Ministry for the Environment
Manatū Mō Te Taiao

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Application no:
Date received:
Date accepted:

Resource Management (National Environmental Standards for Air Quality) Regulations 2004 – Regulation 16A Exceptional Circumstances

APPLICATION FORM

Before completing this form please read section 3.8 of the 2011 User's Guide to the revised National Environmental Standards for Air Quality.

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1 Applicant details

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2 Details of exceedance event

Containment	PM_{10} (24-hour average)
Date of exceedance (*application must be received within 3 months from date of the exceedance*)	9 &10 June 2021
Relevant airshed	Mount Maunganui Airshed

Monitoring station and technical specifications of monitor	Rata Street. Location: 50m south of Rata Street, Mount Maunganui Instrument specifications: Thermo model 5014i Beta Attenuation Monitor (BAM) with PM_{10} size selective inlet.	
Summary of monitoring reading showing exceedance event	PM_{10} 58 µg/m^3 – 9 June 2021 PM_{10} 53 µg/m^3 – 10 June 2021	
Analysis of baseline data	Refer to supporting documentation.	
Source speciation or other analysis	Refer to supporting documentation.	
Explanation of any previous exceedance event/s from this monitoring station in the past 5 years	Due to anthropogenic activities within the Mount Maunganui Airshed, elevated PM_{10} levels are common. Values above the NES PM_{10} standard value have been recorded at the Rata Street site within the past 5 years.	
Monitoring readings covering exceedance event	☒ Attached	☐ Not attached

3 Details of exceptional circumstances

Exceptional circumstances leading to exceedance	☐ Localised impact on a monitor	☐ Anthropogenic extreme event	☒ Natural disaster or natural extreme event	☐ Other
Explanation of circumstances leading to exceedance event	An increased ratio of sea salt particles originating from an elevated sea state and onshore winds is considered to have been the cause of the exceedances occurring on 9 and 10 June 2021 at the Rata Street air quality monitoring station within the Mount Maunganui Airshed in the Bay of Plenty region.			

Reasons why these circumstances were beyond the reasonable control of the regional council	Meteorological conditions conducive to elevated wave heights and the transport and inland deposition of sea spray particles were responsible for the recorded exceedances. These conditions are well beyond the reasonable control of the Bay of Plenty Regional Council. Page 43 of the "2011 Users' Guide to the revised National Environmental Standards for Air Quality 2011: Updated 2014 guide" (the Users' Guide) states: *"Generally, unforeseeable emergencies and natural disasters cannot be prevented or controlled and are likely to satisfy this criterion."* All evidence that we have examined points to sea spray particles being the source of the PM_{10} exceedances on June 9 and 10. In reference to the requirements of page 44 of the Users' Guide, these exceedances can be credibly be considered an unplanned circumstance that could not reasonably be predicted. The events causing the exceedances of the air standards on June 9 and 10 can be considered exceptional due to their nature as an extreme weather event. Page 45 of the Users' Guide states that: *"The majority of exceptional circumstances are likely to be related to a natural disaster or extreme weather event… ".* These exceedances are considered to have been caused by sea salt from unusually high waves being transported by winds as part of an extreme weather event. Extreme weather events are cited in the Users' Guide as an example of exceptional events. The RMA framework is based on the principle of sustainable management when making resource management decisions. There is no evidence that this event is related to poor resource management of air as a resource. It is considered that the source of the PM_{10} exceedances on 9 and 10 June 2021 is an increased ratio of sea salt particles within the local profile. This was generated by the elevated sea state and wind patterns associated with firstly a weak depression located to the north of the Bay of Plenty, and then a belt of anticyclone pressure, both of which pushed an easterly wind flow into the western area of the Bay of Plenty. This connected series of meteorological events provided a means of particle generation and transportation. It is unreasonable to expect the Bay of Plenty Regional Council to control this emission, when it originates from a specific weather pattern and a non-anthropogenic source. For the reasons outlined above we are requesting the exceedances be considered as exceptional events because the exceedances were not foreseeable, not likely to reoccur, beyond the reasonable control of the council and contrary to the purpose of the RMA.	
Supporting evidence **(eg, *meteorological report*)**	☒ Attached	☐ Not attached

8 September 2021

Date

Signed: Sarah Omundsen

General Manager, Regulatory Services
Bay of Plenty Regional Council Toi Moana

Supporting documentation

Background

The Rata Street monitoring station is an integral part of the wider ambient air quality monitoring network within the Mount Maunganui Airshed. Like all of the sites within this network, it is operated by WaterCare Ltd under contract for the Regional Council. Quality assessed and controlled data is provided from WaterCare Ltd on a following month basis. The data used in this supporting document is part of that monthly delivery QA/QC data batch.

Due to its location at the northern-most position within the network (Figure 1), the Rata Street site is fully exposed to a wide range of anthropogenic and natural sources.

Figure 1. Ambient air quality monitoring sites within the Mount Maunganui Airshed.

Previous exceedances recorded at the Rata Street site (Table 1) have been the result of activities to the south of the site associated with human activity. In addition, a successful exceptional circumstances application for a PM_{10} exceedance (52 µg/m^3), stemming from the Australian bushfire/dust events of late 2019/early 2020 was recorded at this site on the 6/12/2019.

Table 1. Rata Street PM_{10} exceedances.

Date	**Location**	**PM_{10} 24 hour average**
31/01/2020	Rata Street	68 µg/m^3
17/03/2020	Rata Street	87 µg/m^3
9/06/2021	Rata Street	58µg/m^3
10/06/2021	Rata Street	53µg/m^3
14/07/2021	Rata Street	62µg/m^3

The PM_{10} exceedances can be seen in the full daily timeseries plot (Figure 2).

