worker exposure to airborne hazardous substances that are injurious to health.

a. Worksafe New Zealand Workplace Exposure Standards, 8th Edition (Effective June 2016)

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APPENDIX C

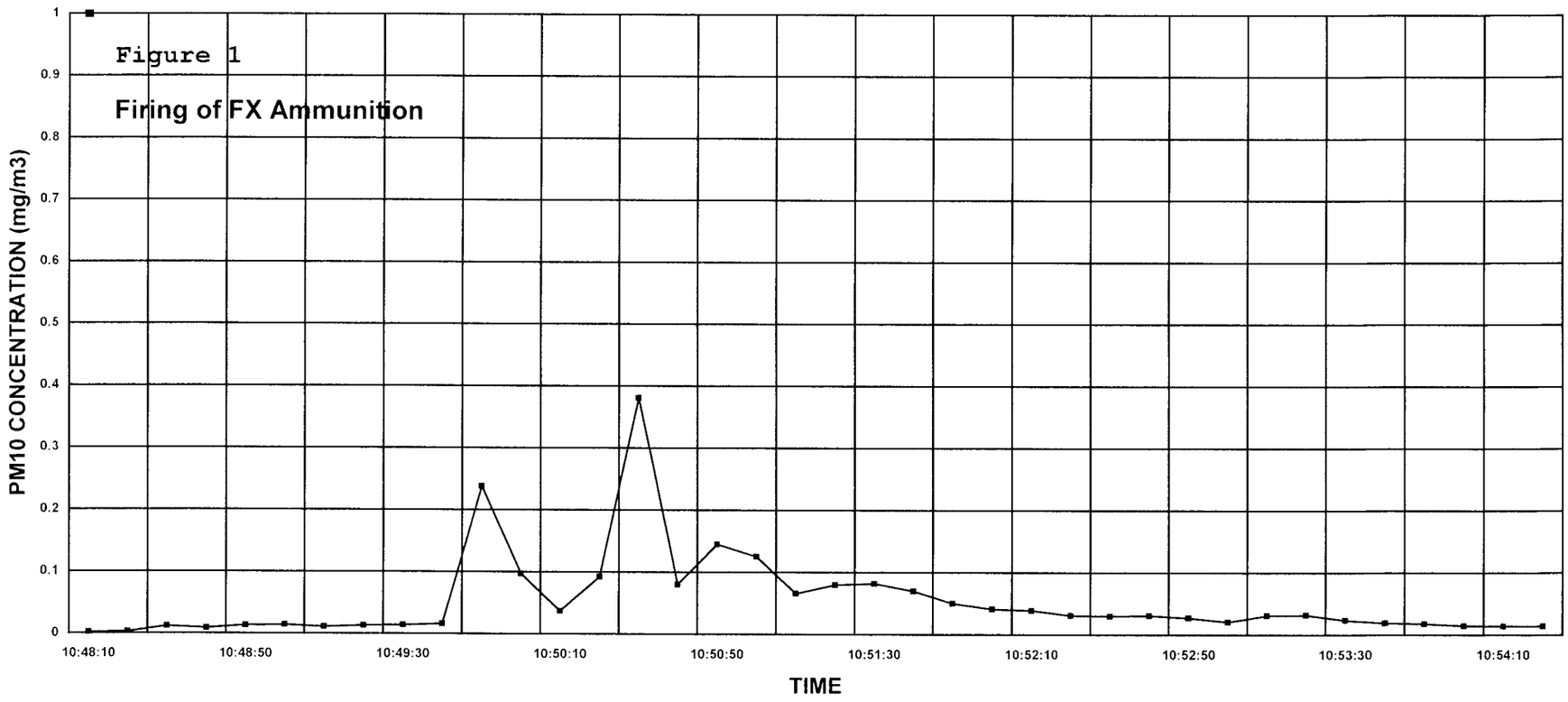
