

IN THE MATTER

FTAA-2512-1153 Central and Southern Block
Mining Project

AND

IN THE MATTER

Scope/Task set out by Panel in Minute 25

EXPERT REPORT OF TRACY FREEMAN

6 OCTOBER 2026

EXPERT REPORT OF TRACY FREEMAN

1 INTRODUCTION

1. My name is Tracy Joanne Freeman. I am employed as a Principal Air Quality Consultant at Jacobs Group (New Zealand) Ltd (Jacobs), currently based in Jacobs' Christchurch office.
2. I have a Masters Degree in Chemical Engineering from the National University of Singapore, and a First Class Honours Bachelor Degree in Chemical and Process Engineering from the University of Canterbury, New Zealand.
3. I have over 33 years' experience in air quality consulting. The first 18 years of my experience were based in New Zealand, before moving to Australia in March 2011 and then returning to Christchurch in March 2022.
4. I am a financial member of the Clean Air Society of Australia and New Zealand ("**CASANZ**"), and am a Certified Air Quality Professional.
5. I have been appointed by the Environmental Protection Authority to provide technical review of the air quality assessment for the fast-track consent applications by Taharoa Ironsands Limited (**TIL**), under the scope set out by the Panel in Minute 25 (attached to this report as **Attachment A**).
6. I visited the site on 24 September 2024, where Mr Wayne Coffey from TIL provided a site tour and answered questions that I raised.
7. I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2023 (the "**practice note**"). This report has been prepared in accordance with the practice note and I agree to comply with it. My qualifications as an expert are set out above, and I confirm that the issues addressed in this report are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

2 SCOPE OF REPORT

8. As directed by Minute 25, my report covers the following matters:
- a) PM₁₀¹ emission inventory for mining activities
 - b) Opinion on potential for adverse health effects from daily and annual PM₁₀ concentrations
 - c) Rationale for and priority ranking for mitigation of PM₁₀ and/or rehabilitation in the event of any measured exceedance of health criteria
 - d) Recommendation for location of a 'background' PM₁₀ monitoring station.

3 SUMMARY OF FINDINGS

3.1 Emission Inventory

9. I developed indicative TSP and PM₁₀ emission inventories using published emission factors, principally from USEPA AP-42 and the Australian National Pollutant Inventory, for bulldozing, excavation and material handling, truck dumping, vehicle movement on unsealed surfaces, and wind erosion from exposed areas.
10. Wet activities, including mining below the water table and ore processing after material enters the slurry system, were excluded because I consider that the saturated material is not capable of generating significant dust. Diesel exhaust emissions were also excluded as insignificant compared with fugitive particulate sources.
11. Wind erosion of large exposed mine surfaces appears to be the principal source of particulate emissions from the mine, rather than routine emissions from bulldozers, haul trucks or material handling. Analysis of TSP monitoring data shows that the highest concentrations downwind of the mine occur as short-duration spikes associated with strong winds, particularly when hourly average wind speeds exceed about 12 m/s, or gusts exceed about 16 m/s.

¹ Particles with equivalent aerodynamic diameter less than 10 µm

12. A number of assumptions were necessarily used because detailed mine-specific activity data were unavailable. The results should therefore be regarded as an indicative comparison of sources rather than a precise prediction of absolute emissions.
13. The mine surfaces have very low measured silt contents, generally around 1% for exposed ironsand and tailings samples, while overburden containing clay potentially has considerably higher fine-particle content. This introduces uncertainty when applying conventional mining emission factors derived from other materials and mining environments.
14. The emission inventory and monitoring observations lead to the same conclusion: wind erosion of exposed surfaces is the dominant source relevant to elevated off-site particulate concentrations.
15. The overall mine emission inventory is expected to decline progressively as Pit 1, the Eastern Block and subsequently the Central Block are rehabilitated, and as mining shifts toward a greater proportion of dredging rather than dry mining.

3.2 PM₁₀ Health Criteria

16. There is substantial uncertainty in directly translating the existing TSP measurements into PM₁₀ concentrations. Surface particle-size testing does not establish what proportion of airborne TSP is PM₁₀, and PM₁₀ is defined by aerodynamic rather than physical particle diameter.
17. Nevertheless, taking the monitoring results, source characteristics, receptor distances and anticipated rehabilitation into account, I conclude that:
 - a) It is very unlikely that the daily or annual PM₁₀ criteria would be exceeded at sensitive receptors around Taharoa as a result of the mining operations.
 - b) If a daily PM₁₀ exceedance did occur, it would probably involve a combination of mine emissions and background PM₁₀, rather than mining alone.

