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CAPTAINS FLAT AIR QUALITY MONITORING REPORT

JUNE 2021 TO SEPTEMBER 2022

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GLOSSARY

Acronym / Symbol	Description
As	Arsenic
AS/NZS	Australian/New Zealand Standard
Ba	Barium
BoM	Bureau of Meteorology
Cd	Cadmium
Co	Cobalt
Cr	Chromium
Cu	Copper
DPIE	Department of Planning, Industry and Environment (NSW)
Fe	Iron
Hg	Mercury
HVAS	High-volume air sampler
IPC-MS	Inductively coupled plasma spectrometric method
Pb	Lead
LOR	Limit of Reporting
Mn	Manganese
Mo	Molybdenum
NATA	National Association of Testing Authorities
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NERDDC	National Health and Medical Research Council
Ni	Nickel
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than 2.5 microns
PM_{10}	Particulate matter with an aerodynamic diameter of less than 10 microns
Regional NSW	NSW Department of Regional NSW
RFS	Rural Fire Service
SAQP	Sampling and Analysis Quality Plan
SCS	Soil Conservation Services
Se	Selenium
Ti	Titanium
TSP	Total suspended particulates, particulate matter with an aerodynamic diameter of less than 50 to 100 microns (measured at less than 50 microns for this report)
Zn	Zinc
$\mu g/m^3$ or $\mu g\ m^{-3}$	Micrograms per cubic metre

1. EXECUTIVE SUMMARY

An air quality monitoring program was commissioned in Captains Flat, NSW to inform air quality risks associated with heavy metals in airborne particulate matter from the legacy Lake George Mine. Sampling at five locations commenced on 22 June 2021 and is on-going. This report summarises all data from 22 June 2021 to 15 September 2022. Sampling is configured to measure a 24-hour average sample every one day in six at five sensitive receptors around the town.

The current annual average total suspended particulate (TSP) concentration remains below the annual average criteria of 90 µg/m³, currently averaging 18.7 µg/m³. Three TSP samples were above this value: AQM2 on 17 February 2022 (117.4 µg/m³), AQM1 on 10 August 2022 (97.2 µg/m³), and AQM4 on 28 August 2022 (109.1 µg/m³). All 24-hour lead concentrations were below the annual average lead air quality criteria of 0.5 µg/m³, averaging 0.004 µg/m³ during the monitoring period. Zinc average concentration during the monitoring period is 51.9 µg/m³.

The monitoring shows spatial and temporal variations in concentrations of arsenic, barium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, titanium and zinc around Captains Flat. Most cadmium and selenium concentrations were measured below the limit of reporting (LOR), and mercury was detected in one sample since monitoring commenced.

Bivariate polar plots were generated with the concentration data and average wind conditions measured at 10 m height by a meteorological station in one of the sampling locations. This analysis provides some indications of potential source direction, but current data is limited by wind directions on sampling days.

The data shows strong correlations when comparing heavy metals, particularly between copper, manganese, cobalt, molybdenum, nickel, chromium and iron.

The monitoring program is on-going, currently commissioned until 31 August 2024 with potential to extend for one additional year. Ambient air quality criteria for lead and TSP are based on annual averages, and air quality is influenced by seasonal variations with potential for distinct annual patterns. Data from subsequent monitoring months will be added to future reports.

2. INTRODUCTION

2.1 Overview

Ramboll Australia Pty Ltd (Ramboll) has been contracted by Department of Regional NSW to implement and maintain an air quality monitoring program to inform air quality risks associated with the legacy Lake George Mine, in Captains Flat, NSW. The Legacy Mines Program is completing a Lead Management Plan for Captains Flat in conjunction with a multi-agency government taskforce (i.e., Department of Regional NSW, NSW EPA, Transport for NSW, Crown Lands, Department of Education, Department of Health, Department of Primary Industries and Queanbeyan-Palerang Regional Council) with the aim to reduce community exposure to lead resulting from historic mining in the town (Regional NSW, 2021).

The air quality monitoring program managed by Ramboll is supporting the Captains Flat Lead Management Plan under the taskforce to ensure contamination of public land is managed to the mutual agreement of all stakeholders. The program involves environmental sampling of multiple media on public properties to assess current risk and provision of guidance regarding lead risk abatement measures. Work commenced early 2021 and is on-going, with additional data collected, analysed and reported on a 2-monthly basis. This report presents the data collected from 22 June 2021 to 15 September 2022.

2.2 Program background

The air quality monitoring program was commissioned on 21 June 2021, with the first sample collected 22 June 2021. From 27 October 2021 routine servicing of the air quality monitoring program was handed over to Soil Conservation Services (SCS), with Ramboll providing calibration and reporting services.

Previous reports delivered by Ramboll are listed below:

- 318001193-T4a Captains Flat Air Quality Monitoring Report 2021-08, summarising data collected from 22 June 2021 to 20 August 2021.
- 318001193-T4a Captains Flat Air Quality Monitoring Report 2021-10, summarising data collected from 22 June 2021 to 02 October 2021.
- 318001193-T4a Captains Flat Air Quality Monitoring Report 2021-12, summarising data collected from 22 June 2021 to 07 December 2021.
- 318001193-T4a Captains Flat Air Quality Monitoring Report 2022-02, summarising data collected from 22 June 2021 to 30 January 2022.
- 318001193-T4a Captains Flat Air Quality Monitoring Report 2022-04, summarising data collected from 22 June 2021 to 31 March 2022.
- 318001193-T4a Captains Flat Air Quality Monitoring Report 2022-06, summarising data collected from 22 June 2021 to 30 May 2022.

2.3 Pollutants of concern

The mine operated from 1892 to 1962 producing lead, zinc, copper, pyrite, silver and gold (Regional NSW, 2021). All of the mine workings were underground with associated processing and transport above ground. Spreading of lead and zinc contamination from the site are the primary issues of concern (Regional NSW, 2021).

Lead (Pb) is emitted to the air from both natural and anthropogenic sources. Measured concentrations in ambient air have greatly reduced nationally following the phase-out of leaded fuels from 2000 to 2002, where typically urban concentrations are now less than 10% of the air quality criteria (NEPC, 2001). **Appendix 2** shows historic annual average lead concentration in

Australian capital cities from 1981 to 2000, after which monitoring ceased in urban areas. Ambient lead remains a risk in areas where local point sources exist, such as metal smelting facilities, mining operations and waste incineration. Inhalation and ingestion of lead at elevated levels can lead to a range of health impacts, including cancer, neurotoxicity, and reproductive toxicity.

Zinc (Zn) occurs widely in the environment, but adverse health effects can occur when exposure is high. Elevated exposure can occur through exposure to mining, smelting and processing or metal ores and metal plating.

Additionally, metals associated with mining and processing ore are of interest to this program. A suite of fifteen metals in air are analysed including: arsenic (As); barium (Ba); cadmium (Cd); chromium (Cr); cobalt (Co); copper (Cu); iron (Fe); lead (Pb); manganese (Mn); mercury (Hg); molybdenum (Mo); nickel (Ni); selenium (Se); titanium (Ti) and zinc (Zn).

3. STUDY AREA

The legacy Lake George Mine is in the town of Captains Flat, in the Southern Tablelands of rural New South Wales, approximately 50 km south-east of Canberra. Captains Flat has a distinctive valley terrain orientated roughly north to south, which is likely to steer winds in the northerly and southerly directions (refer to **Figure 3-1**). This is an important characteristic as wind speed and direction directly impact transport and dispersion of air pollutants.

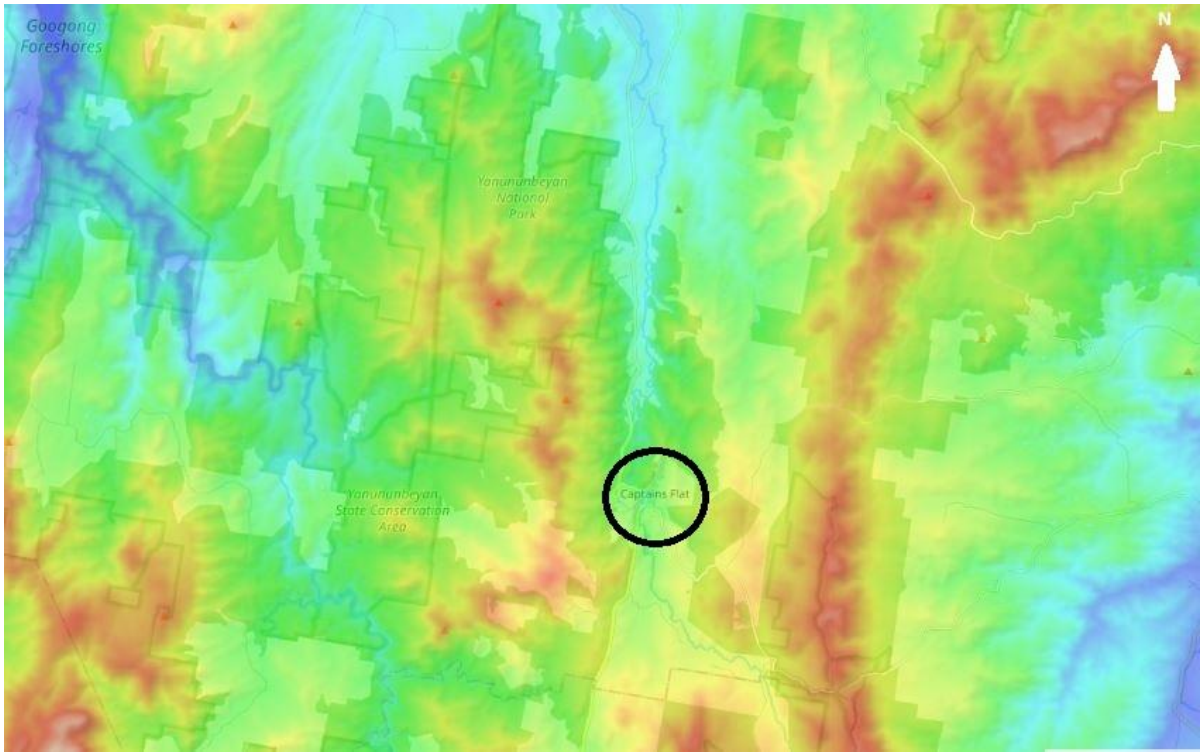

Figure 3-1: Terrain features in and around Captains Flat, NSW (red high, purple low; Yamazaki et al, 2017)

The study area for the air quality monitoring program encompasses areas of former mining activities, including The Old Mine Site, Former Smelter, Northern Tailings Dump, and Former Rail Loadout Facility, which are located around and south-east to the Captains Flat Railway Station. The largest community area is north-east to the station, containing sensitive receptors such as residential properties and Captains Flat Public School. The project boundary and site elements are presented in **Figure 3-2**.

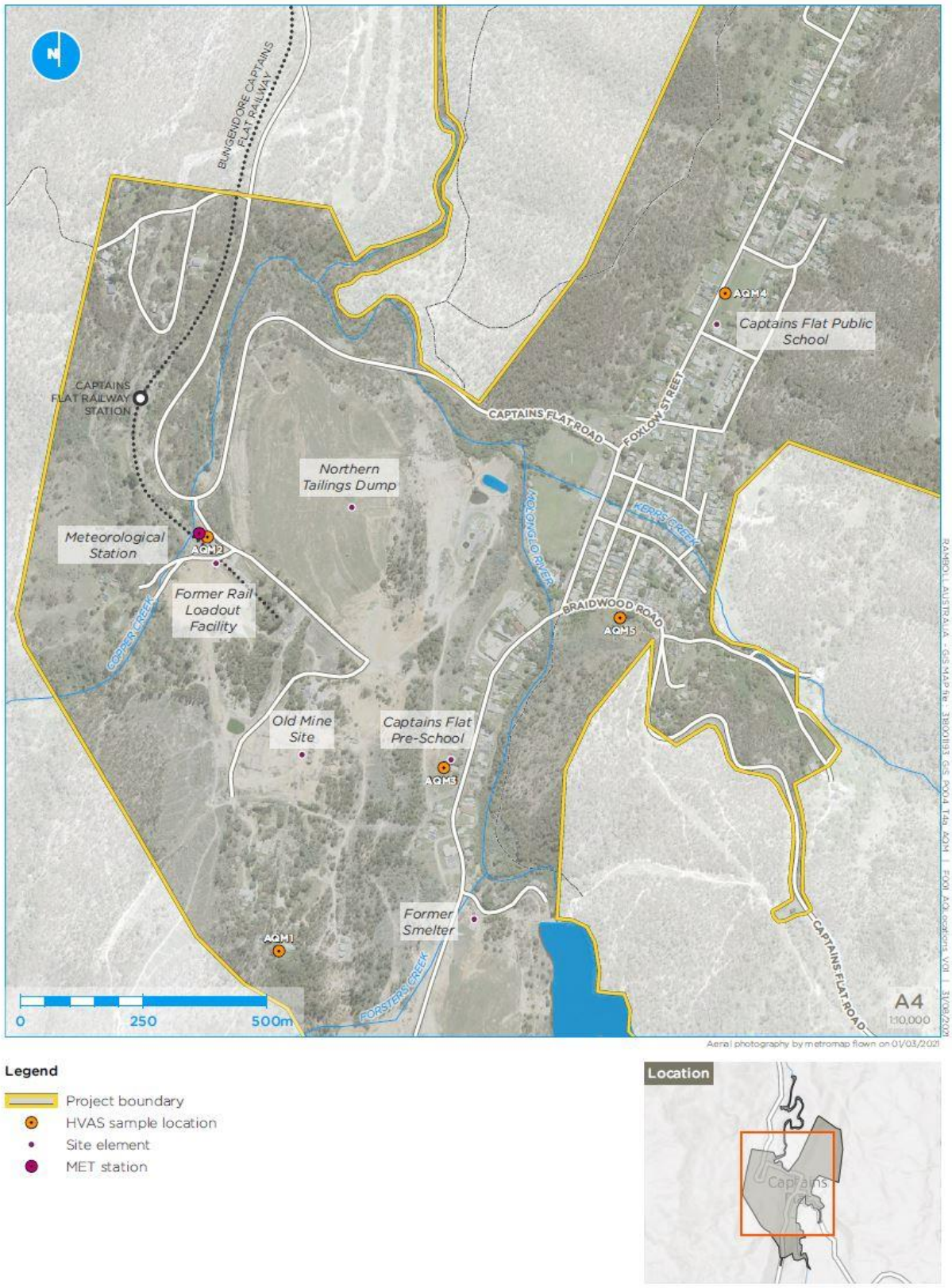

Figure 3-2: Project boundary and locations of interest

4. METHODOLOGY

4.1 Sampling design

The monitoring program involves environmental sampling of TSP and testing for lead and other heavy metals in particulate form. Five locations of concern and/or relevance within the study area were identified for sampling to be carried out. The five monitoring locations are shown in **Figure 3-2** and summarised in **Table 4-1** with the respective justification for selection. A meteorological station is maintained at one location (AQM2) to inform movement and dispersion of air.

Table 4-1: Air Quality Monitoring Locations

ID	Location description	Address	Justification for selection
AQM1	Residence	Old Mine Road	Representative of potential impacts to the south-west. Located on elevated terrain relative to the other selected locations.
AQM2 & MET	Residence	2 Copper Creek Road	Identified as the nearest sensitive receptor (residents) to the northern tailings dump and the former rail loadout facility.
AQM3	Captains Flat former Preschool	27 Foxlow Street	Identified as a sensitive receptor of interest (residents) and representative of potential impacts to the south-east.
AQM4	New Preschool	Foxlow Street	Representative of potentials impacts to the largest community to the north-east.
AQM5	Residence	2 Braidwood Road	Representative of potential impacts to residents down-wind of the mine.

Sensitive receptors include locations where people reside and work, including residential properties, schools and parks. Remnants of materials from past above ground mine processing and transport activities are the source of contaminants (metals, particularly lead and zinc). Wind erosion is expected to be the main exposure pathway, linking pollutant sources to receptors; hence the importance of monitoring wind movements and understanding wind patterns. The five monitoring locations are deemed appropriate to provide results representative of the study area and encompasses the main sensitive receptors in the town.

4.2 Monitoring equipment and siting

High-volume air samplers (HVAS; Hi-Vol 3000) were utilised for sampling TSP. They consist of a TSP sampling head (i.e., inlet) that has a reported cut-point for particles of 50 µm diameter or less. The sampler draws a known volume of air across a pre-weighed filter for 24-hours.

The instruments are calibrated and maintained by Ramboll, as far as practicable, consistent with the recommendations of *AS/NZS 3580.9.3 – Method 9.3 – Determination of suspended particulate matter – Total suspended particulate matter (TSP) – High volume sampler gravimetric method* and the manufacturers recommendations. Sampling is configured for a 24-hour period every 1 day in 6 (midnight to midnight). SCS services the instruments on a 6-day basis, commencing from 27 October 2021.

Quality assurance is done using a field blank to capture any influences of the handling and storage process. A blank sample paper is handled in the same way as the actual sample papers and remains on site throughout the sampling exercise. The blank sample is sent for laboratory analysis along with the actual samples. Established acceptance criterion for TSP field blanks is ±8 mg, above which the handling procedure should be investigated for potential contamination.

A meteorological station was initially supplied by Rural Fire Service (RFS) and subsequently replaced by a project-owned station commissioned by Ramboll (more information in **Section 4.5**). Photos of the monitoring equipment in-situ are shown in **Appendix 3**.

Siting of all equipment was completed, as far as practicable, in accordance with the recommendations of *AS/NZS 3580.1.1 – Methods for sampling and analysis of ambient air – Part 1.1: Guide to siting air monitoring equipment*. Selecting monitoring locations requires compromises to meet the technical recommendations of *AS 3580.1.1* and practical conditions such as access approval, security and power availability.

Locating the AQM2 instrument was limited by sewer connections in the residence backyard, which limited trenching for electrical works. The monitoring location is obstructed by the house and shed between the instrument and the nearest potential source of interest, the former rail loadout facility.

Many residences in Captains Flat operate woodfires during the winter which are a significant source of particulate matter. Woodsmoke from the Old Mine Road (AQM1) residence chimney can be seen in **Appendix 3** near the monitoring location. A temporary air quality monitoring campaign completed for the Miners Road and Copper Creek Road Upgrade on behalf of Queanbeyan-Palerang Regional Council during October 2021 confirmed elevated particulate matter concentrations during the night-time period, likely a result of biomass burning in the town.

4.3 Measurement of metals in TSP

TSP are airborne solid particles and water droplets less than approximately 50 to 100 µm in aerodynamic diameter, consisting of a myriad of different constituents from various sources.

The samples are analysed for 15 heavy metals in TSP: As, Ba, Cd, Cr, Co, Cu, Fe, Pb, Mn, Hg, Mo, Ni, Se, Ti and Zn. The Australian Standard to measure lead in particulates (*AS/NZS 3580.9.15 Determination of suspended particulate matter – Particulate metals high or low volume sampler gravimetric collection – Inductively coupled plasma (ICP) spectrometric method)* requires measurement of the TSP fraction to analyse for lead content. Samples are weighed and analysed by a NATA accredited laboratory consistent with the recommendations of *AS 3580.9.15.*

4.4 Assessment criteria

Relevant NSW ambient air quality criteria for this monitoring program are presented in **Table 4-2**.

Table 4-2: Air Quality Assessment Criteria

Pollutant	Averaging period	Criteria	Source
Lead	Annual	0.5 µg/m³	NEPC (1998)
Total suspended particulates (TSP)	Annual	90 µg/m³	NHMRC (1996)

There are no NSW ambient air quality criteria for the 14 other heavy metals measured in this program.

4.5 Meteorology monitoring and terrain influences

Meteorology is a primary driver of transport and dispersion in the atmosphere. A Bureau of Meteorology (BoM) station is maintained in Tuggeranong, approximately 36 km to the north-west of Captains Flat. These data are unlikely to be representative of Captains Flat given the

differences in terrain, as Tuggeranong is a relatively flat urban environment. The nearest BoM station to Captains Flat is located in Braidwood, approximately 34.5 km to the north-east of Captains Flat. Braidwood may be more representative of the conditions at Captains Flat than Tuggeranong, but again the terrain differs significantly. Absence of local meteorology data in Captains Flat was identified as a data gap for the program in the Sampling and Analysis Quality Plan (SAQP; Ramboll, 2021).

The RFS loaned a meteorological station to the monitoring program for short-term use; prior to the project specific meteorological station being installed. The RFS meteorological station was decommissioned during the October reporting for use by RFS operations during fire season. Data between 22 June and 26 September 2021 was sourced from the RFS meteorological station, and data from 27 September 2021 onwards is sourced from the project meteorological station. From 7 August to 20 September 2022 the project station was not logging from capacity issues; meteorological data for this period was sourced from the BoM Goulburn Airport AWS station, located approximately 90 km to the north-east of Captains Flat. The capacity issue has now been resolved.

The RFS monitoring station measured wind speed and direction at 10 m height, wind speed, wind direction, temperature and humidity at 3 m height, and rainfall at ground level. During the June to August 2021 monitoring period, the 10 m wind sensors was calibrated south, so these data were corrected during analysis by 180º. Some intermittent data loss occurred from the station, caused by an issue with the firmware but data capture remained high (97.9% 10-minute data capture for the monitoring period). On 31 August 2021 the calibration and firmware issues were reported as rectified by RFS.

The project meteorological station (Lufft WSS800-UMB) measures wind speed and direction, temperature, relative humidity, air pressure, precipitation intensity, precipitation quantity and radiation at 10 m height. The sensors are mounted on a sensor arm fixed to a pump-up mast with lightning stake protection, with data capture and telemetry allowing remote access to the data.

4.6 Data presentation and analysis

Monitoring results including all data since program inception were analysed as described below. All generated graphs and plots will be expanded on as the monitoring program continues.

4.6.1 Meteorological conditions

Three sets of wind roses were generated to understand wind patterns and prevailing winds:

- Monthly wind roses with all available data.
- Monthly wind roses with data separated into day and night periods, determined by sunrise and sunset at location.
- Monthly wind roses with 24-hour averaged wind data for sample days only: these data is used to create the polar plots that must match the 24-hour pollutant data. This can be compared with the above wind roses using all raw data, and illustrates a limitation of the method, which is further discussed in **Section 5.4**.

Rainfall can contribute to suppressing particulate matter therefore a timeseries graph with daily rainfall data is presented for comparison with reported pollutant results is presented.

4.6.2 TSP and metal concentrations measured

Timeseries graphs of TSP and metals concentrations analysed since the beginning of the monitoring program were plotted for ease of visualization and identification of peak concentrations. Blank sample results are presented and discussed.

4.6.3 Potential factors influencing dispersion

Bivariate polar plots can be useful for source identification with longer datasets; this technique has been applied to the initial concentration data against the average wind conditions during each sampling day. The requirement to average 24-hour wind conditions to compare to the 24-hour sampling period is a limitation of the method, where wind conditions can vary considerably over a diurnal period (presented in the second set of wind roses mentioned in **Section 4.6.1**).

Additionally, the bivariate plots for the key pollutants TSP, lead and zinc are presented spatially on a topographical map in **Appendix 1**.

The plots were prepared using the openair data analysis package in R (Carslaw & Ropkins, 2012).

4.6.4 Correlations for potential source identification

The relationship between concentrations of air pollutants over time can provide an indication of whether the pollutants originated from the same source. Therefore, correlation matrices have been prepared to compare the relationship between each heavy metal and TSP.

The plots, developed using lattice multivariate data visualisation (Sarkar, 2007) in openair, display the correlation coefficient as a shape, colour and numeric value as a representation of a scatter plot. A perfect or near-perfect correlation is shown as a 45-degree sloped line, whereas zero correlation is shown as a circle.

4.7 Technical limitations

Data collection is limited to a 24-hour period every 1 day in 6, that is, data capture is not continuous which is a limitation of the method appropriate for this application. Moreover, as described in **Section 4.6.3**, the 24-hour sampling period is a limitation of the method, as results are given as a 24-hour average without capturing varying conditions within the day.

Weather during the reported period has been particularly wet due to a strong La Niña influence over Australian summer/autumn 2022. This may have had an impact in the local air quality and reported results as TSP, and consequently metal concentrations, are expected to be higher in drier weather.

As described in **Section 4.5**, the project meteorological station was monitoring but not logging for approximately 1.5 month during August and September 2022. In the absence of local data, meteorological data was sourced from a BoM station. Conditions were however notably different to those at Captains Flat (see **Section 5.2**), reinforcing the importance of having local meteorological data to understand site conditions for dispersion and transport of air pollutants.

