

Detecting dust drift from aerial application of 1080: three West Coast and Taranaki field studies

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Prepared by:

Emission Impossible Ltd

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CONTENTS

EXECUTIVE SUMMARY	4
1. INTRODUCTION	6
1.1 AIM OF THE FIELD STUDIES	6
1.2 DEFINITIONS	6
2. METHOD	7
2.1 SITE LOCATIONS	9
2.2 MONITORING DETAILS	7
2.3 QUALITY ASSURANCE	19
2.4 SECURITY	20
3. RESULTS	21
3.1 OPERATIONAL DETAILS	21
3.2 VISUAL OBSERVATIONS	21
3.3 METEOROLOGY AND CONTINUOUS PM₄₀	22
3.4 1080 DETECTION	24
3.5 QUALITY ASSURANCE SAMPLES	25
4. DISCUSSION	26
5. CONCLUSIONS	29
REFERENCES	30
APPENDIX A: FIELD NOTES	32
APPENDIX B: FIELD MEASUREMENTS	48
APPENDIX C: LABORATORY ANALYSES	58

LIST OF TABLES

TABLE 1: SUMMARY OF MONITORING LOCATIONS

TABLE 2: SUMMARY AERIAL APPLICATION OPERATIONS

TABLE 3: 1080 LABORATORY ANALYSES

TABLE 4: BLANK FILTER LABORATORY ANALYSES

TABLE 5: SPIKED FILTER LABORATORY ANALYSES

LIST OF FIGURES

FIGURE 1: KAITAKE RANGE MAY 2019 APPLICATION IN TARANAKI: EAST AND WEST MONITORING LOCATIONS

FIGURE 2: KAITAKE RANGE MAY 2019 APPLICATION IN TARANAKI: WEST MONITORING LOCATIONS RELATIVE TO APPLICATION ZONE BOUNDARIES

FIGURE 3: KAITAKE RANGE MAY 2019 APPLICATION IN TARANAKI: EAST MONITORING LOCATIONS RELATIVE TO BOUNDARIES

FIGURE 4: TE MARUIA NOVEMBER 2019 APPLICATION NEAR LEWIS PASS: MARBLE HILL AND PALMERS ROAD MONITORING LOCATIONS

FIGURE 5: TE MARUIA NOVEMBER 2019 APPLICATION NEAR LEWIS PASS: MARBLE HILL MONITORING LOCATIONS RELATIVE TO APPLICATION ZONE BOUNDARIES

FIGURE 6: TE MARUIA NOVEMBER 2019 APPLICATION NEAR LEWIS PASS: PALMERS ROAD MONITORING LOCATIONS RELATIVE TO APPLICATION ZONE BOUNDARIES

FIGURE 7: WAITAANGA PLATEAU DECEMBER 2020 APPLICATION IN TARANAKI: MONITORING LOCATIONS

FIGURE 8: WAITAANGA PLATEAU DECEMBER 2020 APPLICATION IN TARANAKI: MONITORING LOCATIONS RELATIVE TO APPLICATION ZONE BOUNDARIES

FIGURE 9: DUST JUST VISIBLE BEHIND THE HELICOPTER, VIEWED FROM KAITAKE WEST 100 MONITORING LOCATION

FIGURE 10: 1080 DETECTED DOWNWIND – MINIMUM ESTIMATED DISTANCE TO APPLICATION BOUNDARY

FIGURE 11: 1080 DETECTED DOWNWIND – MAXIMUM ESTIMATED DISTANCE TO APPLICATION BOUNDARY

EXECUTIVE SUMMARY

This report summarises the findings of three field studies carried out at four locations in 2019 and 2020. The purpose of the field research was to:

Investigate whether sodium fluoroacetate (1080) is present in inhalable particulate downwind of an aerial baiting application.

Ambient air quality monitoring was undertaken downwind of the following aerial applications of bait containing 0.15% 1080:

- Kaitake range in Taranaki on 1 May 2019
- Te Maruia (Marble Hill) near Lewis Pass on the West Coast on 1 November 2019
- Te Maruia (Palmer's Road) near Lewis Pass on the West Coast on 2-3 November 2019
- Waitaanga Plateau in Taranaki on 2 December 2020

All air quality monitoring was undertaken outside the application zones using high-volume samplers with subsequent analysis for 1080 in the laboratory. These monitors typically collect particulate matter less than 30 micrometres in diameter (PM₃₀) at a very high flow rate (70 cubic metres per hour). Particles of this size can travel for significant distances.

Monitoring was carried out at a variety of distances, ranging from the boundary of the application zone to around 500 metres outside the application zone. Sampling commenced prior to the aerial application and finished after the application had ceased. Topography and meteorology varied significantly within and between each field study. Application rates varied from 2 kg to 4 kg per hectare of bait containing 0.15% 1080. The helicopter height above the canopy was between 50 to 150 metres.

Dust was visible on only a few occasions during some of the applications. Positive dust observations require a suitable backdrop and are dependent upon the angle of light (i.e. the helicopter needs to be between the observer and the sun).

1080 was detected in 20 of 21 samples collected at varying distances downwind of the application areas. The mass of 1080 measured ranged from 0.005 µg to 0.14 µg (minimum detection limit 0.005 µg). The maximum 1080 detected occurred between 100 to 300 metres from the application boundary. A decrease in concentration from the source is anticipated. However, a definition of distance to application boundary was confounded by the application zone surrounding the monitoring site on multiple sides in some locations. Quality assurance analyses of field and laboratory blank samples supports the detected measurements being robust.

The findings of these studies suggest that low levels of dust can be generated during aerial applications of bait containing 1080, and that very low levels of 1080 can be detected at distances of 500 metres outside the application boundaries.

It should be noted that the field studies were not designed to assess potential human exposures, or health risks, and therefore these are outside the scope of this report.



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1. INTRODUCTION

A 2015 scoping study (ESR, 2016) researched dust drift downwind of an aerial application of bait containing 0.15% sodium fluoroacetate (1080) near Kumara on the West Coast of New Zealand. This (low-volume) monitoring detected 0.025 micrograms (μg) of 1080 in one sample of particulate matter less than 40 micrometres in diameter (PM_{40}) collected at a location nearly 200 metres downwind of the application area. However, the study did not detect 1080 in PM_{40} collected close to, or inside, the application area. The unusual, and ultimately inconclusive, result suggested a need for additional research into the potential for dust drift from aerial application of 1080.

Aerial applications of 1080 are typically undertaken in extremely rugged and remote terrain. Finding relatively flat, open land suitable for field research adjacent to such operations was not straightforward. With the assistance of Ospri (a non-profit company that works with industry) and the Department of Conservation, Emission Impossible Ltd and Mote Ltd successfully undertook three more field studies in 2019 and 2020.

These later studies employed high-volume samplers which have a much higher sampling rate (70 cubic metres per hour) than the low volume sampling (0.12 cubic metres per hour) employed in the first (Waimea Kawhaka) field study. This significantly increased the possibility of detecting 1080 in airborne particulate downwind.

Two field studies were undertaken in Taranaki and one field study (comprising two separate locations) was undertaken on the West Coast.

This report summarises the findings of these three field studies at four separation locations outside aerial application zones.

1.1 AIM OF THE FIELD STUDIES

The hypothesis of the field research is:

Physical abrasion from transport, loading and aerial application of bait containing sodium fluoroacetate (1080) can generate dust particles that could drift over loading zone and application zone boundaries. Some of these particles may be sufficiently fine to travel significant distances and be inhaled by people.

The aim of these studies, therefore, was to investigate if 1080 is present in particulate measured downwind of an aerial baiting application.

Potential health effects, if any, are out of scope of this study.

1.2 DEFINITIONS

Different sampling methods collect different size fractions of particulate. During these field studies, the following size fractions of particulate were measured:

- 'Bait dust' or particulate matter (PM) – includes all size fractions of PM as measured in a high-volume sampler with the hood open;
- Particulate matter less than 40 micrometres (μm) in diameter (PM_{40}) as measured in a nephelometer (low-volume sampler);



- Particulate matter less than 30 µm in diameter (PM₃₀) as measured in a high-volume sampler. This fraction is also commonly referred to as Total Suspended Particulate (TSP).

The focus of field research was detecting 1080 in airborne particulate. The first field study (undertaken in Waimea Kawhaka ESR, 2016) also attempted to sample and detect 1080 in deposited particulate, which is defined as PM greater than 50 µm in diameter up to several hundred micrometres. No 1080 was detected in any sample and this fraction of PM was not considered further.

1.3 MONITORING DETAILS

High-volume samplers were operated at a sample rate of 70 cubic metres per hour.

A Gill Met-Pak meteorological station was employed during the Kaitake and Te Maruia applications to provide wind speed, wind direction, wind gust (3 second max), air temperature, relative humidity, dew point and barometric pressure.

The Waitaanga application employed a Gill Windsonic ultrasonic wind sensor to measure wind speed and wind direction.

All instruments were calibrated in the laboratory prior to deployment. The high-volume samplers were then calibrated again once deployed, prior to monitoring commencing.

Power for each monitoring site was provided by a portable diesel-powered generator. These were monitored for the duration of the application to ensure there was sufficient fuel. A generator failed after the first hour at one location (Foxglove Road) during the Waitaanga application and sampling at this monitoring location was abandoned.

Application of 1080 near the Palmers Road monitoring locations during the Te Maruia drop in November 2019, continued over two days. To avoid water or condensation forming on the sample filter papers overnight (1080 is highly soluble and degrades quickly in water), the filter papers at Palmers Road monitoring locations were removed at the end of the first day of sampling (2 November 2019) and stored overnight in separate plastic sleeves, within outer plastic sleeves. These filters were then reinserted the following day (3 November 2019) prior to aerial application (and sampling) re-commencing.

In addition to the primary research objective of determining whether 1080 could be detected, two other research questions lend themselves to these field studies:

- (i) How does 1080 detection vary over distance (presumably less 1080, if any, can be detected at greater distances); and
- (ii) What is the role of particle size fraction in sample collection.

To inform the first question, we used different distances downwind of the application boundaries in different field studies.

To inform the second question, we co-located two high-volume samplers during the Te Maruia application as follows:

- one with the hood off so that the filter would collect all size fractions of particulate matter; and

- one with the hood on so that the filter would collect the TSP fraction of particulate matter, or PM₃₀.

We further co-located light scattering instruments (nephelometers) for measurement of continuous, real-time PM₄₀ during the Kaitake and Te Maruia applications. Whilst nephelometers are not particularly accurate for particles greater than 40 µm in diameter, they do provide:

- continuous, real-time data that are precise and responsive with good temporal (1-minute average) resolution; and
- robust portability.¹

By contrast, high-volume samplers give only a single result for the period of monitoring (however, the filter samples can be analysed for chemical composition).

¹ High-volume samplers are heavy and require portable diesel generators (which are also heavy).

2. METHOD

Air quality monitoring was undertaken before, during and after aerial applications of 1080 over 5 days in 2019 and 2020.

Monitoring sites were selected prior to commencing the 1080 aerial application. The choice of location was necessarily driven by:

- terrain, (which sometimes limited access);
- prevailing meteorology;
- a need to minimise disruption to the landowners (most locations were working farms); and
- attempts to maximise the possibility that the site would be *downwind* of the aerial application on the day it occurred.

Monitoring samplers and meteorological instruments were installed and calibrated the day before the operation commenced. Sampling commenced prior to the application starting, continued throughout the entire period of application and ceased when the application stopped as advised by either Department of Conservation or the contractor.

Subsequent analysis for 1080 was performed by Landcare Research using gas chromatography following water extraction (based on method TLM 005, which has a detection limit of 0.005 µg/filter).²

2.1 SITE LOCATIONS

Monitoring locations are shown in the following figures:

- Figure 1: Kaitake Range May 2019 application in Taranaki: East and West monitoring locations
- Figure 2: Kaitake Range May 2019 application in Taranaki: West monitoring locations relative to application zone boundaries
- Figure 3: Kaitake Range May 2019 application in Taranaki: East monitoring locations relative to boundaries
- Figure 4: Te Maruia November 2019 application near Lewis Pass: Marble Hill and Palmers Road monitoring locations
- Figure 5: Te Maruia November 2019 application near Lewis Pass: Marble Hill monitoring locations relative to application zone boundaries

² Gas chromatography method TLM 005, 'Assay of 1080 in water, soil and biological materials by GLC' was developed by Landcare Research, based on the work of Ozawa and Tsukioka (1987, 1989). This method is accredited with IANZ (International Accreditation New Zealand) under Environmental Monitoring.

- Figure 6: Te Maruia November 2019 application near Lewis Pass: Palmers Road monitoring locations relative to application zone boundaries
- Figure 7: Waitaanga Plateau December 2020 application in Taranaki: monitoring locations
- Figure 8: Waitaanga Plateau December 2020 application in Taranaki: monitoring locations relative to application zone boundaries

All aerial applications of 1080 include a slow-speed, small (10-12 metres) sowing swathe employing trickle feed at the edge of the application area. This is referred to as the boundary drop. As such, the application zone areas in Figures 1, 4, 5, 6 and 7 represent the maximum possible extent of 1080 application.³

The terrain in all locations was complex. This means that wind flows are highly localised and may not reflect winds reported (or predicted) at relatively close locations (i.e. even within a few hundred metres).

The fraction of particulate collected, coordinates of monitoring locations and estimated distance to the application boundary are summarised in **Table 1**. It should be noted that the estimated distance to the boundary may be presented as a range as in some cases there was more than one application zone boundary. For example, the Palmers Road monitoring sites were nearly encircled by twin application areas.

³ Figures provided by contracted operators with resulting differences in presentation.