- c) I support the proposed installation of a permanent PM₁₀ monitor at Taharoa School using an Approved Method compliant with Schedule 2 of the National Environmental Standards for Air Quality (**NESAQ**), or an equivalent method, because it will enable these conclusions to be verified using direct PM₁₀ measurements at a sensitive receptor.
- d) Operating a gravimetric PM₁₀ sampler alongside the PM₁₀ monitor at Taharoa School is recommended to allow chemical/source-apportionment analysis and to distinguish sea salt from mine-derived sand or clay.

3.3 Mitigation Priorities

- 18. Reducing the amount of exposed erodible surface should be the primary mitigation measure.
- 19. Restrictions on bulldozer or truck operating rates during high-dust events are highly unlikely to materially reduce the TSP peaks observed at the monitoring stations, because those peaks are principally associated with wind erosion rather than equipment operation.
- 20. Accordingly, rehabilitation should focus on both:
 - a) Surfaces closest to Taharoa and neighbouring residences; and
 - b) Reducing the overall exposed area, particularly within the Eastern Block, Central Block and Pit 1.
- 21. As these areas become rehabilitated, particulate concentrations at the existing northern monitoring locations are expected to decrease substantially. Monitoring locations may eventually need to move southward as the centre of mining activity migrates into the Southern Block.

3.4 Background Monitoring

- 22. In my opinion, the present MP5 location is broadly appropriate for measuring coastal background concentrations under onshore winds. However, there is a significant unexplained difference between the MP5 concentration distributions measured in 2024 and 2026, which

means the current background dataset cannot yet be regarded as reliable.

23. I recommend establishing an additional inland background location, potentially within the Northern Block, at approximately the same inland distance as the Taharoa receptors as far as possible.
24. I also recommend improving backup/remote data logging to minimise monitoring data losses due to intermittent cellular coverage.

3.5 Conclusion

25. The main air-quality risk from the Taharoa mine is episodic wind erosion from large exposed surfaces during strong onshore winds, rather than normal mining equipment activity. Existing monitoring does not indicate that PM₁₀ health criteria are likely to be exceeded at sensitive receptors, but direct PM₁₀ monitoring and better background/source-apportionment information are needed to confirm this. Progressive rehabilitation and reduction of exposed surface areas are therefore the most effective long-term means of reducing particulate emissions.

4 DOCUMENTS RELIED ON

26. In preparing this report, I read and considered the documents listed in Item 1 of Appendix 1 to Minute 25, as well as the applicant's Substantive Application (T+T, 2025) and two documents that were provided to the Panel after the issue of Minute 25:

- a) *Memorandum of Counsel for Applicant dated 8 Sep 2026*
- b) *Appendix C - Air Quality Response to Panel RFI.*

27. All of these documents were provided to me by the Panel.

28. I will refer throughout this report to three reports prepared by Pattle Delamore Partners (**PDP**) (air quality consultant engaged by TIL):

- a) Taharoa Ironsands – Central and Southern Block Fast-track Mining Project – AQ Assessment, report by PDP dated October 2025 (PDP, 2025)

- b) Response to comments relating to Air Quality on the Taharoa Ironsands Fast-track Application, PDP Memorandum dated 22 June 2026 (PDP, 2026a)
 - c) Air Quality Response to Panel RFIs for Taharoa Ironsands, PDP Memorandum dated 3 September 2026 (PDP, 2026b)
29. I received an electronic data file from Mr Andrew Curtis from PDP containing sequential hourly records of total suspended particulate (**TSP**) concentrations from various monitors located within and around the mine boundary. The data received from Mr Curtis was missing all results for 2025 except for the month of January.
30. I also independently purchased meteorological data from the Port Taharoa automatic weather station (**AWS**) for hourly records of wind speed, wind direction, wind gust speed, and temperature using the Earth Sciences New Zealand DataHub (<https://data.niwa.co.nz/>).

5 METEOROLOGY REVIEW

31. Before commencing my commentary on the monitoring data and emission inventory, I will provide some comments on the meteorological data where relevant to my review as part of the process of forming my opinions.
32. I prepared a windrose from the Port Taharoa AWS data for the last full 10-year period 2016-2025. This windrose is shown in Figure 1. The pattern of wind speed and direction distribution is similar to the windrose for the three-year period covering 2022-2024 provided in Figure 3 of PDP (2025). However, the wind distribution is different to that provided in Figure 3 of PDP (2026b). I also calculate different frequencies of calm winds (>0.5 m/s) and average wind speeds compared to that stated in Figure 3 of PDP (2026b)². In the dataset I obtained for Port Taharoa, the average annual wind speed from 2016 to 2025 ranges from 4.8 to 6.0 m/s, with a 10-year average of 5.4 m/s. Calm winds are very infrequent, approximately 0.02%.