5. RESULTS

5.1 Overview

Results from the monitoring period including all data since program inception are presented in the following sections:

- Meteorological conditions (**Section 5.2**).
- TSP and metal concentrations measured (**Section 5.3**).
- Potential factors influencing dispersion (**Section 5.4**).
- Correlations for potential source identification (**Section 5.5**).

5.2 Meteorology conditions

Wind roses from conditions measured at 10 m height at 2 Copper Creek Road, Captains Flat are presented in **Figure 5-1**. As described in **Section 4.5**, data from 7 August 13:00 to the end of the current monitoring period (15 September 2022) was sourced from the BoM Goulburn Airport AWS. Being in a different location with different terrain influences, differences are noted in the August and September 2022 wind roses compared with the previous months, suggesting these conditions are less representative of the local conditions.

Analysis of wind conditions shows prevailing winds are from south-west throughout the year, with the exception of June 2021/22 and July 2021 that recorded dominant winds coming from the north. Calmer conditions were recorded from November 2021 through to February 2022, with more distributed wind directions, with the exception of December which still showed south-westerly dominance. The strongest winds are generally 4 to 6 m/s, however in August, December and April 2021 stronger winds of 6 to 6.7 m/s were measured from the south-west. As observed in the wind roses from August and September 2022, wind speeds recorded by the BoM station are higher (up to 12.9 m/s) and with north-westerly prevalence.

Wind conditions also exhibit diurnal changes. When the data is separated into day and night periods, it shows the northerlies occur more often during the day and the south-westerlies occur during the night (see **Figure 5-2**).

Section 5.4 below presents polar plots using averaged wind conditions over 24-hours to match the 24-hour pollutant data. These averaged wind conditions for sample days only are shown in **Figure 5-3**, to illustrate a limitation of the method (further discussed in **Section 5.4**).

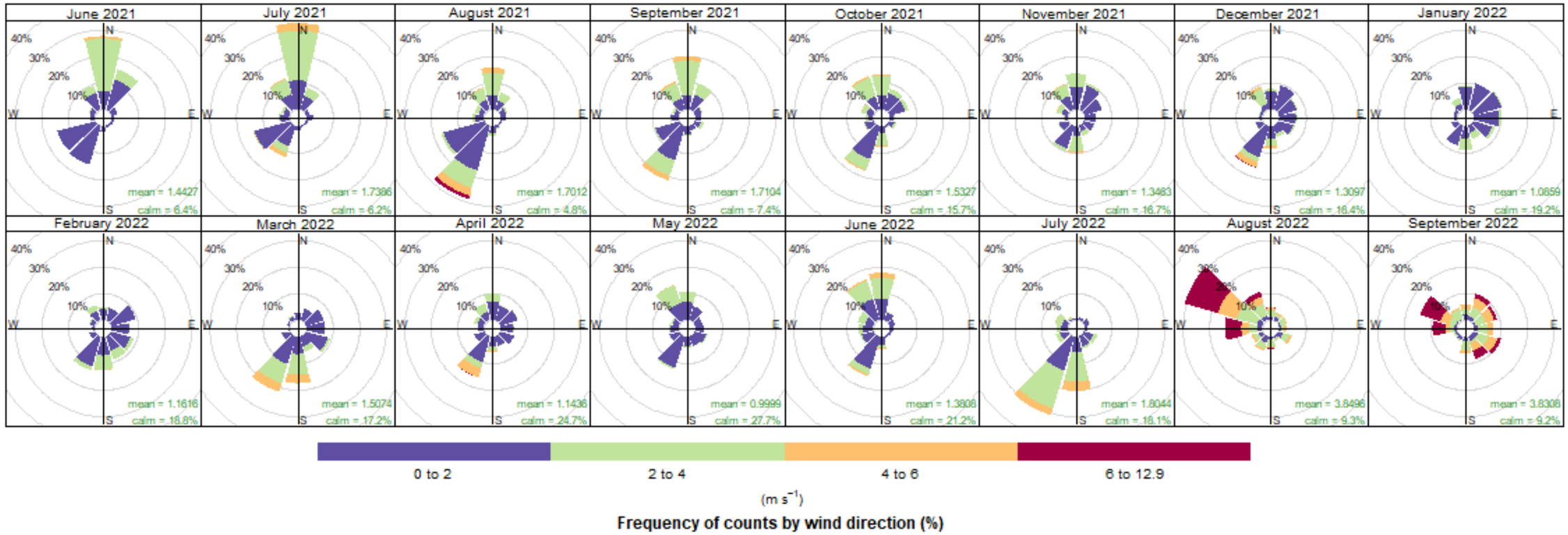

Figure 5-1: Monthly wind roses for all data collected at 2 Copper Creek road, 22 June 2021 to 15 September 2022 (produced with openair; Carslaw & Ropkins, 2012). Note: Data from 07 August 13:00 to 15 September sourced from BoM Goulburn Airport AWS.

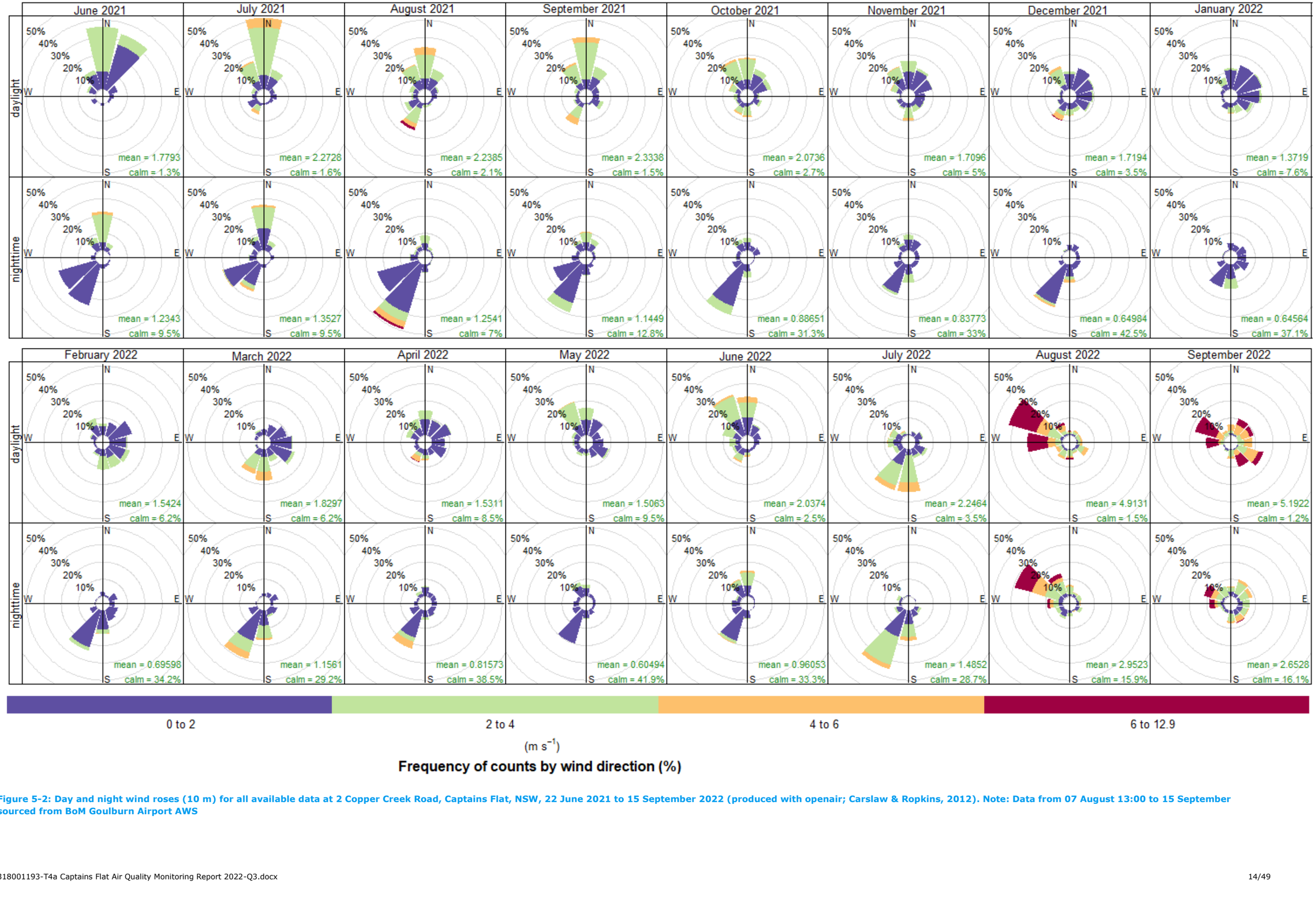

Figure 5-2: Day and night wind roses (10 m) for all available data at 2 Copper Creek Road, Captains Flat, NSW, 22 June 2021 to 15 September 2022 (produced with openair; Carslaw & Ropkins, 2012). Note: Data from 07 August 13:00 to 15 September sourced from BoM Goulburn Airport AWS

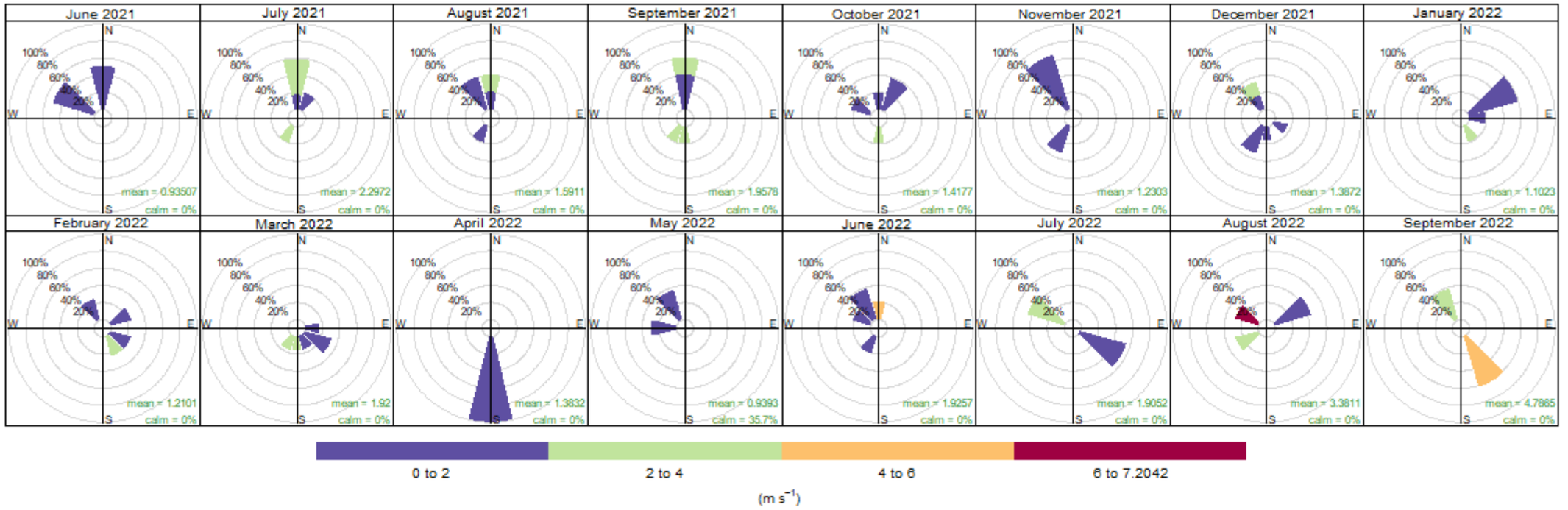

Figure 5-3: 24-hour average wind roses for sample days (24-hour period) only (produced with openair; Carslaw & Ropkins, 2012). Note: Data from 07 August 13:00 to 15 September sourced from BoM Goulburn Airport AWS

The RFS meteorological station and project meteorological station rainfall data are presented below in **Figure 5-4**. No rainfall was measured from 22 June to mid-July after which moderate rainfall was measured. Heavy rainfall events with a total volume of over 50 mm measured in one day were recorded in January, April and May 2022. The Goulburn Airport AWS recorded much higher rainfall than the project station's in the same period in 2021 or any other month.

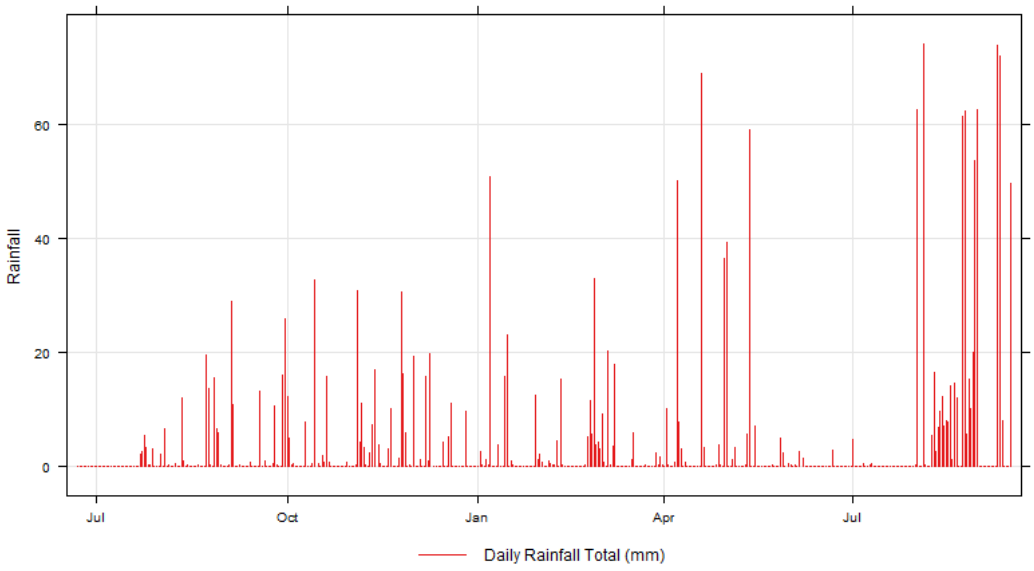

Figure 5-4: Daily rainfall measured to 15 September 2022. Note: Data from 07 August 13:00 to 15 September sourced from BoM Goulburn station.

5.3 TSP and heavy metal concentrations measured

Figure 5-5 to **Figure 5-20** show timeseries of TSP and each of the 15 metals analysed since the beginning of the monitoring program.

The average 24-hour TSP concentrations during the monitoring period is 18.7 µg/m³, remaining well below the annual average air quality criteria of 90 µg/m³. The following days and locations recorded concentrations above this annual criteria:

- 17 February 2022 at AQM2 (117.4 µg/m³);
- 10 August 2022 at AQM1 (97.2 µg/m³); and
- 28 August 2022 at AQM4 (109.1 µg/m³).

All 24-hour lead concentrations were below the annual average lead air quality criteria of 0.5 µg/m³, averaging 0.004 µg/m³ during the monitoring period. The annual average zinc concentration during the monitoring period is 51.9 µg/m³.

Blank sample results are detailed in **Table 5-1** and are within the established acceptance criterion (blank TSP mass = ±8 mg) except for the August 2022 sample (blank TSP mass = 11.3 mg). This result may suggest that the samples were not well handled or stored by the servicing contractor. The program has been modified since this period, with servicing by Ramboll from 16 September 2022.

Table 5-1: Blank sample details

Blank sample ID	Date analysed	Initial filter mass (mg)	Final filter mass (mg)	Blank TSP mass (mg)
AQM5 – HVS723	02/10/2021	2753.3	2755.2	1.9
AQM5 – HVS817	12/10/2021	2741.1	2744.4	3.3
AQM5 – HVS1183	13/12/2021	2684.8	2688.1	3.3
AQM5 – HVS1144	05/02/2022	2829.8	2836.0	6.2
AQM5 - HVS1136	06/04/2022	2821.5	2827	5.5
AQM5 - HVS1436	04/08/2022	2686.5	2697.8	11.3

Invalidated or missing samples during the monitoring program are summarised in **Table 5-2**. One sample was lost on 4 July 2021 from AQM5 when the instrument was impacted by high winds. Four sets of samples were invalidated from all sites (1 and 7 November 2021, 12 April and 24 May 2022), following some confusion about the sampling methodology when the program was handed over to SCS for servicing. Sampling during April and May was not completed by SCS. One sample from AQM2 on 18 May 2022 was not found on site on retrieval by Ramboll.

Table 5-2: Invalidated or missing samples

Date sampled	Site	Sample ID	Comments
04/07/2021	AQM 5	No sample	Lost during high winds
01/11/2021	AQM 1	AQM 1 – HVS847	Invalidated – not serviced on correct day by SCS
01/11/2021	AQM 2	AQM 2 – HVS848	Invalidated – not serviced on correct day by SCS
01/11/2021	AQM 3	AQM 3 – HVS846	Invalidated – not serviced on correct day by SCS
01/11/2021	AQM 4	AQM 4 – HVS844	Invalidated – not serviced on correct day by SCS
01/11/2021	AQM 5	AQM 5 – HVS845	Invalidated – not serviced on correct day by SCS
07/11/2021	AQM 1	AQM 1 – HVS854	Invalidated – not serviced on correct day by SCS
07/11/2021	AQM 2	AQM 2 – HVS855	Invalidated – not serviced on correct day by SCS
07/11/2021	AQM 3	AQM 3 – HVS849	Invalidated – not serviced on correct day by SCS
07/11/2021	AQM 4	AQM 4 – HVS853	Invalidated – not serviced on correct day by SCS
07/11/2021	AQM 5	AQM 5 – HVS856	Invalidated – not serviced on correct day by SCS
12/04/2022	AQM 1	AQM 1 – HVS1073	No sample – Not replaced by SCS
12/04/2022	AQM 2	AQM 2 – HVS1060	No sample – Not replaced by SCS
12/04/2022	AQM 3	AQM 3 – HVS985	No sample – Not replaced by SCS
12/04/2022	AQM 4	AQM 4 – HVS1170	No sample – Not replaced by SCS
12/04/2022	AQM 5	AQM 5 – HVS1163	No sample – Not replaced by SCS
18/04/2022	AQM 1	No sample	No sample – Not replaced by SCS
18/04/2022	AQM 2	No sample	No sample – Not replaced by SCS
18/04/2022	AQM 3	No sample	No sample – Not replaced by SCS
18/04/2022	AQM 4	No sample	No sample – Not replaced by SCS
18/04/2022	AQM 5	No sample	No sample – Not replaced by SCS
30/04/2022	AQM 1	No sample	No sample – Not replaced by SCS
30/04/2022	AQM 2	No sample	No sample – Not replaced by SCS

Date sampled	Site	Sample ID	Comments
30/04/2022	AQM 3	No sample	No sample – Not replaced by SCS
30/04/2022	AQM 4	No sample	No sample – Not replaced by SCS
30/04/2022	AQM 5	No sample	No sample – Not replaced by SCS
18/05/2022	AQM 2	No sample	Missing on retrieval
24/05/2022	AQM 1	AQM 1 – HVS1155	No sample – Not replaced by SCS
24/05/2022	AQM 2	AQM 2 – HVS1122	No sample – Not replaced by SCS
24/05/2022	AQM 3	AQM 3 – HVS1133	No sample – Not replaced by SCS
24/05/2022	AQM 4	AQM 4 – HVS1139	No sample – Not replaced by SCS
24/05/2022	AQM 5	AQM 5 – HVS1246	No sample – Not replaced by SCS
30/05/2022	AQM 1	No sample	No sample – Not replaced by SCS
30/05/2022	AQM 2	No sample	No sample – Not replaced by SCS
30/05/2022	AQM 3	No sample	No sample – Not replaced by SCS
30/05/2022	AQM 4	No sample	No sample – Not replaced by SCS
30/05/2022	AQM 5	No sample	No sample – Not replaced by SCS
23/06/2022	AQM 3	AQM 3 - HVS1255	Filter damaged
05/07/2022	AQM 1	AQM 1 - HVS1240	Invalidated
05/07/2022	AQM 2	AQM 2 - HVS1243	Invalidated
05/07/2022	AQM 3	AQM 3 - HVS1253	Invalidated
05/07/2022	AQM 4	AQM 4 - HVS1270	Invalidated
05/07/2022	AQM 5	AQM 5 - HVS1263	Invalidated
11/07/2022	AQM 1	No sample	
11/07/2022	AQM 2	No sample	
11/07/2022	AQM 3	No sample	
11/07/2022	AQM 4	No sample	
11/07/2022	AQM 5	No sample	
17/07/2022	AQM 2	AQM 2 - HVS1234	Filter damaged
29/07/2022	AQM 1	No sample	
29/07/2022	AQM 2	No sample	
29/07/2022	AQM 3	No sample	
29/07/2022	AQM 4	No sample	
29/07/2022	AQM 5	No sample	
10/08/2022	AQM 2	AQM 2 - HVS1259	Filter damaged
16/08/2022	AQM 1	No sample	Missing
16/08/2022	AQM 2	No sample	Missing
16/08/2022	AQM 3	No sample	Missing
16/08/2022	AQM 4	HVS 1141	Missing
16/08/2022	AQM 5	No sample	Missing
28/08/2022	AQM 2	AQM 2 - HVS1358	Filter damaged
09/09/2022	AQM 3	AQM 3 - HVS1250	Filter damaged

Date sampled	Site	Sample ID	Comments
09/09/2022	AQM 5	AQM 5 - HVS1259	Filter damaged
15/09/2022	AQM 1	AQM 1 - HVS_UNKNOWN	Missing
15/09/2022	AQM 2	AQM 2 - HVS_UNKNOWN	Missing
15/09/2022	AQM 3	AQM 3 - HVS_UNKNOWN	Missing
15/09/2022	AQM 4	AQM 4 - HVS_UNKNOWN	Missing
15/09/2022	AQM 5	AQM 5 - HVS_UNKNOWN	Missing

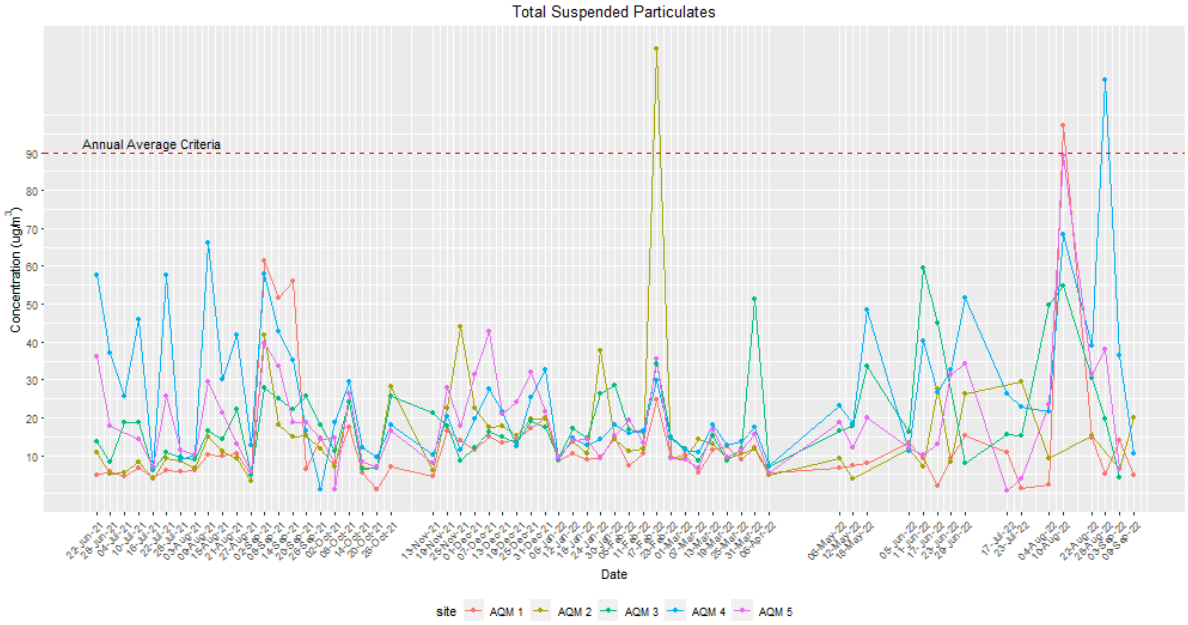

Figure 5-5: 24-hour total suspended particulate (TSP) concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0061 µg/m³)