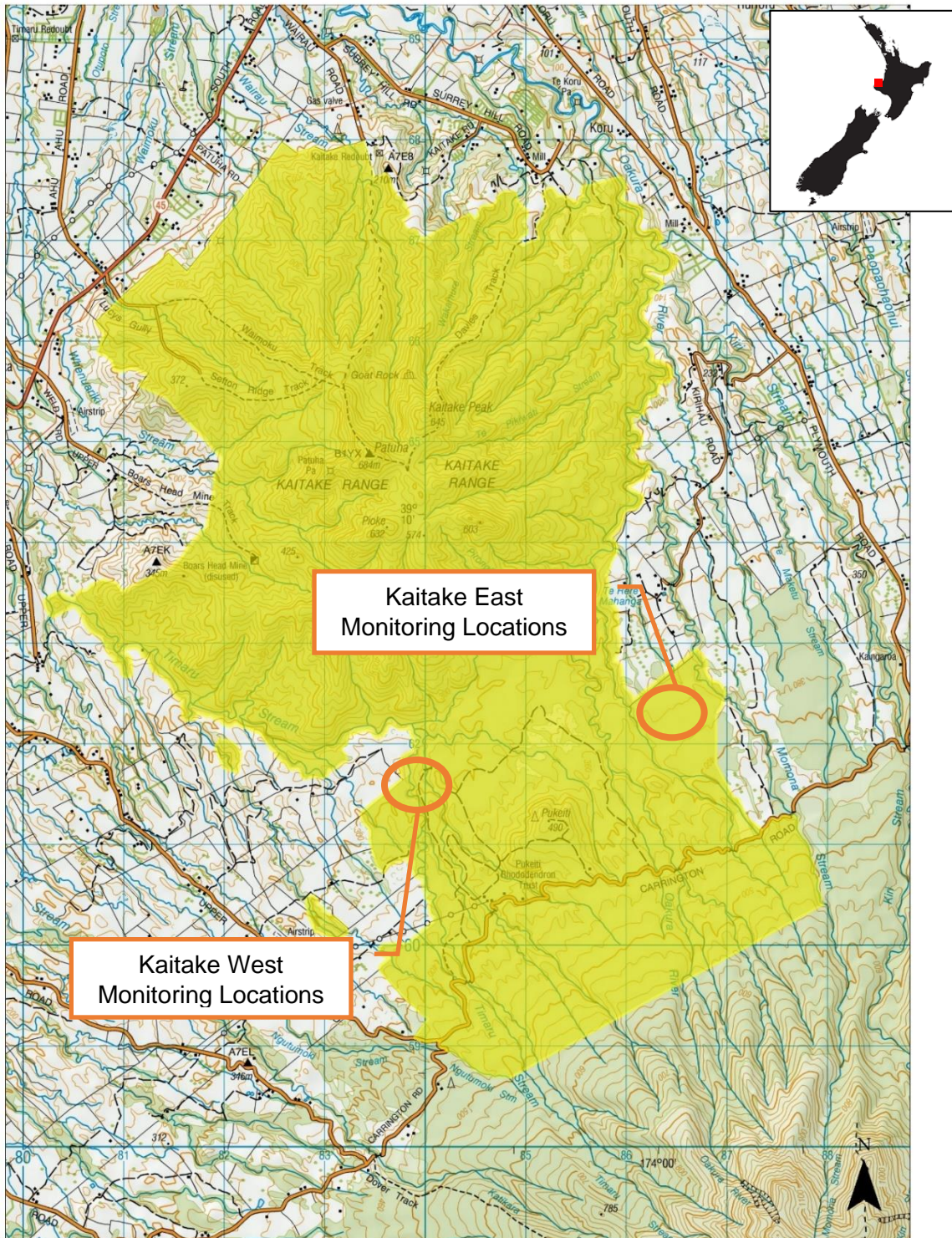


FIGURE 1: KAITAKE RANGE MAY 2019 APPLICATION IN TARANAKI: EAST AND WEST MONITORING LOCATIONS. YELLOW SHADING INDICATES 1080 APPLICATION ZONE.





FIGURE 2: KAITAKE RANGE MAY 2019 APPLICATION IN TARANAKI: WEST MONITORING LOCATIONS RELATIVE TO APPLICATION ZONE BOUNDARIES



FIGURE 3: KAITAKE RANGE MAY 2019 APPLICATION IN TARANAKI: EAST MONITORING LOCATIONS RELATIVE TO APPLICATION ZONE BOUNDARIES

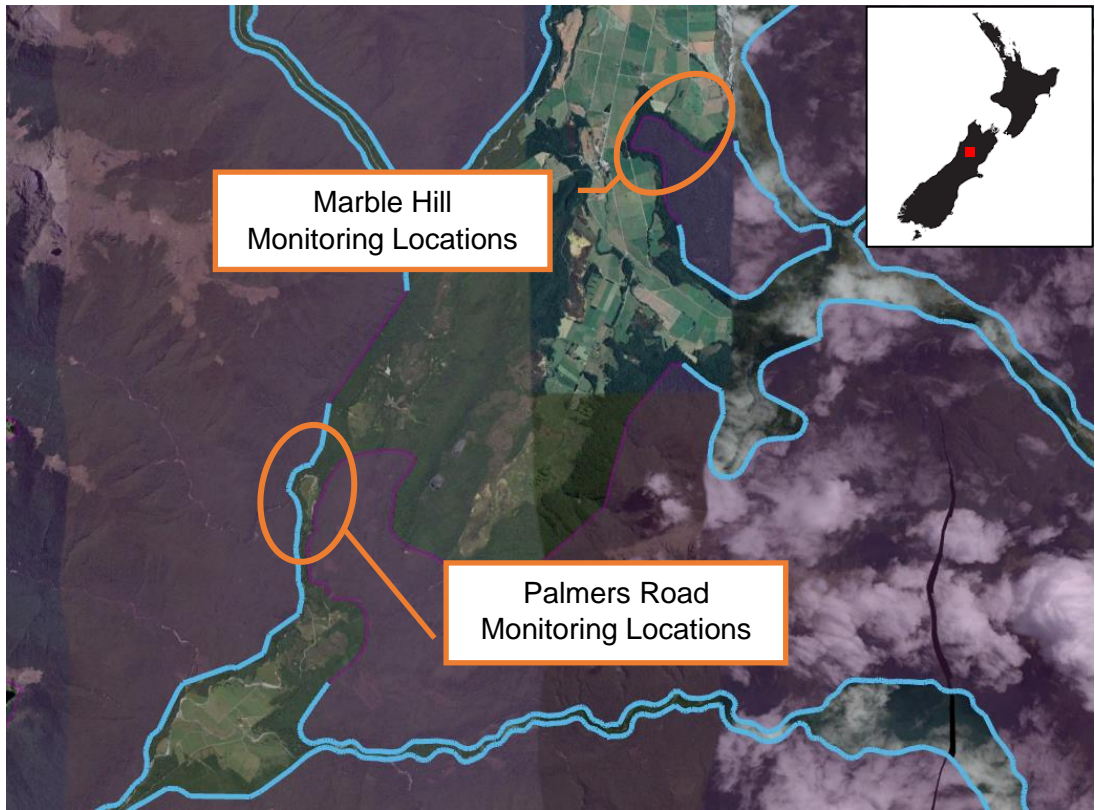


FIGURE 4: TE MARUIA NOVEMBER 2019 APPLICATION NEAR LEWIS PASS: MARBLE HILL AND PALMERS ROAD MONITORING LOCATIONS. PURPLE SHADING INDICATES 1080 APPLICATION ZONE.



FIGURE 5: TE MARUIA NOVEMBER 2019 APPLICATION NEAR LEWIS PASS: MARBLE HILL MONITORING LOCATIONS RELATIVE TO APPLICATION ZONE BOUNDARIES. PURPLE SHADING INDICATES 1080 APPLICATION ZONE.



FIGURE 6: TE MARUIA NOVEMBER 2019 APPLICATION NEAR LEWIS PASS: PALMERS ROAD MONITORING LOCATIONS RELATIVE TO APPLICATION ZONE BOUNDARIES. PURPLE SHADING INDICATES 1080 APPLICATION ZONES. BLUE LINE INDICATES BOUNDARY DROP ON 2 NOVEMBER 2019. WHITE LINE INDICATES PALMER ROAD.

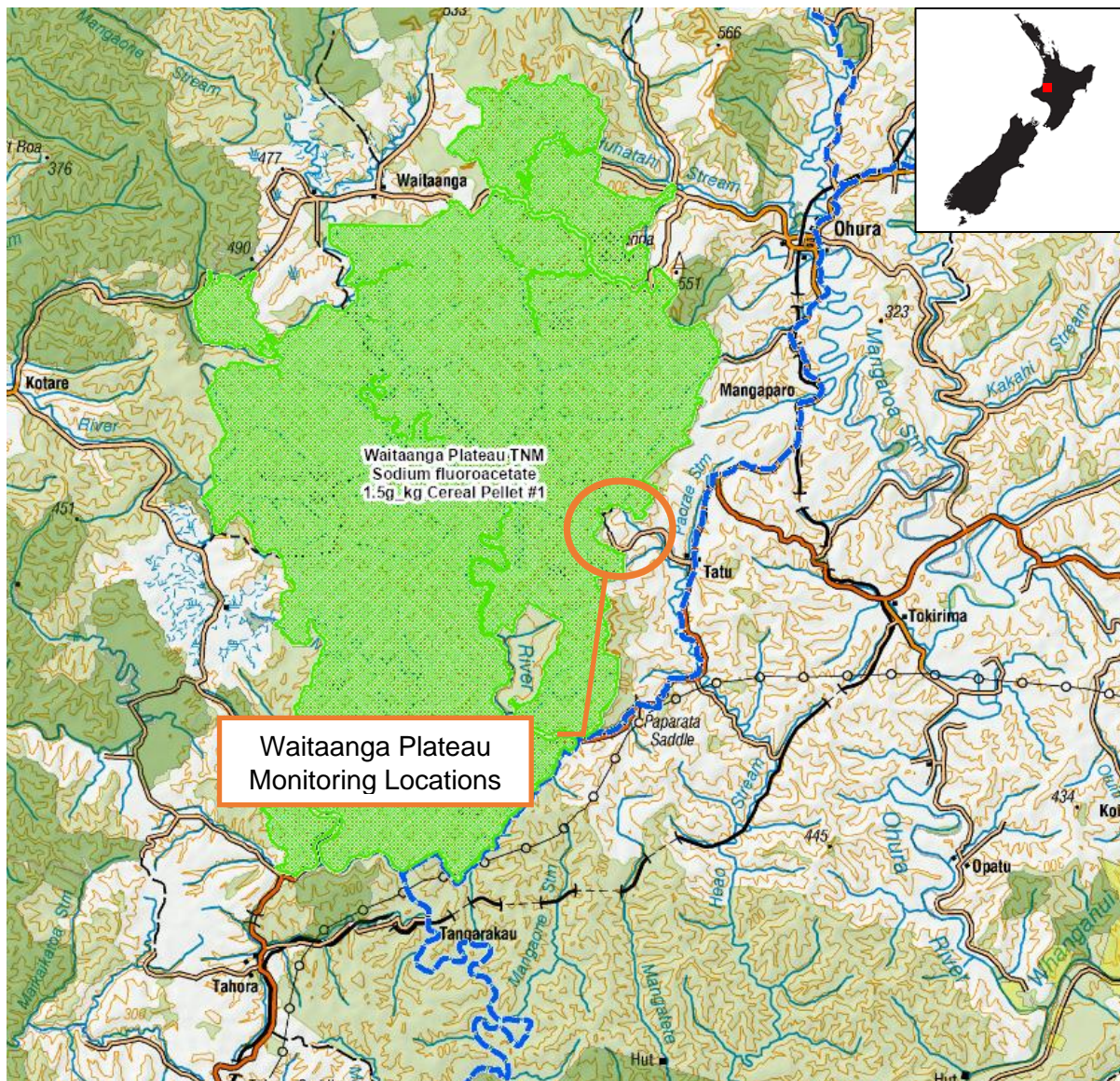


FIGURE 1: WAITAANGA PLATEAU DECEMBER 2020 APPLICATION IN TARANAKI: MONITORING LOCATIONS

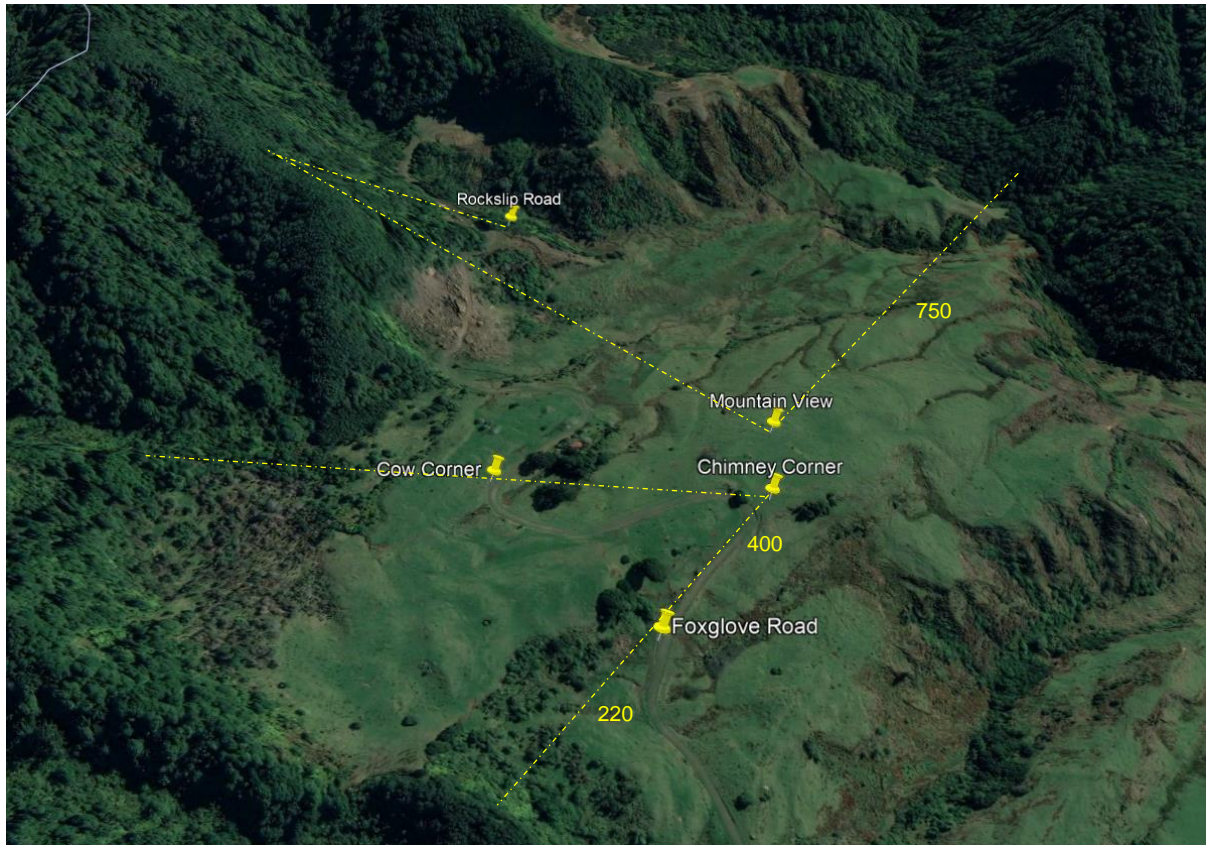


FIGURE 2: WAITAANGA PLATEAU DECEMBER 2020 APPLICATION IN TARANAKI: MONITORING LOCATIONS RELATIVE TO APPLICATION ZONE BOUNDARIES