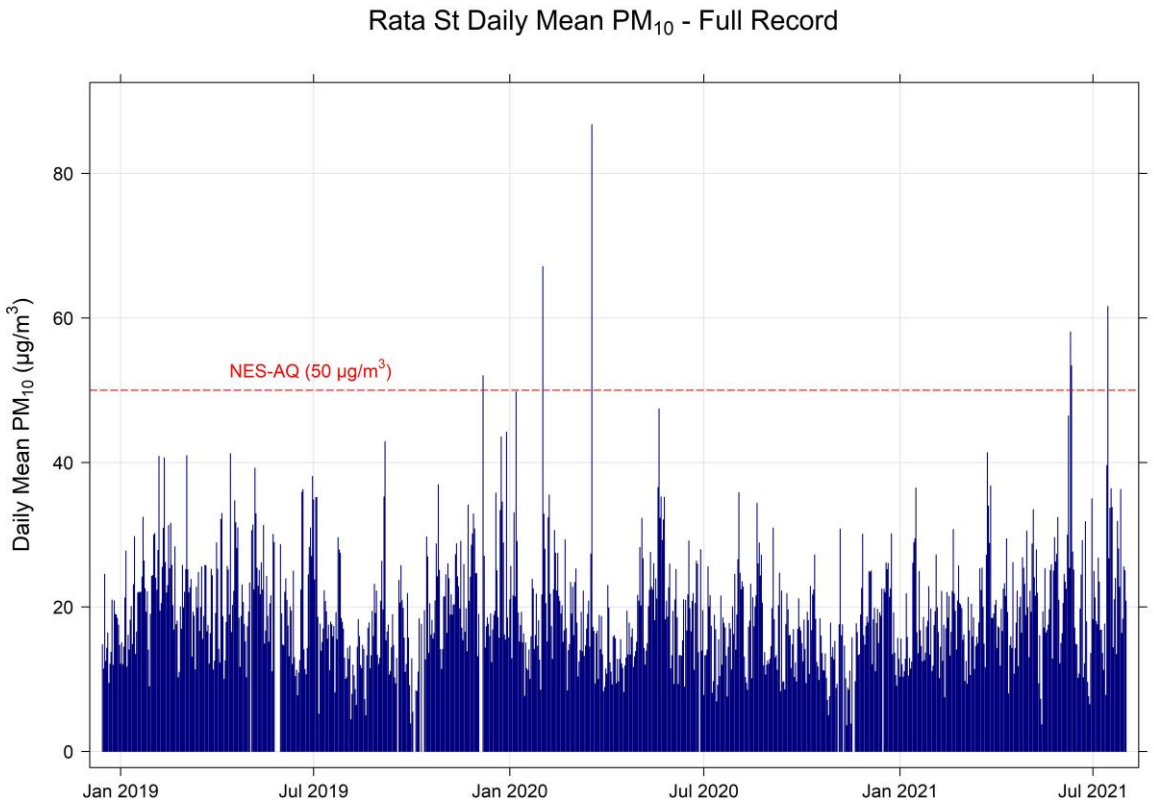

Figure 2. Rata Street PM_{10} 24 hour timeseries, full record.

The Rata Street site has a higher than average annual mean PM_{10} value when compared with all sites within the Council's monitoring network (Table 2). The short record of data collected to date also demonstrates that the PM_{10} levels at this site are at, or just below, the current NZAAQG annual value of 20 µg/m^3.

Table 2. Annual PM_{10} statistics for the Mount Maunganui Airshed.

	Annual mean PM_{10} (µg/m^3)	
Site	**2019**	**2020**
Otumoetai	11	10
Kopeopeo	12	13
Sulphur Point	14	13
Edmund Rd	14	12
Moses Rd	14	15
Marina	16	14
Whareroa Marae	17	14
De Havilland Way	20	18
Rata St	20	18
Totara St	25	21
Rail Yard South	31	24

Like all ambient air quality monitoring sites located within urban areas, the full timeseries (Figure 3) from the Mount Maunganui Airshed exhibits considerable variability. The only real difference from other urban areas is the absence of a dominant winter time domestic heating signature, such as that shown at the Bay of Plenty Regional

Council monitoring site in Rotorua. Analysis shows that the opposite is often the case with the Mount Maunganui sites, where a summer pattern can be statistically defined, which is a result of climatic/meteorological drivers, coupled with anthropogenic activity.