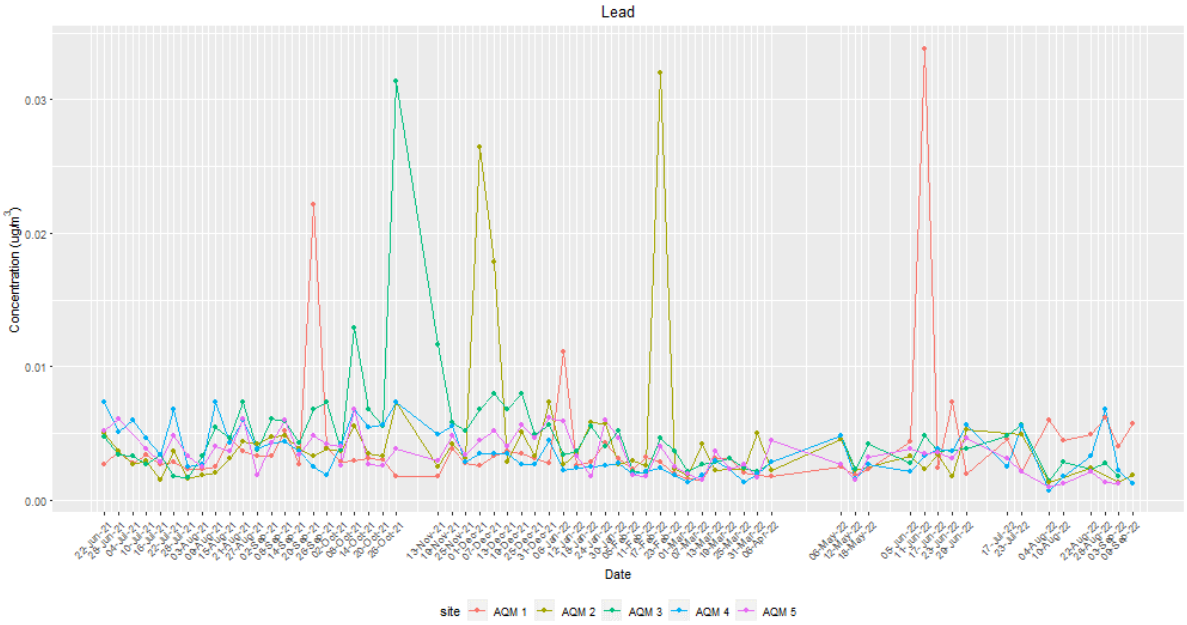

Figure 5-6: 24-hour lead concentration measured at each sampling location every one day in six, from 22 June 2021 (annual average lead criteria not shown: 0.5 µg/m³; LOR 0.0006 µg/m³)

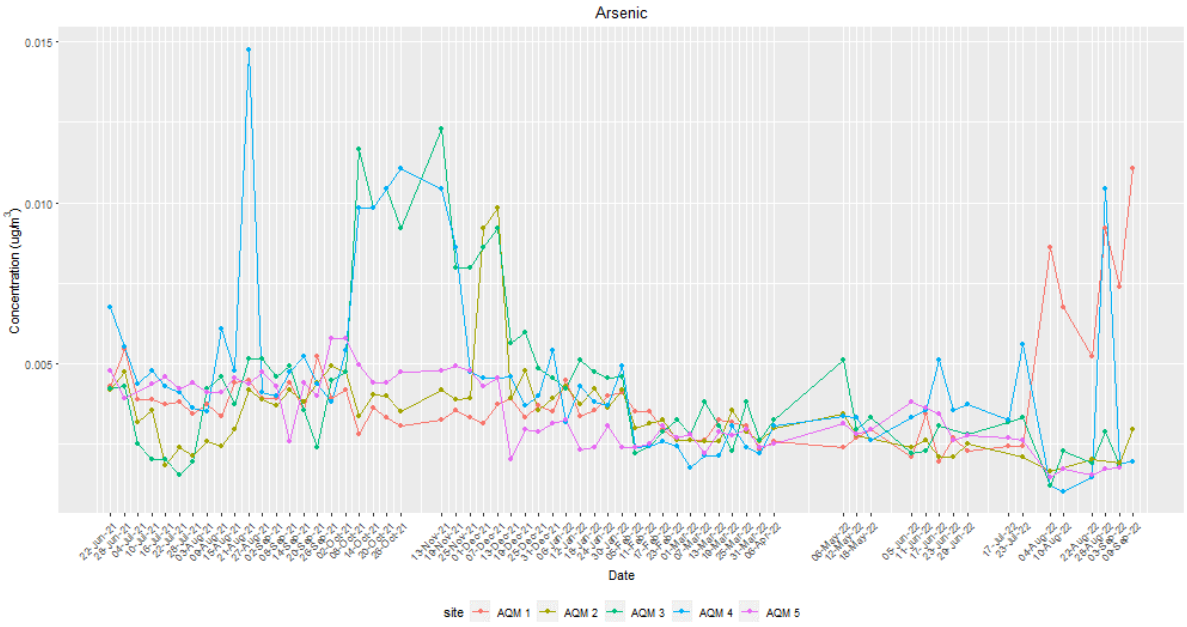

Figure 5-7: 24-hour arsenic concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0006 µg/m³)

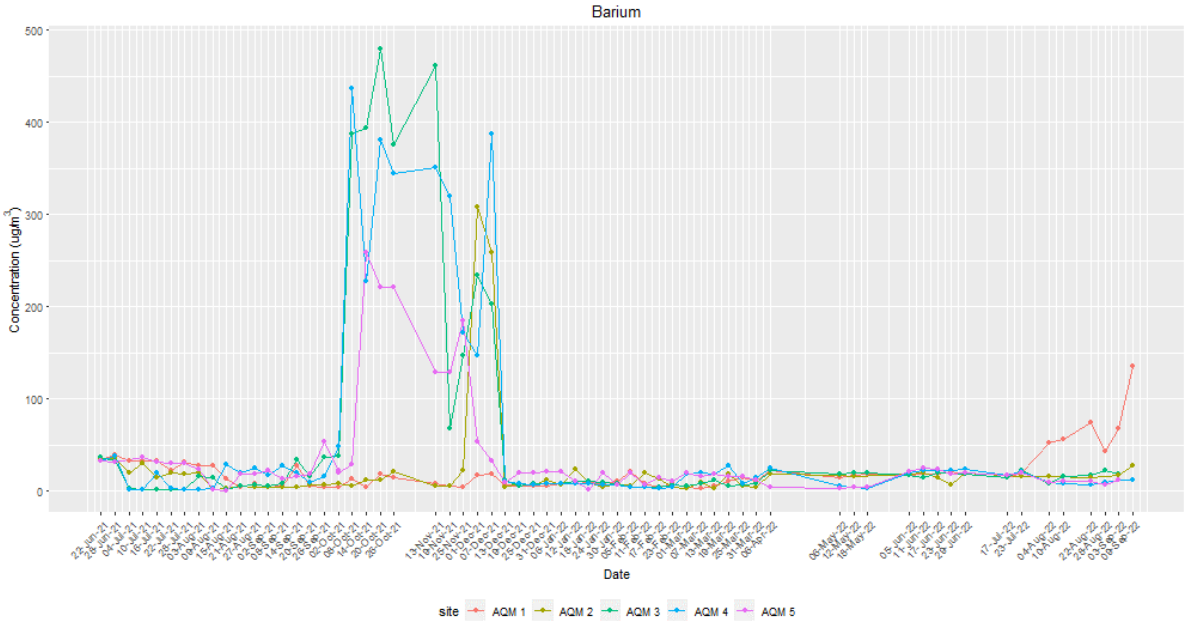

Figure 5-8: 24-hour barium concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0006 µg/m³)

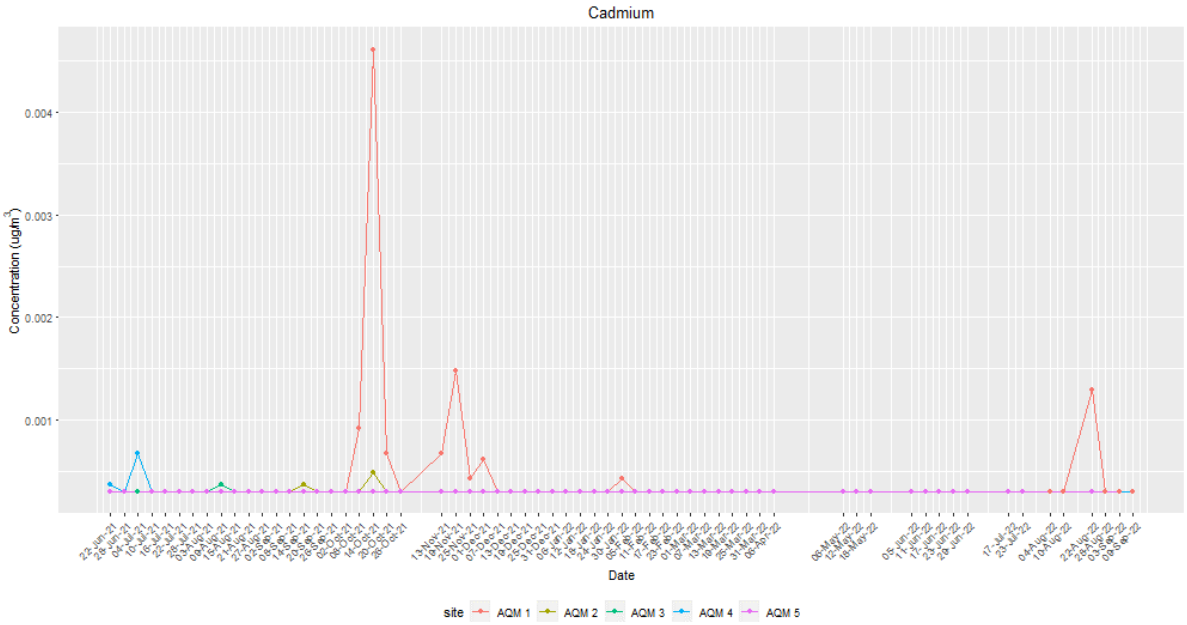

Figure 5-9: 24-hour cadmium concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0003 µg/m³)

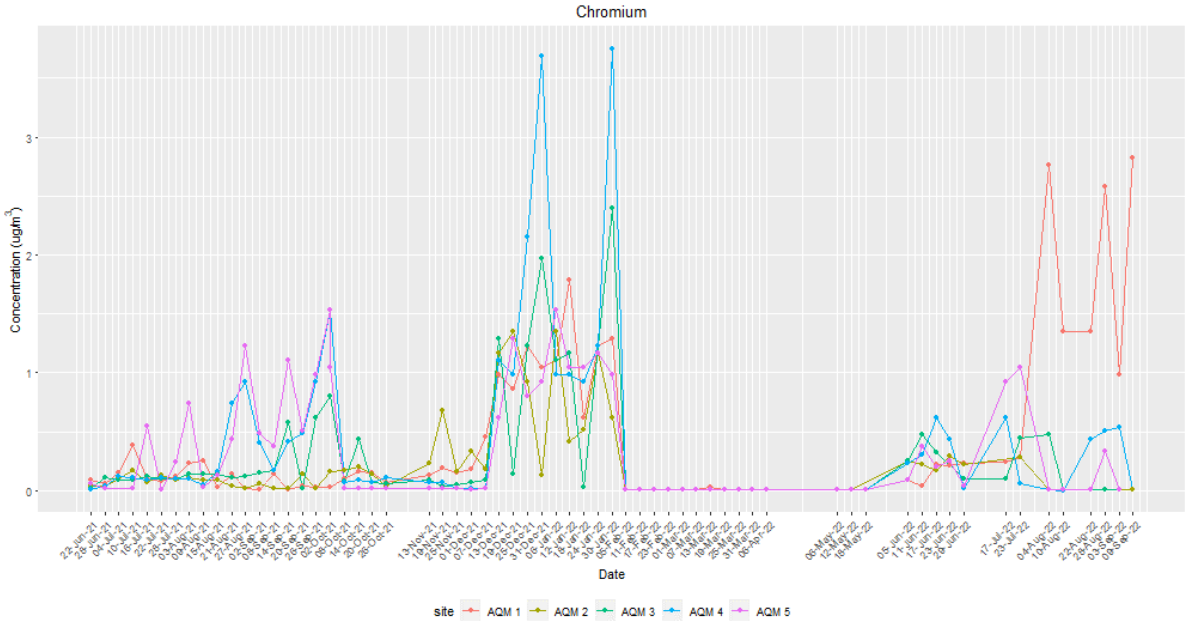

Figure 5-10: 24-hour chromium concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0006 µg/m³)

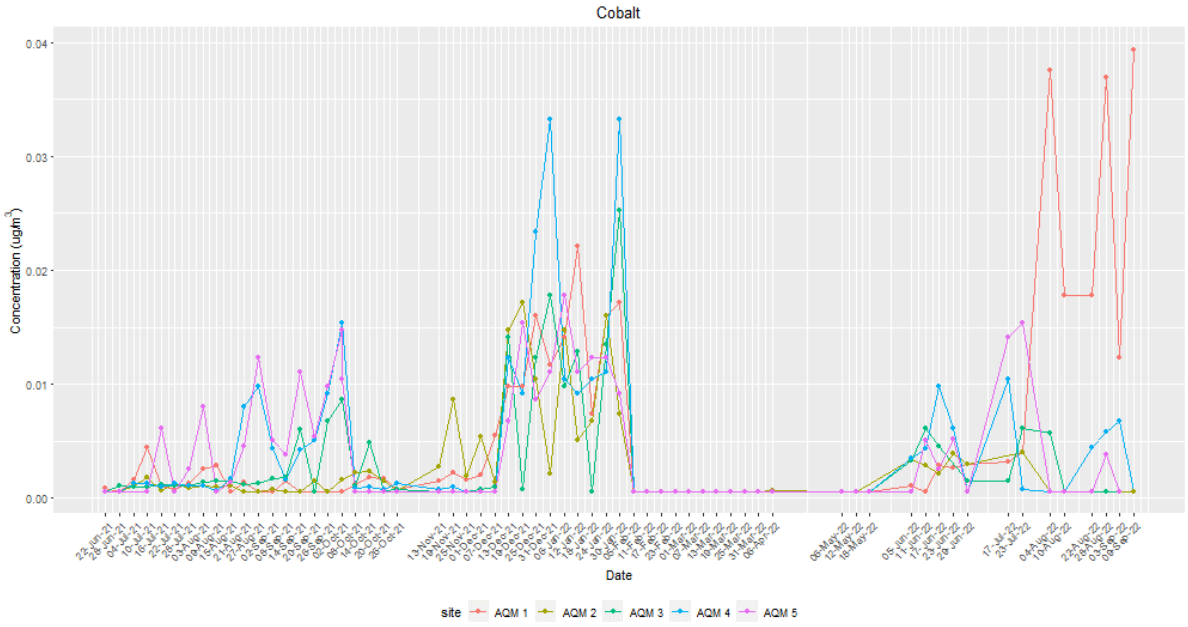

Figure 5-11: 24-hour cobalt concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0006 µg/m³)

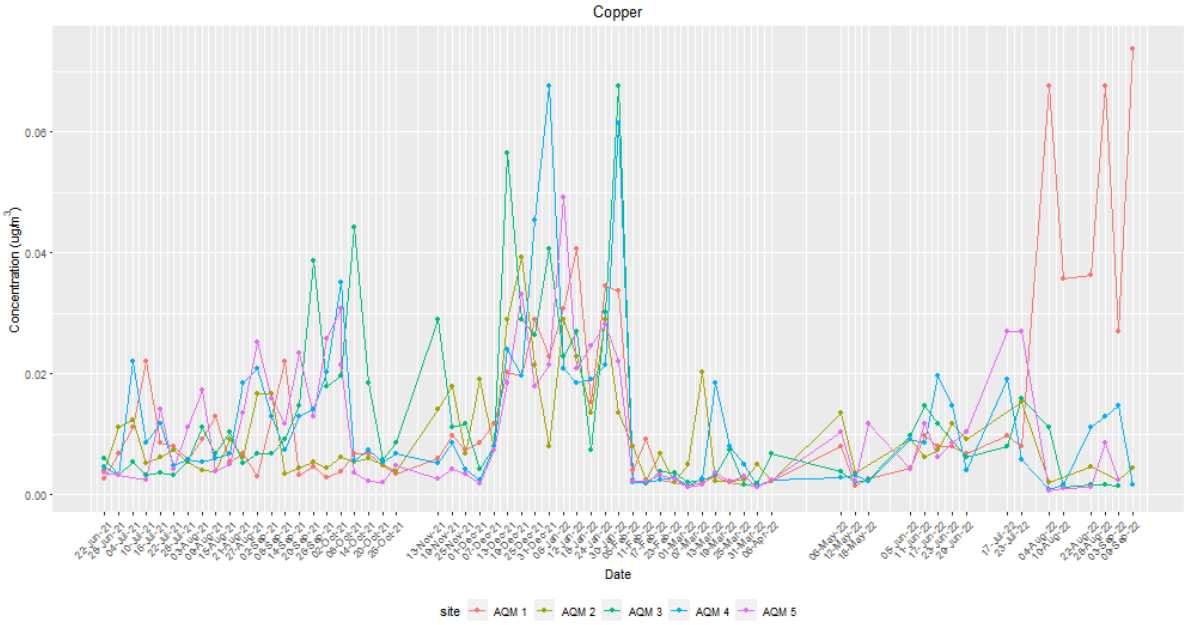

Figure 5-12: 24-hour copper concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0006 µg/m³)

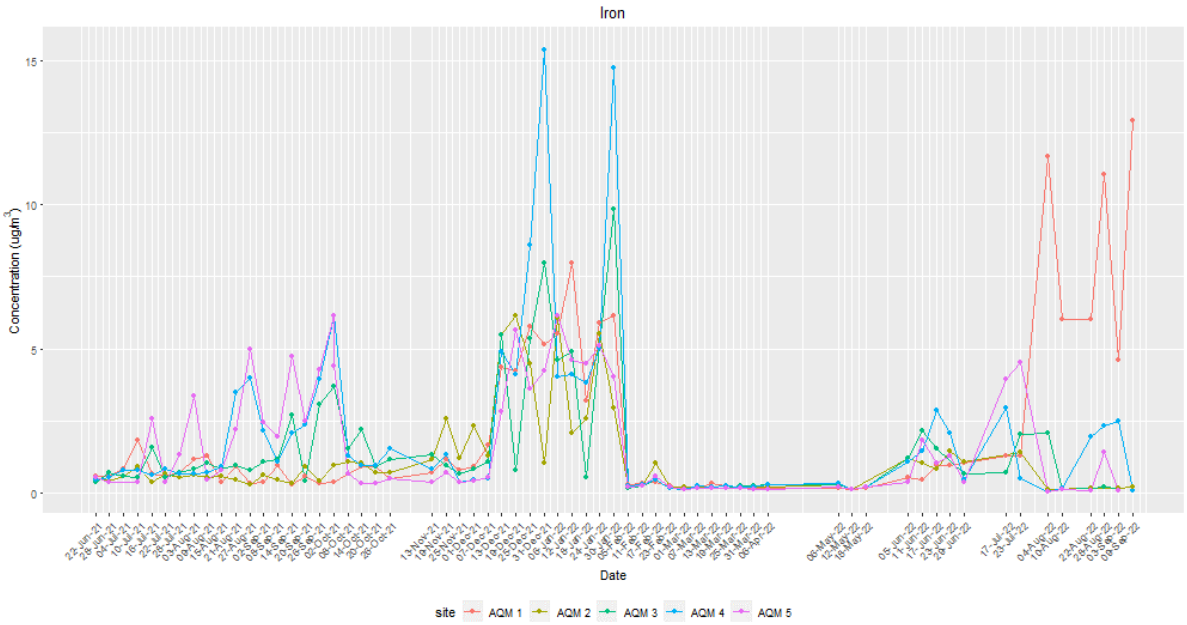

Figure 5-13: 24-hour iron concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0061 µg/m³)

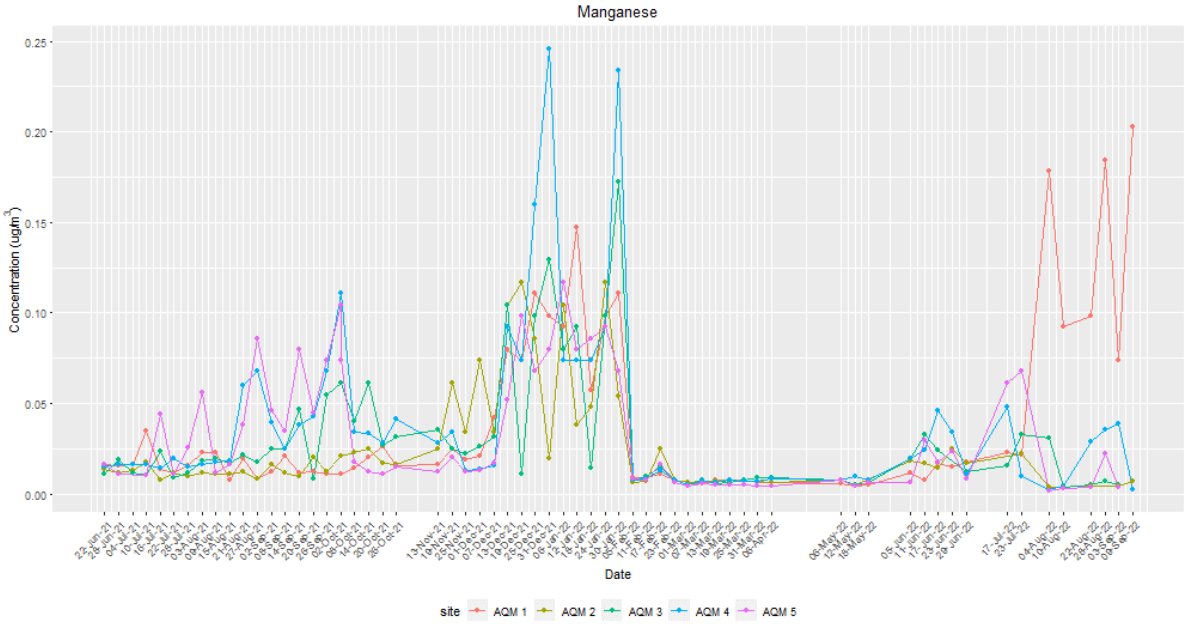

Figure 5-14: 24-hour manganese concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0006 µg/m³)

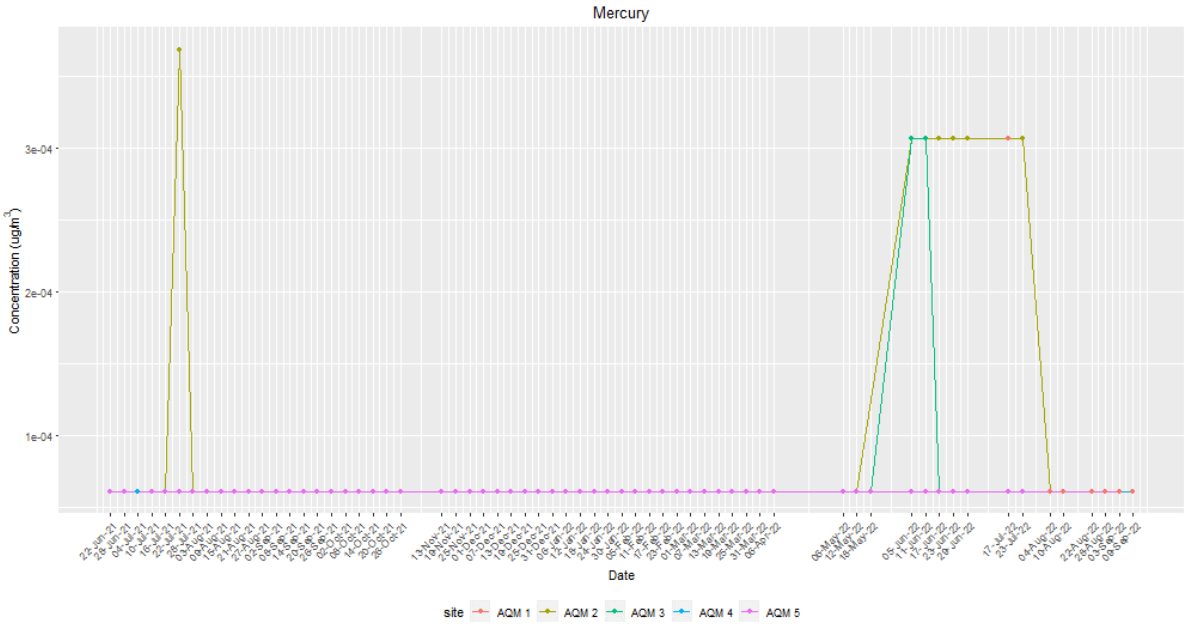

Figure 5-15: 24-hour mercury concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0001 µg/m³[1]) Note: the only sample with detectable concentration was at AQM2 on 22 July 2021 (0.0004 µg/m³).

[1] LOR 0.0003 µg/m³ (5 times dilution needed to be placed) in the AQM1 samples from the 05, 11, 17, 23 and 29 June, and 17 and 23 July 2022, the AQM2 samples from the 05, 11, 17, 23 and 29 June, and 23 July 2022, and the AQM3 samples from the 05 and 11 June 2022.