TABLE 1: SUMMARY OF MONITORING LOCATIONS

SITE REFERENCE	LATITUDE	LONGITUDE	CLOSEST AERIAL APPLICATION BOUNDARIES	INSTRUMENTS
Kaitake Range, 1 May 2019				
K-West Boundary	-39.187355	173.971299	20 m	<ul style="list-style-type: none"> • High-volume sampler (PM₃₀)
K-West 100	-39.187651	173.970434	100 m	<ul style="list-style-type: none"> • High-volume sampler (PM₃₀) • Meteorology (wind speed, wind direction, relative humidity) • Nephelometer (PM₄₀)
K-West 200	-39.187649	173.969531	140 – 200 m	<ul style="list-style-type: none"> • High-volume sampler (PM₃₀)
K-East Boundary	-39.183053	173.996248	20 – 40 m	<ul style="list-style-type: none"> • High-volume sampler (PM₃₀)
K-East 50	-39.182645	173.996600	50 – 70 m	<ul style="list-style-type: none"> • High-volume sampler (PM₃₀) • Meteorology (wind speed, wind direction, relative humidity) • Nephelometer (PM₄₀)
Te Maruaia: Marble Hill, 1 November 2019				
Marble Hill North 1	-42.3317262	172.1999283	175 – 250 m	<ul style="list-style-type: none"> • Open high-volume sampler (PM) • High-volume sampler (PM₃₀) • Meteorology (wind speed, wind direction, relative humidity) • Nephelometer (PM₄₀)
Marble Hill North 2	-42.3309521	172.2005684	250 – 280 m	<ul style="list-style-type: none"> • High-volume sampler (PM₃₀)
Marble Hill South 1	-42.3349777	172.1894084	200 – 290 m	<ul style="list-style-type: none"> • Open high-volume sampler (PM) • High-volume sampler (PM₃₀) • Meteorology (wind speed, wind direction, relative humidity) • Nephelometer (PM₄₀)
Marble Hill South 2	-42.3357032	172.1899210	260 – 280 m	<ul style="list-style-type: none"> • High-volume sampler (PM₃₀)
Te Maruaia: Palmers Road, 2-3 November 2019				
Palmers Road 1	-42.377655	172.128803	200 – 300 m	<ul style="list-style-type: none"> • Open high-volume sampler (PM) • High-volume sampler (PM₃₀)
Palmers Road 2	-42.3788802	172.1296337	180 m	<ul style="list-style-type: none"> • Open high-volume sampler (PM) • High-volume sampler (PM₃₀) • Meteorology (wind speed, wind direction, relative humidity) • Nephelometer (PM₄₀)
Palmers Road 3	-42.379991	172.129886	100 – 170 m	<ul style="list-style-type: none"> • Open high-volume sampler (PM) • High-volume sampler (PM₃₀) • Meteorology (wind speed, wind direction, relative humidity) • Nephelometer (PM₄₀)

TABLE 1: CONTINUED

SITE REFERENCE	LATITUDE	LONGITUDE	CLOSEST AERIAL APPLICATION BOUNDARIES	INSTRUMENTS
Waitaanga Plateau: 2 December 2020				
Rockslip Road	-38.9144756	174.9153592	300 m	• High-volume sampler (PM ₃₀)
Cow Corner	-38.9183226	174.9156629	410 m	• High-volume sampler (PM ₃₀)
Foxglove Road*	-38.9199478	174.9176786	200 m	• High-volume sampler (PM ₃₀)
Chimney Corner	-38.9185391	174.9189480	580 m	• High-volume sampler (PM ₃₀) • Meteorology (wind speed, wind direction, relative humidity)
Mountain View	-38.9176290	174.9190177	650 m	• High-volume sampler (PM ₃₀)

* Site discontinued as generator failed within first hour and could not be repaired.

2.2 QUALITY ASSURANCE

The field studies employed enhanced quality assurance procedures following unresolved questions of possible sample contamination in the Waimea Kawhaka study (ESR, 2016). Quality assurance measures employed included:

- **Laboratory blank:** This was a clean, unexposed filter sent to the analytical laboratory for analysis. The laboratory blank sample should not detect any 1080.
- **Laboratory monitored blank:** This was a filter installed in a calibrated, high-volume sampler at the laboratory and run for a 24-hour period (in the laboratory) before analysis. The laboratory monitored blank sample should not detect any 1080.
- **Field blank:** This clean, unexposed filter was taken into the field sealed within a plastic sleeve, and enclosed within another plastic sleeve, then sent to the laboratory for analysis. The field blank should not detect any 1080.
- **Laboratory spike:** This filter was spiked with a known amount of 1080 (0.025 µg) in the laboratory and analysed soon after in the laboratory. The difference between the spiked amount and detected 1080 provides information on the analytical recovery rate.
- **Field spike:** This filter was spiked with a known amount of 1080 (0.025 µg) in the laboratory prior to field research, sent to research team, taken into field (still in its sealed plastic sleeve enclosed within a separate plastic sleeve) and then sent back to the laboratory for analysis. The difference between the detected 1080 will provide information on possible sample degradation between spiking and analysis.

The glass fibre filters used to sample PM₃₀ (for subsequent analysis for 1080) were kept in pre-labelled, plastic sleeves enclosed within another plastic sleeve prior to deployment.

At the completion of monitoring, each filter was removed from the high-volume samplers and placed in a sealed plastic sleeve before being placed in another, separate, plastic sleeve. A new set of disposable nitrile gloves were used for the insertion and removal of each filter.

The field researchers did not visit any locations where 1080 was being applied, loaded or handled in order to minimise the risk of inadvertent sample contamination. [During the Waimea Kawhaka application the field researchers briefly visited the loading site to obtain operational information].

2.3 SECURITY

Due to heightened sensitivities regarding 1080 application the following precautions were taken to secure the monitoring instruments and minimise the risk of tampering:

- The Kaitake East and southern Palmers Road monitoring sites employed hidden surveillance cameras.
- The field researchers camped in tents next to the high-volume samplers located at the Kaitake West, (northern) Palmers Road and Waitaanga Plateau monitoring sites.

The Marble Hill monitoring locations were on a private farm and no additional security precautions were employed.

There was no evidence of any persons (other than the field researchers) being present at the monitoring sites prior to, during, or after the monitoring period.

3. RESULTS

This section presents results of the visual observations, meteorology and 1080 analysis.

3.1 OPERATIONAL DETAILS

Table 2 presents the operational details for all field studies.

TABLE 2: SUMMARY AERIAL APPLICATION OPERATIONS

Application	Bait	Moisture (%)	Application Rate (kg/ha)	Sowing swathe (m)
Kaitake	6 g	11.7	4.0	75 - 270
Te Maruia: Marble Hill	6 g	11.5	2.0	180
Te Maruia: Palmers Road	6 g	11.5	2.0	160
Waitaanga	6 g	12	4.4	180

3.2 VISUAL OBSERVATIONS

Positive dust observations require a suitable backdrop (against which to see the dust) and are dependent upon the angle of light (i.e. the helicopter needs to be between the observer and the sun).

Detailed field notes are attached in **Appendix A**.

Kaitake Application

Dust was occasionally visible behind one hopper on one of the helicopters during the application.

Visible dust was only observed at the western monitoring locations during the Kaitake application. **Figure 9** shows dust just visible behind the helicopter observed from Kaitake West-100 monitoring location.

The dust appeared to become evident at the start of a flight path when the bucket spinner was turned on to start distributing the bait.

Te Maruia Application

Dust was visible behind one hopper on a helicopter on one day (only) during the application. This was the helicopter operating to the east of the Palmers Road monitoring locations on 3 November 2019.

The dust appeared to become evident on this occasion also, at the start of a flight path when the bucket spinner was turned on to start distributing the bait.

Waitaanga Application

There was no dust visible behind any hopper or helicopter at any stage during the operation.

There was significant light-coloured, thin, high cloud on the day of the drop which may have obscured visible dust.



FIGURE 3: DUST JUST VISIBLE BEHIND THE HELICOPTER, VIEWED FROM KAITAKE WEST 100 MONITORING LOCATION

3.3 METEOROLOGY AND CONTINUOUS PM₄₀

Aerial application of 1080 requires fine, settled weather in which to take place. During all field studies, the winds were typically very light (wind speed less than 3 m/s) and variable. Detailed field observations are provided in **Appendix A**.

Concentrations of continuously-monitored PM₄₀ were:

- Low (less than 10 µg/m³ as a 1-minute average) during the entirety of the Kaitake application in May 2019;
- Very low (less than 5 µg/m³ as a 1-minute average) during the Marble Hill application on 1 November 2019;
- Low (less than 10 µg/m³ as a 1-minute average) during most of application at the Palmers Road monitoring locations on 2 November 2019. However, there were a few minutes of

elevated levels ($>100 \mu\text{g}/\text{m}^3$ as a 1-minute average) on 2 November 2019 with a maximum of $271 \mu\text{g}/\text{m}^3$ measured at 18:26 hours. No helicopter activity was noted at this time; and

- Low (less than $10 \mu\text{g}/\text{m}^3$ as a 1-minute average) for the duration of the aerial application at Palmers Road on 3 November 2019 with one exception. The exception was a PM_{40} concentration of $69 \mu\text{g}/\text{m}^3$ as a 1-minute average at 11:29 am on 3 November 2019. Our field notes record helicopter activity, with visible dust, at this time.

Both nephelometers appeared to be affected by a fog that was present on the morning of 3 November 2019, with 1-minute average concentrations exceeding $1.3 \text{ mg}/\text{m}^3$. Moisture interference is a known limitation of nephelometers. Fortunately, the aerial application did not commence until later in the day when the fog had cleared and measured PM_{40} measurements had returned to normal levels.

Appendix B presents meteorology and PM_{40} measured during each application.

NB: Monitoring for PM_{40} was not undertaken during the Waitaanga application.

3.4 1080 DETECTION

Table 3 presents the results of the filter analyses for 1080 (excluding quality assurance samples which are discussed in section 3.5). The minimum detection limit (**MDL**) was 0.005 µg.

Copies of laboratory certificates are in **Appendix C**.

TABLE 3: 1080 LABORATORY ANALYSES

Monitoring Location	Nearest Boundary(ies)	Fraction PM	1080 (µg)
Kaitake, 1 May 2019			
K-West Boundary	20 m	PM ₃₀	<MDL
K-West 100	100 m	PM ₃₀	0.007
K-West 200	140 – 200 m	PM ₃₀	0.038
K-East Boundary	20 – 40 m	PM ₃₀	0.058
K-East 50	50 – 70 m	PM ₃₀	0.077
Te Maruia: Marble Hill, 1 November 2019			
Marble Hill North 1	175 – 250 m	PM	0.022
Marble Hill North 1	175 – 250 m	PM ₃₀	0.017
Marble Hill North 2	250 – 280 m	PM ₃₀	0.013
Marble Hill South 1	200 – 290 m	PM	0.005
Marble Hill South 1	200 – 290 m	PM ₃₀	0.012
Marble Hill South 2	260 – 280 m	PM ₃₀	0.006
Te Maruia: Palmers Road, 2-3 November 2019			
Palmers Road 1	200 – 300 m	PM	0.11
Palmers Road 1	200 – 300 m	PM ₃₀	0.072
Palmers Road 2	180 m	PM	0.14
Palmers Road 2	180 m	PM ₃₀	0.072
Palmers Road 3	100 – 170 m	PM	0.13
Palmers Road 3	100 – 170 m	PM ₃₀	0.099
Waitaanga, 1 December 2020			
Rockslip Road	300 m	PM ₃₀	0.015
Cow Corner	410 m	PM ₃₀	0.015
Chimney Corner	580 m	PM ₃₀	0.011
Mountain View	650 m	PM ₃₀	0.018

3.5 QUALITY ASSURANCE SAMPLES

Tables 4 and 5 present the results of the quality assurance filter analyses for blanks and spiked samples respectively.

TABLE 4: BLANK FILTER LABORATORY ANALYSES

Sample No.	Sample Type	1080 (µg)
Kaitake Application: 1 May 2019		
Kaitake-03	Lab-monitored blank	<MDL
Kaitake-10	Field blank	<MDL
Te Maruia: Marble Hill, 1 November 2019		
TM-07	Lab blank	<MDL
TM-14	Lab blank	<MDL
Waitaanga, 1 December 2020		
006	Lab blank	<MDL

TABLE 5: SPIKED FILTER LABORATORY ANALYSES

Sample No. (spiked)	Date analysed	Amount (µg 1080)	1080 recovered(µg)	Fraction recovered (%)
Kaitake Application: 1 May 2019				
Kaitake-04 (24 Apr 2019)*	3-6 May 2019	0.025	0.014	56%
Kaitake-11 (lab)	3-6 May 2019	0.025	0.035	140%
Kaitake-12 (lab)	16-20 May 2019	0.025	0.017	68%
Kaitake-13 (lab)	16-20 May 2019	0.025	0.016	64%
Kaitake-14 (lab)	16-20 May 2019	0.025	0.019	76%
Te Maruia Application: 1-3 November 2019				
TM-15 (lab)	11-14 Nov 2019	0.025 µg	0.025	100%
<i>Mean recovery rate</i>				<i>84%</i>

* Spiked in laboratory, sent into field (unexposed) then returned to laboratory for analysis

4. DISCUSSION

All 1080 applications were undertaken during light, variable winds over complex terrain in fine, dry weather. The one exception was the application undertaken at Marble Hill near Lewis Pass during which intermittent periods of very light rain was observed in the early afternoon (only).

Despite the varying wind directions, or perhaps because of the light winds, 1080 was detected at the majority of monitoring locations indicating the sampling locations were successfully located downwind. This was likely assisted by the monitoring locations being bounded on more than one side by the application area. Whilst this successfully increased the opportunity for 1080 detection, it has necessarily decreased the certainty with which we can view the estimated distance to boundary.

Quality assurance

All laboratory blank samples and field blank samples reported less than minimum detection levels. This supports the findings being robust.

Six analyses were undertaken of samples spiked with a known amount of 1080. The results show that the analysis recovery rate can vary significantly (min 56%, max 140%, mean 84%, number of samples 6). The laboratory suggests the high spike (sample Kaitaki-11) may be due to contamination during testing.⁴ The lowest recovery rate (56%) was for a sample analysed 10 days after being spiked.

Particle Size

The Te Maruia application trialled sample collection with the high-volume sampler hoods open co-located with normal high-volume samplers.

With one exception, more 1080 was detected on samples collected from high-volume samplers with open hoods (all PM) than samples collected from high-volume samplers with closed hoods (PM₃₀) in the same location (8 samples).

The one exception was the Marble Hill South monitoring location, where the 1080 detected in PM from the high-volume sampler was just over double (0.012 µg) the 1080 detected in PM₃₀ from the co-located high-volume sampler with an open hood (0.005 µg). This variability is not unreasonable given the very small amounts of 1080 being measured.

Distance

As noted above, the estimated distance to boundary is presented as a range due to the presence of more than one application zone boundary. This necessarily limits potential interpretation of findings regarding dispersion with distance.

Figure 10 presents the levels of 1080 detected as a function of the minimum distance to the application boundary. **Figure 11** presents the levels of 1080 detected as a function of the maximum distance to the application boundary.

⁴ Personal comms. Landcare Research. 16 Apr 2021.

The most conservative approach (in the sense of selecting the highest-likely levels of 1080 at the greatest downwind distance) is to take the maximum estimated distance to the nearest application boundary (i.e. Figure 11).