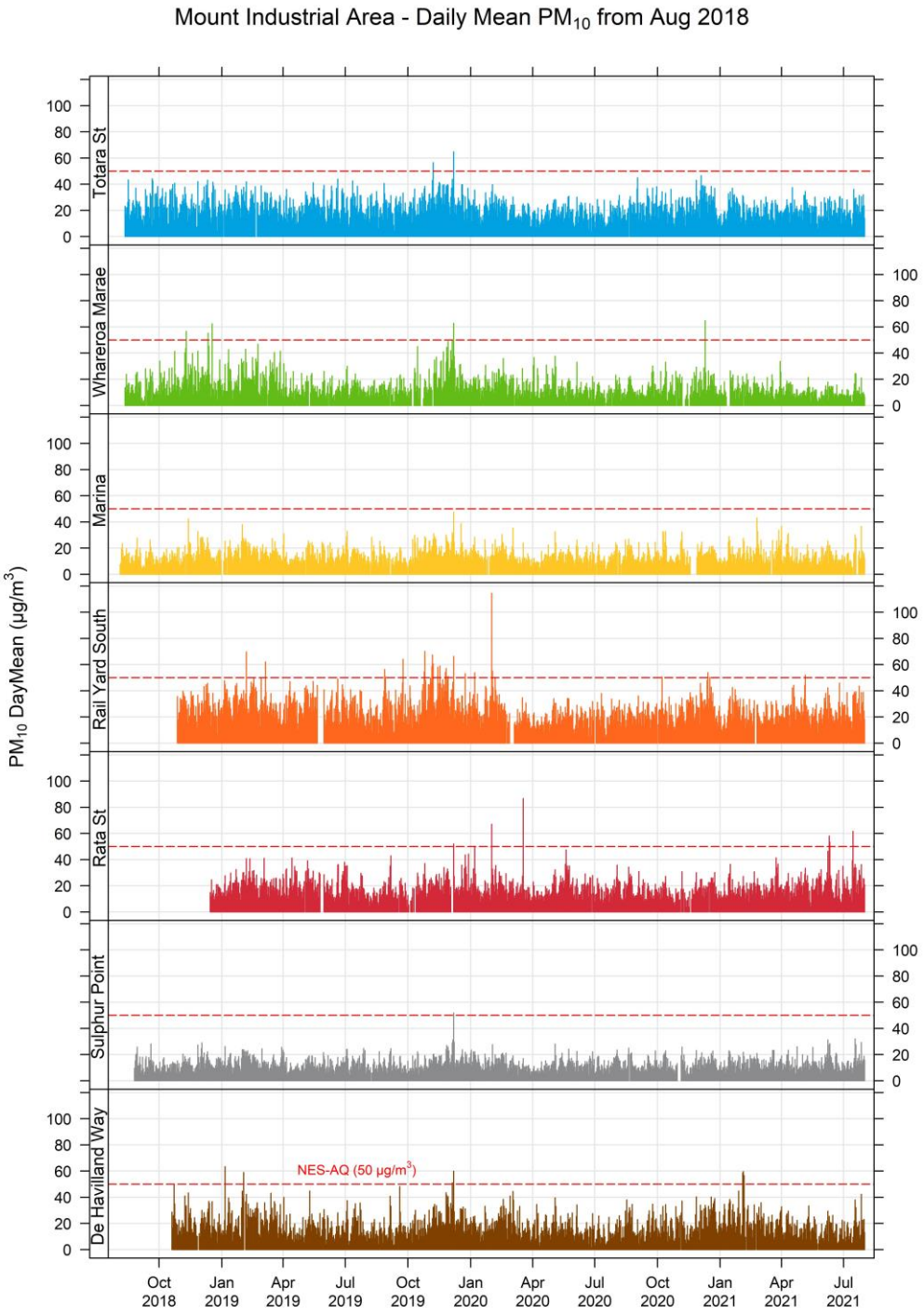

Figure 3. Full PM_{10} data for all site within The Mount Maunganui Airshed.

Polar plots for the mean and maximum statistic for the full record of data at Rata Street (Figure 4) show a dominant pattern whereby higher concentrations are experienced at the site when winds are from the southern quadrant and typically when wind speeds are higher; this latter point aligns well with general particle transport theory. Other sectors of the compass do show occasions of elevated values but winds from the coastal sector typically have low particle concentration loads in comparison.

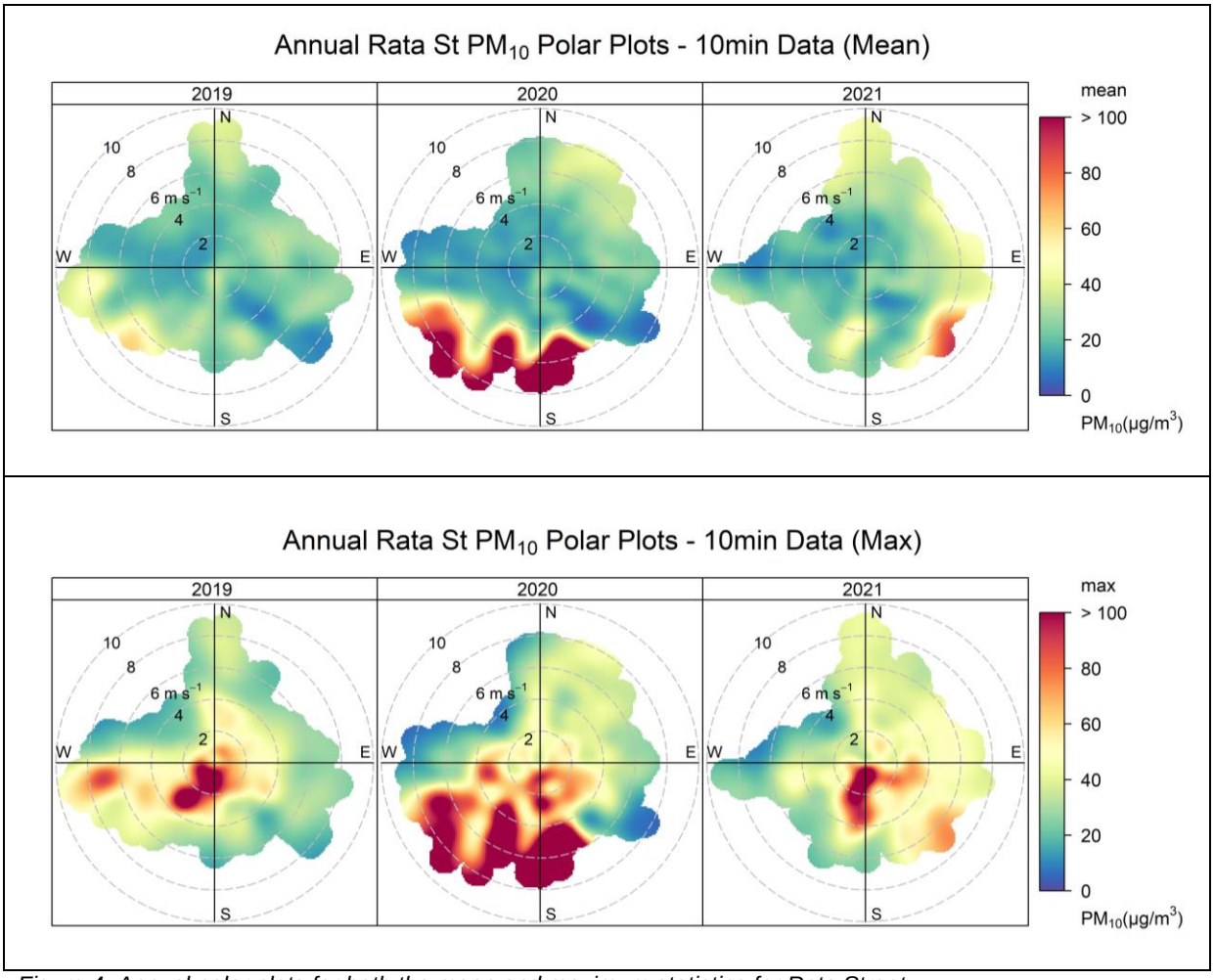

Figure 4. Annual polar plots for both the mean and maximum statistics for Rata Street.

The spatial aspect can be seen in Figure 5 when the 2020 polar plot (from Figure 4) is overlaid on a recent aerial image which also shows the boundary of the Mount Maunganui Airshed. Major anthropogenic particle sources are to the south/southwest and coastal sources are in an arc from the north through to the east.