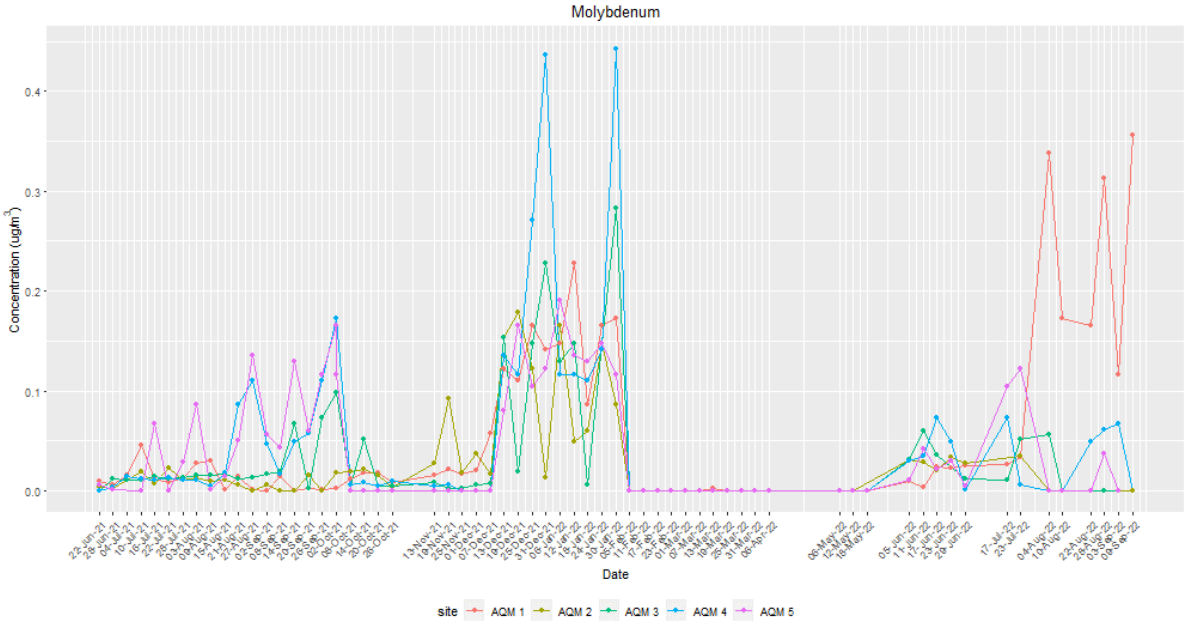

Figure 5-16: 24-hour molybdenum concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0006 µg/m³)

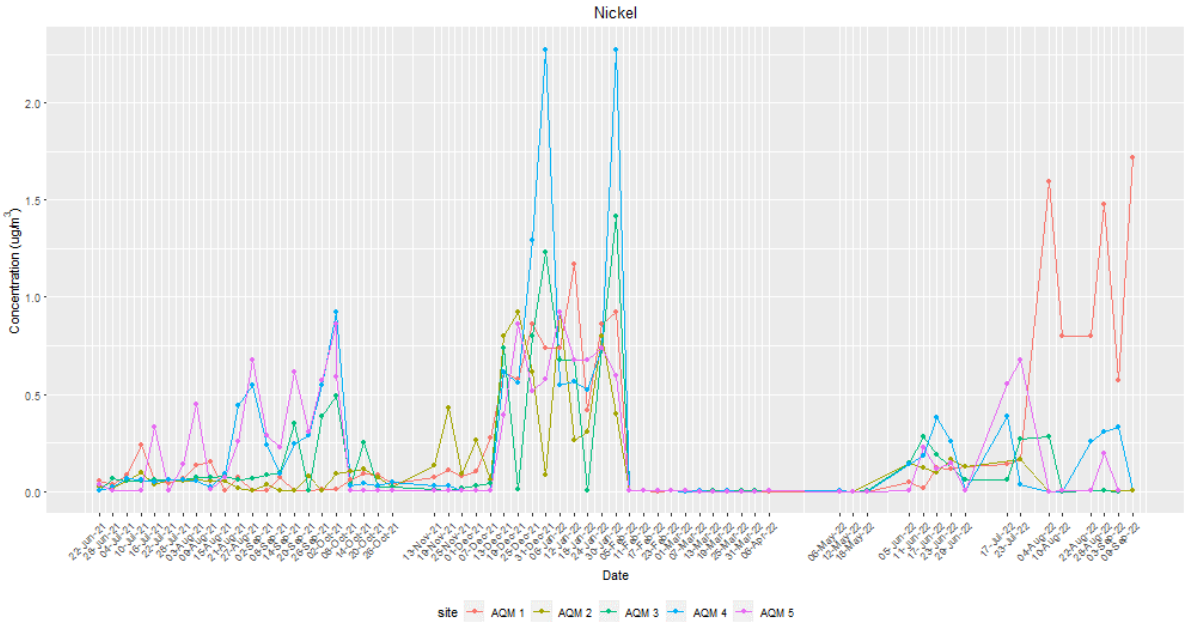

Figure 5-17: 24-hour nickel concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0006 µg/m³)

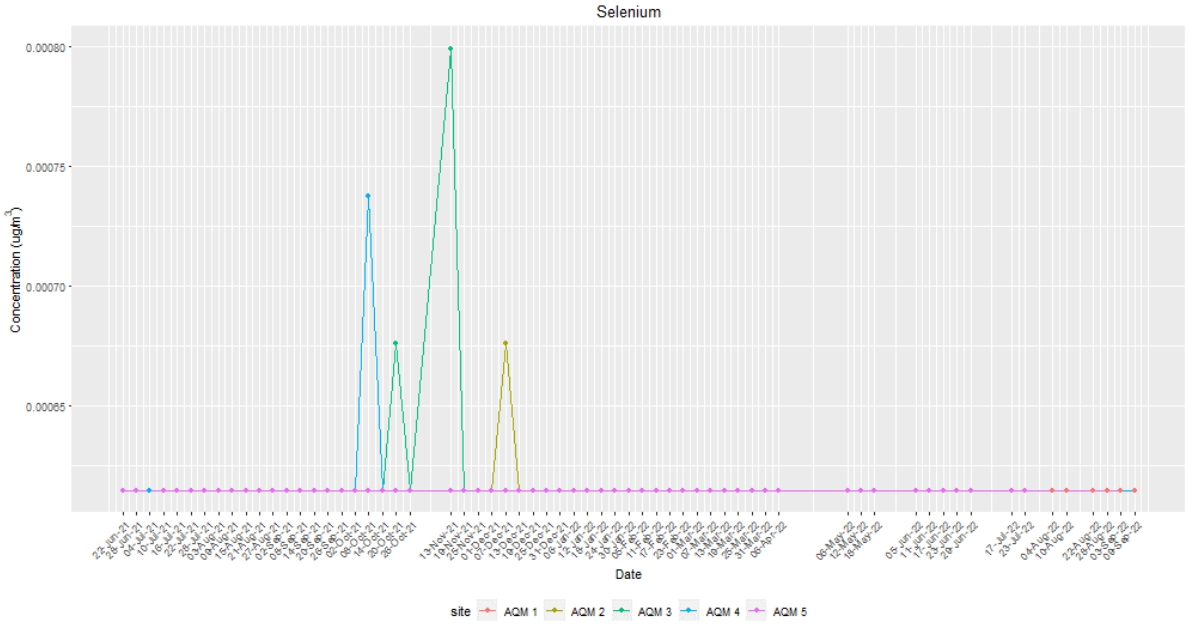

Figure 5-18: 24-hour selenium concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0006 µg/m³)

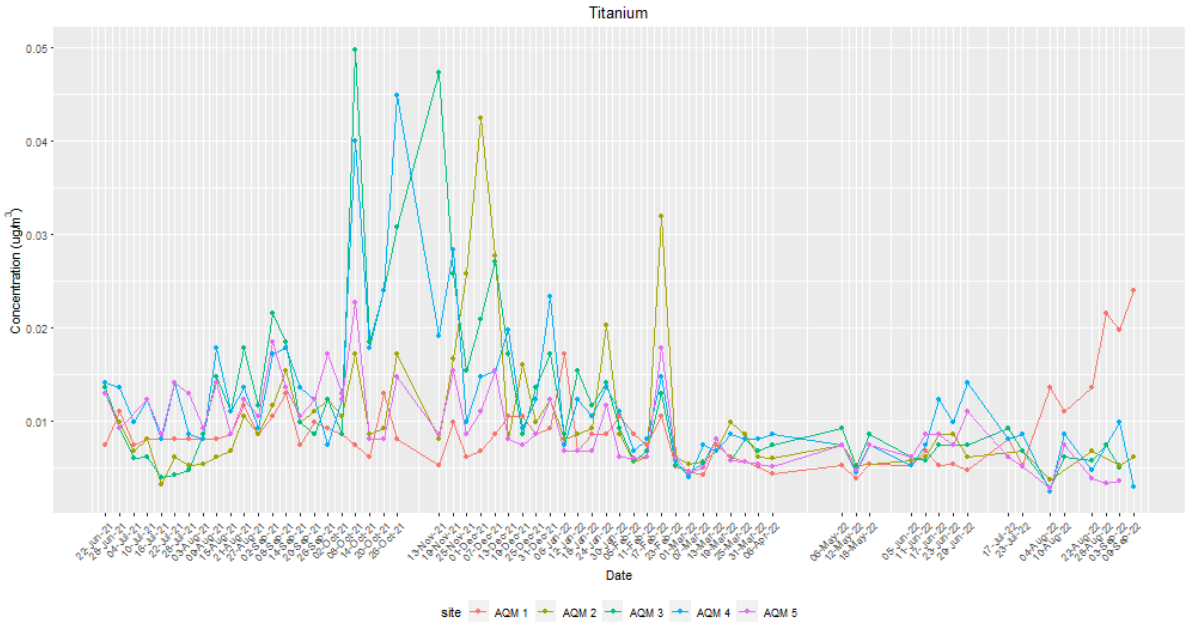

Figure 5-19: 24-hour titanium concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0006 µg/m³)

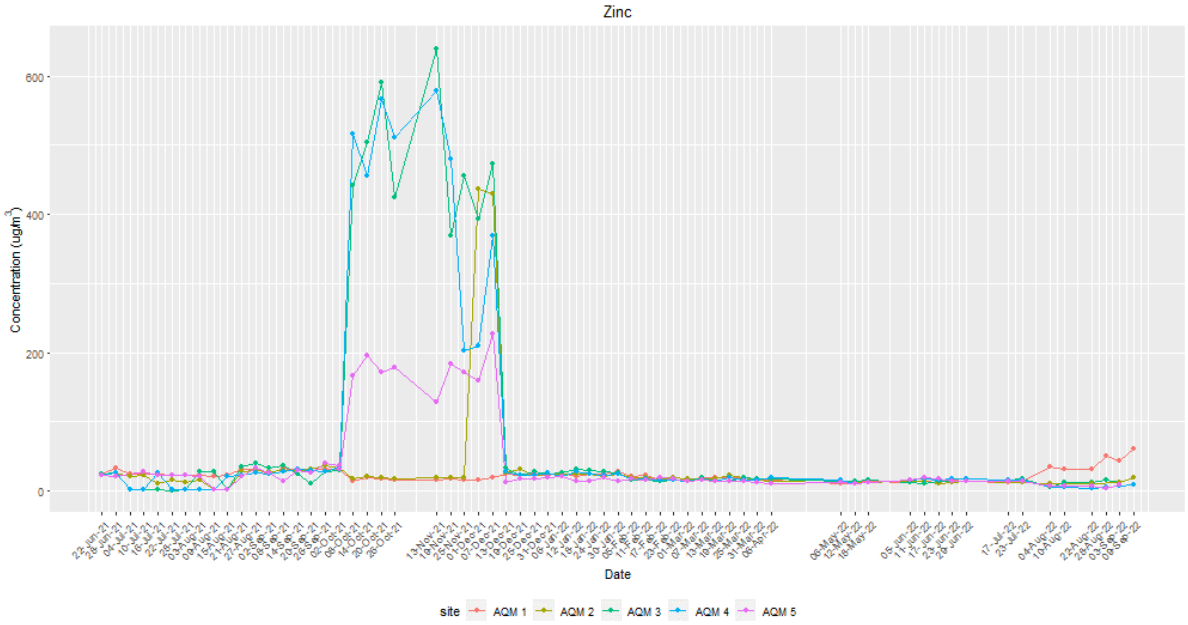

Figure 5-20: 24-hour zinc concentration measured at each sampling location every one day in six, from 22 June 2021 (LOR 0.0006 µg/m³)

5.3.1 Investigation days

Days of comparatively high results were selected for further investigation and are summarised in **Table 5-3**. The daily-average TSP concentrations from the 10 and 28 August 2022 recorded by AQM1 and AQM4, respectively, that exceeded the annual criteria were not further investigated due to the absence of local meteorological data which can lead to erroneous conclusions. Moreover, these samples are from August when QA was not met, suggesting potential contamination during the handling procedure.

Table 5-3: Investigation days

Location and sample ID	Date	Pollutant (concentration)	Reason	On the day and antecedent rainfall
AQM 2 – HVS541	22/07/2021	Mercury (0.0004 µg/m³)	Only sample with detected concentration (above LOR)	2 mm, first rain event since the beginning of monitoring
AQM 2 – HVS1059	17/02/2022	TSP (117.4 µg/m³)	Above annual average criteria	0 mm, 6th day without rain

On 22 July 2021, mercury was recorded with concentration above LOR at location AQM2. On this day 2 mm of rain were recorded however conditions were expected to have been dry as no rainfall had been recorded for at least a month prior. Wind roses (**Figure 5-21**) of the day show night winds coming from south-west, and stronger day winds coming from north-east (northern tailings dump).

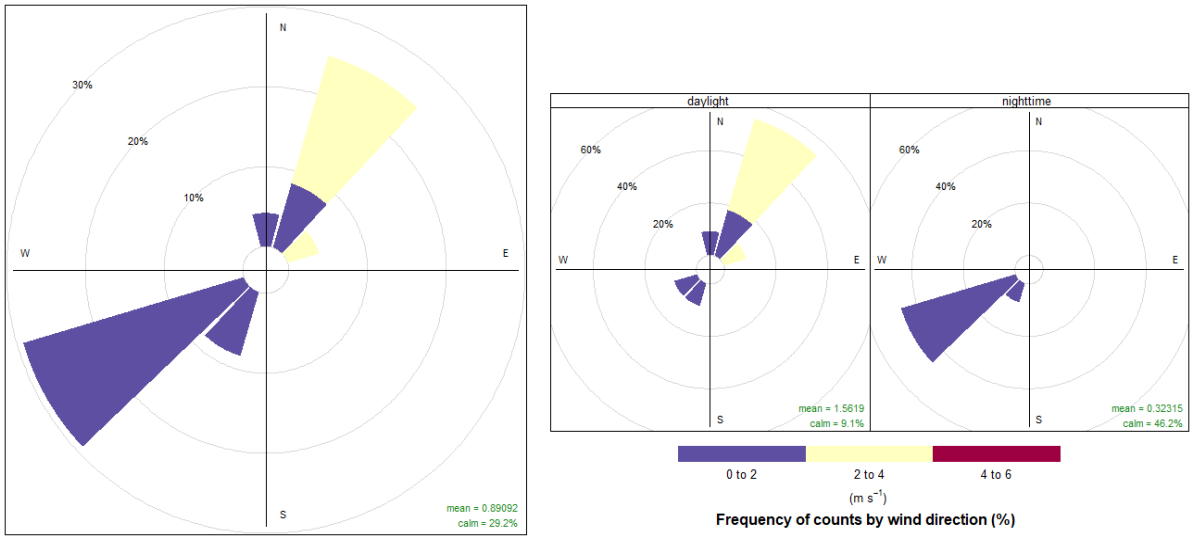

Figure 5-21: Wind roses (10 m) for 22 July 2021 at 2 Copper Creek Road, Captains Flat, NSW (produced with openair; Carslaw & Ropkins, 2012)

On 17 February 2022, TSP was recorded with concentration above the annual average criterion at location AQM2. It is worth highlighting that this criterion applies for annual period averages, so the comparison to a daily average is a conservative approach to identify concentrations worth further investigation. Rainfall results indicate that the weather was dry, with no recorded rainfall on that or 5 days prior. Wind roses (**Figure 5-22**) of the day show night winds coming from south-west, and stronger day winds coming from north (border of the northern tailings dump) and north-west.

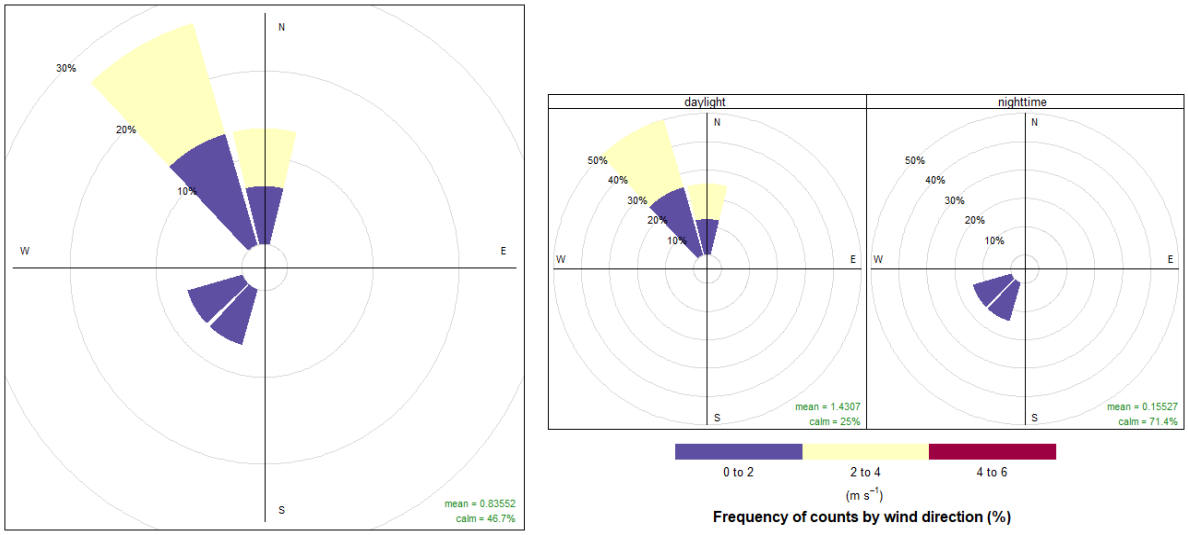

Figure 5-22: Wind roses (10 m) for 17 February 2022 at 2 Copper Creek Road, Captains Flat, NSW (produced with openair; Carslaw & Ropkins, 2012)

5.4 Potential factors influencing dispersion

Bivariate polar plots are presented for TSP and each heavy metal analysed in **Figure 5-23** to **Figure 5-38**. Additionally, the bivariate plots for key pollutants TSP, lead and zinc are presented spatially on a topographical map in **Appendix 1**.

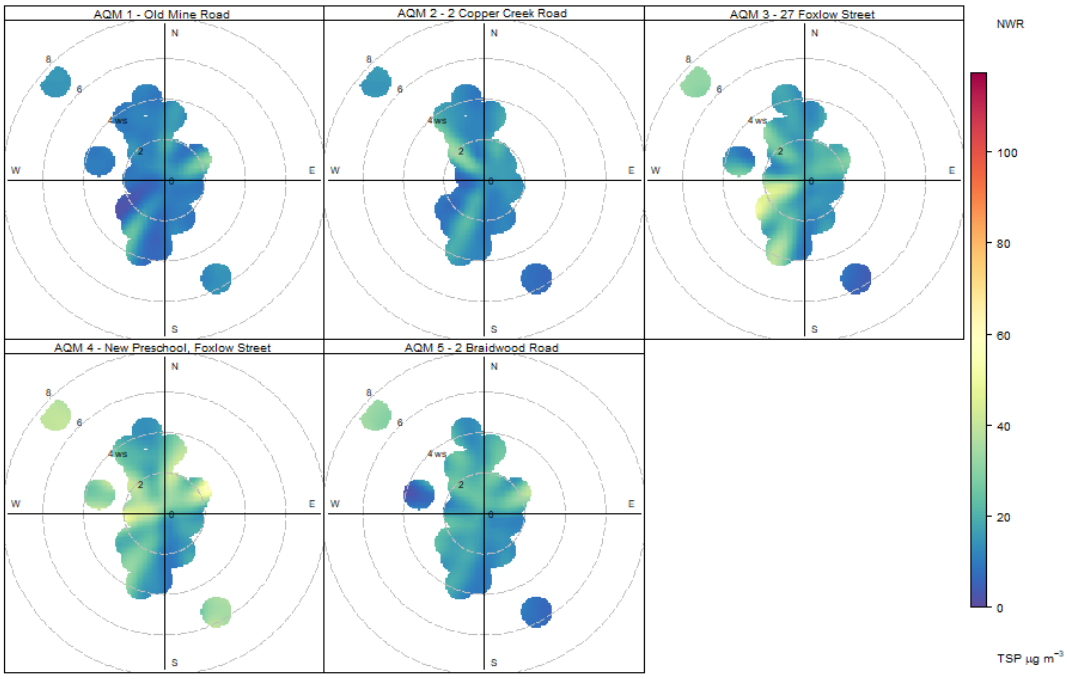

Figure 5-23: Polar plots showing 24-hour TSP concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021 (prepared with openair; Carslaw & Ropkins, 2012)

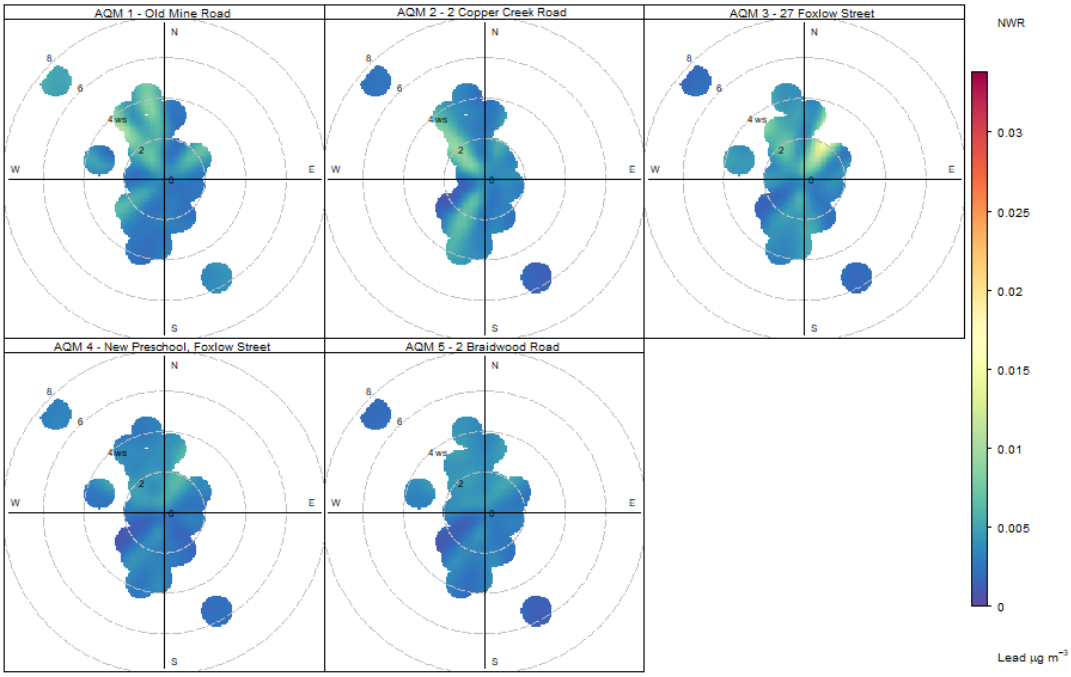

Figure 5-24: Polar plots showing 24-hour lead concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