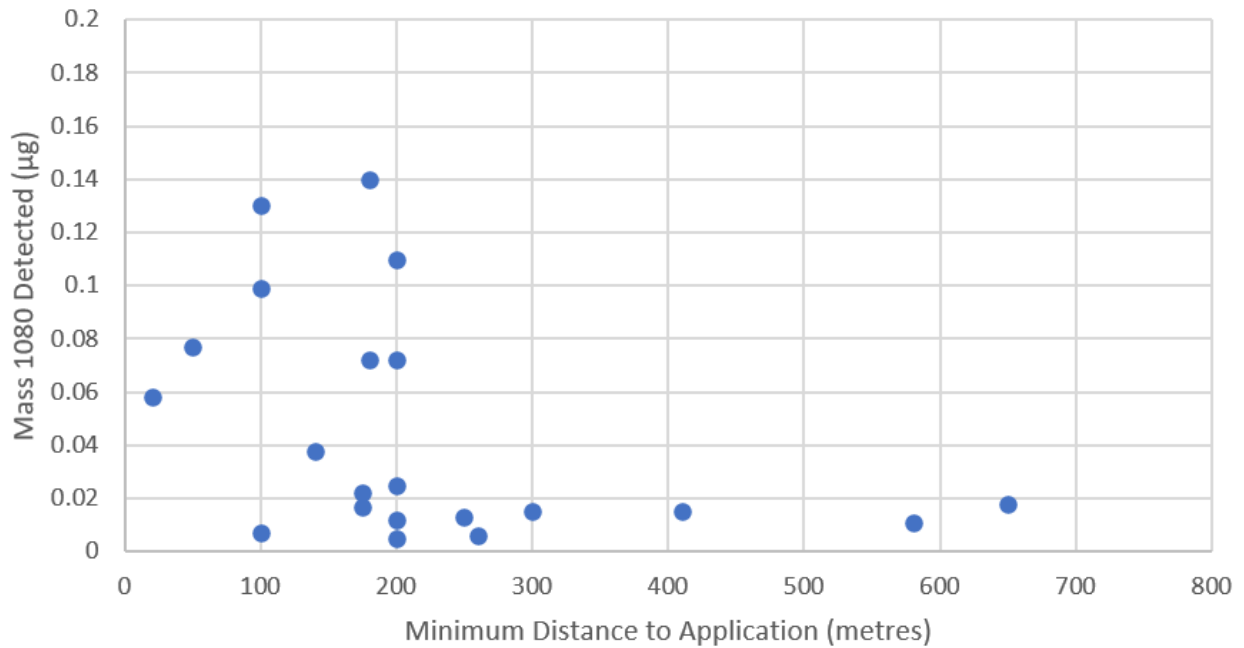


FIGURE 10: 1080 DETECTED DOWNWIND AS A FUNCTION OF MINIMUM ESTIMATED DISTANCE TO APPLICATION BOUNDARY

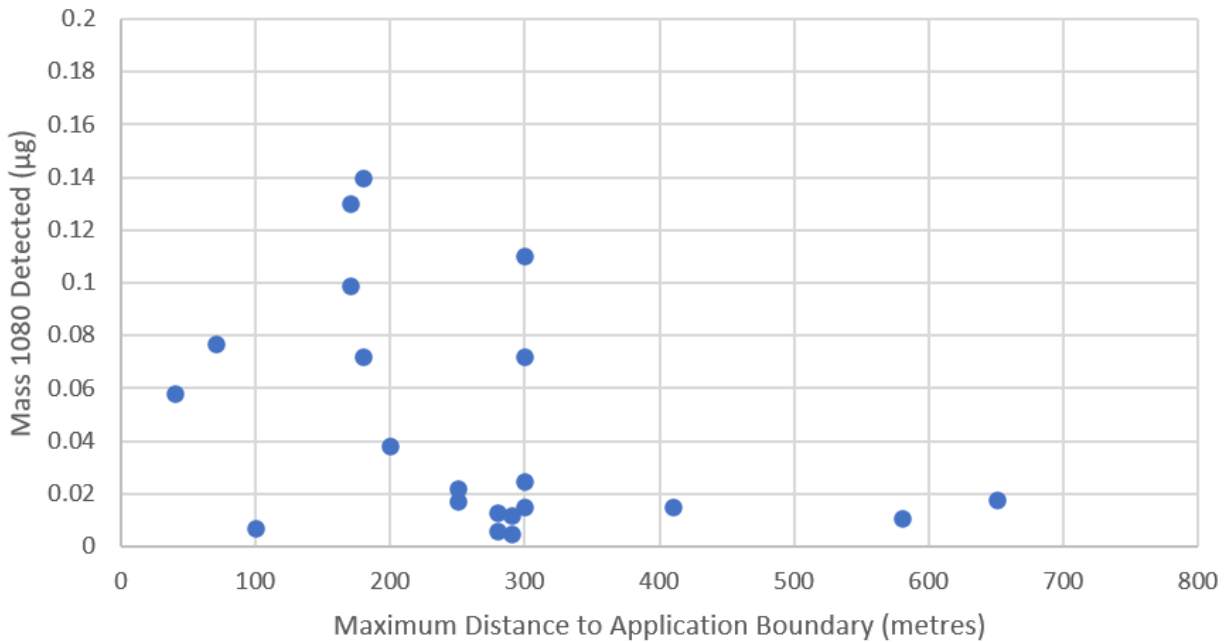


FIGURE 11: 1080 DETECTED DOWNWIND AS A FUNCTION OF MAXIMUM ESTIMATED DISTANCE TO APPLICATION BOUNDARY



Figures 10 and 11 show a peak 1080 mass up to 0.14 µg between 100 m to 300 m away from the application boundaries, dropping to 0.02 µg beyond these distances. A decrease in concentration from the source is anticipated. As mentioned already, a definition of distance to application boundary is confounded if the application zone surrounds the monitoring site in multiple directions.

The situation is also complicated by the likely wind patterns in the vicinity of each monitor, and possible effects of the forest canopy. We note the inconsistencies in 1080 mass increasing with (some but not all) distance in the Kaitake and Waitaanga applications. It is possible that, in some locations, for the samplers located closer to the forest edge; dust may have been blown over the canopy to reach the surface further away, rather than being blown through the trees and arriving with higher concentrations just at the boundary.

Concentration

Concentration is the mass of a substance in a defined volume of air. It is not representative, however, to use the volume of air sampled during the field studies to estimate a concentration of 1080. This is because sampling commenced before the aerial application started and continued during and after the aerial application had finished. The amount of 1080 collected on the filter is, therefore, a function of the 1080 air concentration over the whole sampling period – including periods of time when there was no 1080 in the air being sampled.

The mass of 1080 detected is so low it is possible that a few particles were sampled within a very short time (e.g., minutes to an hour). Equally, the mass of 1080 could have resulted from a very low concentration collected over a longer time frame (multiple hours). This means that consideration of the potential human exposure is only possible through speculative scenarios.

One approach would be to assume the entire mass detected at a particular location (0.005 – 0.14 µg) was inhaled by a person at that location. At the upper end of this range (0.14 µg) and assuming a nominal adult body weight of 70 kg, the resulting exposure dose would be 0.002 µg/kg body weight. This speculative exposure is more than five orders of magnitude below the acute threshold value (minimum lethal dose) for 1080 of 700 µg/kg body weight (ERMA 2007).

Another, much more conservative, approach would be to compare this upper end speculative exposure dose with an acceptable daily exposure (**ADE**). The speculative exposure dose for an adult is one order of magnitude lower than New Zealand's ADE for 1080 of 0.02 µg/kg of body weight per day (ERMA 2007).

It should be noted that the ADE assumes daily exposure averaged over a lifetime, which is unrealistically conservative as a basis of comparison for potential exposure from a one-day aerial application. Further, the uncertainty factors that are used to calculate the ADE value sum to a total of 3,000, which is the maximum typically used by the United States Environmental Protection Agency to account for uncertainties in individual variability, interspecies differences, database deficiencies, and use of a sub-chronic study to derive a chronic (lifetime exposure) ADE.

There is no published acute reference dose for 1080 (i.e., reference criterion for intermittent, short-term, exposures as compared with an ADE which is calculated for continuous, lifetime exposure).

5. CONCLUSIONS

Three field studies were carried out at four locations in 2019 and 2020 to investigate whether sodium fluoroacetate (1080) was present in inhalable particulate downwind of aerial applications of bait containing 0.15% 1080.

1080 was detected in 20 of 21 samples collected in high-volume air samplers located at varying distances downwind of aerial application areas. The mass of 1080 measured ranged from 0.005 – 0.14 micrograms (μg), with a minimum detection limit of 0.005 μg .

The aerial operations employed a variety of helicopters, with application rates ranging from 2 kg to 4 kg of bait containing 0.15% of 1080 per hectare. Dust was visible occasionally behind helicopters.

Concentrations of particulate matter less than 40 micrometres in diameter (PM_{40}) measured continuously (using nephelometers) were typically very low ($< 10 \mu\text{g}/\text{m}^3$) throughout the aerial applications.

The monitoring locations varied topographically and meteorologically, however the results indicate that the monitors were successfully located downwind of the aerial application.

Quality assurance procedures provide good confidence that the findings of the field studies are robust.

The focus of this field research was detecting 1080 in airborne particulate downwind of an aerial baiting application. It should be noted that the field studies were not designed to assess potential human exposures, or health risks, and therefore these are outside the scope of this report.

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APPENDIX A: FIELD NOTES

FIELD NOTES: KAITAKE 1080 APPLICATION

Date: Wednesday 1 May 2019

Person: Paul Baynham

Location: Kaitake East site, Taranaki

08:15 Arrived on site

08:17 Started 50m monitor (ST957, Serial# 07-1381) vol start 11974

08:22 Started 5m boundary monitor (ST956, Serial# 07-1382) vol start 12768

[08:30 received text to say application commencing]

08:32 Spotted Gold chopper doing boundary run. No visible evidence of dust or pellets.

09:00 Very light winds, direction variable but generally blowing from the East. Very faint smell of cinnamon present.

09:20 Checked both monitors running OK, fuel level still full

09:34 White helicopter active around site. No visible evidence of dust or pellets.

09:50 Checked both monitors running OK, fuel level still full

10:20 Wind direction appears to have changed to a Northerly, wind speed increasing slightly.

10:30 Can hear helicopter operating near by

11:00 Helicopters performing long runs to the west. Wind still northerly.

11:29 Checked both monitors running OK, fuel level near full.

12:55 Checked both monitors running OK, fuel level about 80% full.

13:00 Can hear helicopters operating to the west.

[14:30 received text to say application completed by 1400]

14:32 Checked both monitors running OK, fuel level about 70% full.

15:07 Stopped 5m boundary monitor vol end 13240

15:22 Stopped 50m boundary monitor vol end 12467

17:42 Left site



FIELD NOTES: KAITAKE 1080 APPLICATION

Date: Wednesday 1 May 2019

Person: Lou Wickham

Location: Kaitake West site, Taranaki

Location	Time	Notes
K-West B.	06:33	Start high-volume sampler (#05)
K-West 100	06:40	Start high-volume sampler (#06)
K-West 200	06:52	Start high-volume sampler (#07)
Ridgeline	07:23	Kane texted – delay to drop, now starting after 8 am
K-West B.	07:30	Check instrument @ boundary ✓
Ridgeline	08:16	Sunny, clear, 3°, very slow drift SE wind 0% cloud
K-East B.	08:17	Start high-volume sampler (#08) (text from Paul)
K-West 100	08:20	Check instruments @ K-West 100 ✓ Top of hill, 2-3 m/s E wind, calm
K-East 50	08:22	Start high-volume sampler (#09) (text from Paul)
K-West 200	08:25	Check instrument @ K-West 200 ✓ Very light (< 1m/s) SE drift
Ridgeline	08:30	Heli over near Pukeiti Reserve Kane texted to say drop has started
	08:34	Paul texted to say heli @ his location
	08:35	Ice from fields evaporating, took videos to show direction of slow drift (very little wind)
	08:40	White heli doing wide turns (bucket swinging lots beneath)
K-West 100	08:50	Gold heli appears to be on boundary Zero wind @ K-West 100, Check instruments ✓ Took photos & video of both heli working with K-West 100 instruments in foreground
K-West 200	09:00	Check instrument @ K-West 200 ✓
K-West 100	09:05	Helis continuing to work SW corner of area No puffs or dust observed White heli bucket swinging lots under chopper Gold heli bucket less swing
	09:15	Still no breeze, barely any drift
Ridgeline	09:24	Zero wind, ice nearly all gone from fields Heli flying path alongside monitor @ K-West Boundary



Location	Time	Notes
	09:26	Very still, no breeze, barely any drift on ridge. Car still says 3° but feels warmer in sun. Heli running parallel to boundary around 500 (?) m away, maybe less.
	09:28	Can hear white heli still working SE corner and see it along Carrington Rd
	09:35	Gold heli flying line parallel to K-West boundary
	09:39	Gold heli flying line closest to boundary
KW-200	09:42	Check instrument @ K-West 200 ✓
	09:43	Gold heli flying boundary line Stream of dust evident from hopper underneath heli when against sun. Tried to get video but not sure captured. Not captured! Drew picture. It was a thin line, in a continuous stream, that looked white against the sunshine.
Ridgeline	09:50 ish	White heli did same line (closer to me) & no dust evident. Time time video worked (sigh). Wind 2-3 m/s, light breeze from boundary towards me (on ridge).
	09:55	Gold heli now working to continue boundary line. Can see dust when turns on spinner. Got 2 videos showing dust behind hopper.
	10:00	Gold heli on 3 rd pass – no dust visible, even against sun. Strong breeze, 3-4 m/s now, from application area towards me.
	10:05	All quiet (no helis)
	10:10	Gold heli pass – dust? Uncertain
	10:15	Another gold heli pass, no dust visible
K-West B.	10:20	Check instrument @ K-West B. ✓
Ridgeline	10:23	Gold heli pass, no dust visible
	10:25	White heli pass, up high, no dust visible
	10:26	Gold heli pass – dust? Uncertain. Appears to only be when the light is right. Saw turn and start of run – no visible dust.
	10:30	Gold heli pass, no dust during entire pass, further away.
	10:34	Gold heli pass, no dust Wind @ ridgeline now S (SW?), 1-2 m/s, light.
K-West 200	10:35	Check instrument @ K-West 200 ✓ Wind S or SW, light, 2-3 m/s. Pleasant temp (warm)
Fence	10:37	Gold heli pass, no dust visible even on turn and start of second pass, no dust visible. Wind 3-4 m/s SW.
K-West 200	10:43	Gold heli pass, no dust visible
K-West 100	10:45	Check instruments @ K-West 100 ✓

Location	Time	Notes
		Wind 3-4 m/s, SW
K-West B.	10:49	Gold heli pass, no dust visible Wind 1-3 m/s from S
	10:55	Gold heli pass, no dust visible
	11:05	Gold heli pass, no dust visible Very little to no wind now
	11:10	Gold heli pass, no dust visible
	11:12	White heli trickle feed next to boundary monitor. No dust. Can see pellets discharging sporadically from bucket. Got photos and video.
	11:23	White heli continuing boundary line. Wind now N, 1-3 m/s, light and occasionally gusty.
	11:26	White heli still on boundary. No wind, gust 1-2 m/s, N Can hear other heli to east.
K-West B.	11:35	White heli doing boundary by K-West 100 & K- West 200 Zero wind.
K-West 200	11:38	Gentle breeze from forest towards KW-200. 2-3 m/s, very light.
K-West 100	11:39	Gold heli, around 150 m up pass near boundary S to N, white dust evident behind hopper @ base. Check instruments @ K-West 100 ✓ Light breeze (2-3 m/s) from NE, i.e. blowing from northern boundary of forest towards monitor.
	11:44	Gold heli flying N to S, no dust visible.
	11:45	Gold heli flying S to N, thick white stream of dust evident behind hopper
	11:51	Gold heli flying S to N & turn, dust evident
	11:54	Gold heli flying N to S, nothing evident Wind from NW (?) varying from zero to gust (2-3 m/s)
K-West B.	12:00	Check instrument @ K-West Boundary ✓ No wind. Warm
K-West 100	12:06	Check instruments @ K-West 100 ✓ Wind 2-4 m/s, N-NE, moderate breeze, no heli activity
	12:15	Topped up petrol in generator
K-West 200	12:22	Check instrument @ K-West 200 ✓ Very faint NE, 1-2 m/s Clear, 0% clouds, strong solar radiation Topped up petrol in generator
K-West 100	12:30	Gentle breeze, 2-3 m/s, maybe gusting to 3 m/s, NE
K-West B.	12:36	Gentle breeze 2-3 m/s, N, warm.
	12:50	Topped up petrol in generator