GRAPHICAL PROFILES OF PARTICLE MASS CONCENTRATIONS

GRAPHICAL PROFILES OF COMBUSTION GASES

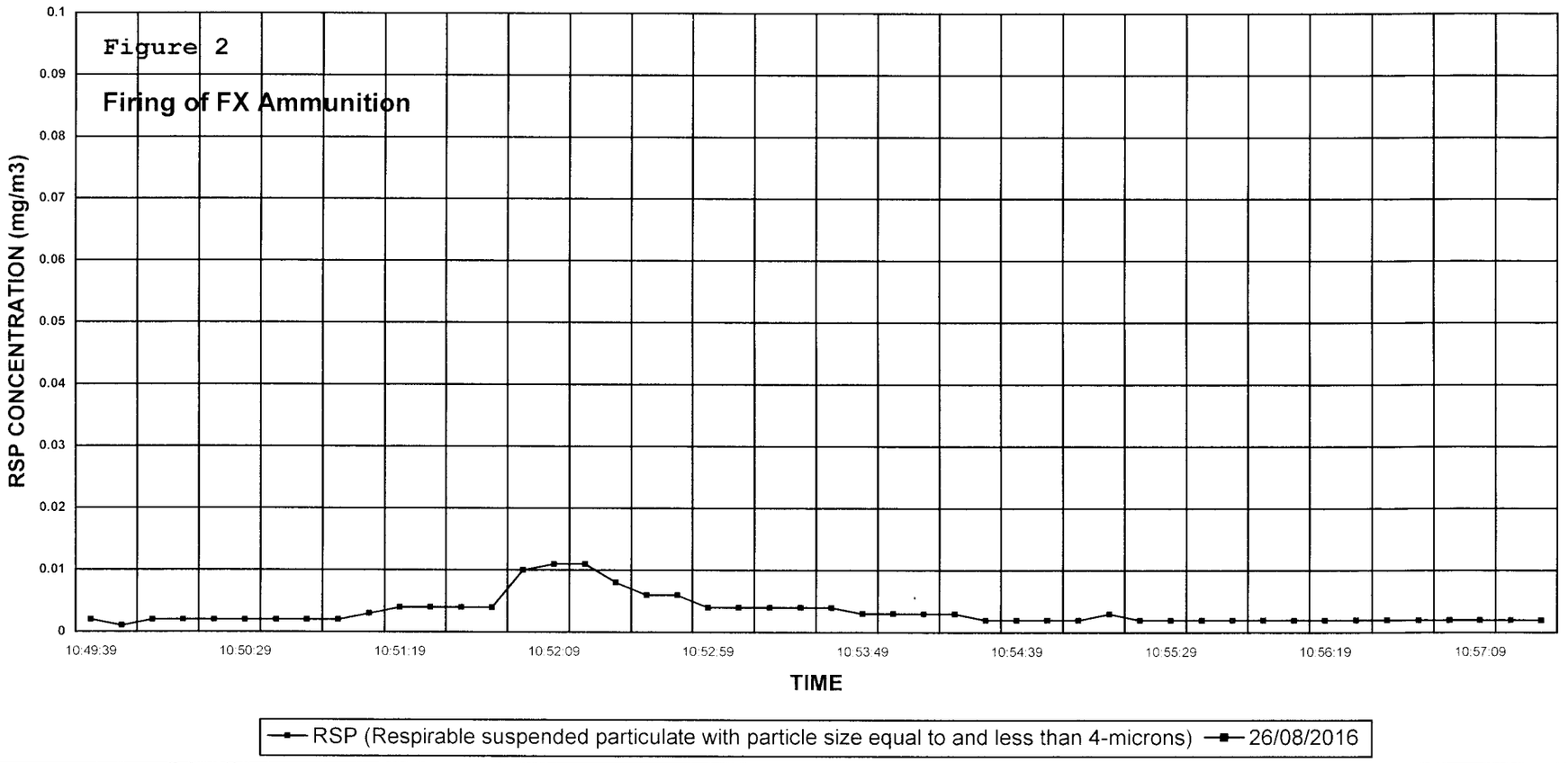
ROYAL NEW ZEALAND POLICE COLLEGE
PAPAKOWHAI ROAD, PORIRUA
AREA AIR SAMPLE BEHIND SHOOTER IN GARAGE
STRUCTURE ADJACENT TO THE UPPER FIRING RANGE BUILDING