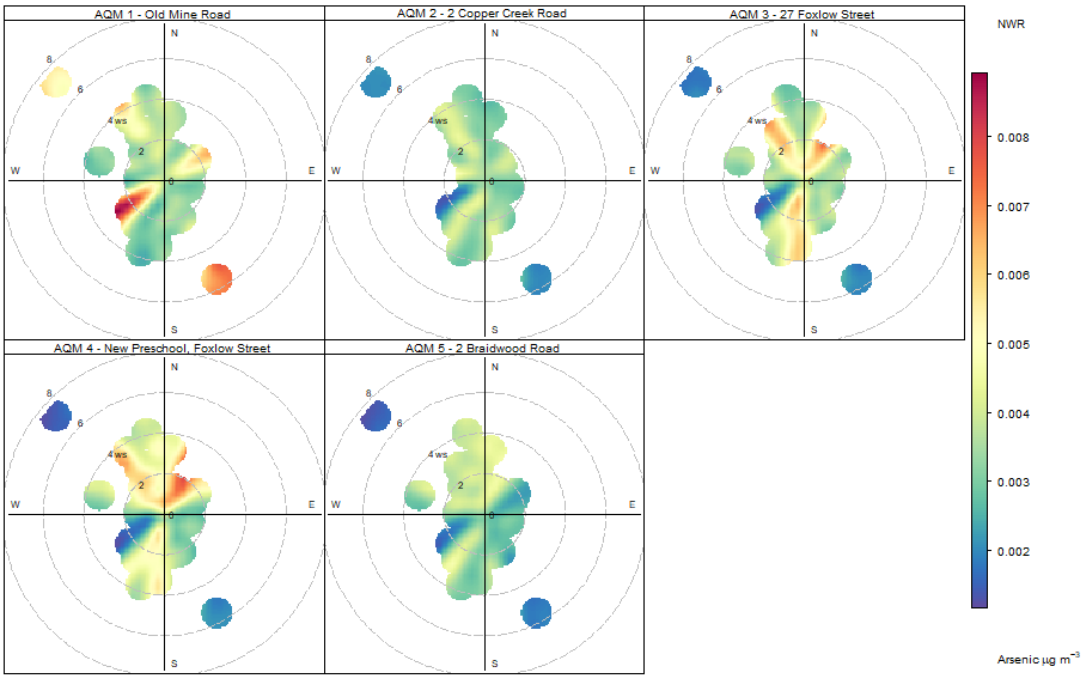

Figure 5-25: Polar plots showing 24-hour arsenic concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

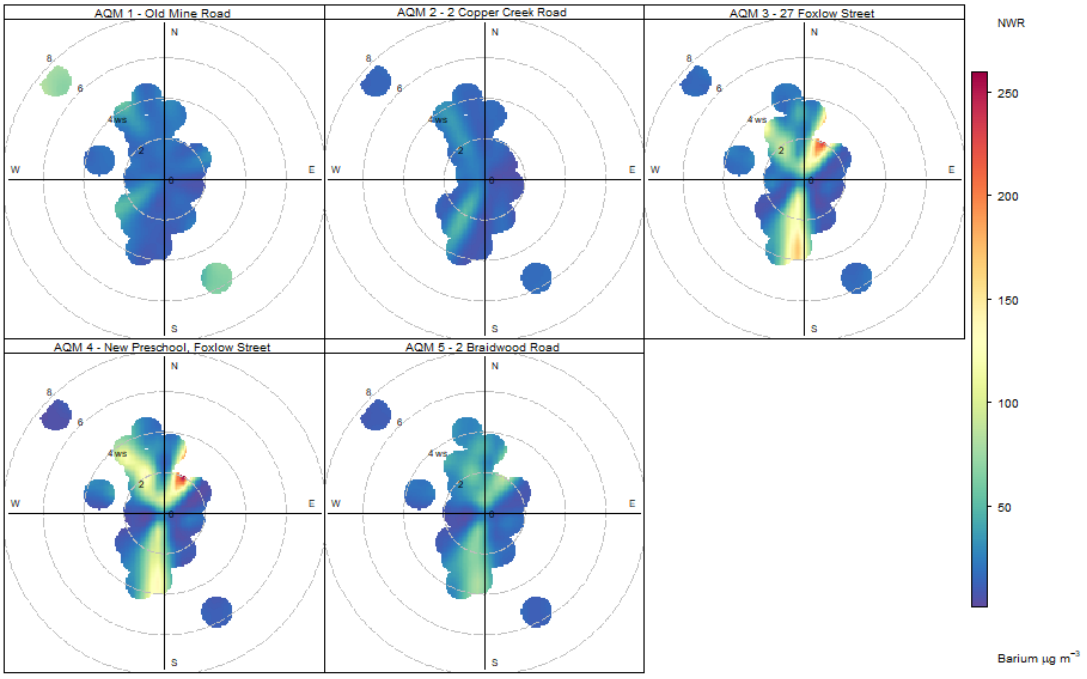

Figure 5-26: Polar plots showing 24-hour barium concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

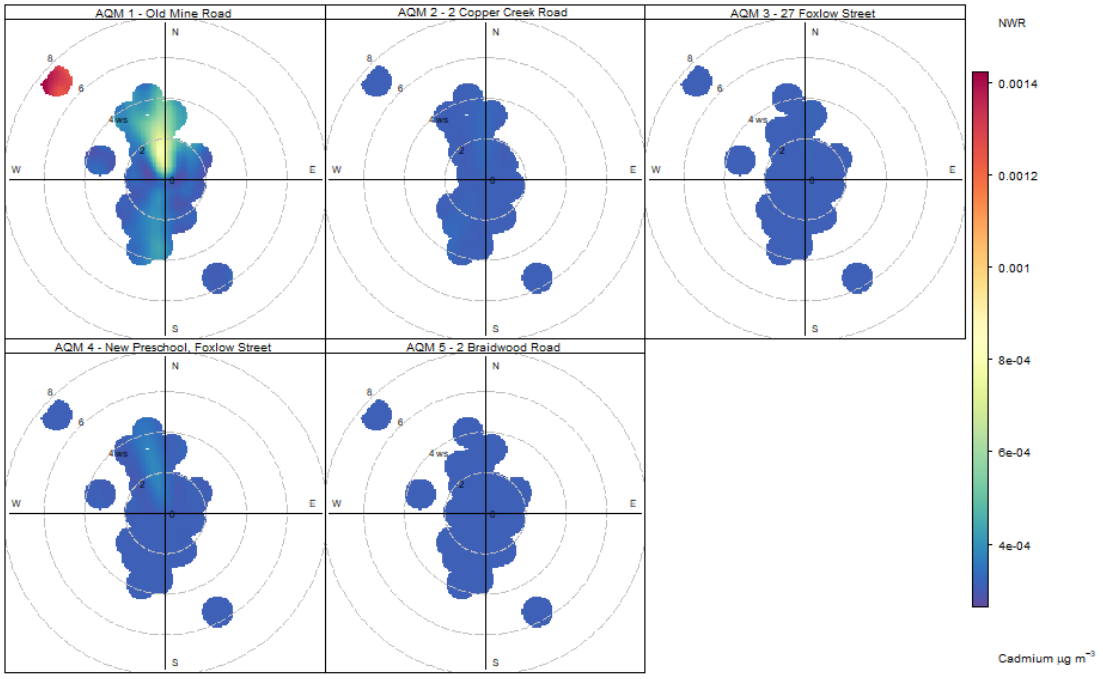

Figure 5-27: Polar plots showing 24-hour cadmium concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

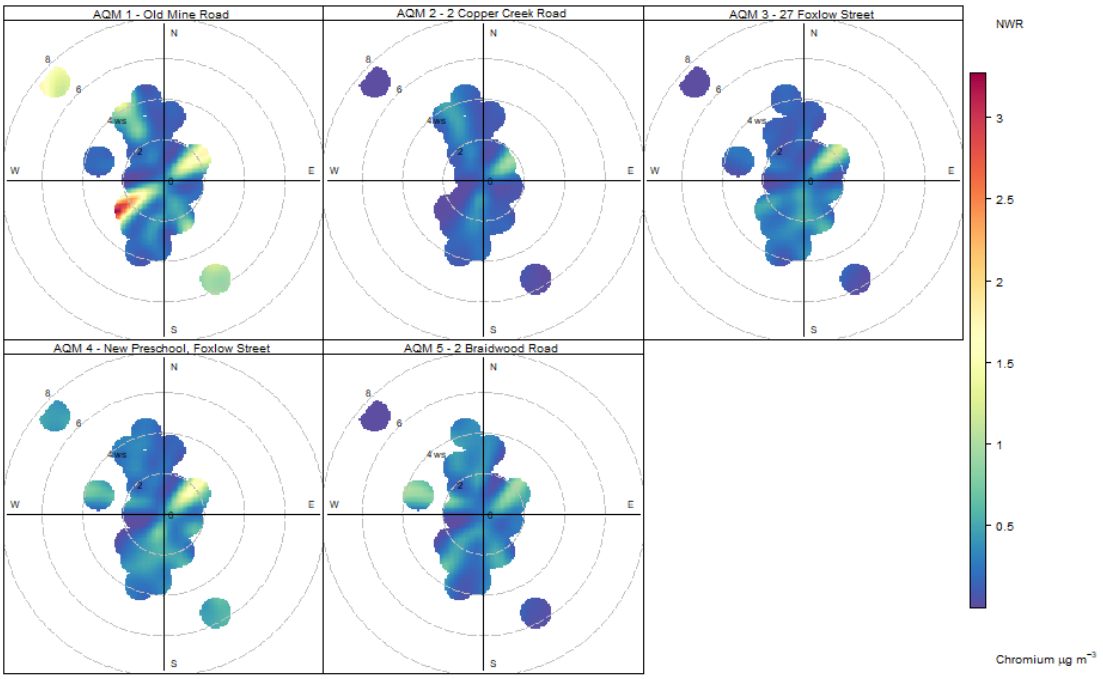

Figure 5-28: Polar plots showing 24-hour chromium concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

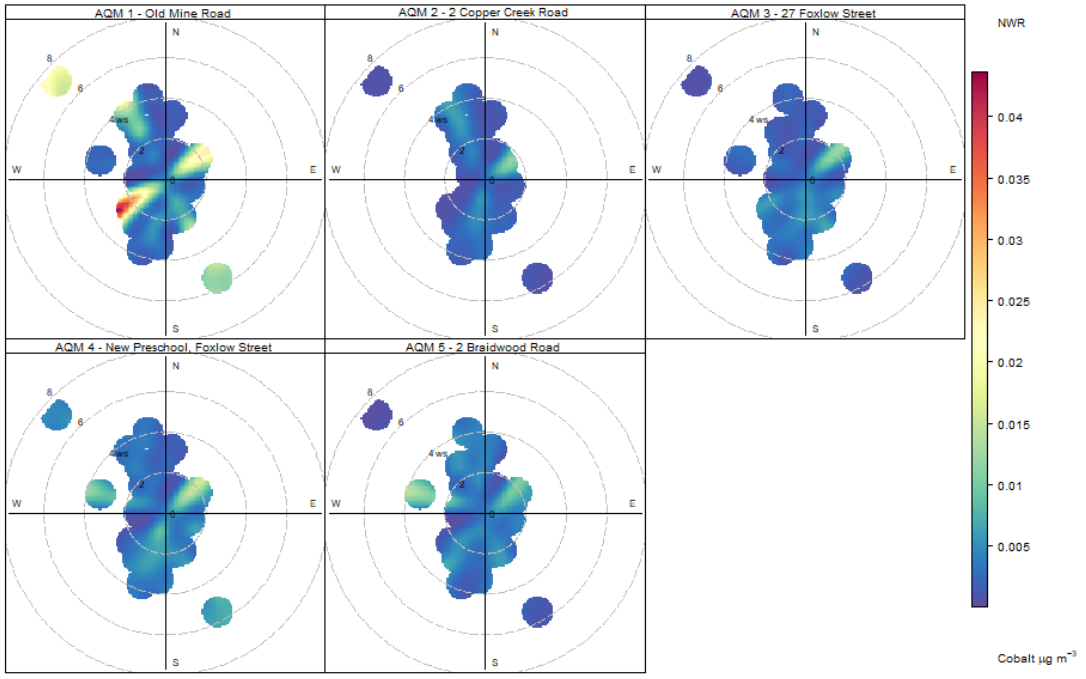

Figure 5-29: Polar plots showing 24-hour cobalt concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

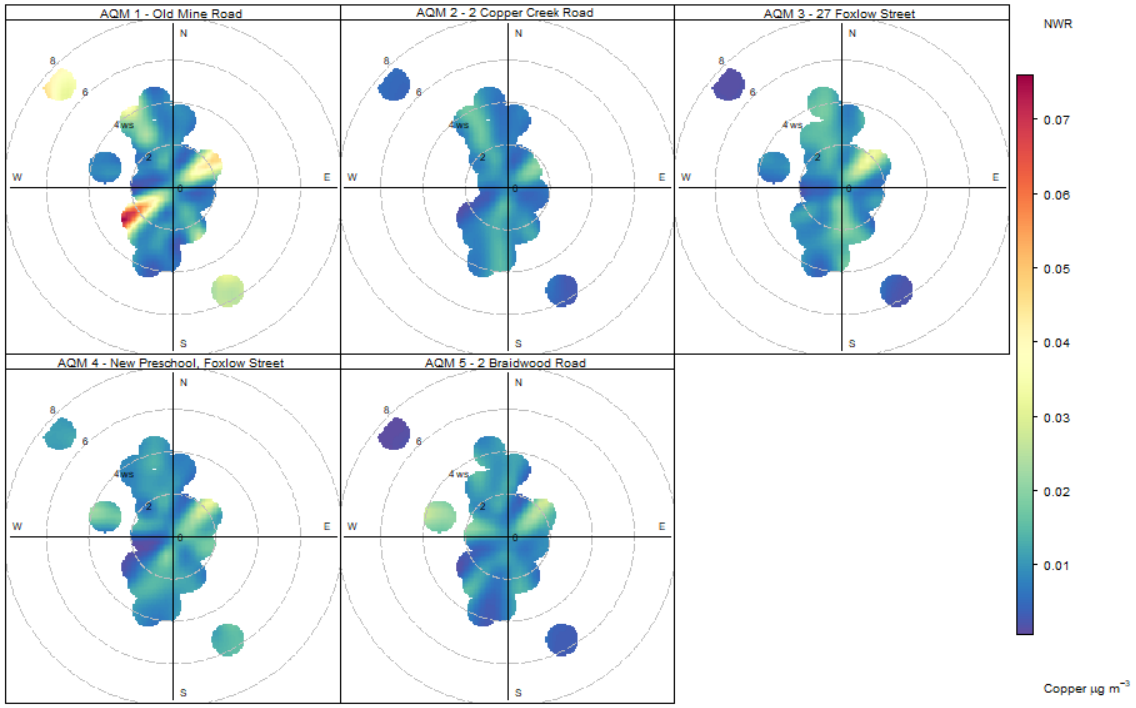

Figure 5-30: Polar plots showing 24-hour copper concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

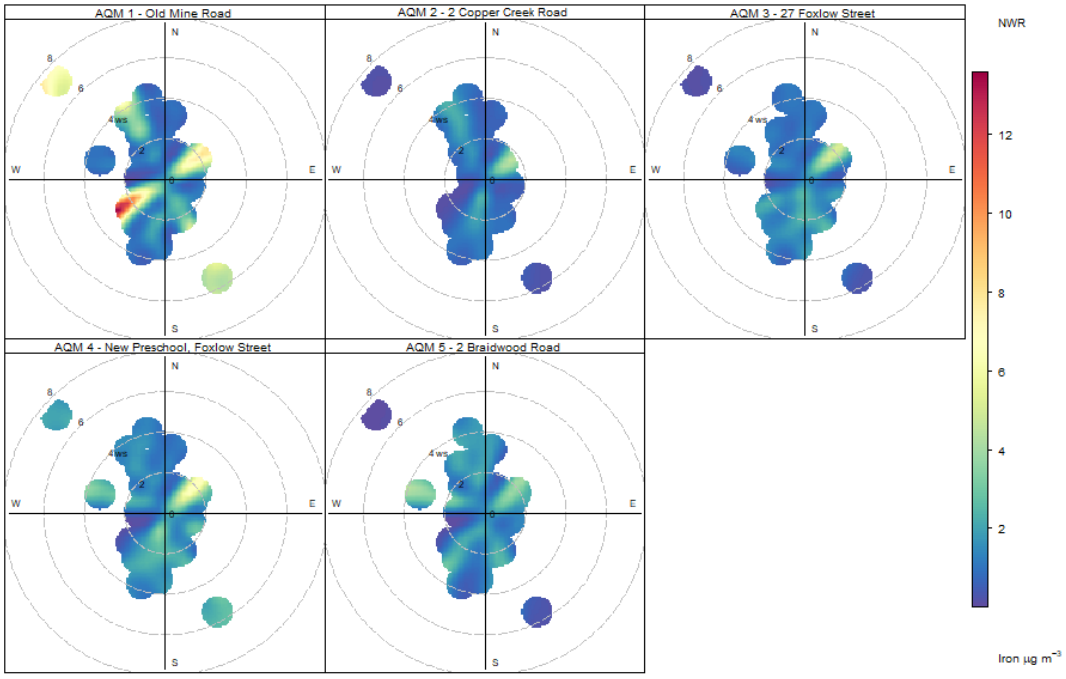

Figure 5-31: Polar plots showing 24-hour iron concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

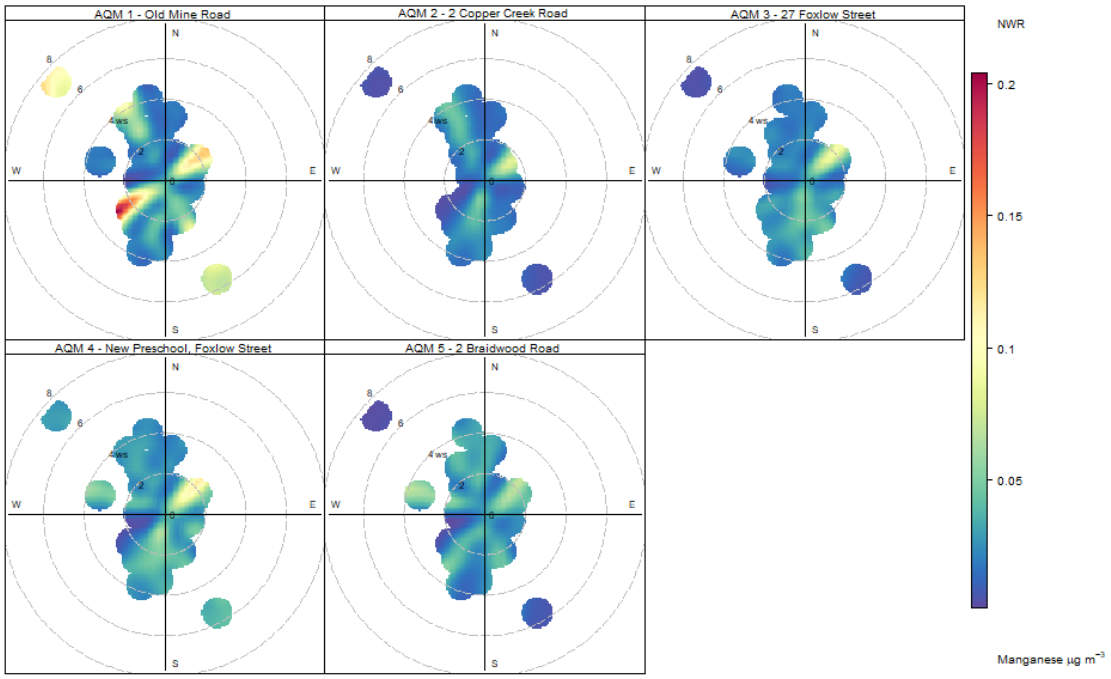

Figure 5-32: Polar plots showing 24-hour manganese concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

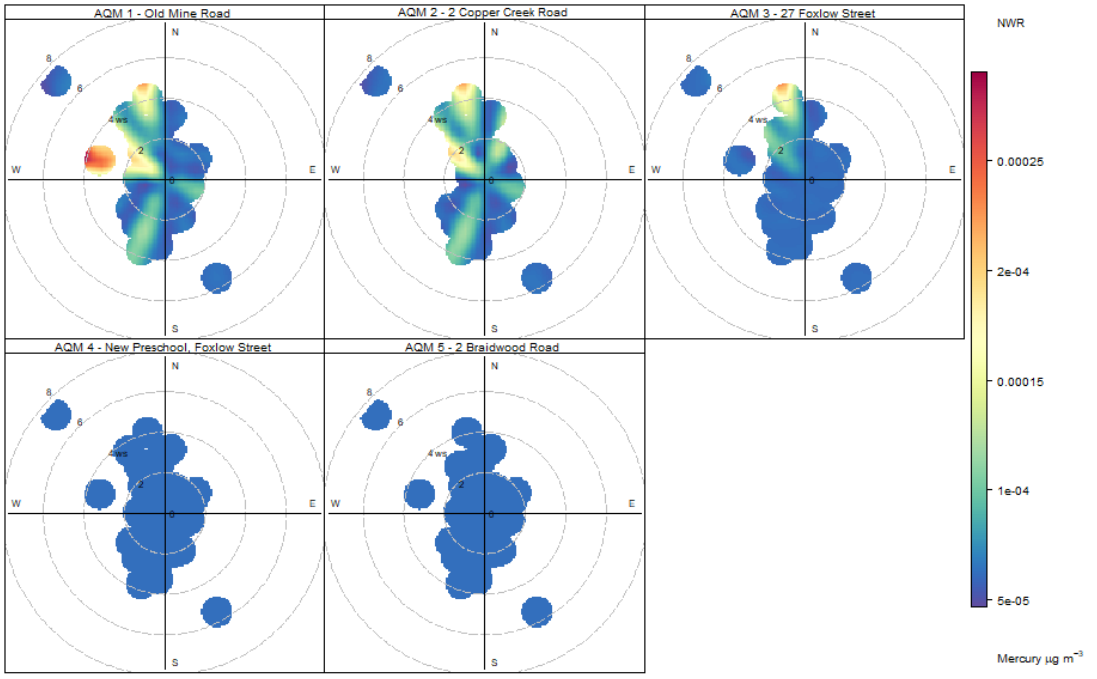

Figure 5-33: Polar plots showing 24-hour mercury concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

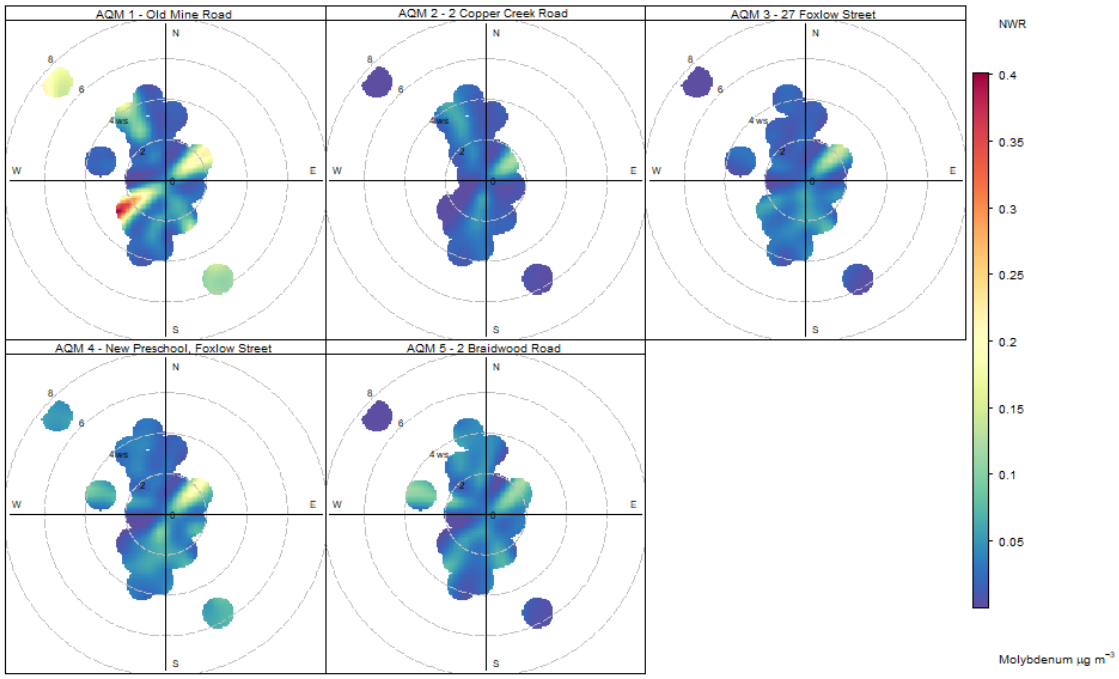

Figure 5-34: Polar plots showing 24-hour molybdenum concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