Location	Time	Notes
	12:53	Gold heli flying S to N, dust evident after turn when turning on spinner.
	12:59	White heli flying S to N, high & fast, no dust. Wind light from N boundary forest towards monitor.
Ridgeline	13:02	Gold heli flying N to S, something flapping under hopper? No dust
K-West 200	13:07	Check instrument @ K-West 200 ✓
	14:16	Check instrument @ K-West 200 ✓ Light Northerly, 3-4 m/s ? (grass moving gently)
K-West 100	14:18	Check instruments @ K-West 100 ✓ Light to moderate NE, 3 – 4.5 m/s, breeze reasonably consistent
Ridgeline	14:29	NE, light breeze
K-West B.	15:00	Stop high-volume sampler @ K-West Boundary
K-West 100	15:06	Stop high-volume sampler @ K-West 100 Moderate to strong NW breeze at top
K-East B.	15:07	Stopped high-volume sampler (text from Paul)
K-West 200	15:14	Stop high-volume sampler @ K-West 200 Moderate breeze, 4 m/s westerly
K-East 50	15:22	Stopped high-volume sampler (text from Paul)

FIELD NOTES: TE MARUIA 1080 APPLICATION

Date: Friday 1 November 2019

Person: Lou Wickham

Location: Marble Hill (Springs Junction) Monitoring Sites

Location	Time ⁵	Notes
Marble Hill South 2	10:30	Commence monitoring: TSP (071382) Light southerly, estimate wind speed (ws) 2-2.5 m/s, slight spit rain,
Marble Hill South 1	10:38	Commence monitoring: TSP (ST955)
Marble Hill South 1	10:38	Commence monitoring: All PM (ST957) Very light southerly, ws 1m/s, slight spit rain, low cloud
Marble Hill North 2	11:21	Commence monitoring: TSP (A123VCA) Very, very light south/ south easterly, estimate ws 0-0.5 m/s. Slight spit rain.
Marble Hill North 1	11:27	Commence monitoring: All PM (A099)
Marble Hill North 1	11:27	Commence monitoring: TSP (ST956) Very, very light south easterly, estimate ws 0-0.5 m/s. Light spit turning to drizzle
Paddock 54: Marble Hill North Monitoring Locations (only)		
Marble Hill North 1	12:00	Very light south westerly, ws 0.5 m/s
Marble Hill North 2	12:03	Light south westerly, ws 0-0.5 m/s, light spit rain
Marble Hill North 1	12:15	Very light north easterly, ws 0-0.5 m/s
Marble Hill North 2	12:18	Very light south westerly, ws 0.5 – 1m/s First load leaving now heading to Lake Daniels (text from Darrell)
Marble Hill North 1	12:30	Light westerly, ws 0-1 m/s. Fine (no spitting rain). Opened lid of A099 (TM-002)
Marble Hill North 2	12:33	Very light south westerly, ws 0-0.5 m/s. Fine (no spitting)
Marble Hill North 1	12:45	Very light north easterly from NE boundary towards monitor, ws 0-0.5 m/s. Light spit & sunshine
Marble Hill North 2	12:47	Very light easterly from NE boundary towards monitor, ws 0-0.5 m/s. Light spit & sunshine
	12:50	Chopper doing trickle feed NE boundary Took video. No visible dust (however grey cloud background)

⁵ Local time (NZ summertime daylight savings time)

Location	Time ⁵	Notes
		Perfect (very) light wind drift from chopper towards Marble Hill North 2 monitor
Marble Hill North 1	13:00	Very light north easterly, ws 0-0.5 m/s NB: When walking from Marble Hill North 2 to Marble Hill North 1 can feel southerly breeze on face right up til top of rise (@ Marble Hill North 1) when it stops
Marble Hill North 2	13:03	Light easterly, ws 0.5 m/s Light spit becoming a drizzle Slight easterly drift to spits when in car
	13:10	Chopper doing trickle line by Paul (Marble Hill South monitoring locations) Slight drizzle straight down / slight southerly drift
	13:12	Chopper doing trickle line by me at Marble Hill North 1 and 2. Very slight southerly drift. Spitting stopped. No visible dust (grey cloud behind chopper)
Marble Hill North 1	13:15	Chopper doing trickle line again by me Light southerly, ws 0.5-1 m/s
Marble Hill North 2	13:20	Light southerly drift, ws 0.5-1 m/s
	13:20-13:25	Videos of chopper doing passes No visible dust against blue mountain Faint whiff (Intensity = 1-2), flea powder(?) odour No visible dust at any time
	13:45	Easterly drift, ws 0-1m/s Fine
Marble Hill North 1	13:50	Easterly drift, ws 0-1m/s NB: South easterly breeze when walking to Marble Hill North 1
	13:55	Can see chopper working on northern block – no visible dust
	14:00	Chopper flying our block – possible dust at point of turn. Nothing visible on return leg against grey sky or green mountain.
Marble Hill North 2	14:03	No visible dust from chopper working our block
	14:04	Pellets? Line visible @ turn
	14:08	North easterly, ws 3-4 m/s. Fine
Marble Hill North 1	14:10	North easterly, ws 2-3 m/s. Fine
	14:35	South easterly, ws 1-3 m/s. Fine
Marble Hill North 2	14:40	South easterly, ws 1-3 m/s. Fine
	15:00	Stopped monitoring TSP (A123VCA)
Marble Hill North 1	15:10	Stopped monitoring TSP (ST956)
	15:10	Stopped monitoring All PM (A099)

FIELD NOTES: TE MARUIA 1080 APPLICATION

Date: Friday 1 November 2019

Person: Paul Baynham

Location: Marble Hill (Springs Junction) South Monitoring Sites

11:45 light southerly wind 1 m/s light drizzle

12:00 as above heard chopper?

12:15 wind light south/south-easterly 1.5 m/s Drizzle

12:30 SE 1.5 m/s light drizzle. Removed sample head from 957

12:45 S 2 m/s light drizzle chopper visible.

13:00 SE 1.5 m/s dry conditions. Chopper doing boundary drop. Photo taken

13:15 SE 1 m/s light drizzle back

13:30 S 1.5 m/s drizzle stopped.

13:45 S 1.5 m/s chopper operating.

14:00 SW wind. met station repaired. Chopper back to the east of this site.

14:15 SW wind 1.5 m/s

14:30 very light S 0.3 m/s still no drizzle. Lots of sandflies. Can't hear chopper

14:58 southern monitors switched off.

FIELD NOTES: TE MARUIA 1080 APPLICATION

Date: Saturday 2 November 2019

Person: Lou Wickham

Location: Palmers Road Monitoring Sites

Location	Time ⁶	Notes
Palmers Rd 2	07:17	Commence monitoring: All PM opened hood (07-1382) Commence monitoring: TSP (A123VCA)
Palmers Rd 3	07:33	Commence monitoring: All PM opened hood (B146VCA) Commence monitoring: TSP (A099) Light south westerly drift, ws 0-1 m/s, low cloud, fine Damp & still, chopper flyby – trickle?
Palmers Rd 1	07:34	Commence monitoring: All PM opened hood (ST957) Commence monitoring: TSP (ST955)
	07:55	Very light south easterly flow evident by cloud drift, ws 0-1 m/s Sun just breaking through. Fine, cool ~8°C NB: Nothing visible (dust) during chopper flyby.
	08:05	Chopper visible doing trickle feed to south east of Palmers Rd 1 monitoring site. Sky has cleared, now blue, still some low cloud
	08:30	Most of low cloud cleared off, sunny with blue sky. Light drift south westerly, ws 0-1 m/s.
	08:56	Trickle feed by our block on western edge ~ 50 m up, slow, no dust visible. Very light southerly drift from forest towards monitors, ws 1-2 m/s, grass just moving.
Palmers Rd 2	09:10	Light south easterly breeze walking to PR2, ws 2-3 m/s Blue sky, clear. Instrument check, all ✓
Palmers Rd 1	09:25	No low cloud left
	11:00	Light south/ south easterly breeze, ws 2-3 m/s, sunny, blue sky
	11:30	Sunny, light south/ south easterly breeze, ws 3-4 m/s
	12:00-12:30	As above
	12:05	1080 trucks went by. Took video
	13:00	Light south / south easterly breeze, ws 0-2 m/s Instrument check – all ✓

⁶ Local time (NZ summertime daylight savings time)

Location	Time ⁶	Notes
	13:30	High cloud cover, warm & sunny
	14:00	High cloud, light southerly breeze, ws 2-3 m/s, sunny, warm Still no choppers
	14:30	As above
	15:00	As above, cooling
	15:20	Chopper flying north to south on western edge Light southerly breeze, ws 1-3 m/s, high cloud. All instruments ticketyboo
	16:20	Chopper to west of us
	16:30	Light south easterly, ws 1-2 m/s, fine blue sky, warm 19°C Instrument check – all ✓
	17:00	As above
	17:25	Iroquois flying to landing zone Chopper working ~ 1 km to south of us
	17:49	Iroquois flying directly to south of PR3
	17:52	Iroquois flying south and east of PR3
	18:00	Trucks w hoist drove by, lots of dust. Hot, no wind, ws 0 m/s. Blue sky, very thin high cloud.
	18:40	Iroquois doing western side of our block (to west of PR2)
0Palmers Rd 1	19:01	Stopped monitoring: All PM opened hood (ST957) Stopped monitoring: TSP (ST955)
Palmers Rd 2	19:15	Stopped monitoring: All PM opened hood (07-1382) Stopped monitoring: TSP (A123VCA)
Palmers Rd 3	19:22	Stopped monitoring: All PM opened hood (B146VCA) Stopped monitoring: TSP (A099)

FIELD NOTES: TE MARUIA 1080 APPLICATION

Date: Saturday 2 November 2019

Person: Paul Baynham

Location: Palmers Road Monitoring Sites

All sites operating at 08:00

08:06 helicopter observed to the south.

9:00 helicopter trickle feed observed traversing along western boundary. Video taken.

9:30 SE 2m/s fine. No chopper.

10:00 SE 2.5m/s fine. No chopper. All units operating.

10:30 TSP generator out of petrol.

11:00 Southerly 2 m/s no chopper

11:30 Lou did check

12:00 wind picked up to 2.5 m/s from S/SW

12:30 refuelled generators. All units OK. No Chopper.

13:00 TSP unit at top end timed out. Unit restarted at 13:04

13:30 Wind dropped slightly still southerly. No chopper all units ok

14:00 refuelled mid site generator. All units OK. No chopper.

14:30 Lou did instrument check

15:00 Topped up mid site generators. All units OK. Still southerly wind 1-2 m/s. No chopper.

15:19 chopper passed along western boundary.

17:40 iriquoi chopper operating

19:01 top site sampling stopped. Palmer's Rd Site1

FIELD NOTES: TE MARUIA 1080 APPLICATION

Date: Sunday 3 November 2019

Person: Lou Wickham

Location: Palmers Road Monitoring Sites

Location	Time ⁷	Notes
Palmers Rd 1	06:15	Still, no wind, very low cloud/fog in river valley
	06:22	Commence monitoring: All PM (ST957) Commence monitoring: TSP (ST955)
Palmers Rd 2	06:30	Commence monitoring: All PM (07-1382)
		Commence monitoring: TSP (A123VCA)
Palmers Rd 3	06:44	Commence monitoring: All PM (B146VCA)
		Commence monitoring: TSP (A099)
Palmers Rd 1	07:00-07:30	Fog increasing, slight south westerly drift, ws <0.5 m/s
	09:33	Fine. Sunny. Warm. No cloud, very still. Chopper flying west of us, broadcast (can hear spinner going) Very gentle southerly drift, ws <0.5 m/s
	10:00-11:00	Choppers everywhere Very hot, very still. Very slight northerly (?) drift.
	11:14	Chopper flying out block on eastern side. Can see dust when turns chopper & turns spinner on to do a swath.
	11:14-11:30	Repeated passes of our block Dust evident when against mountain with light behind us. Paul took video No odour Slight north easterly drift (from east side of block to PR2 and PR3) Very low ws, 0-0.5 m/s only HOT
	12:00	DOC rep stopped to say flying finished
	12:30	Chopper flying broadcast on west boundary PR1 Wind now 2-3 m/s southerly (away from monitor)

⁷ Local time (NZ summertime daylight savings time)

Location	Time⁷	Notes
	13:30	No activity since last chopper, decided to finish monitoring to make last ferry back to Wellington
Palmers Rd 1	13:43	Stopped monitoring: All PM (ST957) Stopped monitoring: TSP (ST955)
Palmers Rd 2	13:25	Stopped monitoring: All PM (07-1382) Stopped monitoring: TSP (A123VCA)
Palmers Rd 3	13:59	Stopped monitoring: All PM (B146VCA) Stopped monitoring: TSP (A099)

FIELD NOTES: TE MARUIA 1080 APPLICATION

Date: Sunday 3 November 2019

Person: Paul Baynham

Location: Palmers Road Monitoring Sites

6:13 Chopper heard

Ground fog low visibility around sampling sites.

6:22 Palmer's Rd 1 top site started

6:34 Palmer's Rd 2 started

6:44 Palmer's Rd 3 started

7:30 all monitors OK. Refuelled all generators. No wind, fog. Occasionally hear chopper.

08:30 no wind, fog. All units ok

09:00 refuelled Palmer 2 generators. Fog lifting sun. No chopper.

09:15 can hear chopper to West no visual.

09:17 chopper flying west to east. Photo take.

09:25 Another chopper flying south to north. Photo taken. Fog totally gone.

09:30 chopper flying south to north on western boundary. Spinner heard. Light easterly wind. Video taken.

10:00 Lou performed instrument check. Light NE wind 0.5m/s

10:30 instrument check all OK. Wind v light NE.

11:00 all monitors OK. Wind change to southerly/SE

11:30 Lou checked monitors.

12:00 wind from S picking up. Helicopters active

12:30 checked monitors refuelled Palmer 2 generators.

13:00 checked monitors. Unusual odour on Palmer's Rd adjacent to Palmer's 3 site. Chemical odour, vaguely resembling chlorophenoxy.

FIELD NOTES: WAITAANGA 1080 APPLICATION

Date: Wednesday 2 December 2020

Person: Lou Wickham

Location: Primarily camp located in field between Chimney Corner and Mountain View monitoring site locations.

06:15 Started Mountain View generator and high-volume monitor (No.4)

06:24 Started Chimney Corner generator and high-volume monitor (ST955), problems with wind sensor

06:32 Started Floxglove Road generator and high-volume monitor (Lier Siegler)

06:36 Started Cow Corner generator – problems starting high-volume monitor (ST956)

06:45 Started Rockslip Corner generator and high-volume monitor (ST957)

06:46 Blue sky, still (<0.5 m/s) conditions, very high thin cloud ~ 40% cover

07:15 Started Cow Corner high-volume monitor (ST956)

07:28 Started wind sensor at Chimney Corner

08:00 Light variable winds, no sounds of choppers.

08:30 Text response from DoC advising application has started

08:30 Monitor check – Foxglove Paddock generator failed, cannot restart (turns over but will not catch). Fuel lines clear.