Figure 1

Firing of FX Ammunition

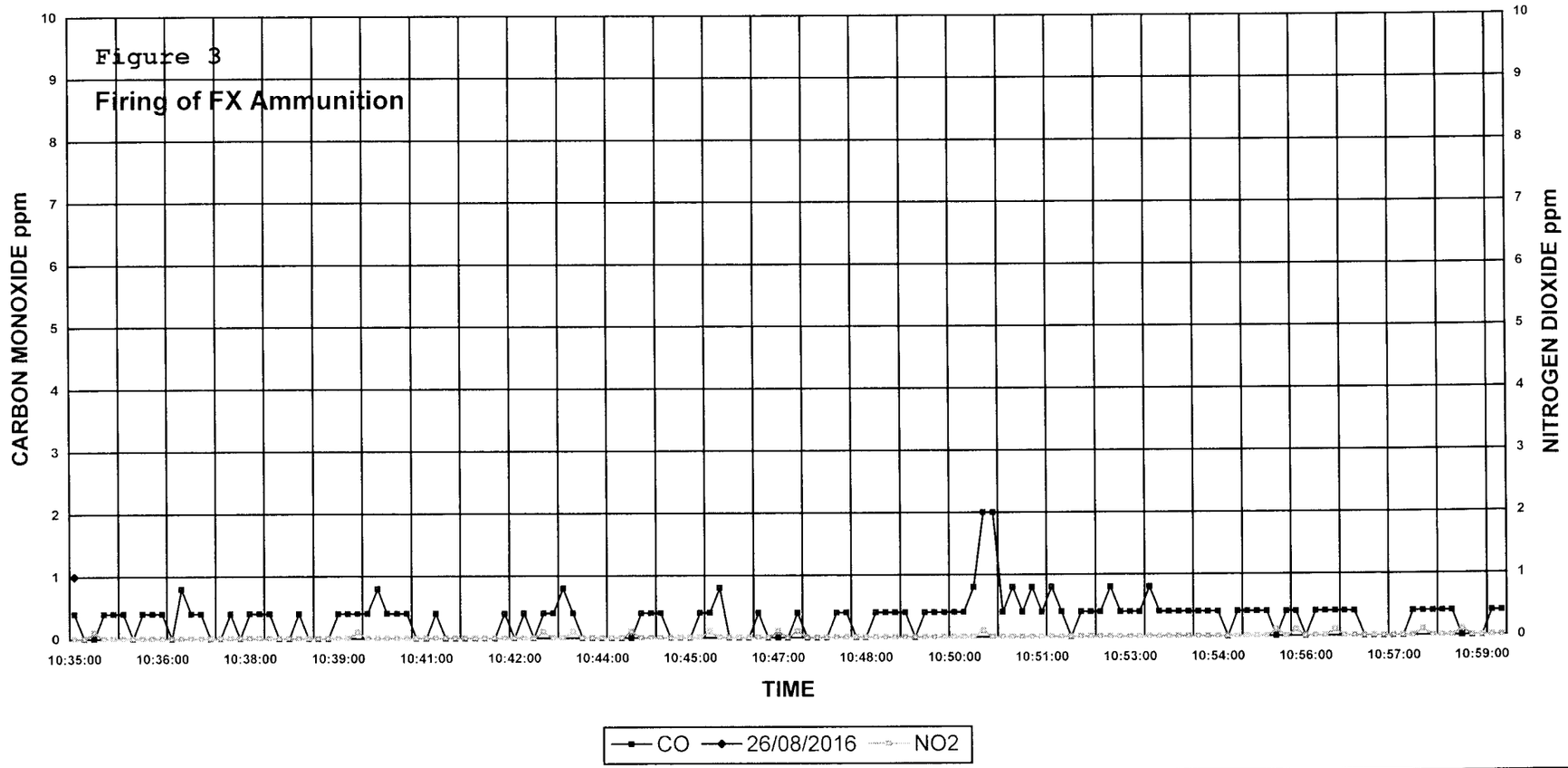


ROYAL NEW ZEALAND POLICE COLLEGE
PAPAKOWHAI ROAD, PORIRUA
AREA BEHIND SHOOTER IN A GARAGE
STRUCTURE IS ADJACENT TO THE UPPER FIRING RANGE BUILDING