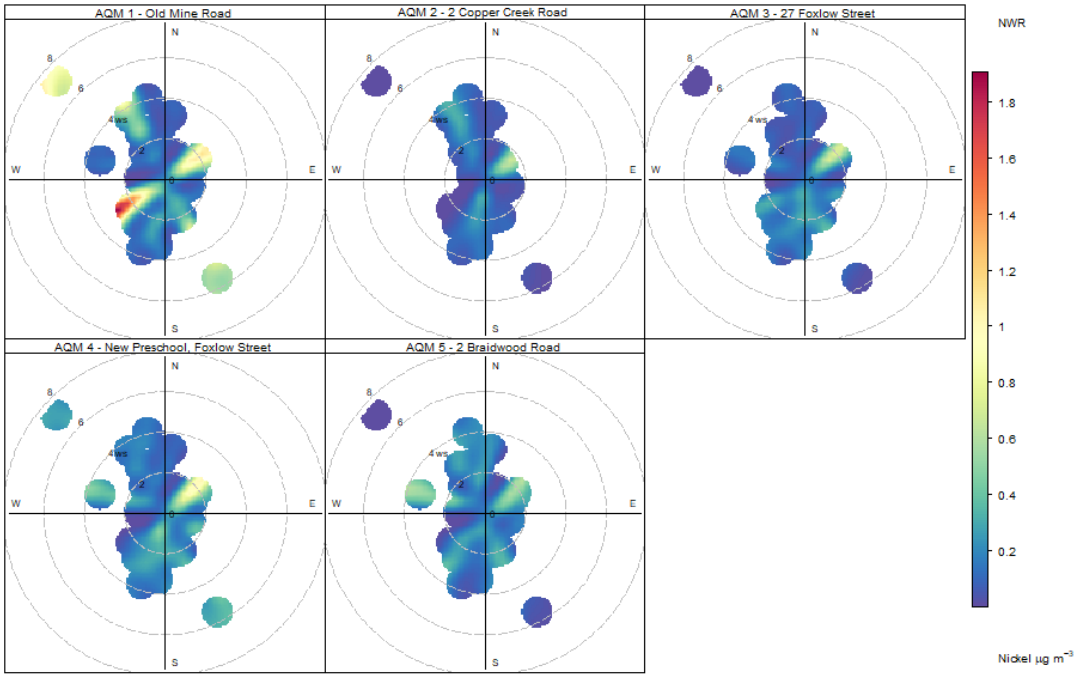

Figure 5-35: Polar plots showing 24-hour nickel concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

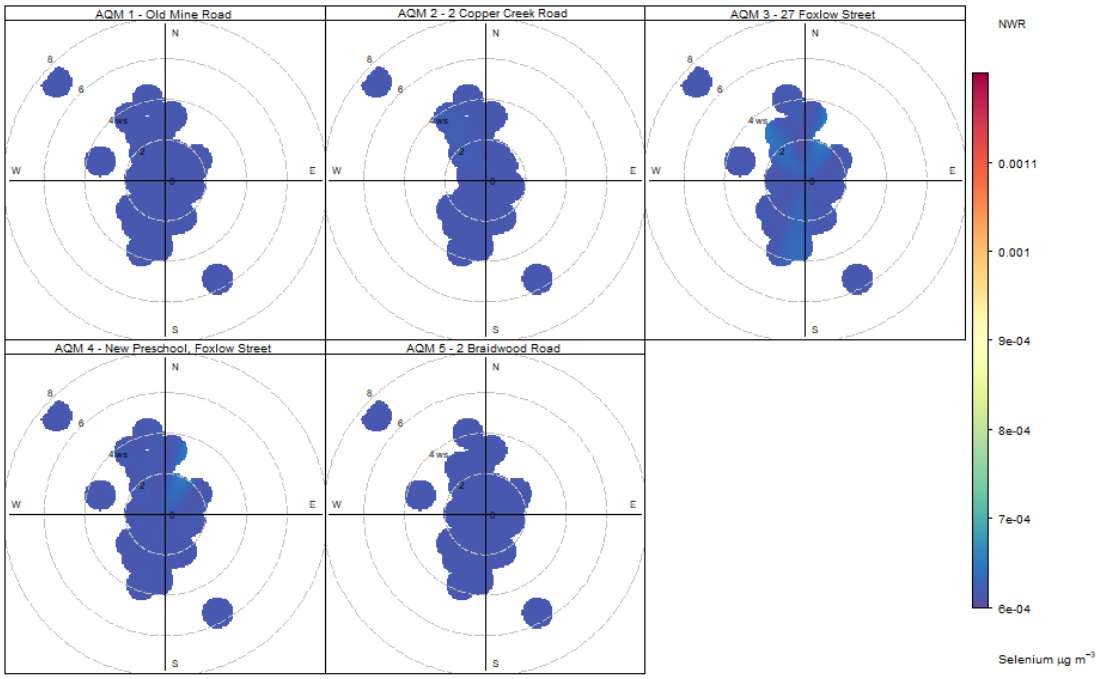

Figure 5-36: Polar plots showing 24-hour selenium concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

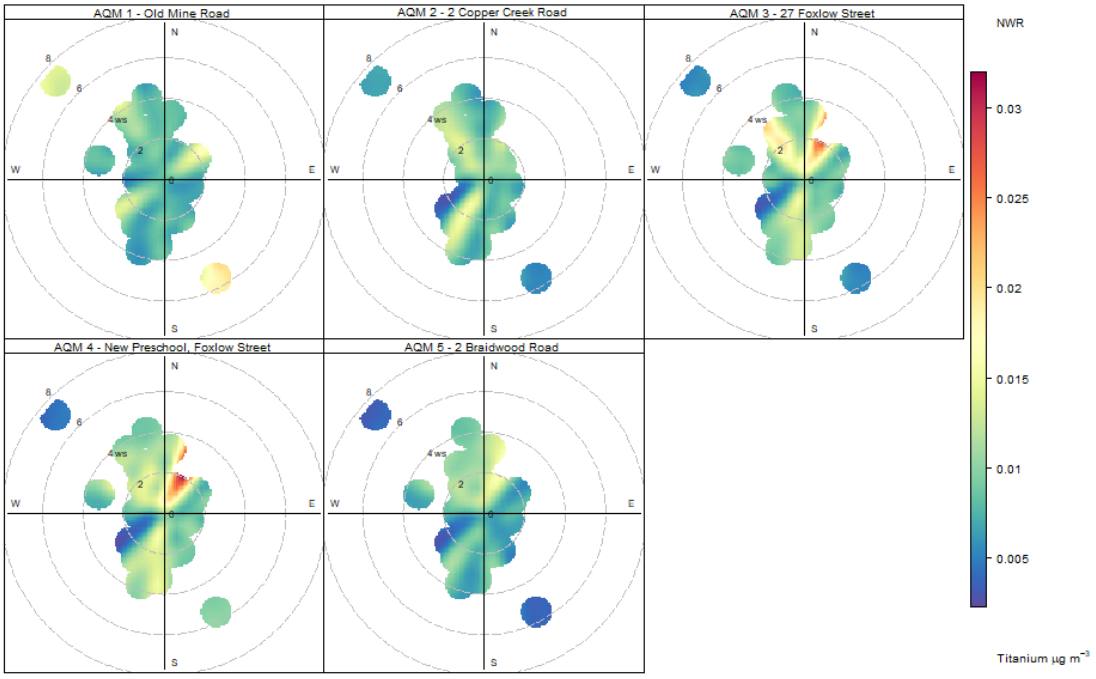

Figure 5-37: Polar plots showing 24-hour titanium concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

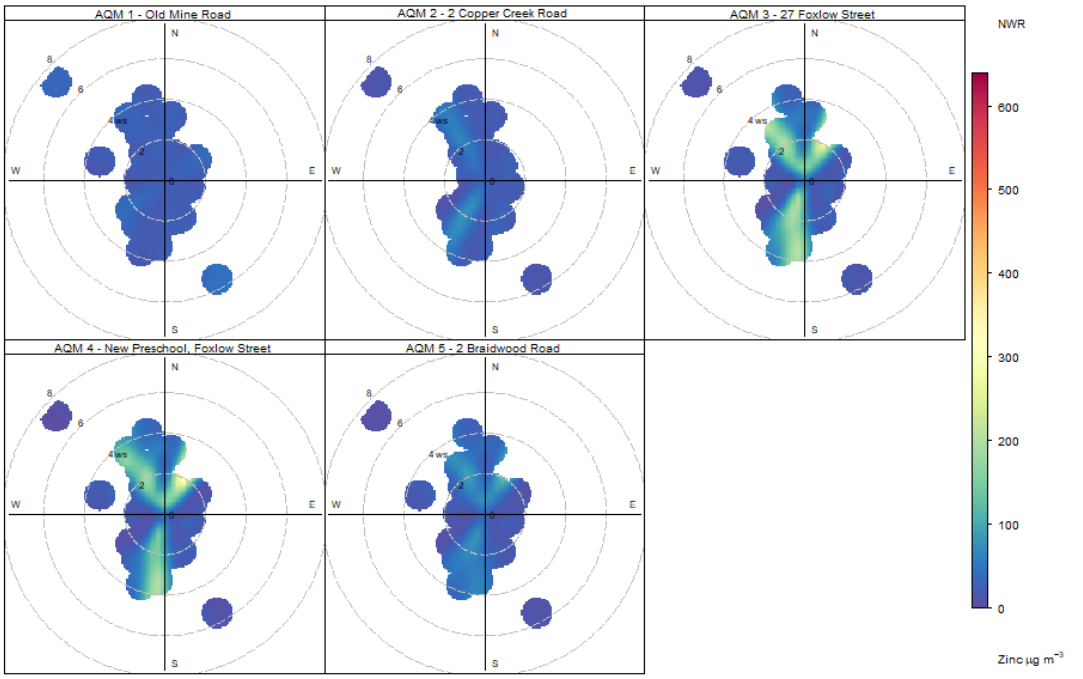

Figure 5-38: Polar plots showing 24-hour zinc concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021

5.5 Correlations for potential source identification

Correlation matrices are presented for each sampling location from **Figure 5-39** to **Figure 5-43** to compare the relationship between each heavy metal and TSP. Note that the data is clustered

by relationship, so each plot is ordered differently depending on the determined correlation, and there are limits on presentation when pollutants are below LOR. **Figure 5-44** presents a comparison between the five locations, where the number of pollutants was reduced to 13 (pollutants with concentrations below LOR in at least one location were disregarded) and the cluster of pollutants was forced in the same order for ease of comparison.

The data shows strong correlations when comparing some pollutants, particularly between copper, manganese, cobalt, molybdenum, nickel, chromium and iron.

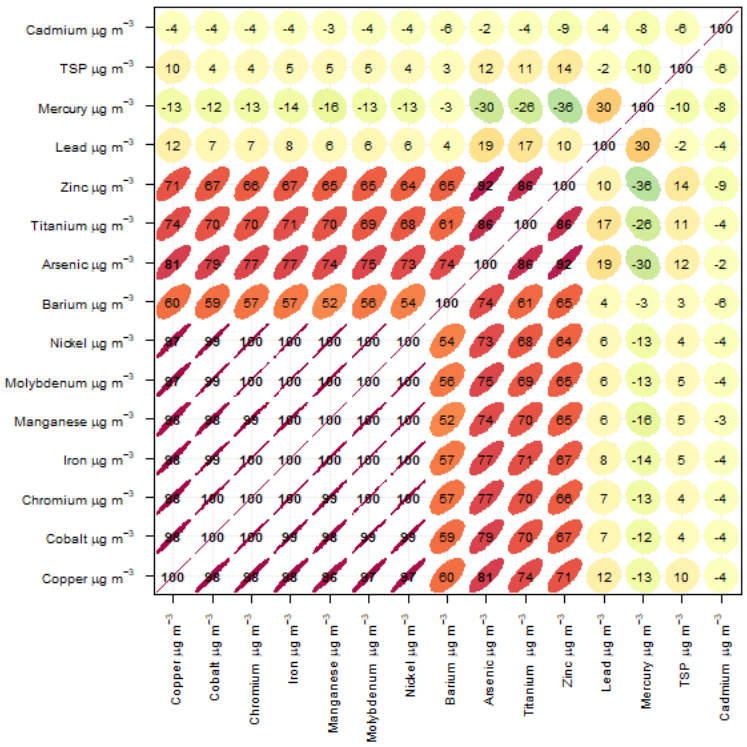

Figure 5-39: Heavy metal and TSP correlations in all samples collected since 22 June 2021 at AQM1 – Old Mine Road

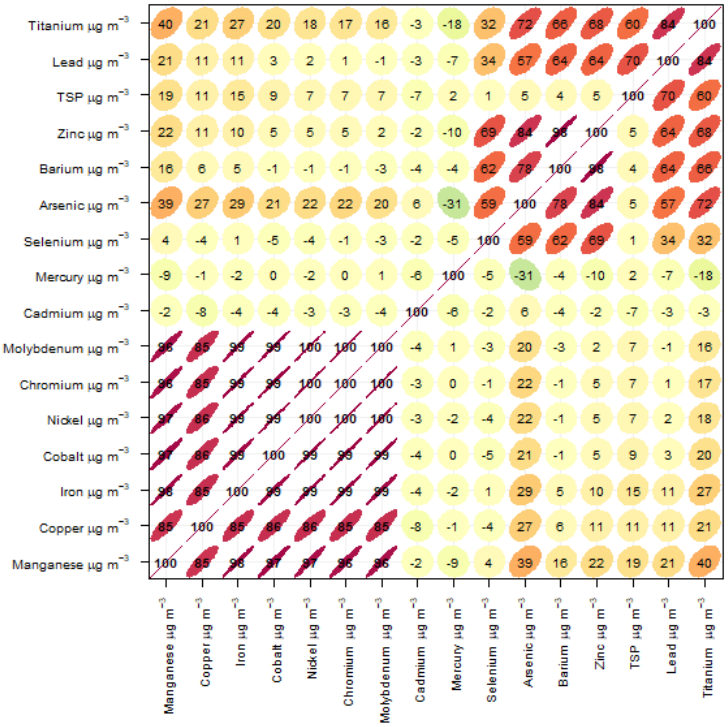

Figure 5-40: Heavy metal and TSP correlations in all samples collected since 22 June 2021 at AQM2 – 2 Copper Creek Rd

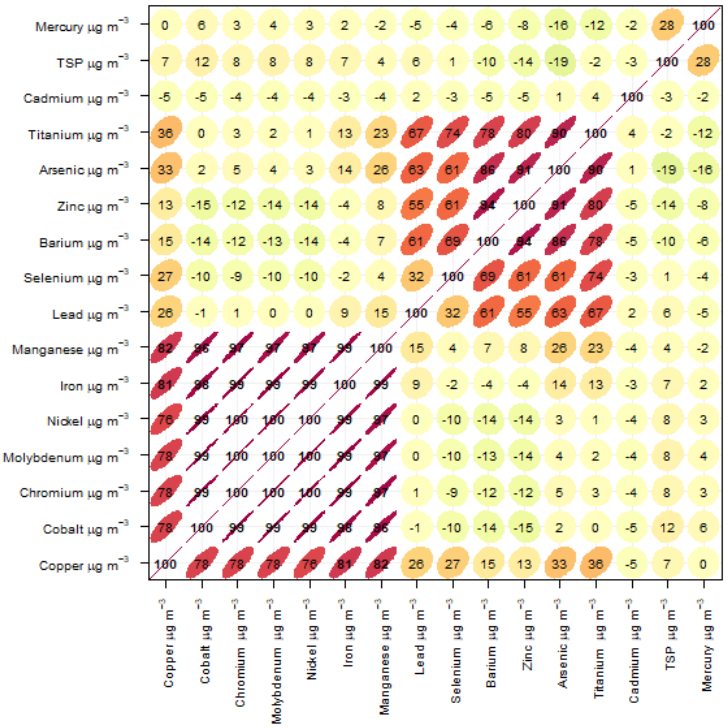

Figure 5-41: Heavy metal and TSP correlations in all samples collected since 22 June 2021 at AQM3 – Former Pre-School

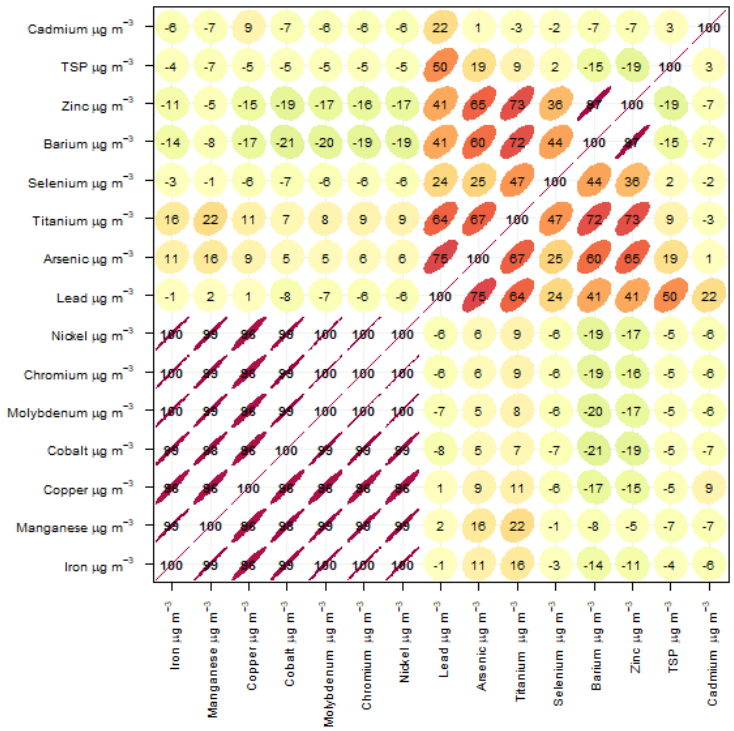

Figure 5-42: Heavy metal and TSP correlations in all samples collected since 22 June 2021 at AQM4 – New Preschool

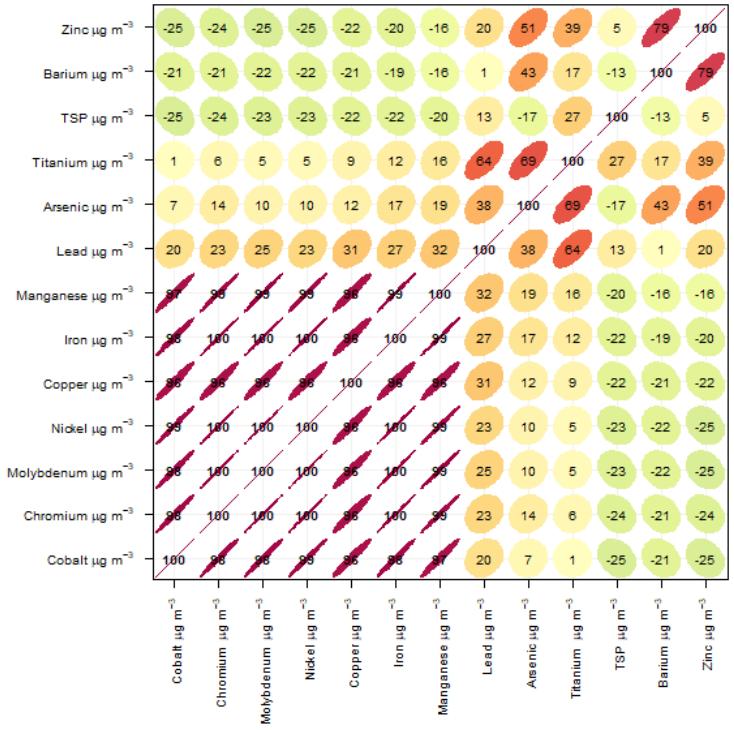

Figure 5-43: Heavy metal and TSP correlations in all samples collected since 22 June 2021 at AQM5 – 2 Braidwood Road

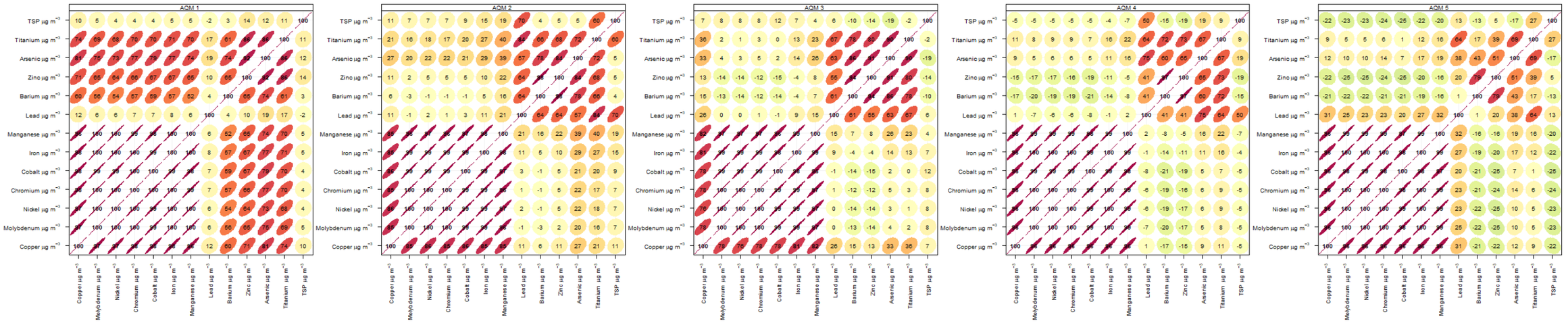

Figure 5-44: Heavy metal and TSP correlations in all samples collected since 22 June 2021 at all locations

6. DISCUSSION

AQM3 and AQM4 reported similar results for some pollutants (i.e. As, Ba, Cr, Co, Cu, Fe, Mn, Ni, Mo, Se, Ti, Zn), suggesting they are affected by the same pollution source. A very strong correlation exists between Cr, Co, Cu, Fe, Mn, Mo and Ni, suggesting that these pollutants are from the same source(s).

AQM2 recorded comparatively high concentrations of Hg and TSP. Investigation of weather conditions on these days suggests that the source of pollution may originate from the northern tailings dump especially for Hg, with pollutants transported by relatively stronger daytime winds. This monitoring location is near the former rail loadout facility, a potential source of pollution.

Analysis of some polar plots (i.e. TSP, Zn, As, Ti and Ba) suggests that a north-south transport of the pollutants is dominant, affecting locations AQM3 and AQM4 in particular. This is in accordance with the expected wind pattern from the distinctive valley terrain in the north-south orientation.

7. LIMITATIONS

This document is issued in confidence to Regional NSW for the purposes of assessing air quality risks to inform the lead management plan for Captains Flat, NSW. It should not be used for any other purpose.

Whilst reasonable attempts have been made to ensure that the contents of this report are accurate and complete at the time of writing, Ramboll Australia Pty Ltd disclaims any responsibility for loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this report.

8. REFERENCES

Carslaw, D. & Ropkins, K. (2012). Openair - an R package for air quality data analysis. Environmental Modelling & Software. Volume 27-28, 52-61.

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Sarkar, D. (2007). Lattice Multivariate Data Visualisation with R. New York: Springer.