08:52 Chopper flying boundary run. Winds very light & variable

09:20 Can hear choppers working in NW. Thick high cloud.

09:30 – 10:00 Paul doing monitor check, all working. Refuelled to top.

09:32 Another boundary run

09:50 Chopper visible flying to north, appears very high. Bucket swinging a lot on turns and passes. Winds SW @ cloud level, E @ ground level

10:00 Chopper working to north. Left site to get more fuel and buy spark plug removal tool to see if we can restart the generator.

10:00 – 11:45 Taumarunui return trip (50 min drive each way)

10:30 – 11:30 Paul states choppers flying long runs in between boundaries. Monitor check undertaken at 11:15.

12:00 Cannot remove spark plug. Abandoned sampling at this location.



12:30 Monitor check, all sites ok.

12:45 Chopper working to south of camp.

13:10 Sudden wind shift to NW @ ground level, ws ~ 3-4 m/s. Cloud level wd also NW.

13:15 Chopper visible. No dust visible (or @ any time so far)

13:32 Chopper flying our block to W. Winds very light and in direction from block (to west) towards us @ camp. ws ~ 1-2 m/s

14:00 Monitor check, all ok. Refuel Rockslip Road.

14:45 Winds light and variable from NW-NE ws 2-3 m/s @ ground level. Winds W @ cloud level.

15:20 Winds moderate breeze from W – SW @ ground level. ws 3-4 m/s

15:30 Monitor check, all ok.

16:00 Strong NW breeze @ ground level. ws 3-4 m/s. Can hear choppers to W.

16:56 Text from DoC advising aerial application complete

17:01 Stop Mountain View monitor. Sample 001 filter removed, double bagged.

17:17 Stop Chimney Corner monitor. Sample 002 filter removed, double bagged.

17:35 Stop Cow Corner monitor. Sample 003 filter removed, double bagged.

17:44 Stop Rockslip Road monitor. Sample 004 filter removed, double bagged.

18:00 Leave site.

APPENDIX B: FIELD MEASUREMENTS

Wind Speed and Wind Direction during 1080 Aerial Application
Kaitake West, 1 May 2019

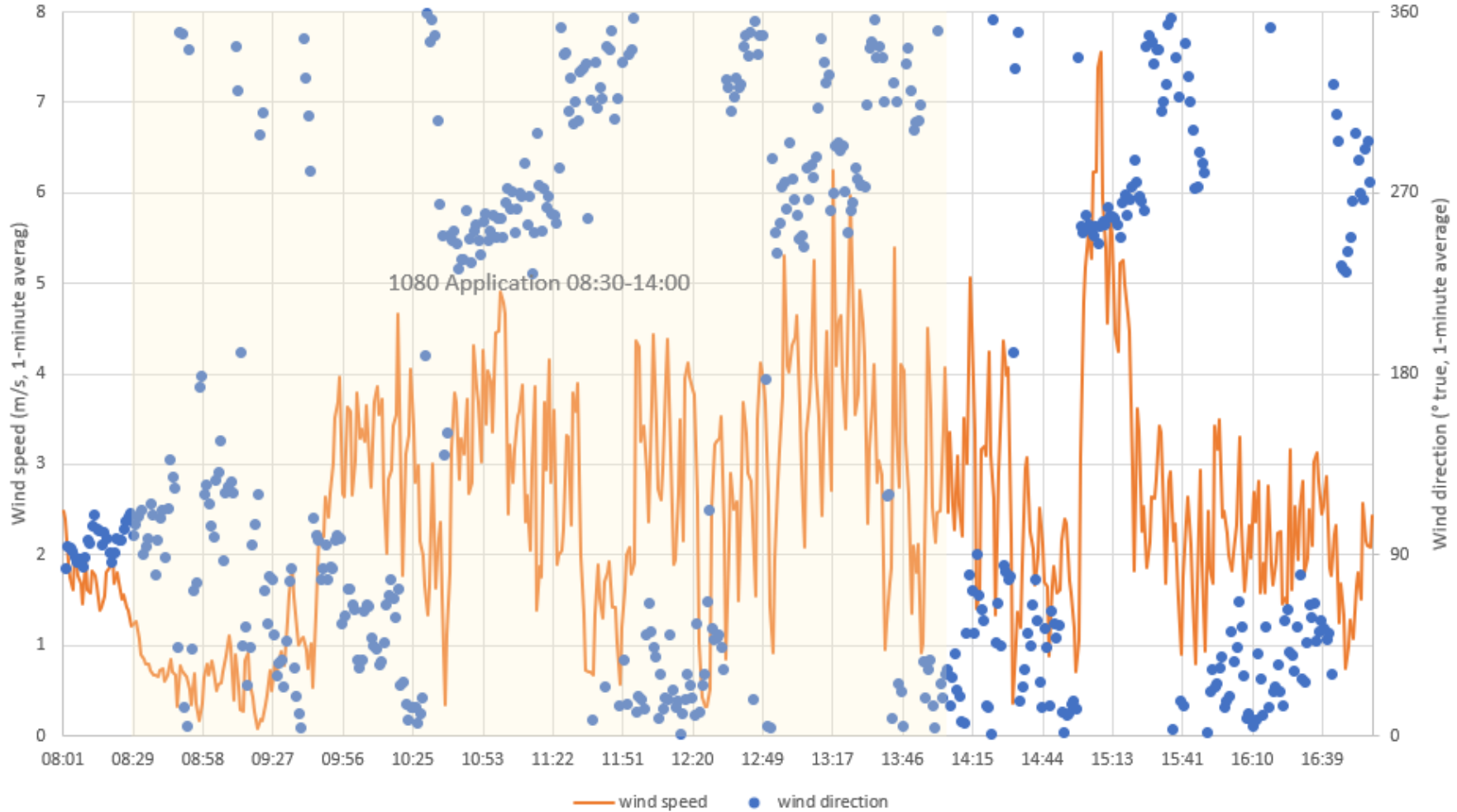


FIGURE B1: WIND SPEED AND WIND DIRECTION (1-MINUTE AVERAGES) DURING 1080 AERIAL APPLICATION (08:30-14:00) AT KAITAKE WEST MONITORING LOCATION, 1 MAY 2019



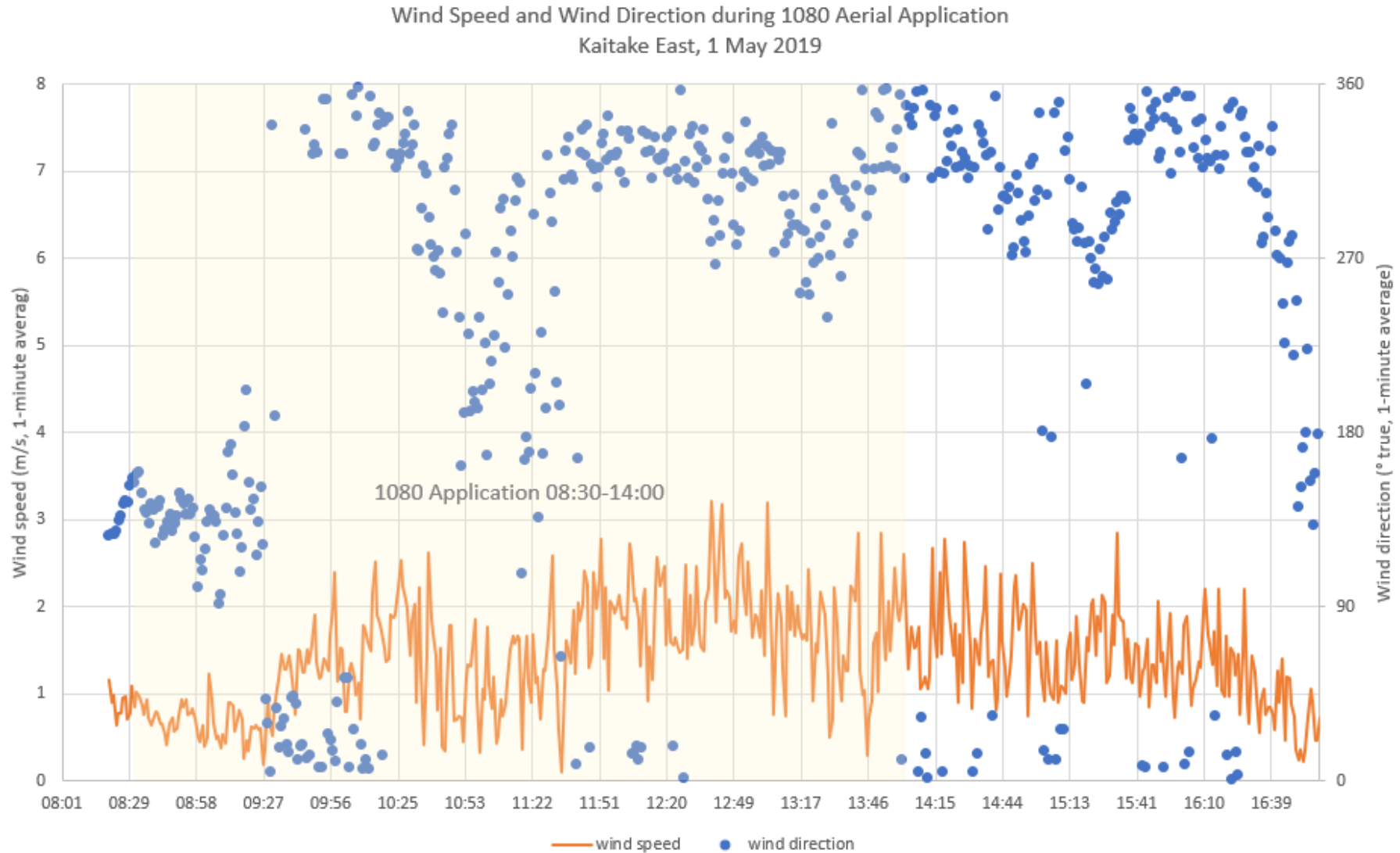


FIGURE B2: WIND SPEED AND WIND DIRECTION (1-MINUTE AVERAGES) DURING 1080 AERIAL APPLICATION (08:30-14:00) AT KAITAKE EAST MONITORING LOCATION, 1 MAY 2019



Wind Speed and Wind Direction During 1080 Application
Marble Hill North, 1 Nov 2019

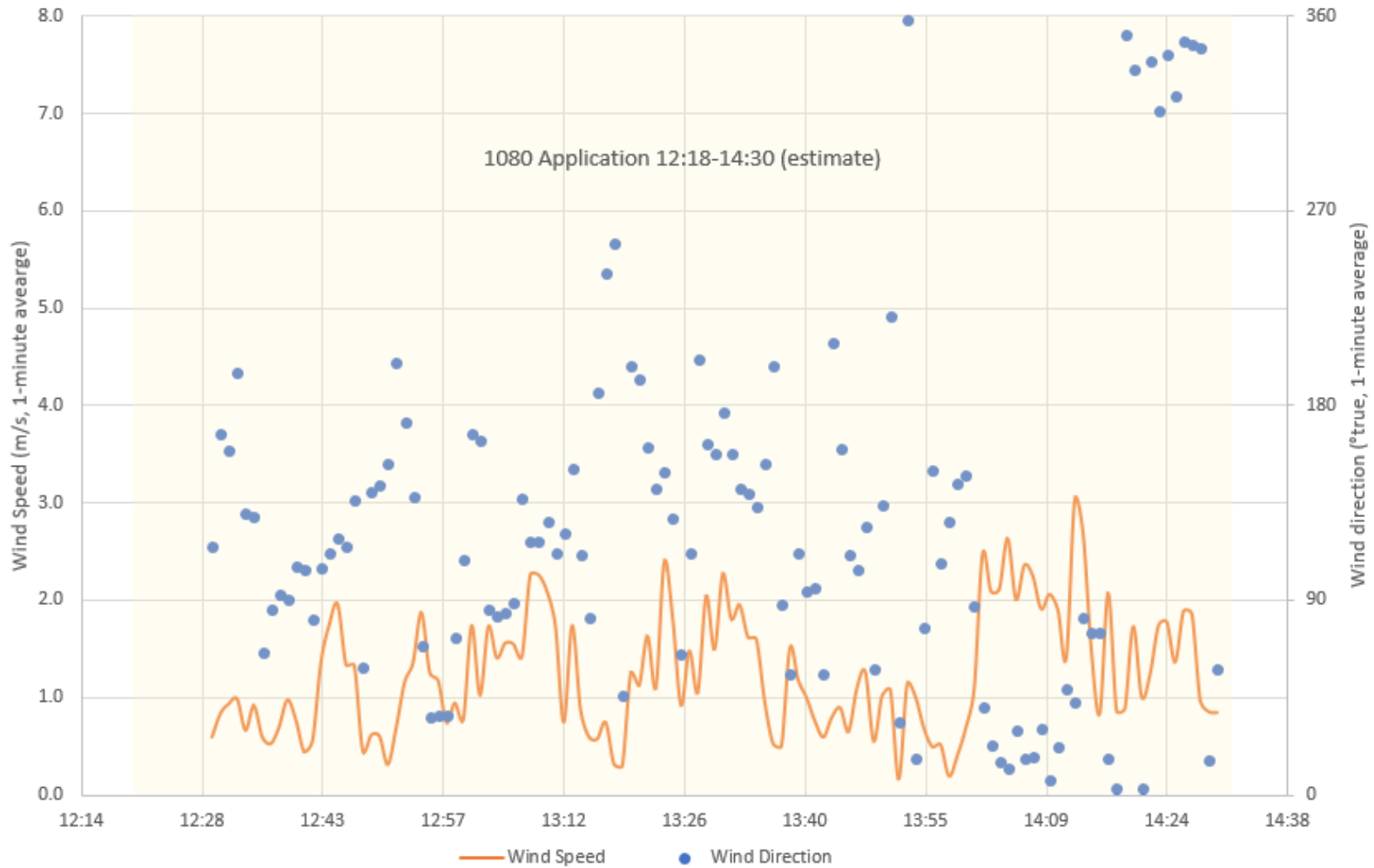


FIGURE B3: WIND SPEED AND WIND DIRECTION (1-MINUTE AVERAGES) DURING 1080 AERIAL APPLICATION (12:18-14:30) AT MARBLE HILL NORTH, 1 NOVEMBER 2019



Wind Speed and Wind Direction During 1080 Application
Marble Hill South, 1 Nov 2019