² In Figure 3 of PDP (2026b), the average wind speed for the 5-year period 2022-2026 is quoted as 4.8 m/s, with 0.2% calms.

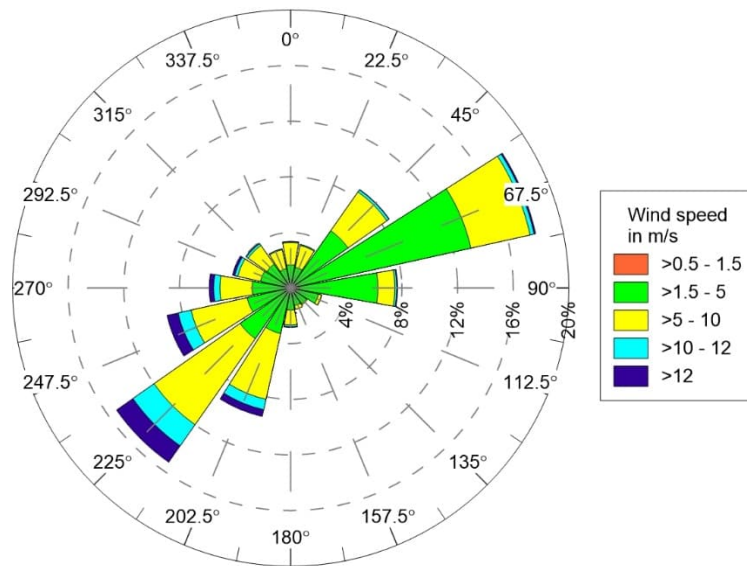


Figure 1. Windrose of 1-hour average wind speeds from Port Taharoa AWS; 2016-2025.

33. I have not been able to replicate the wind direction distribution provided in PDP (2026b). I note that similar wind direction distributions appear in the pollution roses provided in Figure 8 of PDP (2026b) but I have not relied on those roses in my analysis.
34. I also conducted some analysis of meteorological data to confirm the statement in PDP (2026b) (section 3.2.1.1) that *'there is a high probability that strong winds (greater than 10 m/s) from the west will be associated with rainfall events and therefore not generate dust'*. I isolated all occasions from January 2020 to August 2026 where the 1-hour average wind speed exceeded 10.0 m/s for wind directions where the mine is potentially downwind of sensitive receptors (winds from 180-290 degrees as I will explain further in the following section). For each of those hours, I extracted the daily rainfall amount also measured at Port Taharoa on the same day. This does not take into account whether the rain happened before or after the hour where the wind speed >10 m/s was recorded.
35. I found that in that time period, there were 3922 hours with a wind speed > 10 m/s, with daily rainfall amounts as listed in Table 1.

Table 1. Daily rainfall amounts associated with hourly wind speeds exceeding 10 m/s; Port Taharoa AWS January 2022-August 2026.

Rainfall in day (mm)	Percentage of hours where hourly-average wind speed exceeded 10 m/s
0	20%
<1	46%
<2	58%
<3	65%
<4	69%
<5	75%
<10	87%
<20	96%

36. I am not aware of how much rain needs to fall at the mine site in a day before dust is found to be effectively suppressed. My own experience from living in a rural area is that small amounts of rain (less than 1-2 mm in a day) provide only short-term relief from dust (i.e. a matter of hours), and this would be particularly the case with strong wind speeds. I also note that the Ministry for the Environment (2016) *Good Practice Guide for Assessing and Managing Dust* (MfE, 2016) indicates that as a very general rule of thumb, typical water requirements for most parts of New Zealand for wet suppression of unpaved areas are up to 1 litre per square metre per hour – equivalent to 1mm of rain per hour.
37. As I will discuss in the next section, analysis of TSP concentrations measured at the monitors downwind of the mine does show some trend for the potential for occurrence of TSP concentration spikes under high wind speeds to be suppressed following rainfall events – but the graphs supporting that analysis do not clearly show how much rainfall is needed, and often show significant rainfall in days prior to the wind speeds.
38. Table 1 shows that over the 2022-2026 period, 70% of hours where wind speeds exceeded an average of 10 m/s occurred on days with less than 4 mm of rain, and 58% occurred on days with less than 2 mm of rain. I consider that the data does not support the statement in PDP (2026b) that there is a high probability that dust will not be generated during strong onshore winds due to coincidence of rainfall events.