ROYAL NEW ZEALAND POLICE COLLEGE
PAPAKOWHAI ROAD, PORIRUA
AREA AIR SAMPLE BEHIND SHOOTER IN GARAGE
STRUCTURE ADJACENT TO THE UPPER FIRING RANGE BUILDING

Figure 3
Firing of FX Ammunition



HEALTHY ENVIRONMENTS LTD

APPENDIX D

LABORATORY ANALYSIS REPORTS FOR SAMPLES

PHOTOGRAPHS

Hill Laboratories
BETTER TESTING **BETTER RESULTS**

R J Hill Laboratories Limited
1 Clyde Street
Private Bag 3205
Hamilton 3240, New Zealand

Tel +64 7 858 2000
Fax +64 7 858 2001
Email mail@hill-labs.co.nz
Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Healthy Environments	**Lab No:**	1639754 SPv1
Contact:	Mr L Stratton	**Date Received:**	30-Aug-2016
	C/- Healthy Environments	**Date Reported:**	14-Sep-2016
	PO Box 338	**Quote No:**	
	Wellington 6140	**Order No:**	
		Client Reference:	Royal New Zealand Police College
		Submitted By:	Mr L Stratton

Sample Type: 100/50 mg CSC SKC 226-01

Sample Name:		VFX1 28-Aug-2016				
Lab Number:		1639754.3				
Individual Tests						
VOC Library Search	Report	No Peaks Identified	-	-	-	-
VOC Suite from charcoal tubes (screen)						
Chloroform front	µg/sample	< 1.0	-	-	-	-
Chloroform back	µg/sample	< 1.0	-	-	-	-
1,1,1-Trichloroethane front	µg/sample	< 0.10	-	-	-	-
1,1,1-Trichloroethane back	µg/sample	< 0.10	-	-	-	-
1,2-Dichloroethane front	µg/sample	< 0.10	-	-	-	-
1,2-Dichloroethane back	µg/sample	< 0.10	-	-	-	-
Carbon tetrachloride front	µg/sample	< 0.10	-	-	-	-
Carbon tetrachloride back	µg/sample	< 0.10	-	-	-	-
1,1-Dichloropropene front	µg/sample	< 0.10	-	-	-	-
1,1-Dichloropropene back	µg/sample	< 0.10	-	-	-	-
Benzene front	µg/sample	< 0.3	-	-	-	-
Benzene back	µg/sample	< 0.3	-	-	-	-
Trichloroethylene front	µg/sample	< 0.10	-	-	-	-
Trichloroethylene back	µg/sample	< 0.10	-	-	-	-
1,2-Dichloropropane front	µg/sample	< 0.10	-	-	-	-
1,2-Dichloropropane back	µg/sample	< 0.10	-	-	-	-
Dibromomethane front	µg/sample	< 0.10	-	-	-	-
Dibromomethane back	µg/sample	< 0.10	-	-	-	-
Bromodichloromethane front	µg/sample	< 0.10	-	-	-	-
Bromodichloromethane back	µg/sample	< 0.10	-	-	-	-
cis-1,3-Dichloropropene front	µg/sample	< 0.10	-	-	-	-
cis-1,3-Dichloropropene back	µg/sample	< 0.10	-	-	-	-
Toluene front	µg/sample	< 0.10	-	-	-	-
Toluene back	µg/sample	< 0.10	-	-	-	-
trans-1,3-Dichloropropene front	µg/sample	< 0.10	-	-	-	-
trans-1,3-Dichloropropene back	µg/sample	< 0.10	-	-	-	-
1,1,2-Trichloroethane front	µg/sample	< 0.10	-	-	-	-
1,1,2-Trichloroethane back	µg/sample	< 0.10	-	-	-	-
1,3-Dichloropropane front	µg/sample	< 0.10	-	-	-	-
1,3-Dichloropropane back	µg/sample	< 0.10	-	-	-	-
Dibromochloromethane front	µg/sample	< 0.10	-	-	-	-
Dibromochloromethane back	µg/sample	< 0.10	-	-	-	-
Tetrachloroethylene (Perchloroethylene) front	µg/sample	< 0.10	-	-	-	-
Tetrachloroethylene (Perchloroethylene) back	µg/sample	< 0.10	-	-	-	-
1,2-Dibromoethane (ethylene dibromide) front	µg/sample	< 0.10	-	-	-	-