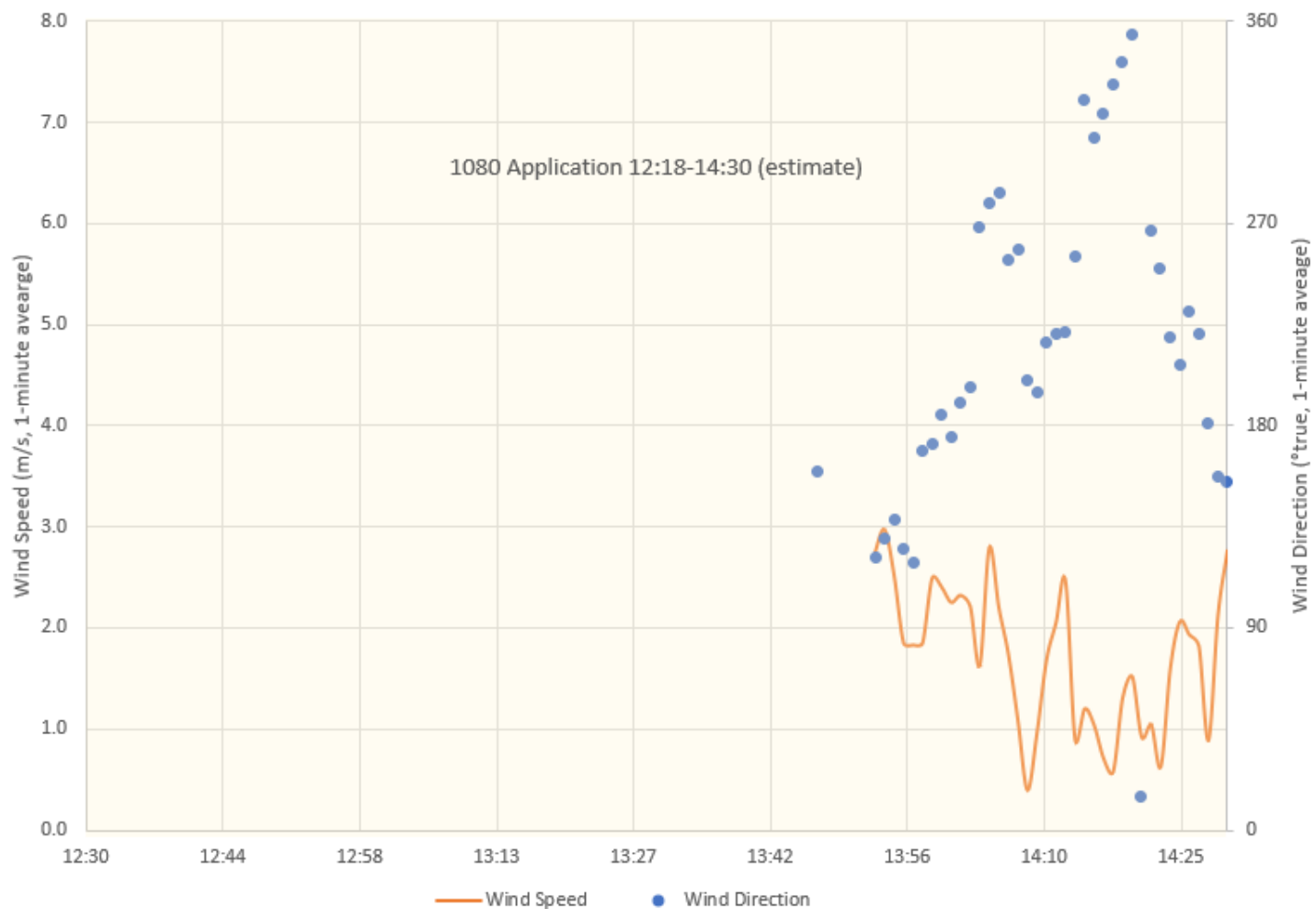


FIGURE B4: WIND SPEED AND WIND DIRECTION (1-MINUTE AVERAGES) DURING 1080 AERIAL APPLICATION (12:18-14:30) AT MARBLE HILL SOUTH, 1 NOVEMBER 2019. DATA LOSS DUE TO EQUIPMENT ISSUES 12:30 – 13:50.



Wind Speed and Wind Direction During 1080 Application
Palmer Road, 3 Nov 2019

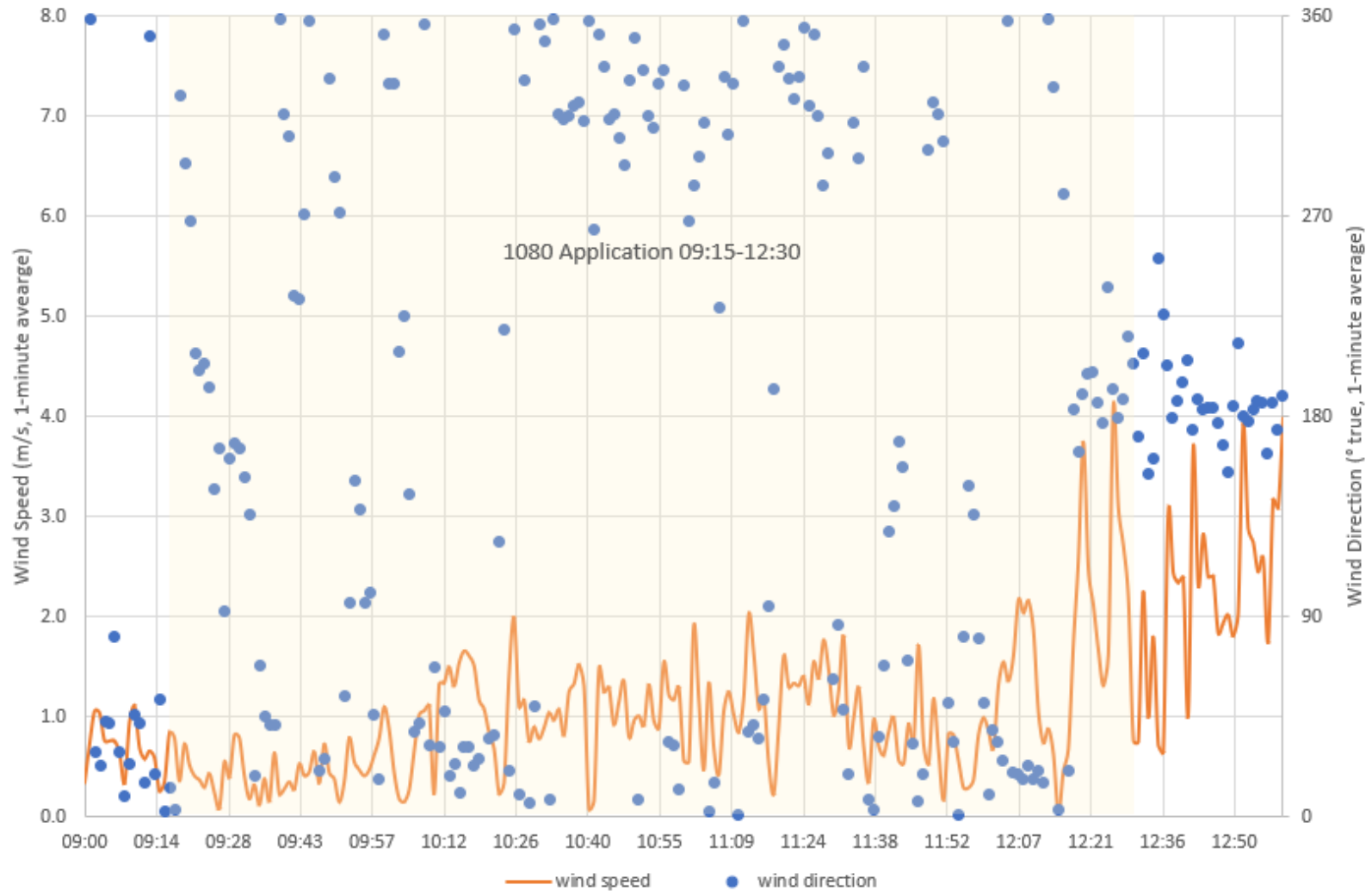


FIGURE B5: WIND SPEED AND WIND DIRECTION (1-MINUTE AVERAGES) DURING 1080 AERIAL APPLICATION (09:15-12:30) AT PALMERS ROAD, 3 NOVEMBER 2019



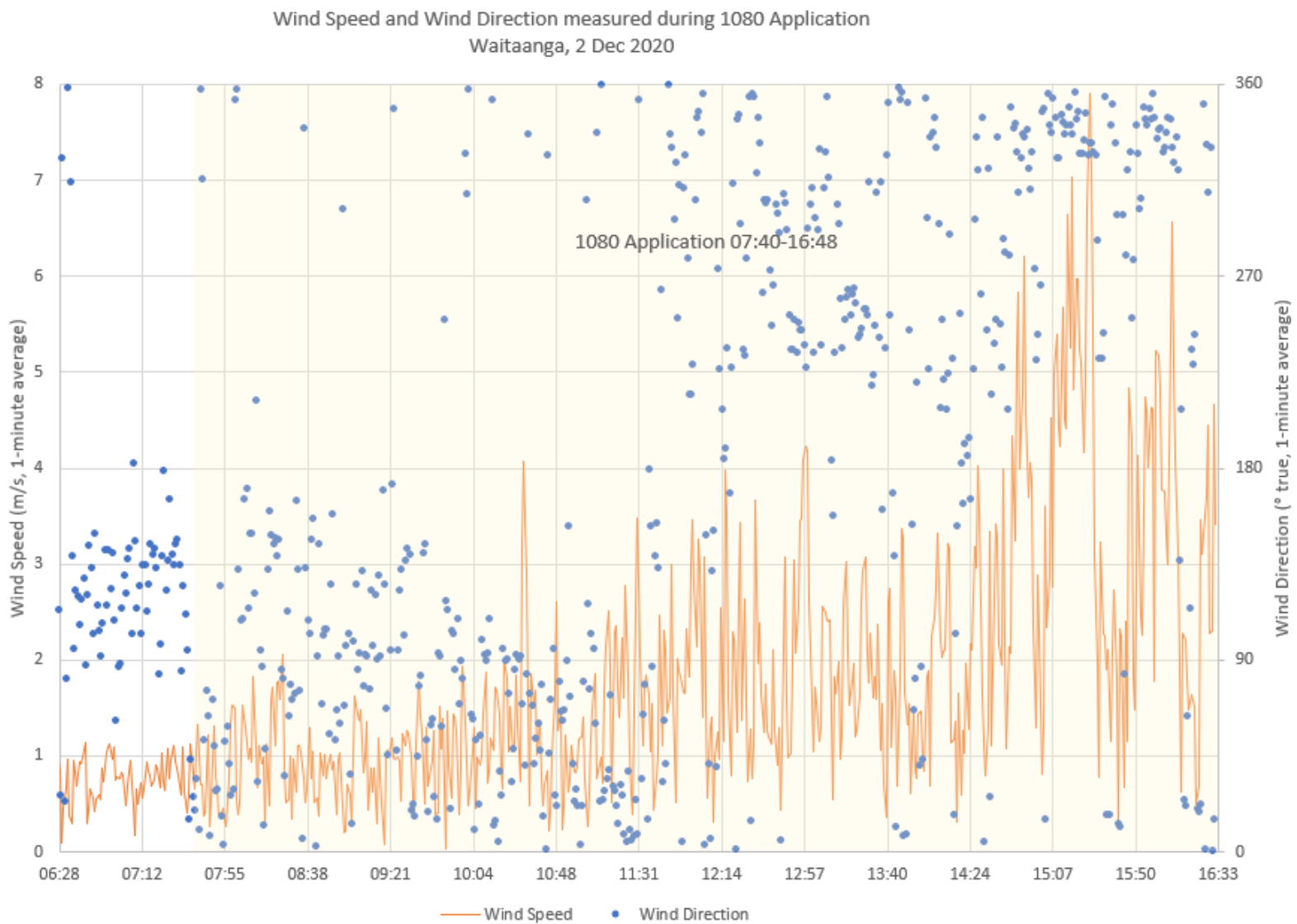


FIGURE B6: WIND SPEED AND WIND DIRECTION (1-MINUTE AVERAGES) DURING 1080 AERIAL APPLICATION (07:40-16:48) AT WAITAANGA, 1 DECEMBER 2020



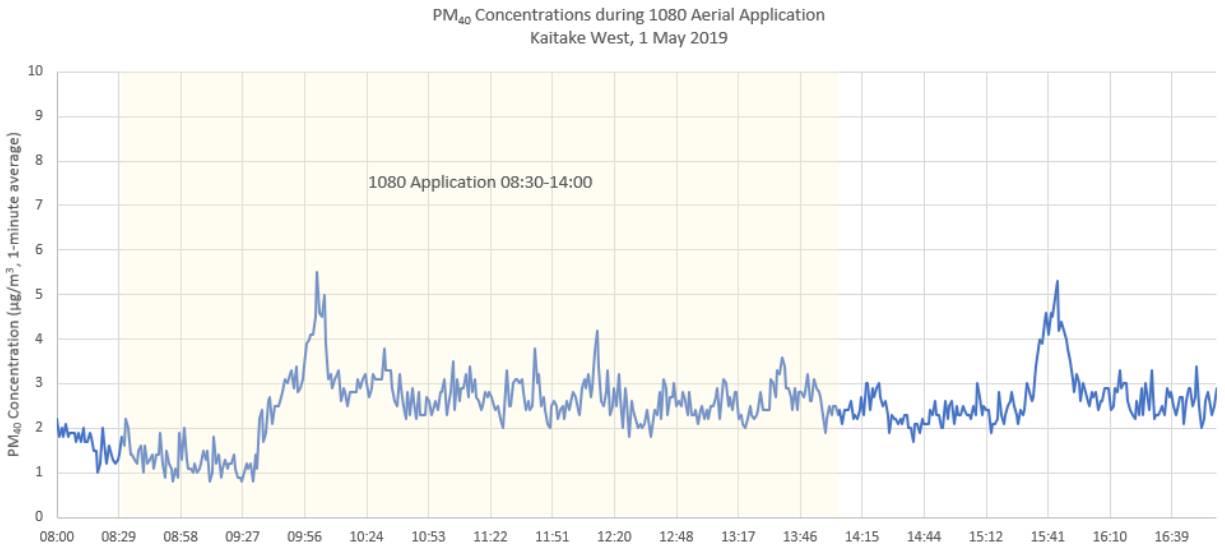


FIGURE B7: PM₄₀ MEASURED DURING 1080 AERIAL APPLICATION (08:30-14:30) AT KAITAKE WEST, 1 MAY 2019

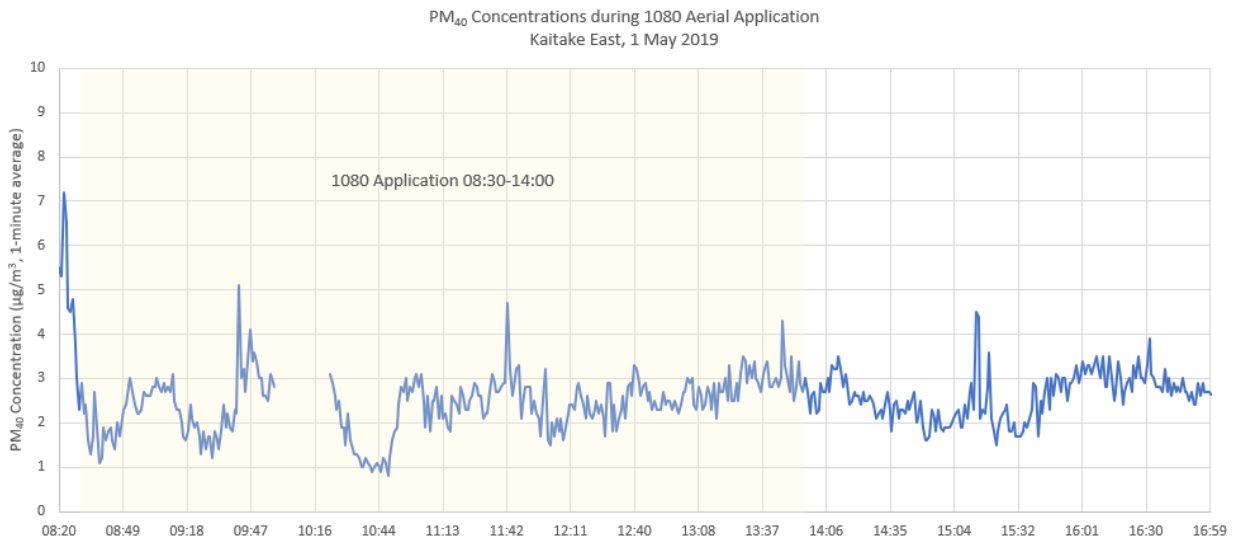


FIGURE B8: PM₄₀ MEASURED DURING 1080 AERIAL APPLICATION (08:30-14:00), KAITAKE EAST, 1 MAY 2019
[NB: 20 minutes lost data between 09:59 and 10:20 due to communication failure]