Figure 5. The Rata Street 2020 polar plot overlaid on aerial imagery to show source locations.

9th and 10th June 2021 PM_{10} exceedance events

The following information builds on the background information in the previous section and is more specific to the PM_{10} exceedance events recorded at Rata Street monitoring station on the 9th and 10th June 2021.

Firstly, wind direction for the two days was investigated and shown to be within the arc from east through to south east (Figure 6) which is a band that is away from the industrial sources of PM_{10}.Potential upwind PM_{10} sources are traffic roadways, residential areas and the Bay of Plenty coastal environment. A wide view of the surrounds in shown in Figure 7 which shows the wind direction for the events was from the coastal environment.

Figure 6. Windrose for the 9th and 10th June 2021.

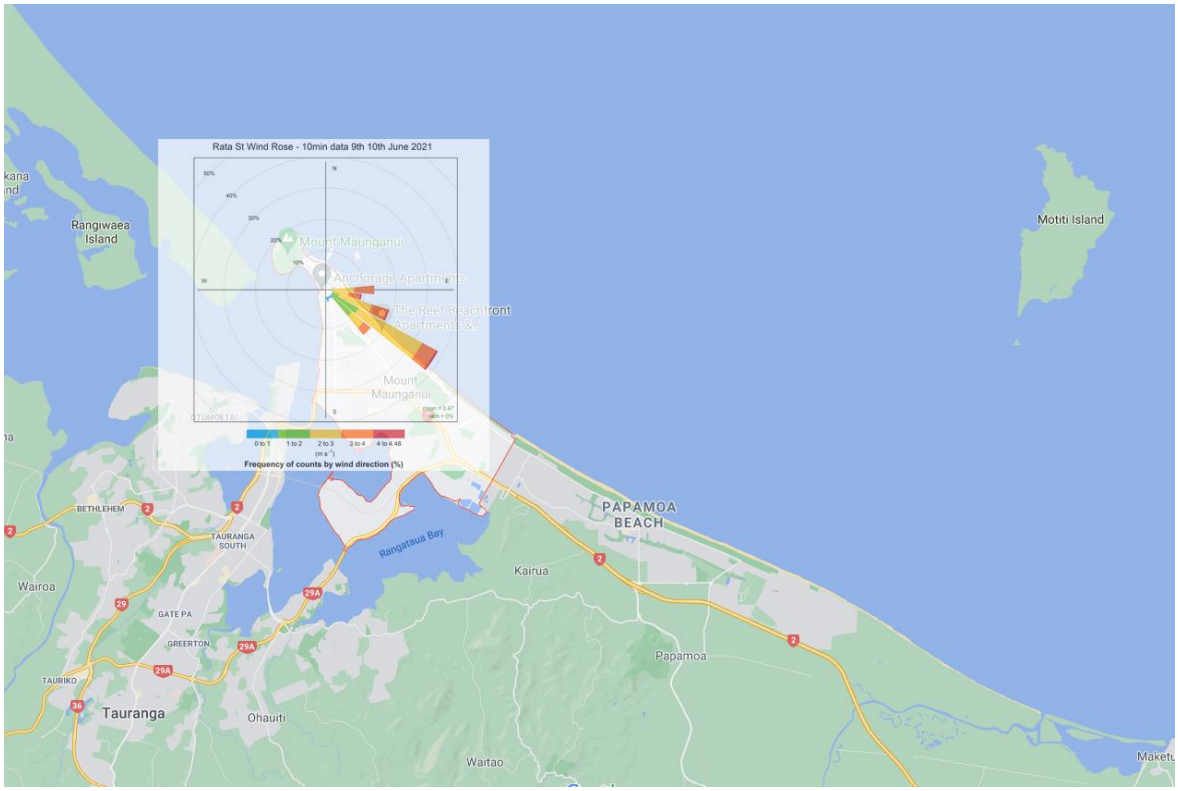

Figure 7. Windrose for the 9th and 10th June 2021 showing alignment with the Bay of Plenty coastline

The wind flow over the Bay of Plenty is shown in the following synoptic maps (Figure 8). They show several important features and drivers related to the exceedance events. Firstly, the presence of a depression located to the north of the Bay of Plenty for several days, and a substantial anticyclone to the south. The resulting wind flow over the Bay of Plenty is an easterly one with a substantial fetch which creates a sea state which will be discussed further in this section. The depression weakened after several days but the anticyclone's continued presence to the south saw a persistent easterly wind flow.