Sample Type: 100/50 mg CSC SKC 226-01						
Sample Name:		VFX1 28-Aug-2016				
Lab Number:		1639754.3				
VOC Suite from charcoal tubes (screen)						
1,2-Dibromoethane (ethylene dibromide) back	µg/sample	< 0.10	-	-	-	-
Chlorobenzene front	µg/sample	< 0.10	-	-	-	-
Chlorobenzene back	µg/sample	< 0.10	-	-	-	-
1,1,1,2-Tetrachloroethane front	µg/sample	< 0.10	-	-	-	-
1,1,1,2-Tetrachloroethane back	µg/sample	< 0.10	-	-	-	-
Ethylbenzene front	µg/sample	< 0.10	-	-	-	-
Ethylbenzene back	µg/sample	< 0.10	-	-	-	-
m-, p-Xylene front	µg/sample	< 0.10	-	-	-	-
m-, p-Xylene back	µg/sample	< 0.10	-	-	-	-
o-Xylene front	µg/sample	< 0.10	-	-	-	-
o-Xylene back	µg/sample	< 0.10	-	-	-	-
Styrene front	µg/sample	< 0.10	-	-	-	-
Styrene back	µg/sample	< 0.10	-	-	-	-
Bromoform (tribromomethane) front	µg/sample	< 0.10	-	-	-	-
Bromoform (tribromomethane) back	µg/sample	< 0.10	-	-	-	-
iso-Propylbenzene (Cumene) front	µg/sample	< 0.10	-	-	-	-
iso-Propylbenzene (Cumene) back	µg/sample	< 0.10	-	-	-	-
1,1,2,2-Tetrachloroethane front	µg/sample	< 0.10	-	-	-	-
1,1,2,2-Tetrachloroethane back	µg/sample	< 0.10	-	-	-	-
1,2,3-Trichloropropane front	µg/sample	< 0.10	-	-	-	-
1,2,3-Trichloropropane back	µg/sample	< 0.10	-	-	-	-
Bromobenzene front	µg/sample	< 0.10	-	-	-	-
Bromobenzene back	µg/sample	< 0.10	-	-	-	-
2-Chlorotoluene front	µg/sample	< 0.10	-	-	-	-
2-Chlorotoluene back	µg/sample	< 0.10	-	-	-	-
n-Propylbenzene front	µg/sample	< 0.10	-	-	-	-
n-Propylbenzene back	µg/sample	< 0.10	-	-	-	-
4-Chlorotoluene front	µg/sample	< 0.10	-	-	-	-
4-Chlorotoluene back	µg/sample	< 0.10	-	-	-	-
1,3,5-Trimethylbenzene front	µg/sample	< 0.10	-	-	-	-
1,3,5-Trimethylbenzene back	µg/sample	< 0.10	-	-	-	-
tert-Butylbenzene front	µg/sample	< 0.10	-	-	-	-
tert-Butylbenzene back	µg/sample	< 0.10	-	-	-	-
1,2,4-Trimethylbenzene front	µg/sample	< 0.10	-	-	-	-
1,2,4-Trimethylbenzene back	µg/sample	< 0.10	-	-	-	-
1,3-Dichlorobenzene front	µg/sample	< 0.10	-	-	-	-
1,3-Dichlorobenzene back	µg/sample	< 0.10	-	-	-	-
sec-Butylbenzene front	µg/sample	< 0.10	-	-	-	-
sec-Butylbenzene back	µg/sample	< 0.10	-	-	-	-
1,4-Dichlorobenzene front	µg/sample	< 0.10	-	-	-	-
1,4-Dichlorobenzene back	µg/sample	< 0.10	-	-	-	-
4-iso-Propyltoluene (p-Cymene) front	µg/sample	< 0.10	-	-	-	-
4-iso-Propyltoluene (p-Cymene) back	µg/sample	< 0.10	-	-	-	-
1,2-Dichlorobenzene front	µg/sample	< 0.10	-	-	-	-
1,2-Dichlorobenzene back	µg/sample	< 0.10	-	-	-	-
n-Butylbenzene front	µg/sample	< 0.10	-	-	-	-
n-Butylbenzene back	µg/sample	< 0.10	-	-	-	-
1,2-Dibromo-3-chloropropane front	µg/sample	< 0.10	-	-	-	-
1,2-Dibromo-3-chloropropane back	µg/sample	< 0.10	-	-	-	-
1,2,4-Trichlorobenzene front	µg/sample	< 0.10	-	-	-	-
1,2,4-Trichlorobenzene back	µg/sample	< 0.10	-	-	-	-
Naphthalene front	µg/sample	< 0.10	-	-	-	-
Naphthalene back	µg/sample	< 0.10	-	-	-	-