PM₄₀ at Marble Hill Monitoring Locations
1 Nov 2019

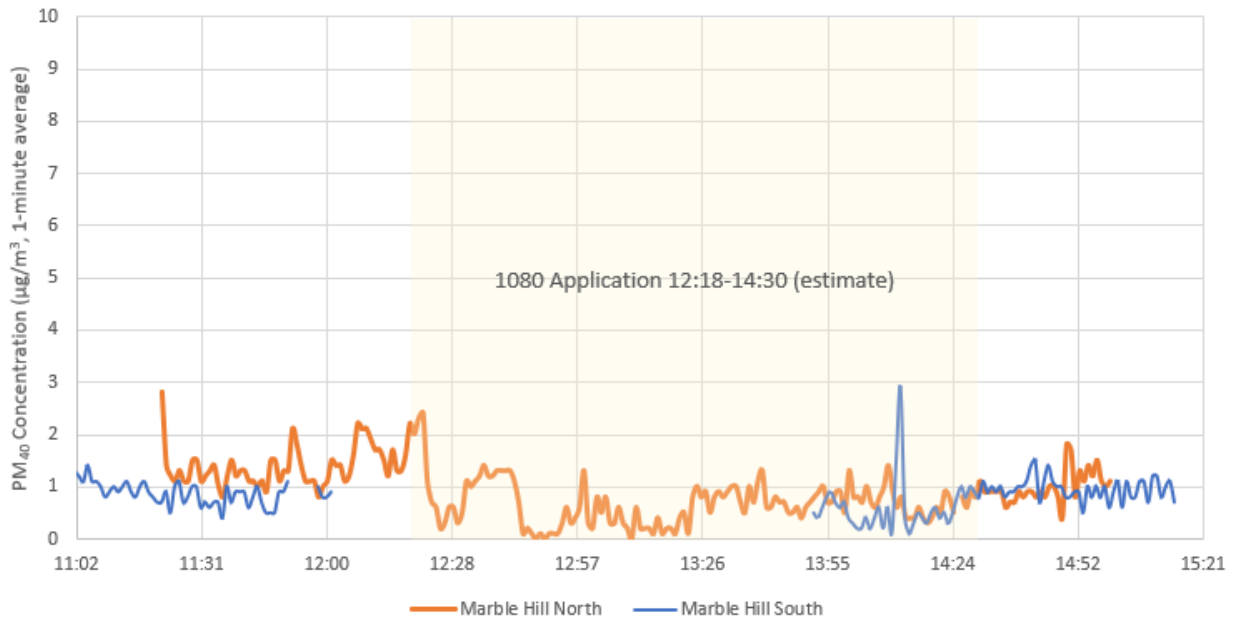


FIGURE B9: CONTINUOUS PM₄₀ MEASURED DURING 1080 AERIAL APPLICATION, MARBLE HILL, 1 NOVEMBER 2019

PM₄₀ at Palmers Road Monitoring Locations
2-3 November 2019

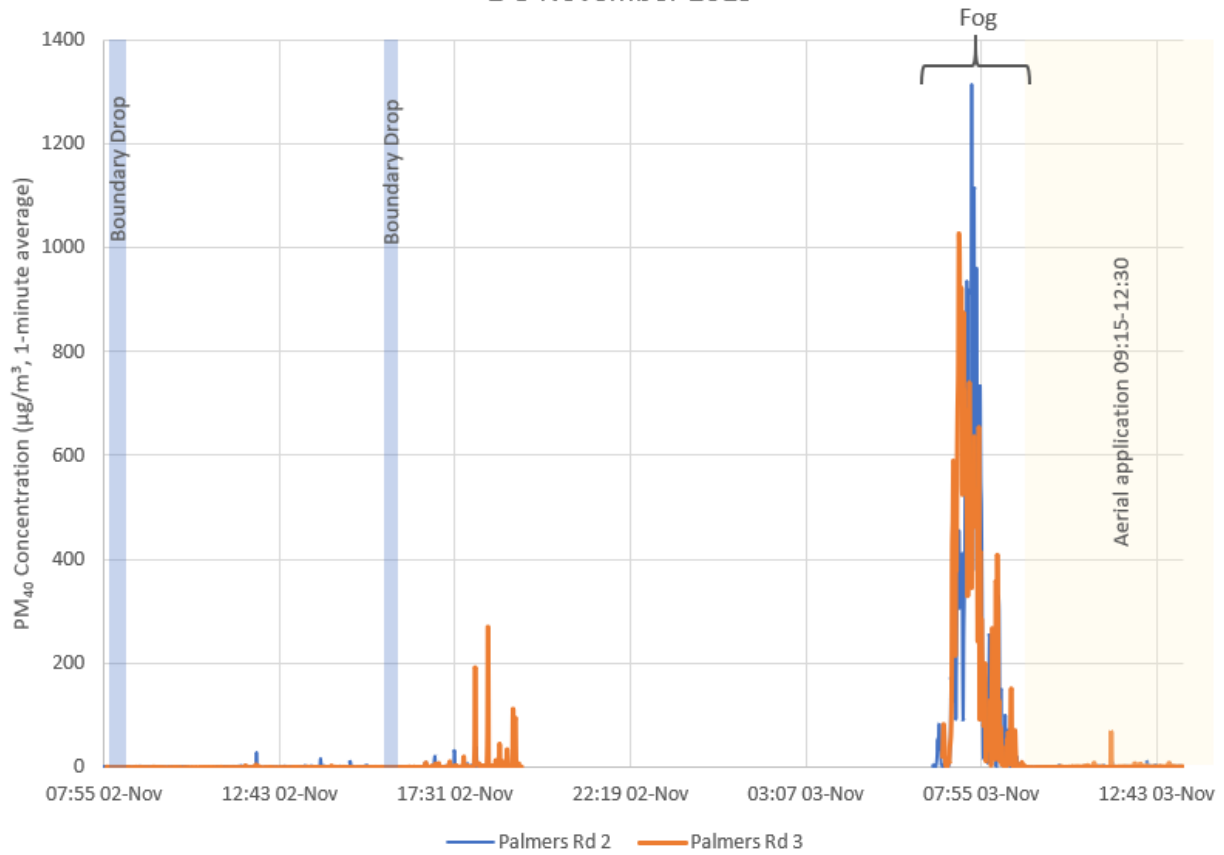


FIGURE B10: CONTINUOUS PM₄₀ MEASURED DURING PERIODS OF 1080 AERIAL APPLICATION AT PALMERS ROAD MONITORING LOCATIONS, 2 – 3 NOVEMBER 2019. VERY HIGH PM₄₀ ON 3 NOV BELIEVED DUE TO FOG

APPENDIX C: LABORATORY ANALYSES



Toxicology Laboratory Analysis Report

54 Gerald Street
PO Box 89040
Lincoln, 7640
Ph: +64 3 321 9999
Fax: +64 3 321 9998

Report No: T7075

CLIENT: Auckland 1024 Emission Impossible, Suite 1-6, 72 Dominion Road, Mt Eden

CLIENT REFERENCE No.: Telephone No:

SAMPLES: Seven air filter samples

REQUIREMENT: Examine for fluoroacetate

RECEIVED: 03 May 2019

Sample/s were received for analysis. The details were entered into the laboratory sample system and the sample/s given a reference number. The sample details and results are as follows:

No. samples: 9

LabNo.	Description	Fluoroacetate, µg/fit
22748	Air filter, Kaitaki 03, Lab mote	<MDL
22749	Air filter, Kaitaki 04, Lab spike	0.014
22750	Air filter, Kaitaki 05, Kaitaki West Boundary	<MDL
22751	Air filter, Kaitaki 06, Kaitaki West - 100	0.007
22752	Air filter, Kaitaki 07, Kaitaki West - 200	0.038
22753	Air filter, Kaitaki 08, Kaitaki East - Boundary	0.058
22754	Air filter, Kaitaki 09, Kaitaki East - 50	0.077
22755	Air filter, Kaitaki 10, Field blank	<MDL
Blank	Air filter, Kaitaki 01, True blank	<MDL
Spike	Air filter, Kaitaki 02, Lab spike	0.035

Report No: T7075

Page 1 of 2



All results are reported to two significant figures.

The determination was carried out using TLM005, the assay of fluoroacetate in water, soil and biological materials by GLC. The method detection limit (MDL) for air filter samples is 0.005µg/filter.

TESTED BY: lhb WORKBOOK REF: 12/18
TEST PERIOD: 3-8/5/19

AUTHORISED BY:

Date: 7/05/2019

These results are confidential to the client and relate only to the samples as received and tested. This report may be reproduced in full only. The samples relating to this report will be disposed of after two months from the report date unless requested otherwise by the client. Where appropriate, the above results will be included in anonymised form in the National Vertebrate Pesticide Residue Database.



Toxicology Laboratory Analysis Report

54 Gerald Street
PO Box 89040
Lincoln, 7640
Ph: +64 3 321 9999
Fax: +64 3 321 9998

Report No: T7095

CLIENT: Emission Impossible, Suite 1-6, 72 Dominion Road, Mt Eden
Auckland 1024

CLIENT REFERENCE No.:

Telephone No:

SAMPLES: Three spiked air filter samples

REQUIREMENT: Examine for fluoroacetate

RECEIVED: 03 May 2019

Sample/s were received for analysis. The details were entered into the laboratory sample system and the sample/s given a reference number. The sample details and results are as follows:

No. samples: 3

LabNo.	Description	Fluoroacetate, µg/filter
Spike 1	Air filter, Spike 1, 0.025 µg	0.017
Spike 2	Air filter, Spike 2, 0.025 µg	0.016
Spike 3	Air filter, Spike 3, 0.025 µg	0.019

All results are reported to two significant figures.

The determination was carried out using TLM005, the assay of fluoroacetate in water, soil and biological materials by GLC. The method detection limit (MDL) for air filter samples is 0.005µg/filter.

TESTED BY: lhb

WORKBOOK REF: 13/7

TEST PERIOD: 18-20/5/19

AUTHORISED BY:

Date: 20/05/2019

These results are confidential to the client and relate only to the samples as received and tested. This report may be reproduced in full only. The samples relating to this report will be disposed of after two months from the report date unless requested otherwise by the client. Where appropriate, the above results will be included in anonymized form in the National Vertebrate Pesticide Residue Database.

Report No: T7095

Page 1 of 1





Manaaki Whenua
Landcare Research

Toxicology Laboratory Analysis Report

54 Gerald Street
PO Box 69040
Lincoln, 7640
Ph: +64 3 321 9999
Fax: +64 3 321 9998

Report No: T7332

CLIENT: Emission Impossible, Suite 1-6, 72 Dominion Road, Mt Eden
Auckland 1024

CLIENT REFERENCE No.: **Telephone No:**

SAMPLES: Fifteen air filter samples

REQUIREMENT: Examine for fluoroacetate

RECEIVED: 05 November 2019

Sample/s were received for analysis. The details were entered into the laboratory sample system and the sample/s given a reference number. The sample details and results are as follows:

No. samples: 15

LabNo.	Description	Fluoroacetate, µg/filter
23498	Air filter sample, TM-01, Springs North 1, TSP	0.017
23499	Air filter sample, TM-02, Springs North 1, ALL	0.022
23500	Air filter sample, TM-03, Springs North 2, TSP	0.013
23501	Air filter sample, TM-04, Springs South 1, TSP	0.012
23502	Air filter sample, TM-05, Springs South 1, ALL	0.005
23503	Air filter sample, TM-06, Springs South 2, TSP	0.006
23504	Air filter sample, TM-07, Blank	<MDL
23505	Air filter sample, TM-08, Palmers Rd 3, ALL	0.13
23506	Air filter sample, TM-09, Palmers Rd 3, TSP	0.099
23507	Air filter sample, TM-10, Palmers Rd 2, TSP	0.072
23508	Air filter sample, TM-11, Palmers Rd 2, ALL	0.14
23509	Air filter sample, TM-12, Palmers Rd 1, ALL	0.11
23510	Air filter sample, TM-13, Palmers Rd 1, TSP	0.072
23511	Air filter sample, TM-14, Blank	<MDL
23512	Air filter sample, TM-15, Lab spike (0.025 µg)	0.025

Report No: T7332

Page 1 of 2



All results are reported to two significant figures.

The determination was carried out using TLM005, the assay of fluoroacetate in water, soil and biological materials by GLC. The method detection limit (MDL) for air filter samples is 0.005µg/filter.

TESTED BY: lhb WORKBOOK REF 17/11
TEST PERIOD: 11-14/11/19

AUTHORISED BY:

Date: 14/11/2019

These results are confidential to the client and relate only to the samples as received and tested. This report may be reproduced in full only. The samples relating to this report will be disposed of after two months from the report date unless requested otherwise by the client. Where appropriate, the above results will be included in anonymised form in the National Vertebrate Pesticide Residue Database.



Manaaki Whenua
Landcare Research

Toxicology Laboratory Analysis Report

54 Gerald Street
P.O.Box 69040
Lincoln, 7640
Ph: +64 3 321 9999
Fax: +64 3 321 9998

Report No: T7574

CLIENT: 1024 Emission Impossible, Suite 1-8, 72 Dominion Road, Mt Eden Auckland

CLIENT REFERENCE No.: Waitaangi **Telephone No:**

SAMPLES: Five air filter samples

REQUIREMENT: Examine for fluoroacetate

RECEIVED: 07 December 2020

Sample/s were received for analysis. The details were entered into the laboratory sample system and the sample/s given a reference number. The sample details and results are as follows:

No. samples: 5

Waitaangi 1080 Dust Drift Research

LabNo.	Description	Fluoroacetate, µg/filter
24089	Air filter sample, 001 Mountain View	0.018
24090	Air filter sample, 002 Chimney Corner	0.011
24091	Air filter sample, 003 Cow Corner	0.015
24092	Air filter sample, 004 Rockslip Road	0.015
24093	Air filter sample, 006 Blank	<MDL

All results are reported to two significant figures.

The determination was carried out using TLM005, the assay of fluoroacetate in water, soil and biological materials by GLC. The method detection limit (MDL) for air filter samples is 0.005µg/filter. NOT AN ACCREDITED TEST.

TESTED BY: lhb **WORKBOOK REF:** 20/9

TEST PERIOD: 7-9/12/20

AUTHORISED BY:

Date: 9/12/2020

These results are confidential to the client and relate only to the samples as received and tested. This report may be reproduced in full only. The samples relating to this report will be disposed of after two months from the report date unless requested otherwise by the client. Where appropriate, the above results will be included in anonymised form in the National Vertebrate Pesticide Residue Database.

Report No: T7574

Page 1 of 1