Yamazaki D., D. Ikeshima, R. Tawatari, T. Yamaguchi, F. O'Loughlin, J.C. Neal, C.C. Sampson, S. Kanae & P.D. Bates (2017). A high accuracy map of global terrain elevations. Geophysical Research Letters, vol.44, pp.5844-5853, doi: 10.1002/2017GL072874. https://en-au.topographic-map.com/maps/jyzc/Captains-Flat/

APPENDIX 1
SPATIAL BIVARIATE PLOTS

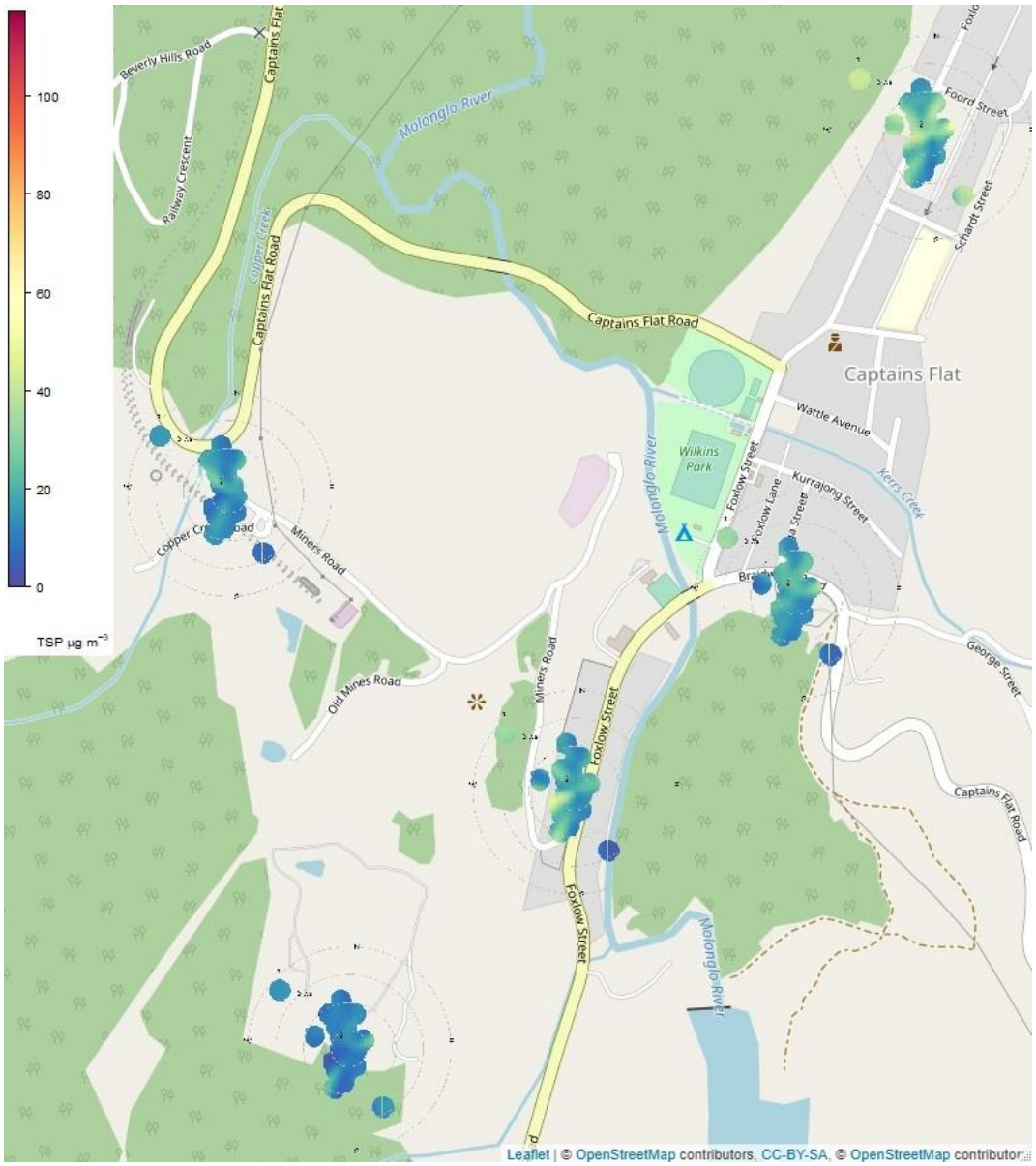

Figure 8-1: Polar map plots showing 24-hour TSP concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021 (prepared with openair; Carslaw & Ropkins, 2012)

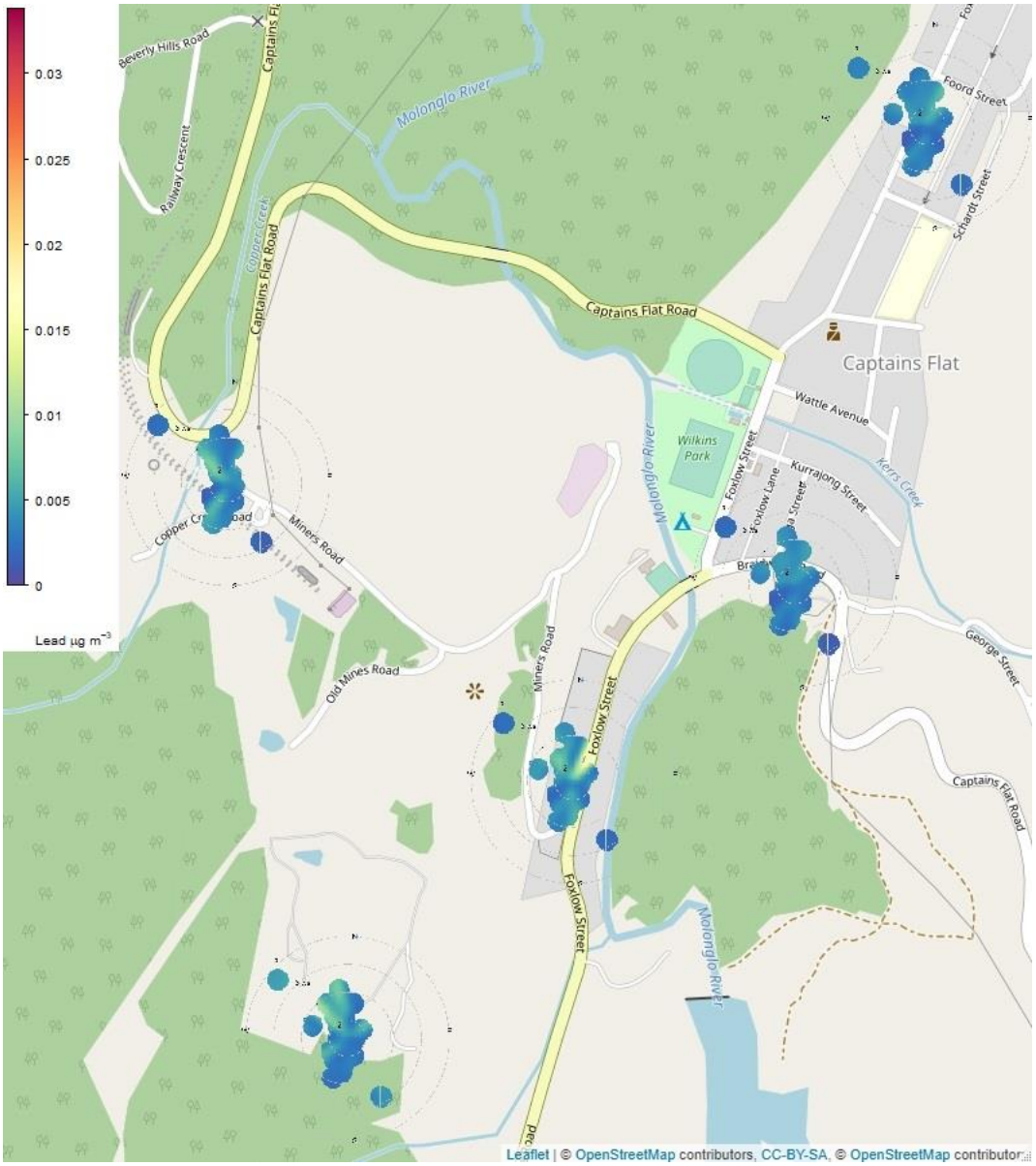

Figure 8-2: Polar map plots showing 24-hour lead concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021 (prepared with openair; Carslaw & Ropkins, 2012)

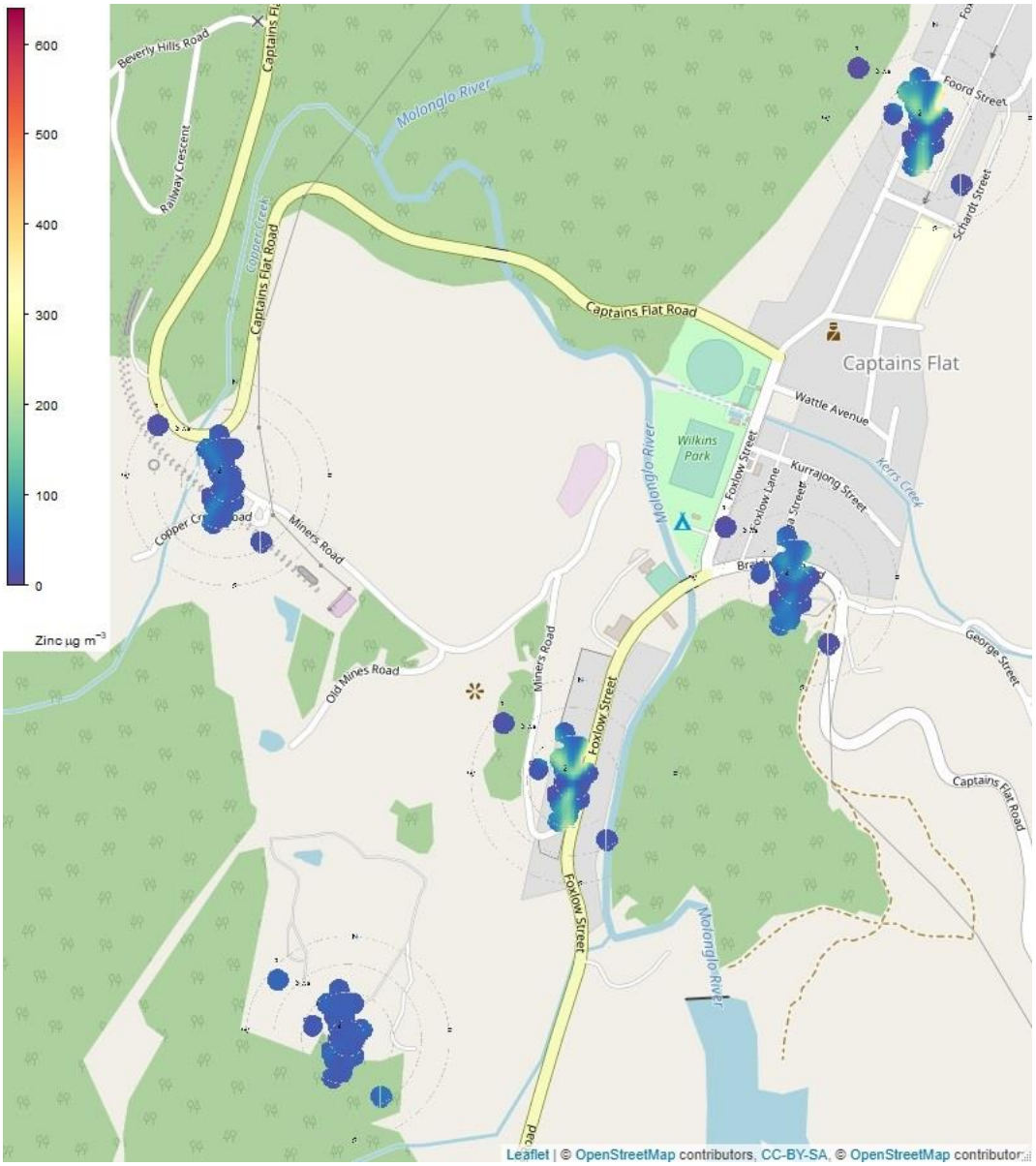

Figure 8-3: Polar map plots showing 24-hour zinc concentration and 24-hour average wind speed and direction at each monitoring location, from 22 June 2021 (prepared with openair; Carslaw & Ropkins, 2012)

APPENDIX 2
HISTORICAL LEAD CONCENTRATIONS AROUND AUSTRALIA (NEPC, 2001)

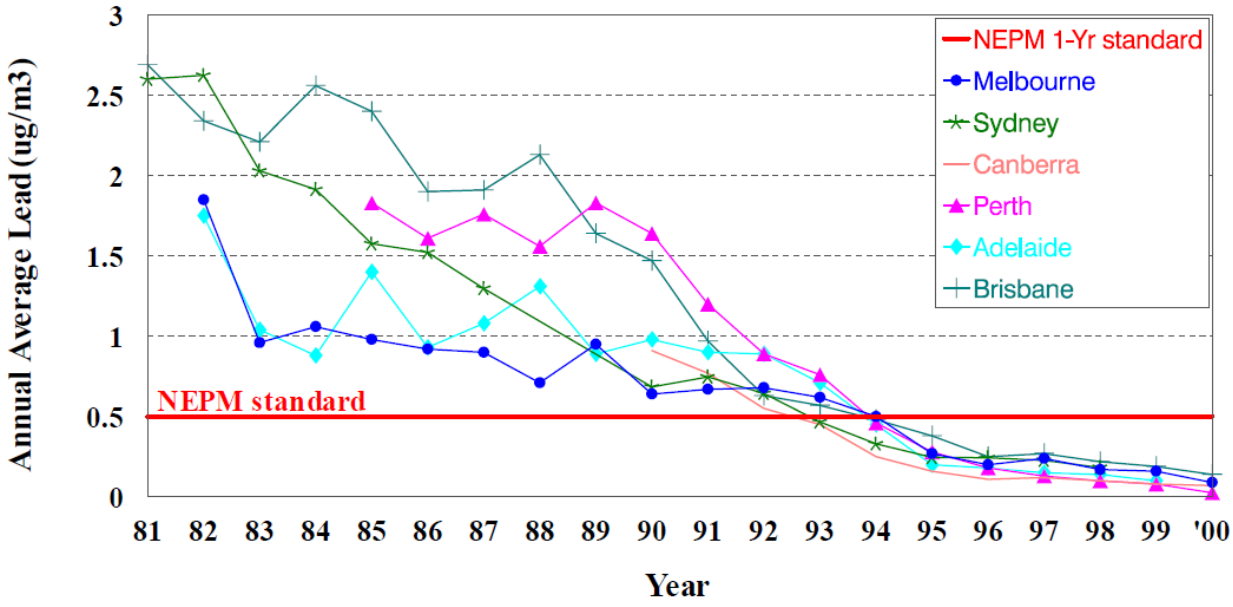

Figure A: Annual lead concentrations in Australian Capital Cities, 1981-2000 (NEPC, 2001)

APPENDIX 3
IMAGES OF AIR QUALITY MONITORING INSTRUMENTS IN-SITU

AQM1 – Old Mine Road

AQM2 – 2 Cooper Creek Road

MET – 2 Copper Creek Road (project station foreground, RFS station background)

AQM3 – Former Pre-School

AQM4 – New Preschool

AQM5 – 2 Braidwood Road

Figure B: High-volume air samplers and meteorological station in-situ in Captains Flat, NSW

APPENDIX 4
LABORATORY REPORTS

Ramboll Australia Pty Ltd
Level 3/100 Pacific Highway
North Sydney
NSW 2060

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Greer Laing**

Report **934219-A**
Project name CAPTAINS FLAT LEAD MANAGEMENT PLAN
Project ID 318001193
Received Date Oct 24, 2022

Client Sample ID			**AQM 3 - HVS1250**
Sample Matrix			**Filter paper**
Eurofins Sample No.			**M22-Oc0047640**
Date Sampled			**Sep 09, 2022**
Test/Reference	LOR	Unit	
Heavy Metals			
Arsenic	1.0	Total ug	6.9
Barium	1.0	Total ug	55000
Cadmium	0.5	Total ug	< 0.5
Chromium	1.0	Total ug	20
Cobalt	1.0	Total ug	< 1
Copper	1.0	Total ug	6.5
Iron	10	Total ug	670
Lead	1	Total ug	7.3
Manganese	1.0	Total ug	15
Mercury	0.1	Total ug	< 0.1
Molybdenum	1	Total ug	< 1
Nickel	1.0	Total ug	1.7
Selenium	1.0	Total ug	< 1
Titanium	1.0	Total ug	16
Zinc	1	Total ug	37000
Sample Comment			Filter Damaged
Particulates - Final weighing	0.01	mg	2712.6
Particulates - Initial weighing	0.01	mg	2768.2

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Heavy Metals	Melbourne	Oct 24, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Particulates - Final weighing	Field	Oct 24, 2022	30 Days
- Method: Filters weighed according to AS 3640 (Inhalable), AS 2985 (Respirable), AS4323.3 (Stack Filters)			
Particulates - Initial weighing	Field	Oct 25, 2022	30 Days
- Method: Filters weighed according to AS 3640 (Inhalable), AS 2985 (Respirable), AS4323.3 (Stack Filters) & QS-INS-4033 (HVAS - Non NATA Endorsed).			

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PO Box 60 Wickham 2293
Tel: +61 2 4968 8448
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Tel: 0800 856 450
IANZ# 1290

Company Name: Ramboll Australia Pty Ltd
Address: Level 3/100 Pacific Highway
North Sydney
NSW 2060

Project Name: CAPTAINS FLAT LEAD MANAGEMENT PLAN
Project ID: 318001193

Order No.: 318001193
Report #: 934219
Phone: 02 9954 8118
Fax: 02 9954 8150

Received: Oct 24, 2022 8:30 AM
Due: Oct 31, 2022
Priority: 5 Day
Contact Name: Greer Laing

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Particulates - Final weighing	Particulates - Initial weighing	Sample Comment	Selenium	Titanium	Zinc
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
External Laboratory																							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																		
1	AQM 3 - HVS1250	Sep 09, 2022		Filter paper	M22-Oc0047640	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Test Counts						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
µg/L: micrograms per litre
ppm: parts per million
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	N/A
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Andrew Black	Analytical Services Manager
Scott Beddoes	Senior Analyst-Metal

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

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Certificate of Analysis

Ramboll Australia Pty Ltd
Level 3/100 Pacific Highway
North Sydney
NSW 2060

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Greer Laing**

Report **930132-A**
Project name CAPTAINS FLAT LEAD MANAGEMENT PLAN
Project ID 318001193
Received Date Oct 07, 2022

Client Sample ID			**AQM 1 - HVS1235**	**AQM 1 - HVS1352**	**AQM 1 - HVS1351**	**AQM 1 - HVS1350**
Sample Matrix			**Filter paper**	**Filter paper**	**Filter paper**	**Filter paper**
Eurofins Sample No.			**S22-Oc0015556**	**S22-Oc0015557**	**S22-Oc0015558**	**S22-Oc0015559**
Date Sampled			**Aug 04, 2022**	**Aug 10, 2022**	**Aug 22, 2022**	**Aug 28, 2022**
Test/Reference	LOR	Unit				
Heavy Metals						
Arsenic	1.0	Total ug	14	11	8.5	15
Barium	1.0	Total ug	84000	91000	120000	69000
Cadmium	0.5	Total ug	< 0.5	< 0.5	2.1	< 0.5
Chromium	1.0	Total ug	4500	2200	2200	4200
Cobalt	1.0	Total ug	61	29	29	60
Copper	1.0	Total ug	110	58	59	110
Iron	10	Total ug	19000	9800	9800	18000
Lead	1	Total ug	9.8	7.2	8.0	10
Manganese	1.0	Total ug	290	150	160	300
Mercury	0.1	Total ug	< 0.1	< 0.1	< 0.1	< 0.1
Molybdenum	1	Total ug	550	280	270	510
Nickel	1.0	Total ug	2600	1300	1300	2400
Selenium	1.0	Total ug	< 1	< 1	< 1	< 1
Titanium	1.0	Total ug	22	18	22	35
Zinc	1	Total ug	58000	51000	50000	81000
Particulates - Final weighing	0.01	mg	2839.2	2847.9	2707.2	2705.3
Particulates - Initial weighing	0.01	mg	2835.6	2689.7	2683.2	2696.8

Client Sample ID			**AQM 1 - HVS1349**	**AQM 1 - HVS1348**
Sample Matrix			**Filter paper**	**Filter paper**
Eurofins Sample No.			**S22-Oc0015560**	**S22-Oc0015561**
Date Sampled			**Sep 03, 2022**	**Sep 09, 2022**
Test/Reference	LOR	Unit		
Heavy Metals				
Arsenic	1.0	Total ug	12	18
Barium	1.0	Total ug	110000	220000
Cadmium	0.5	Total ug	< 0.5	< 0.5
Chromium	1.0	Total ug	1600	4600
Cobalt	1.0	Total ug	20	64
Copper	1.0	Total ug	44	120
Iron	10	Total ug	7500	21000

Client Sample ID			AQM 1 - HVS1349	AQM 1 - HVS1348
Sample Matrix			**Filter paper**	**Filter paper**
Eurofins Sample No.			**S22-Oc0015560**	**S22-Oc0015561**
Date Sampled			**Sep 03, 2022**	**Sep 09, 2022**
Test/Reference	LOR	Unit		
Heavy Metals				
Lead	1	Total ug	6.6	9.3
Manganese	1.0	Total ug	120	330
Mercury	0.1	Total ug	< 0.1	< 0.1
Molybdenum	1	Total ug	190	580
Nickel	1.0	Total ug	930	2800
Selenium	1.0	Total ug	< 1	< 1
Titanium	1.0	Total ug	32	39
Zinc	1	Total ug	71000	100000
Particulates - Final weighing	0.01	mg	2713.3	2706.3
Particulates - Initial weighing	0.01	mg	2690.4	2698.7

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Heavy Metals	Melbourne	Oct 10, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Particulates - Final weighing	Field	Oct 10, 2022	30 Days
- Method: Filters weighed according to AS 3640 (Inhalable), AS 2985 (Respirable), AS4323.3 (Stack Filters)			
Particulates - Initial weighing	Field	Oct 10, 2022	30 Days
- Method: Filters weighed according to AS 3640 (Inhalable), AS 2985 (Respirable), AS4323.3 (Stack Filters) & QS-INS-4033 (HVAS - Non NATA Endorsed).			

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NSW 2060

Project Name: CAPTAINS FLAT LEAD MANAGEMENT PLAN
Project ID: 318001193

Order No.: 318001193
Report #: 930132
Phone: 02 9954 8118
Fax: 02 9954 8150

Received: Oct 7, 2022 1:50 PM
Due: Oct 14, 2022
Priority: 5 Day
Contact Name: Greer Laing

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	HOLD	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Particulates - Final weighing	Particulates - Initial weighing	Selenium	Titanium	Zinc
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
External Laboratory																							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																		
1	AQM 1 - HVS1235	Aug 04, 2022		Filter paper	S22-Oc0015556	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
2	AQM 1 - HVS1352	Aug 10, 2022		Filter paper	S22-Oc0015557	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
3	AQM 1 - HVS1351	Aug 22, 2022		Filter paper	S22-Oc0015558	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
4	AQM 1 - HVS1350	Aug 28, 2022		Filter paper	S22-Oc0015559	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
5	AQM 1 - HVS1349	Sep 03, 2022		Filter paper	S22-Oc0015560	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
6	AQM 1 - HVS1348	Sep 09, 2022		Filter paper	S22-Oc0015561	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
7	AQM 1 - HVS_UNKNOWN	Sep 15, 2022		Filter paper	S22-Oc0015562							X											
Test Counts						6	6	6	6	6	6	1	6	6	6	6	6	6	6	6	6	6	6

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
µg/L: micrograms per litre
ppm: parts per million
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

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QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	N/A
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Andrew Black	Analytical Services Manager
Emily Rosenberg	Senior Analyst-Metal

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Ramboll Australia Pty Ltd
Level 3/100 Pacific Highway
North Sydney
NSW 2060

Attention: **Greer Laing**

Report **930125-A**
Project name CAPTAINS FLAT LEAD MANAGEMENT PLAN
Project ID 318001193
Received Date Oct 07, 2022

Client Sample ID			**AQM 5 - HVS1258**	**AQM 5 - HVS1371**	**AQM 5 - HVS1370**	**AQM 5 - HVS1369**
Sample Matrix			**Filter paper**	**Filter paper**	**Filter paper**	**Filter paper**
Eurofins Sample No.			**S22-Oc0015515**	**S22-Oc0015516**	**S22-Oc0015517**	**S22-Oc0015518**
Date Sampled			**Aug 04, 2022**	**Aug 10, 2022**	**Aug 22, 2022**	**Aug 28, 2022**
Test/Reference	LOR	Unit				
Heavy Metals						
Arsenic	1.0	Total ug	2.4	2.8	2.5	2.8
Barium	1.0	Total ug	16000	18000	18000	10000
Cadmium	0.5	Total ug	< 0.5	< 0.5	< 0.5	< 0.5
Chromium	1.0	Total ug	5.9	8.5	7.4	540
Cobalt	1.0	Total ug	< 1	< 1	< 1	6.3
Copper	1.0	Total ug	1.2	1.6	2.1	14
Iron	10	Total ug	120	210	160	2300
Lead	1	Total ug	1.6	2.0	3.5	2.1
Manganese	1.0	Total ug	3.3	5.3	5.8	36
Mercury	0.1	Total ug	< 0.1	< 0.1	< 0.1	< 0.1
Molybdenum	1	Total ug	< 1	< 1	< 1	61
Nickel	1.0	Total ug	1.1	2.6	1.8	320
Selenium	1.0	Total ug	< 1	< 1	< 1	< 1
Titanium	1.0	Total ug	4.5	12	6.3	5.3
Zinc	1	Total ug	11000	12000	12000	6900
Particulates - Final weighing	0.01	mg	2855.3	2849.5	2755.4	2749
Particulates - Initial weighing	0.01	mg	2817.1	2704.2	2704.4	2687

Client Sample ID			**AQM 5 - HVS1366**	**AQM 5 - HVS1259**
Sample Matrix			**Filter paper**	**Filter paper**
Eurofins Sample No.			**S22-Oc0015519**	**S22-Oc0015520**
Date Sampled			**Sep 03, 2022**	**Sep 09, 2022**
Test/Reference	LOR	Unit		
Heavy Metals				
Arsenic	1.0	Total ug	2.9	3.5
Barium	1.0	Total ug	20000	25000
Cadmium	0.5	Total ug	< 0.5	< 0.5
Chromium	1.0	Total ug	7.5	11
Cobalt	1.0	Total ug	< 1	< 1
Copper	1.0	Total ug	4.1	2.4
Iron	10	Total ug	150	170