Sample Type: 100/50 mg CSC SKC 226-01

Sample Name:		VFX1 28-Aug-2016				
Lab Number:		1639754.3				
VOC Suite from charcoal tubes (screen)						
1,2,3-Trichlorobenzene front	µg/sample	< 0.10	-	-	-	-
1,2,3-Trichlorobenzene back	µg/sample	< 0.10	-	-	-	-
Hexachlorobutadiene front	µg/sample	< 0.10	-	-	-	-
Hexachlorobutadiene back	µg/sample	< 0.10	-	-	-	-
MIBK (methylisobutyl ketone) front	µg/sample	< 1.0	-	-	-	-
MIBK (methylisobutyl ketone) back	µg/sample	< 1.0	-	-	-	-

Sample Type: 400/200 mg specially cleaned silica gel SKC 226-10-03

Sample Name:		VFX2 28-Aug-2016				
Lab Number:		1639754.4				
Bromide from silica gel tube						
Bromide front and particulate	µg/sample	< 0.5	-	-	-	-
Bromide back	µg/sample	< 0.5	-	-	-	-
Chloride from silica gel tube						
Chloride front and particulate	µg/sample	11	-	-	-	-
Chloride back	µg/sample	8	-	-	-	-
Fluoride from silica tube						
Fluoride front and particulate	µg/sample	< 0.5	-	-	-	-
Fluoride back	µg/sample	< 0.5	-	-	-	-
Nitrate						
Nitrate front and particulate	µg/sample	< 0.5	-	-	-	-
Nitrate back	µg/sample	< 0.5	-	-	-	-
Phosphate						
Phosphate front and particulate	µg/sample	< 5	-	-	-	-
Phosphate back	µg/sample	< 5	-	-	-	-
Sulphate						
Sulphate front and particulate	µg/sample	250	-	-	-	-
Sulphate back	µg/sample	140	-	-	-	-

Sample Type: Miscellaneous filter type less than 50 mm diameter

Sample Name:		DPOLFX1 (4-222976) 28-Aug-2016	DPOLFX2 (4-222985) 28-Aug-2016			
Lab Number:		1639754.1	1639754.2			
Individual Tests						
Antimony	µg/sample	0.027	0.019	-	-	-
Copper	µg/sample	< 0.03	0.09	-	-	-
Lead	µg/sample	0.097	0.075	-	-	-
Tin	µg/sample	< 0.03	< 0.03	-	-	-
Zinc	µg/sample	< 0.05	< 0.05	-	-	-

Analyst's Comments

Appendix No.1 - 1639754 Filter Weight Results

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: 100/50 mg CSC SKC 226-01

Test	Method Description	Default Detection Limit	Sample No
Library Search on Air Quality VOC samples	A Library Search is conducted of the Mass Spectra for unidentified peaks against the NIST 2008 Mass Spectral Library containing 220,460 mass spectra of 192,108 different chemical compounds. Only peaks with a greater than 70% quality match are reported, along with their semi-quantitative concentrations, to a maximum of 100 peaks matched.	-	3
VOC Suite from charcoal tubes (screen)	Break into fractions & desorb with CS2, analysis by GC-MS	0.10 - 1.0 µg/sample	3