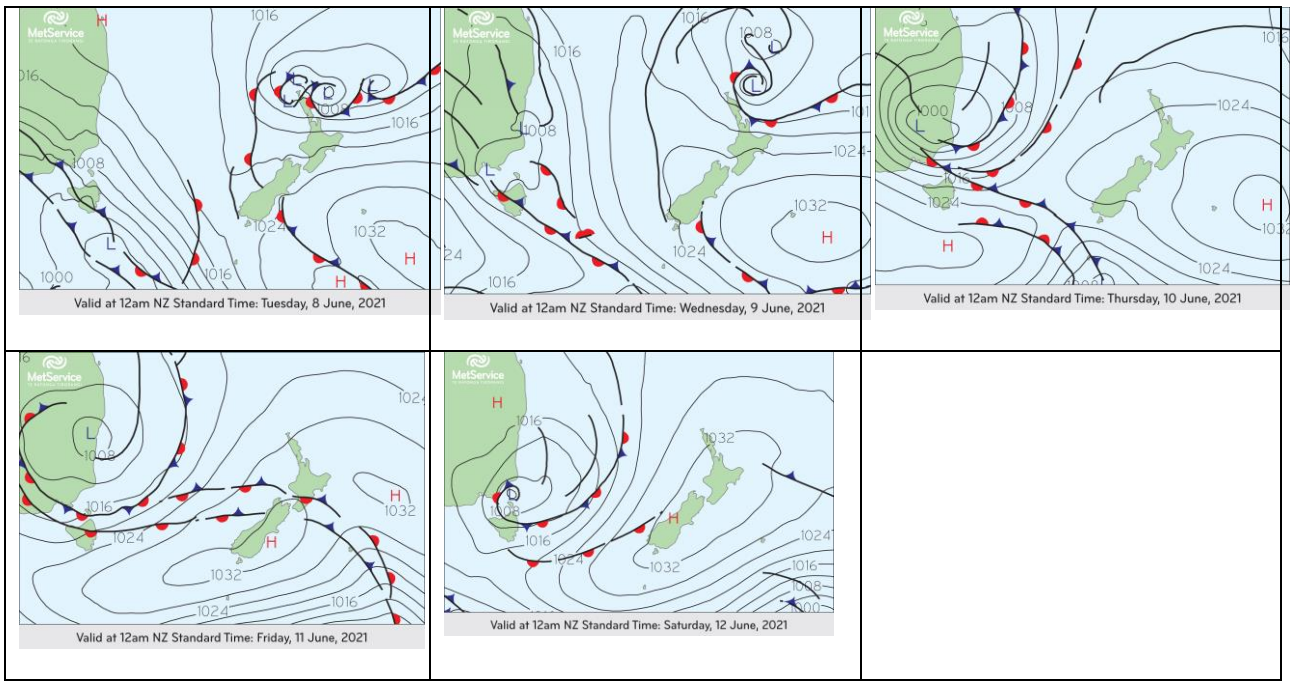

Figure 8. Synoptic maps for the period of interest.

PM_{10} 24 hour datasets from the Airshed sites (Figure 9) show an increase in PM_{10} concentration over a time period straddling the events, with only the Rata Street site exceeding the PM_{10} standard. It should be noted that individual site locations are not equidistant from the coastline (as shown in Figure 14) and this situation in relation to measured concentrations is discussed later in this section.

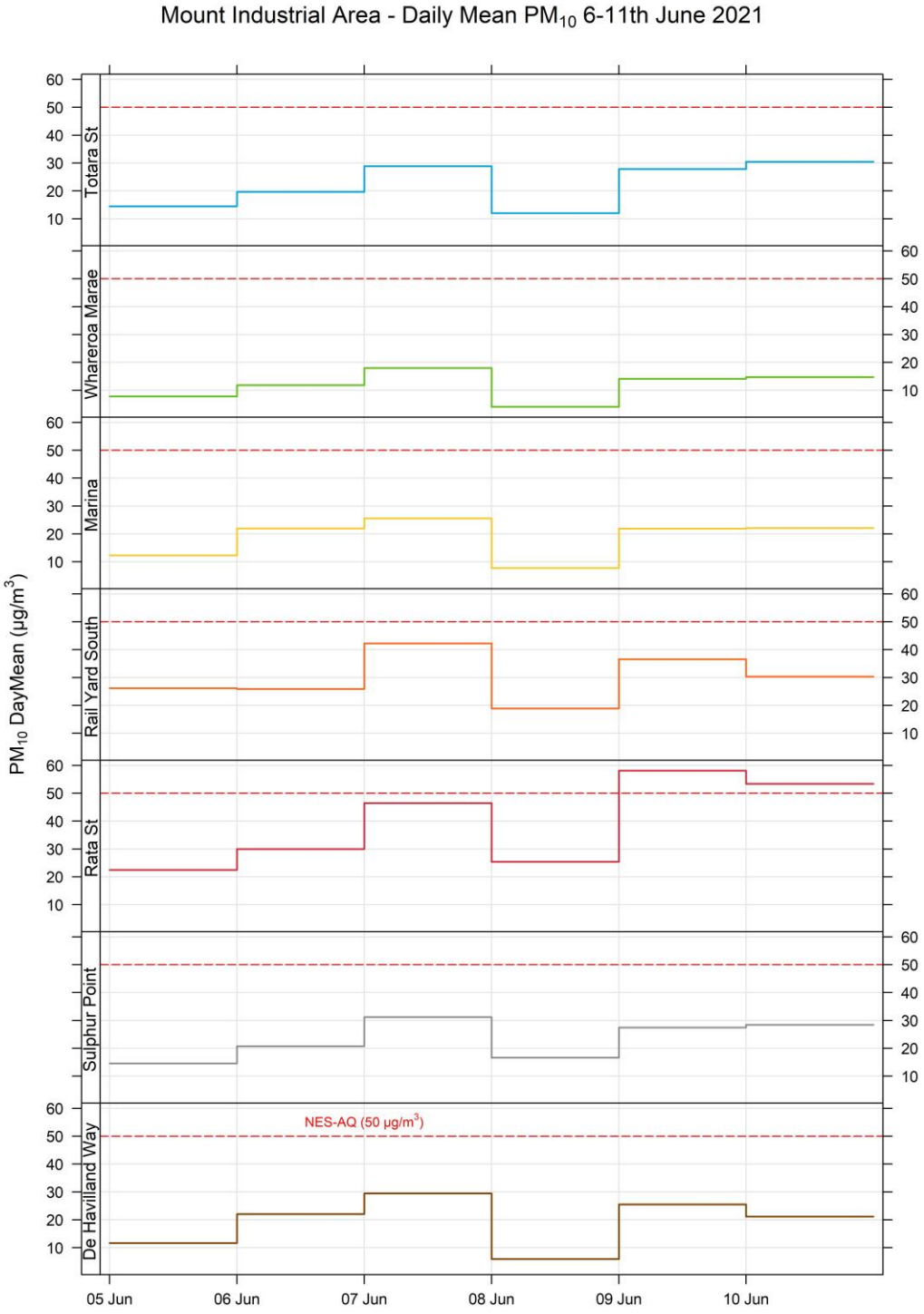

Figure 9. Daily PM_{10} plots for the Airshed sites.

Rata Street timeseries for the two events is shown in Figure 10. The first plot shows an initial peak and then a sustained elevation of PM_{10} concentrations for the several days. Inspection of the wind direction timeseries in the second plot show a pattern whereby when wind direction moves away from the south and heads more easterly, then the PM_{10} concentrations increased. The easterly wind direction relates well with the location of the coastal environment. This easterly/increasing concentration relation is further demonstrated with the polar plots for the two days in Figure 11, with high values recorded when the easterly wind flow is present.