Client Sample ID			AQM 5 - HVS1366	AQM 5 - HVS1259
Sample Matrix			**Filter paper**	**Filter paper**
Eurofins Sample No.			**S22-Oc0015519**	**S22-Oc0015520**
Date Sampled			**Sep 03, 2022**	**Sep 09, 2022**
Test/Reference	LOR	Unit		
Heavy Metals				
Lead	1	Total ug	2.0	2.1
Manganese	1.0	Total ug	5.6	6.1
Mercury	0.1	Total ug	< 0.1	< 0.1
Molybdenum	1	Total ug	< 1	< 1
Nickel	1.0	Total ug	1.5	2.7
Selenium	1.0	Total ug	< 1	< 1
Titanium	1.0	Total ug	5.7	5.2
Zinc	1	Total ug	14000	18000
Particulates - Final weighing	0.01	mg	2706.2	2720.1
Particulates - Initial weighing	0.01	mg	2695.7	2830.5

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Heavy Metals	Melbourne	Oct 10, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Mercury	Melbourne	Oct 10, 2022	28 Days
- Method: SOP #6 Analysis of Volatile Organic Compounds in Passivated Canisters EPA Method TO-15			
Particulates - Final weighing	Field	Oct 10, 2022	30 Days
- Method: Filters weighed according to AS 3640 (Inhalable), AS 2985 (Respirable), AS4323.3 (Stack Filters)			
Particulates - Initial weighing	Field	Oct 10, 2022	30 Days
- Method: Filters weighed according to AS 3640 (Inhalable), AS 2985 (Respirable), AS4323.3 (Stack Filters) & QS-INS-4033 (HVAS - Non NATA Endorsed).			

eurofins

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NATA# 1261 Site# 1254

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Tel: +61 2 9900 8400
NATA# 1261 Site# 18217

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IANZ# 1290

Company Name: Ramboll Australia Pty Ltd
Address: Level 3/100 Pacific Highway
North Sydney
NSW 2060

Project Name: CAPTAINS FLAT LEAD MANAGEMENT PLAN
Project ID: 318001193

Order No.: 318001193
Report #: 930125
Phone: 02 9954 8118
Fax: 02 9954 8150

Received: Oct 7, 2022 1:50 PM
Due: Oct 14, 2022
Priority: 5 Day
Contact Name: Greer Laing

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	HOLD	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Particulates - Final weighing	Particulates - Initial weighing	Selenium	Titanium	Zinc
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
External Laboratory																							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																		
1	AQM 5 - HVS1258	Aug 04, 2022		Filter paper	S22-Oc0015515	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
2	AQM 5 - HVS1371	Aug 10, 2022		Filter paper	S22-Oc0015516	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
3	AQM 5 - HVS1370	Aug 22, 2022		Filter paper	S22-Oc0015517	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
4	AQM 5 - HVS1369	Aug 28, 2022		Filter paper	S22-Oc0015518	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
5	AQM 5 - HVS1366	Sep 03, 2022		Filter paper	S22-Oc0015519	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
6	AQM 5 - HVS1259	Sep 09, 2022		Filter paper	S22-Oc0015520	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
7	AQM 5 - HVS_UNKNOWN	Sep 15, 2022		Filter paper	S22-Oc0015521							X											
Test Counts						6	6	6	6	6	6	1	6	6	6	6	6	6	6	6	6	6	6

Internal Quality Control Review and Glossary

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Holding Times

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MPN/100 mL: Most Probable Number of organisms per 100 millilitres

Terms

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COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
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SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

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NOTE: pH duplicates are reported as a range not as RPD

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PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	N/A
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Bonnie Pu	Analytical Services Manager
Emily Rosenberg	Senior Analyst-Metal

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

eurofins | Environment Testing

Certificate of Analysis

Ramboll Australia Pty Ltd
Level 3/100 Pacific Highway
North Sydney
NSW 2060

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

Attention: **Greer Laing**

Report **930122-A**
Project name CAPTAINS FLAT LEAD MANAGEMENT PLAN
Project ID 318001193
Received Date Oct 07, 2022

Client Sample ID			**BLANK - HVS 1436**
Sample Matrix			**Filter paper**
Eurofins Sample No.			**S22-Oc0015513**
Date Sampled			**Aug 04, 2022**
Test/Reference	LOR	Unit	
Heavy Metals			
Arsenic	1.0	Total ug	19
Barium	1.0	Total ug	88000
Cadmium	0.5	Total ug	0.5
Chromium	1.0	Total ug	5600
Cobalt	1.0	Total ug	79
Copper	1.0	Total ug	130
Iron	10	Total ug	24000
Lead	1	Total ug	9.6
Manganese	1.0	Total ug	380
Mercury	0.1	Total ug	< 0.1
Molybdenum	1	Total ug	700
Nickel	1.0	Total ug	3300
Selenium	1.0	Total ug	< 1
Titanium	1.0	Total ug	29
Zinc	1	Total ug	92000
Particulates - Final weighing	0.01	mg	2697.8
Particulates - Initial weighing	0.01	mg	2686.5

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Heavy Metals	Melbourne	Oct 10, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Particulates - Final weighing	Field	Oct 10, 2022	30 Days
- Method: Filters weighed according to AS 3640 (Inhalable), AS 2985 (Respirable), AS4323.3 (Stack Filters)			
Particulates - Initial weighing	Field	Oct 10, 2022	30 Days
- Method: Filters weighed according to AS 3640 (Inhalable), AS 2985 (Respirable), AS4323.3 (Stack Filters) & QS-INS-4033 (HVAS - Non NATA Endorsed).			

eurofins

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Company Name: Ramboll Australia Pty Ltd
Address: Level 3/100 Pacific Highway
North Sydney
NSW 2060

Project Name: CAPTAINS FLAT LEAD MANAGEMENT PLAN
Project ID: 318001193

Order No.: 318001193
Report #: 930122
Phone: 02 9954 8118
Fax: 02 9954 8150

Received: Oct 7, 2022 1:50 PM
Due: Oct 14, 2022
Priority: 5 Day
Contact Name: Greer Laing

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Particulates - Final weighing	Particulates - Initial weighing	Selenium	Titanium	Zinc
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
External Laboratory																						
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																	
1	BLANK - HVS 1436	Aug 04, 2022		Filter paper	S22-Oc0015513	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Test Counts						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

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General

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ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

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QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	N/A
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	N/A
Some samples have been subcontracted	No

Authorised by:

Bonnie Pu	Analytical Services Manager
Emily Rosenberg	Senior Analyst-Metal

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Ramboll Australia Pty Ltd
Level 3/100 Pacific Highway
North Sydney
NSW 2060

Attention: **Greer Laing**

Report **930120-A**
Project name CAPTAINS FLAT LEAD MANAGEMENT PLAN
Project ID 318001193
Received Date Oct 07, 2022

Client Sample ID			**AQM 2 - HVS1359**	**AQM 2 - HVS1259**	**AQM 2 - HVS1235**	**AQM 2 - HVS1358**
Sample Matrix			**Filter paper**	**Filter paper**	**Filter paper**	**Filter paper**
Eurofins Sample No.			**S22-Oc0015506**	**S22-Oc0015507**	**S22-Oc0015508**	**S22-Oc0015509**
Date Sampled			**Aug 04, 2022**	**Aug 10, 2022**	**Aug 22, 2022**	**Aug 28, 2022**
Test/Reference	LOR	Unit				
Heavy Metals						
Arsenic	1.0	Total ug	2.7	4.5	3.3	3.2
Barium	1.0	Total ug	26000	35000	24000	22000
Cadmium	0.5	Total ug	< 0.5	< 0.5	< 0.5	< 0.5
Chromium	1.0	Total ug	8.4	15	7.5	6.7
Cobalt	1.0	Total ug	< 1	< 1	< 1	< 1
Copper	1.0	Total ug	3.2	5.5	7.5	4.5
Iron	10	Total ug	220	670	260	210
Lead	1	Total ug	2.1	6.7	3.9	2.7
Manganese	1.0	Total ug	6.5	15	7.0	5.3
Mercury	0.1	Total ug	< 0.1	< 0.1	< 0.1	< 0.1
Molybdenum	1	Total ug	< 1	< 1	< 1	< 1
Nickel	1.0	Total ug	< 1	2.6	2.2	< 1
Selenium	1.0	Total ug	< 1	< 1	< 1	< 1
Titanium	1.0	Total ug	6.0	25	11	6.5
Zinc	1	Total ug	18000	27000	17000	16000
Particulates - Final weighing	0.01	mg	2704.2	2754.7	2856.8	2855.7
Particulates - Initial weighing	0.01	mg	2689.1	2782	2832.1	2705.3
Sample Comment			-	Filter Damaged	-	Filter Damaged

Client Sample ID			**AQM 2 - HVS1357**	**AQM 2 - HVS1356**
Sample Matrix			**Filter paper**	**Filter paper**
Eurofins Sample No.			**S22-Oc0015510**	**S22-Oc0015511**
Date Sampled			**Sep 03, 2022**	**Sep 09, 2022**
Test/Reference	LOR	Unit		
Heavy Metals				
Arsenic	1.0	Total ug	3.1	4.8
Barium	1.0	Total ug	28000	44000
Cadmium	0.5	Total ug	< 0.5	< 0.5
Chromium	1.0	Total ug	8.8	18
Cobalt	1.0	Total ug	< 1	< 1
Copper	1.0	Total ug	3.8	7.1

Client Sample ID			AQM 2 - HVS1357	AQM 2 - HVS1356
Sample Matrix			**Filter paper**	**Filter paper**
Eurofins Sample No.			**S22-Oc0015510**	**S22-Oc0015511**
Date Sampled			**Sep 03, 2022**	**Sep 09, 2022**
Test/Reference	LOR	Unit		
Heavy Metals				
Iron	10	Total ug	260	380
Lead	1	Total ug	2.1	3.1
Manganese	1.0	Total ug	7.0	11
Mercury	0.1	Total ug	< 0.1	< 0.1
Molybdenum	1	Total ug	< 1	< 1
Nickel	1.0	Total ug	3.2	4.0
Selenium	1.0	Total ug	< 1	< 1
Titanium	1.0	Total ug	8.6	10
Zinc	1	Total ug	20000	31000
Particulates - Final weighing	0.01	mg	2722.9	2727.2
Particulates - Initial weighing	0.01	mg	2712.3	2694.9

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Heavy Metals	Melbourne	Oct 10, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Particulates - Final weighing	Field	Oct 10, 2022	30 Days
- Method: Filters weighed according to AS 3640 (Inhalable), AS 2985 (Respirable), AS4323.3 (Stack Filters)			
Particulates - Initial weighing	Field	Oct 10, 2022	30 Days
- Method: Filters weighed according to AS 3640 (Inhalable), AS 2985 (Respirable), AS4323.3 (Stack Filters) & QS-INS-4033 (HVAS - Non NATA Endorsed).			

eurofins

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IANZ# 1290

Company Name: Ramboll Australia Pty Ltd
Address: Level 3/100 Pacific Highway
North Sydney
NSW 2060

Project Name: CAPTAINS FLAT LEAD MANAGEMENT PLAN
Project ID: 318001193

Order No.: 318001193
Report #: 930120
Phone: 02 9954 8118
Fax: 02 9954 8150

Received: Oct 7, 2022 1:50 PM
Due: Oct 14, 2022
Priority: 5 Day
Contact Name: Greer Laing

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	HOLD	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Particulates - Final weighing	Particulates - Initial weighing	Selenium	Titanium	Zinc
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
External Laboratory																							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																		
1	AQM 2 - HVS1359	Aug 04, 2022		Filter paper	S22-Oc0015506	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
2	AQM 2 - HVS1259	Aug 10, 2022		Filter paper	S22-Oc0015507	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
3	AQM 2 - HVS1235	Aug 22, 2022		Filter paper	S22-Oc0015508	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
4	AQM 2 - HVS1358	Aug 28, 2022		Filter paper	S22-Oc0015509	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
5	AQM 2 - HVS1357	Sep 03, 2022		Filter paper	S22-Oc0015510	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
6	AQM 2 - HVS1356	Sep 09, 2022		Filter paper	S22-Oc0015511	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
7	AQM 2 - HVS_UNKNOWN	Sep 15, 2022		Filter paper	S22-Oc0015512							X											
Test Counts						6	6	6	6	6	6	1	6	6	6	6	6	6	6	6	6	6	6

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
µg/L: micrograms per litre
ppm: parts per million
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	N/A
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Andrew Black	Analytical Services Manager
Scott Beddoes	Senior Analyst-Metal

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Ramboll Australia Pty Ltd
Level 3/100 Pacific Highway
North Sydney
NSW 2060

Attention: **Greer Laing**

Report **930118-A**
Project name CAPTAINS FLAT LEAD MANAGEMENT PLAN
Project ID 318001193
Received Date Oct 07, 2022

Client Sample ID			**AQM 3 - HVS1246**	**AQM 3 - HVS1347**	**AQM 3 - HVS1346**	**AQM 3 - HVS1345**
Sample Matrix			**Filter paper**	**Filter paper**	**Filter paper**	**Filter paper**
Eurofins Sample No.			**S22-Oc0015482**	**S22-Oc0015483**	**S22-Oc0015484**	**S22-Oc0015485**
Date Sampled			**Aug 04, 2022**	**Aug 10, 2022**	**Aug 22, 2022**	**Aug 28, 2022**
Test/Reference	LOR	Unit				
Heavy Metals						
Arsenic	1.0	Total ug	2.0	3.7	3.1	4.7
Barium	1.0	Total ug	13000	26000	28000	36000
Cadmium	0.5	Total ug	< 0.5	< 0.5	< 0.5	< 0.5
Chromium	1.0	Total ug	770	8.1	9.2	12
Cobalt	1.0	Total ug	9.3	< 1	< 1	< 1
Copper	1.0	Total ug	18	2.0	2.7	2.8
Iron	10	Total ug	3400	240	310	370
Lead	1	Total ug	2.3	4.7	3.7	4.5
Manganese	1.0	Total ug	50	6.2	8.2	11
Mercury	0.1	Total ug	< 0.1	< 0.1	< 0.1	< 0.1
Molybdenum	1	Total ug	91	< 1	< 1	< 1
Nickel	1.0	Total ug	460	< 1	1.5	1.5
Selenium	1.0	Total ug	< 1	< 1	< 1	< 1
Titanium	1.0	Total ug	4.5	10	9.4	12
Zinc	1	Total ug	9000	19000	19000	25000
Particulates - Final weighing	0.01	mg	2857.4	2795.4	2740.9	2711.2
Particulates - Initial weighing	0.01	mg	2776.4	2706.2	2691.3	2679.2

Client Sample ID			**AQM 3 - HVS1344**
Sample Matrix			**Filter paper**
Eurofins Sample No.			**S22-Oc0015486**
Date Sampled			**Sep 03, 2022**
Test/Reference	LOR	Unit	
Heavy Metals			
Arsenic	1.0	Total ug	3.0
Barium	1.0	Total ug	29000
Cadmium	0.5	Total ug	< 0.5
Chromium	1.0	Total ug	9.6
Cobalt	1.0	Total ug	< 1
Copper	1.0	Total ug	2.4
Iron	10	Total ug	280

Client Sample ID			AQM 3 - HVS1344
Sample Matrix			**Filter paper**
Eurofins Sample No.			**S22-Oc0015486**
Date Sampled			**Sep 03, 2022**
Test/Reference	LOR	Unit	
Heavy Metals			
Lead	1	Total ug	2.9
Manganese	1.0	Total ug	8.0
Mercury	0.1	Total ug	< 0.1
Molybdenum	1	Total ug	< 1
Nickel	1.0	Total ug	< 1
Selenium	1.0	Total ug	< 1
Titanium	1.0	Total ug	8.0
Zinc	1	Total ug	20000
Particulates - Final weighing	0.01	mg	2702.2
Particulates - Initial weighing	0.01	mg	2695.2

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Heavy Metals	Melbourne	Oct 10, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Particulates - Final weighing	Field	Oct 10, 2022	30 Days
- Method: Filters weighed according to AS 3640 (Inhalable), AS 2985 (Respirable), AS4323.3 (Stack Filters)			
Particulates - Initial weighing	Field	Oct 10, 2022	30 Days
- Method: Filters weighed according to AS 3640 (Inhalable), AS 2985 (Respirable), AS4323.3 (Stack Filters) & QS-INS-4033 (HVAS - Non NATA Endorsed).			

eurofins

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Project Name: CAPTAINS FLAT LEAD MANAGEMENT PLAN
Project ID: 318001193

Order No.: 318001193
Report #: 930118
Phone: 02 9954 8118
Fax: 02 9954 8150

Received: Oct 7, 2022 1:50 PM
Due: Oct 14, 2022
Priority: 5 Day
Contact Name: Greer Laing

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	HOLD	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Particulates - Final weighing	Particulates - Initial weighing	Selenium	Titanium	Zinc
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
External Laboratory																							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																		
1	AQM 3 - HVS1246	Aug 04, 2022		Filter paper	S22-Oc0015482	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
2	AQM 3 - HVS1347	Aug 10, 2022		Filter paper	S22-Oc0015483	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
3	AQM 3 - HVS1346	Aug 22, 2022		Filter paper	S22-Oc0015484	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
4	AQM 3 - HVS1345	Aug 28, 2022		Filter paper	S22-Oc0015485	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
5	AQM 3 - HVS1344	Sep 03, 2022		Filter paper	S22-Oc0015486	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
6	AQM 3 - HVS_UNKNOWN	Sep 15, 2022		Filter paper	S22-Oc0015487							X											
Test Counts						5	5	5	5	5	5	1	5	5	5	5	5	5	5	5	5	5	5

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram
mg/L: milligrams per litre
µg/L: micrograms per litre
ppm: parts per million
ppb: parts per billion
%: Percentage
org/100 mL: Organisms per 100 millilitres
NTU: Nephelometric Turbidity Units
MPN/100 mL: Most Probable Number of organisms per 100 millilitres

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

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QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	N/A
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Andrew Black	Analytical Services Manager
Emily Rosenberg	Senior Analyst-Metal
Scott Beddoes	Senior Analyst-Metal

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Ramboll Australia Pty Ltd
Level 3/100 Pacific Highway
North Sydney
NSW 2060

Attention: **Greer Laing**

Report **930112-A**
Project name CAPTAINS FLAT LEAD MANAGEMENT PLAN
Project ID 318001193
Received Date Jan 18, 2022

Client Sample ID			**AQM 4 - HVS1141**	**AQM 4 - HVS1316**	**AQM 4 - HVS1314**	**AQM 4 - HVS1315**
Sample Matrix			**Filter paper**	**Filter paper**	**Filter paper**	**Filter paper**
Eurofins Sample No.			**S22-Oc0015421**	**S22-Oc0015422**	**S22-Oc0015423**	**S22-Oc0015424**
Date Sampled			**Aug 04, 2022**	**Aug 10, 2022**	**Aug 22, 2022**	**Aug 28, 2022**
Test/Reference	LOR	Unit				
Heavy Metals						
Arsenic	1.0	Total ug	2.0	1.7	2.4	17
Barium	1.0	Total ug	15000	12000	10000	15000
Cadmium	0.5	Total ug	< 0.5	< 0.5	< 0.5	< 0.5
Chromium	1.0	Total ug	5.2	4.3	700	820
Cobalt	1.0	Total ug	< 1	< 1	7.2	9.5
Copper	1.0	Total ug	1.4	2.6	18	21
Iron	10	Total ug	120	310	3200	3800
Lead	1	Total ug	1.2	2.9	5.3	11
Manganese	1.0	Total ug	3.6	6.8	47	58
Mercury	0.1	Total ug	< 0.1	< 0.1	< 0.1	< 0.1
Molybdenum	1	Total ug	< 1	< 1	81	100
Nickel	1.0	Total ug	1.1	1.1	420	500
Selenium	1.0	Total ug	< 1	< 1	< 1	< 1
Titanium	1.0	Total ug	4.0	14	7.6	12
Zinc	1	Total ug	9900	7900	6800	10000
Particulates - Final weighing	0.01	mg	2857.9	2898.7	2863.5	2963
Particulates - Initial weighing	0.01	mg	2822.9	2787.6	2800.1	2785.5

Client Sample ID			**AQM 4 - HVS1313**	**AQM 4 - HVS1312**
Sample Matrix			**Filter paper**	**Filter paper**
Eurofins Sample No.			**S22-Oc0015425**	**S22-Oc0015426**
Date Sampled			**Sep 03, 2022**	**Sep 09, 2022**
Test/Reference	LOR	Unit		
Heavy Metals				
Arsenic	1.0	Total ug	3.1	3.2
Barium	1.0	Total ug	19000	20000
Cadmium	0.5	Total ug	< 0.5	< 0.5
Chromium	1.0	Total ug	880	11
Cobalt	1.0	Total ug	11	< 1
Copper	1.0	Total ug	24	2.8
Iron	10	Total ug	4100	150

Client Sample ID			AQM 4 - HVS1313	AQM 4 - HVS1312
Sample Matrix			**Filter paper**	**Filter paper**
Eurofins Sample No.			**S22-Oc0015425**	**S22-Oc0015426**
Date Sampled			**Sep 03, 2022**	**Sep 09, 2022**
Test/Reference	LOR	Unit		
Heavy Metals				
Lead	1	Total ug	3.6	2.0
Manganese	1.0	Total ug	63	4.3
Mercury	0.1	Total ug	< 0.1	< 0.1
Molybdenum	1	Total ug	110	< 1
Nickel	1.0	Total ug	540	3.4
Selenium	1.0	Total ug	< 1	< 1
Titanium	1.0	Total ug	16	4.8
Zinc	1	Total ug	13000	14000
Particulates - Final weighing	0.01	mg	2850.2	2820.3
Particulates - Initial weighing	0.01	mg	2791	2803.3

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Heavy Metals	Melbourne	Oct 10, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Mercury	Melbourne	Oct 10, 2022	28 Days
- Method: SOP #6 Analysis of Volatile Organic Compounds in Passivated Canisters EPA Method TO-15			
Particulates - Final weighing	Field	Oct 10, 2022	30 Days
- Method: Filters weighed according to AS 3640 (Inhalable), AS 2985 (Respirable), AS4323.3 (Stack Filters)			
Particulates - Initial weighing	Field	Oct 10, 2022	30 Days
- Method: Filters weighed according to AS 3640 (Inhalable), AS 2985 (Respirable), AS4323.3 (Stack Filters) & QS-INS-4033 (HVAS - Non NATA Endorsed).			

eurofins

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Tel: 0800 856 450
IANZ# 1290

Company Name: Ramboll Australia Pty Ltd
Address: Level 3/100 Pacific Highway
North Sydney
NSW 2060

Project Name: CAPTAINS FLAT LEAD MANAGEMENT PLAN
Project ID: 318001193

Order No.: 318001193
Report #: 930112
Phone: 02 9954 8118
Fax: 02 9954 8150

Received: Oct 7, 2022 1:50 PM
Due: Oct 14, 2022
Priority: 5 Day
Contact Name: Greer Laing

Eurofins Analytical Services Manager : Andrew Black

Sample Detail						Arsenic	Barium	Cadmium	Chromium	Cobalt	Copper	HOLD	Iron	Lead	Manganese	Mercury	Molybdenum	Nickel	Particulates - Final weighing	Particulates - Initial weighing	Selenium	Titanium	Zinc
Melbourne Laboratory - NATA # 1261 Site # 1254						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
External Laboratory																							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																		
1	AQM 4 - HVS1141	Aug 04, 2022		Filter paper	S22-Oc0015421	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
2	AQM 4 - HVS1316	Aug 10, 2022		Filter paper	S22-Oc0015422	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
3	AQM 4 - HVS1314	Aug 22, 2022		Filter paper	S22-Oc0015423	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
4	AQM 4 - HVS1315	Aug 28, 2022		Filter paper	S22-Oc0015424	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
5	AQM 4 - HVS1313	Sep 03, 2022		Filter paper	S22-Oc0015425	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
6	AQM 4 - HVS1312	Sep 09, 2022		Filter paper	S22-Oc0015426	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
7	AQM 4 - HVS_UNKNOWN	Sep 15, 2022		Filter paper	S22-Oc0015427							X											
Test Counts						6	6	6	6	6	6	1	6	6	6	6	6	6	6	6	6	6	6

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Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	N/A
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised by:

Andrew Black	Analytical Services Manager
Emily Rosenberg	Senior Analyst-Metal

Glenn Jackson
General Manager

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.