Sample Type: 400/200 mg specially cleaned silica gel SKC 226-10-03

Test	Method Description	Default Detection Limit	Sample No
Bromide from silica gel tube	Break into fractions, desorption with bicabonate buffer, IC-conductivity analysis, analysed at Hill Laboratories - Air Quality; 25 Te Aroha Street, Hamilton	0.5 µg/sample	4
Chloride from silica gel tube	Break into fractions, desorption with bicabonate buffer, IC-conductivity analysis, analysed at Hill Laboratories - Air Quality; 25 Te Aroha Street, Hamilton	5 µg/sample	4
Fluoride from silica tube	Break into fractions, desorption with bicabonate buffer, IC-conductivity analysis, analysed at Hill Laboratories - Air Quality; 25 Te Aroha Street, Hamilton	0.5 µg/sample	4
Nitrate	Break into fractions, desorption with bicabonate buffer, IC-conductivity analysis, analysed at Hill Laboratories - Air Quality; 25 Te Aroha Street, Hamilton	0.5 µg/sample	4
Phosphate	Break into fractions, desorption with bicabonate buffer, IC-conductivity analysis, analysed at Hill Laboratories - Air Quality; 25 Te Aroha Street, Hamilton	5 µg/sample	4
Sulphate	Break into fractions, desorption with bicabonate buffer, IC-conductivity analysis, analysed at Hill Laboratories - Air Quality; 25 Te Aroha Street, Hamilton	5 µg/sample	4

Sample Type: Miscellaneous filter type less than 50 mm diameter

Test	Method Description	Default Detection Limit	Sample No
Miscellaneous Air Quality procedure		-	1-2
Antimony	Modified aqua regia digestion of client filter, analysis by ICP-MS (see NIOSH 7303). In-house based on NIOSH Method 7303, issue 1 (modified).	0.010 µg/sample	1-2
Copper	Modified aqua regia digestion of client filter, analysis by ICP-MS. In-house based on NIOSH Method 7303, issue 1 (modified).	0.03 µg/sample	1-2
Lead	Modified aqua regia digestion of client filter, analysis by ICP-MS (see NIOSH 7303). In-house based on NIOSH Method 7303, issue 1 (modified).	0.005 µg/sample	1-2
Tin	Modified aqua regia digestion of client filter, analysis by ICP-MS (see NIOSH 7303). In-house based on NIOSH Method 7303, issue 1 (modified).	0.03 µg/sample	1-2
Zinc	Modified aqua regia digestion of client filter, analysis by ICP-MS. In-house based on NIOSH Method 7303, issue 1 (modified).	0.05 µg/sample	1-2

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Ara Heron BSc (Tech)
Client Services Manager - Environmental

Sample Type: Matched weight MCE filter

Lab No	Sample Name	Top filter (g)	Bottom filter (g)
1639754.1	DPOLFX1 (4-222976)	0.04276	0.04275
1639754.2	DPOLFX2 (4-222985)	0.04247	0.04241

Summary of Methods Used and Detection Limits

The following table(s) gives a brief description of the methods used to conduct the analyses for this job.
The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Matched weight MCE filter

Parameter	Method Used	Detection Limit
Weight	Temperature/humidity equilibration for 24 hr. Weighed in duplicate, average reported. Analysed at Hill Laboratories - Air Quality; 25 Te Aroha Street, Hamilton	0.00005 g.

The photograph above shows air sampling instruments set up inside a garage that is adjacent to the building containing the upper indoor firing range at the Royal New Zealand Police College. See the arrows.

The photograph above shows air sampling instruments set up either side of a doorway from a kitchen into lounge area in the garage. To simulate fume emissions from the firing of FX ammunition an officer stood in the doorway and fired into the lounge. An arrow shows the direction of firing the handgun.