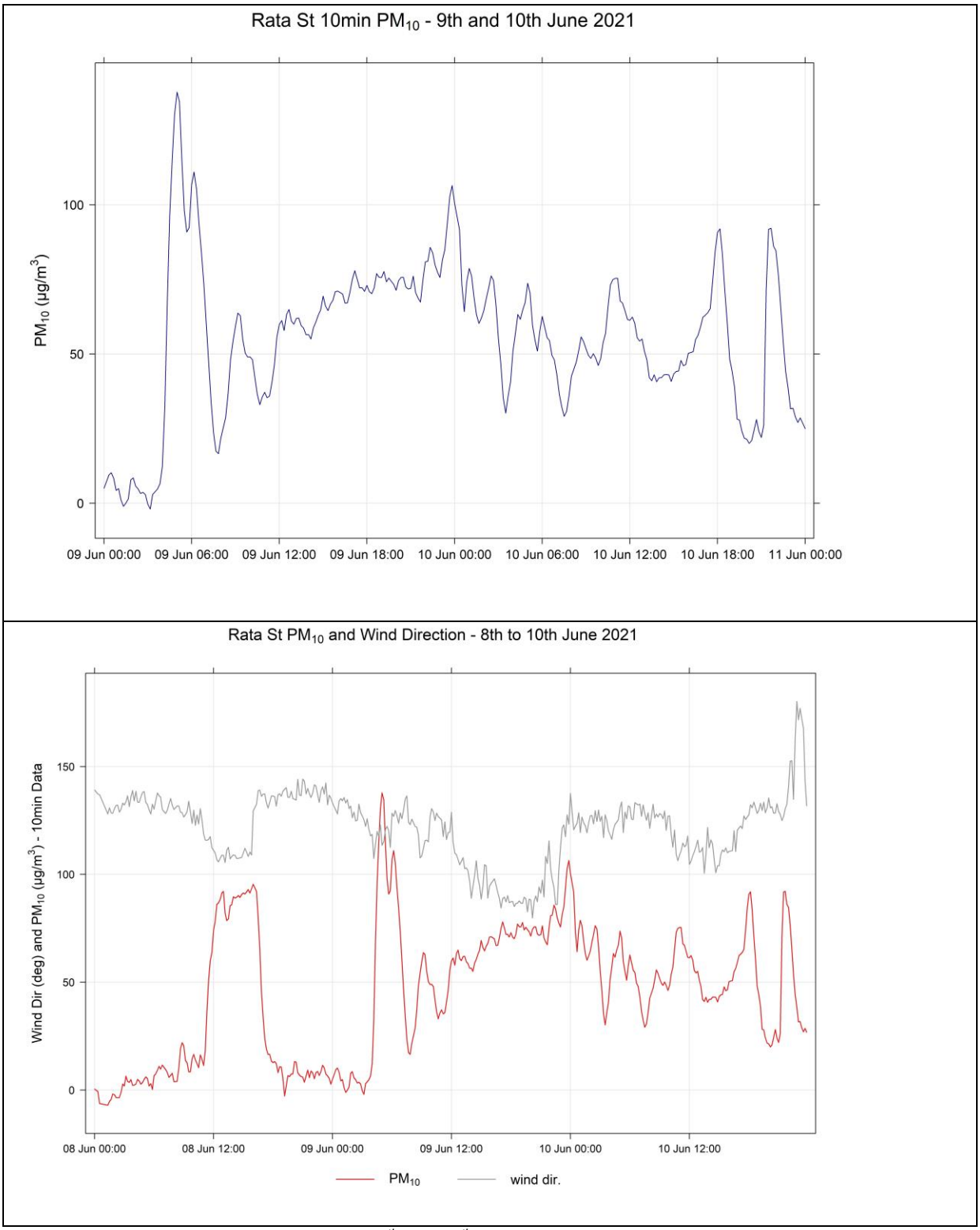

Figure 10. PM10 and wind direction for the 9th and 10th June 2021.

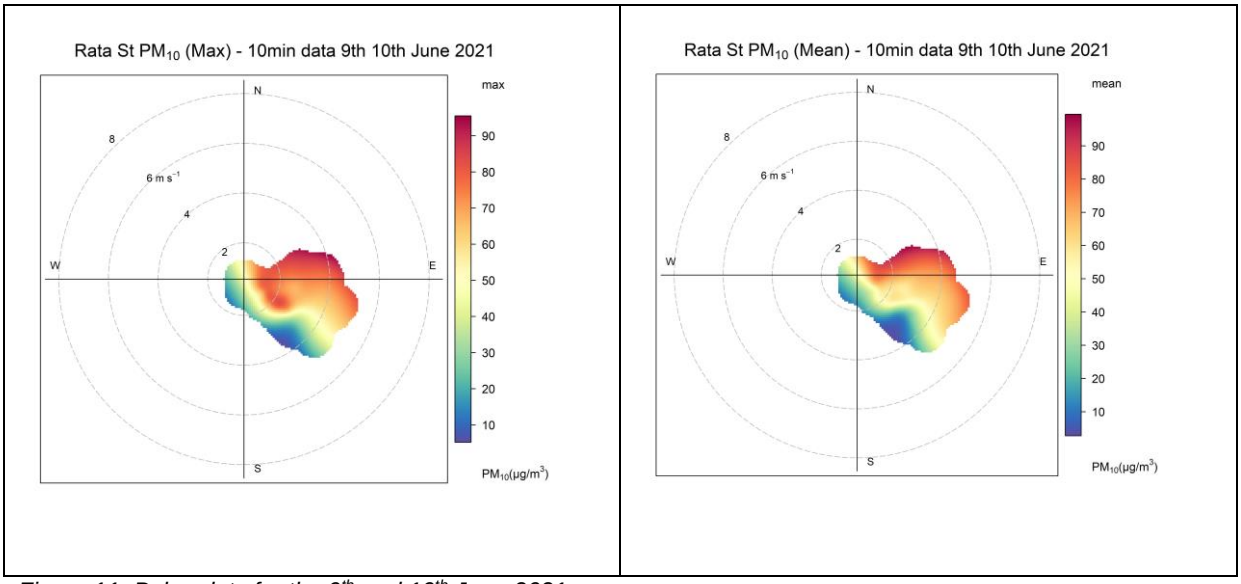

Figure 11. Polar plots for the 9th and 10th June 2021.

In addition to traditional air quality datasets, several other parameters have been checked as part of this investigation. Firstly, precipitation, which is recorded by acoustic techniques at each of the sites within the Airshed. Rainfall was recorded on the 6th and 7th of June but not on the dates that the exceedances were recorded. Secondly, wave parameters from a wave buoy located within the Bay of Plenty, approximately 10km off the coastline. As can be seen in Figure 12, at the time of the two recorded PM_{10} exceedances, an elevated sea state event was present within the Bay of Plenty (which was significant enough to result in areas of pronounced coastal shoreline erosion within the western Bay of Plenty). Wave heights were in excess of 5m for a period of more than three days. It is this elevated sea state that generated a source of natural sea spray particles. Council Officer observations within the Mount Maunganui beach area at the time of the elevated PM_{10} reading clearly showed a haze associated with wave activity (Figure 13).

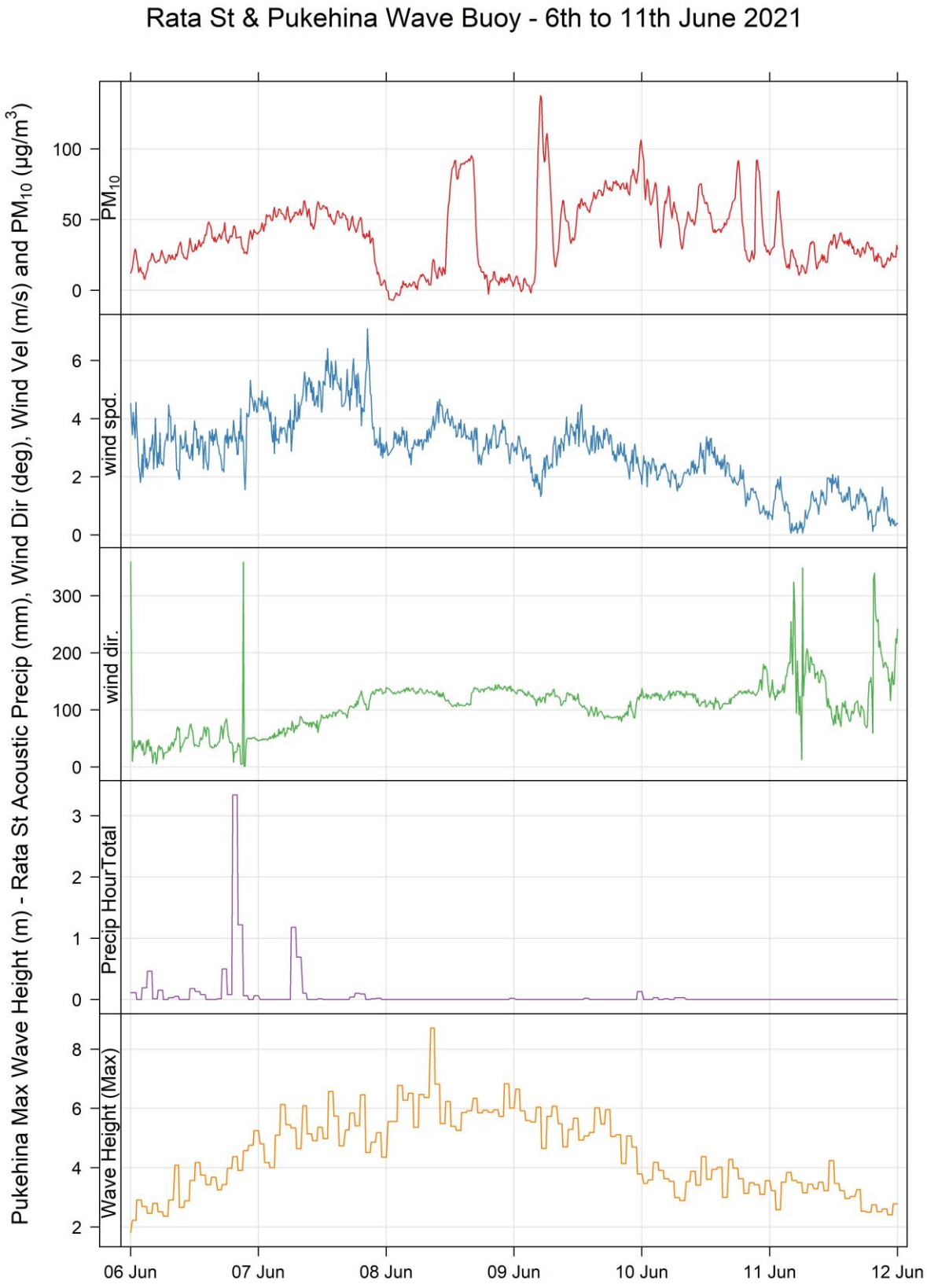

Figure 12. Air quality, precipitation and wave height data for 6th to 12th June 2021.

Figure 13. Photographs taken by Council Officer showing sea spray along the Mount Maunganui beach area.

To investigate the wave height relationship with PM_{10} concentration values, a filtered dataset was generated from four of the Airshed monitoring stations (Rata Street, Rail Yard South, Totara Street and Whareroa Marae). These chosen sites represent increasing distances from the open coastline. Firstly, a wind direction arc was chosen which mimics that seen for the two PM_{10} exceedance events. Then box and whisker plots were generated for each site based on a series of wave height bins. This overall approach was applied to just the June 2021 dataset. It should be stated that, in addition to the natural coastal environment source, there is a increasing anthropogenic source list for Rail Yard South, Totara and Whareroa. Overall, Figure 14 shows the influence of the coastal event, with a diminishing influence the greater the distance from the coast, thus also explaining the patterns in PM_{10} concentration seen in Figure 9.

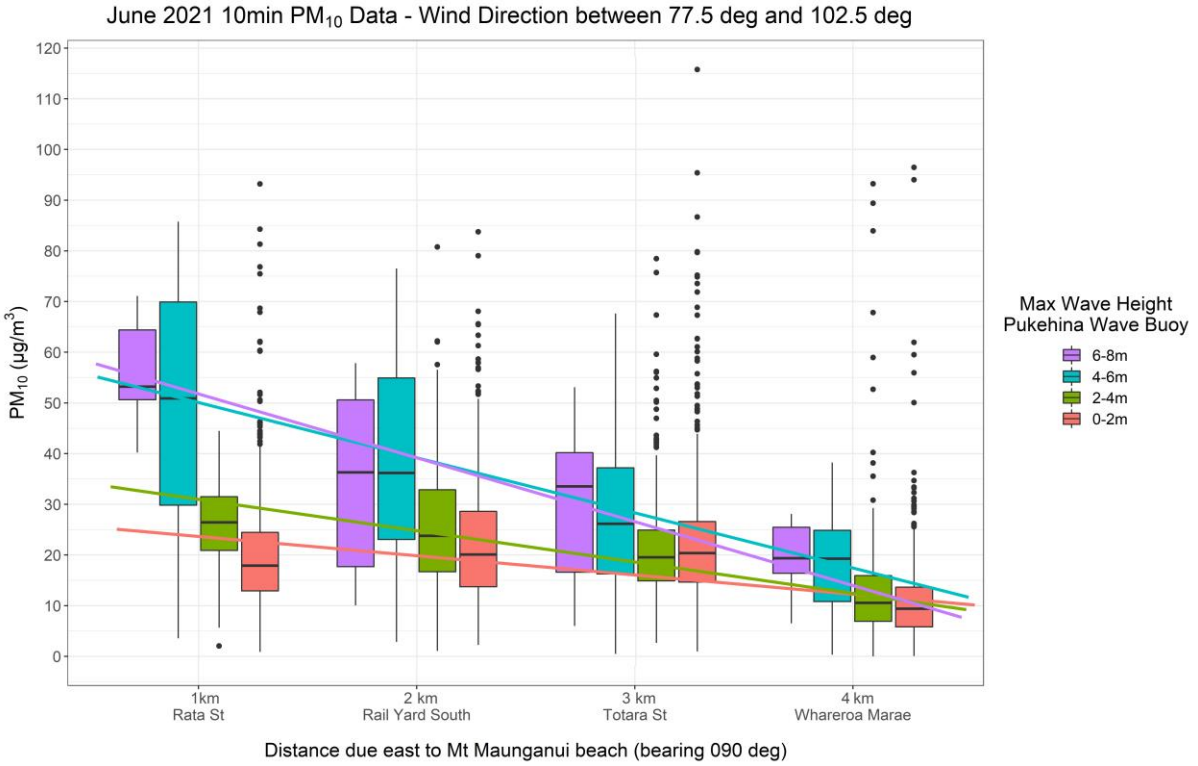

Figure 14. Relationship between wave heights, distance from the coastline and PM_{10} concentrations.

Further Council Officer observations were made shortly after the events in the neighbourhood to the east of the site (Figure 15). These were focussed on any potential particulate source activities that could have given rise to a period of several days of elevated PM_{10} readings. No activities were identified and, furthermore, the Council's Pollution Hotline recorded no calls that could be related to such activities either.

Figure 15. General area of Council officer observations.

Scanning Electron Microscope (SEM) data

Filter tapes from the Rata Street PM_{10} recording instrument for the two day's PM_{10} exceedances were sent to the University of Waikato's Scanning Electron Microscope (SEM) laboratory for further qualitative analysis. This

technique allows for visual identification of individual particles along with elemental composition of said particles. Previous work using this technique allows for the easy identification of sea spray particles which are visually and elementally unique. An example of this is shown in Figure 16.

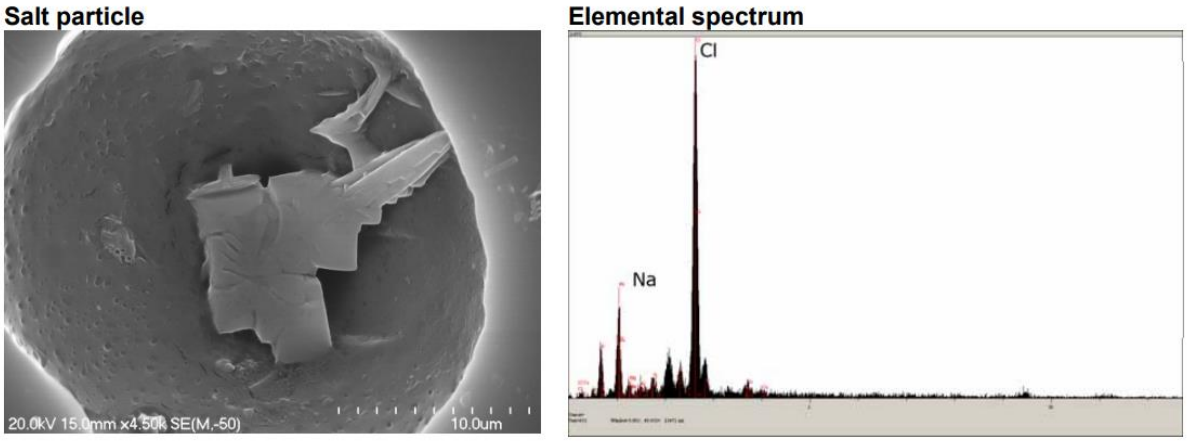

Figure 16. Example of SEM imagery and spectra from previous Council investigations.

Preliminary Conclusion

The information presented within this supporting document demonstrates a pattern of recorded ambient air quality, meteorological data and Council Officer observations for the 9th and 10th June 2021 that is in line with the influencing factor of a natural coastal environment source (sea spray derived particles). This presence of natural particles resulted in concentrations of PM_{10} recorded at the Rata Street monitoring site that exceeded the 24 hour standard of 50µg/m^3 on two successive days. SEM data was to be included in this application but is currently unavailable due to COVID 19 restrictions imposed on the University of Waikato laboratory which has delayed analysis of the filter tapes. BOPRC anticipate that these microscope results will show a significant presence of NaCl-based particles, from sea spray, which have regularly been observed in similar samples collected in this general locale in the past. BOPRC are happy to provide these SEM results as an addendum in support of this application once they have been supplied by the laboratory.

Shane Iremonger

Science Team Leader