6 EXISTING AIR QUALITY

39. I conducted some analysis on the air quality data from the TIL monitoring sites to inform my responses to the Panel's questions.
40. I did not consider any of the monitoring data from the monitors labelled MP1 and MP3 due to their locations in close proximity to mine sources as confirmed at the site visit. I was informed at the site visit that MP1 is not in the location shown in Figure 6 of PDP (2025), as it was moved "a couple of years ago" to a location within the mine site. I visited the MP3 site, which was located on the contoured surface of the Eastern Block. Similarly, I did not include monitor MP6 in my analysis, because footnote 7 in PDP (2026b) comments that MP6 was located in the middle of the Central Block prior to the works being completed in the Eastern Block, and therefore historical data from this site is not representative of effects that might be experienced off-site.
41. I also confirmed during the site visit that the 'background' monitor MP5 is still in the coastal location shown in Figure 6 of PDP (2025), and has not been moved to the new site proposed in Figure 4 of PDP (2026a). Data for the new MP5 location is available from 27 July 2024. All data that I refer to in this report regarding MP5 relates to that new location.

6.1 Background data

42. I defined background data for the MP5 monitor as any TSP records when the wind direction from the Port Taharoa AWS was blowing from 220 degrees through to 300 degrees (Figure 2).
43. I filtered the TSP monitoring data for MP5 to produce a 'background' data set comprising only the data records during these wind directions. There were 2578 records in this background data set covering the period from 27 July 2024 to 7 August 2026 (and noting again that most of the 2025 data was missing). Graphs showing the cumulative distribution of TSP concentrations under these wind directions, and scatter graphs showing the relationship between wind speed and TSP concentration for the background data set, are shown in **Attachment B**.



Figure 2. Windrose of 1-hour average wind speeds from Port Taharoa AWS overlaid on aerial map of mine site from Google Earth (image flown November 2023); showing nominated onshore wind directions for background air quality analysis at MP5.

Note: Windrose appears slightly different to Figure 1 due to alignment of direction petals to the nearest 20 degrees.

44. I noticed a substantial difference in distribution of concentrations recorded at that monitor before the 2025 data gap versus from the start of 2026. I do not have any indication of what may have caused this, but I suspect it is related to the monitoring method or instrument itself rather than the actual background air quality.

45. In my interpretation, the graphs show the following:

a) July 2024 – January 2025 data set:

- (i) No apparent relationship between wind speed and TSP, although at wind speeds exceeding about 12 m/s (hour average) TSP concentrations are more likely to be elevated.
- (ii) 99.5% of the readings reported a TSP concentration of less than 10 $\mu\text{g}/\text{m}^3$.
- (iii) The maximum concentration measured was 17 $\mu\text{g}/\text{m}^3$

b) January 2026 – August 2026 data set:

- (i) Some suggestion of a relationship between increasing wind speed and increasing TSP, although not strongly correlated except at wind speeds exceeding about 12 m/s (hour average).
- (ii) 19% of the readings reported a TSP concentration of less than 10 $\mu\text{g}/\text{m}^3$.
- (iii) 95% of the readings reported a TSP concentration of less than 50 $\mu\text{g}/\text{m}^3$.
- (iv) Only three of the records reported a TSP concentration of more than 70 $\mu\text{g}/\text{m}^3$. Two of those records did not have valid wind speed data associated with the hour. The maximum concentration measured was 82.3 $\mu\text{g}/\text{m}^3$

6.2 Monitoring data downwind of mine

- 46. For my analysis of monitoring data from the monitors MP2, MP4, MP7 and MP8, I defined the wind directions of 180 degrees to 290 degrees as being downwind of the mine (Figure 3). Whilst some monitors, particularly MP7 and MP8 could justify including winds from the southeast within the 'downwind' subset, there are very few winds from that direction so I simplified the analysis by using the same 'downwind' definition for all monitors.
- 47. I plotted graphs showing concurrent records of TSP concentrations at each monitor, wind speed measured at Port Taharoa, and daily rainfall. These graphs are shown in **Attachment C**, with one graph for each two-month period. There are no graphs provided for March-December 2025 due to the missing data for that period.
- 48. I did not plot data prior to November 2023, due to the implementation of the new dust management plan by TIL in early 2024. I also note that data for MP7 and MP8 only became available from October 2024.

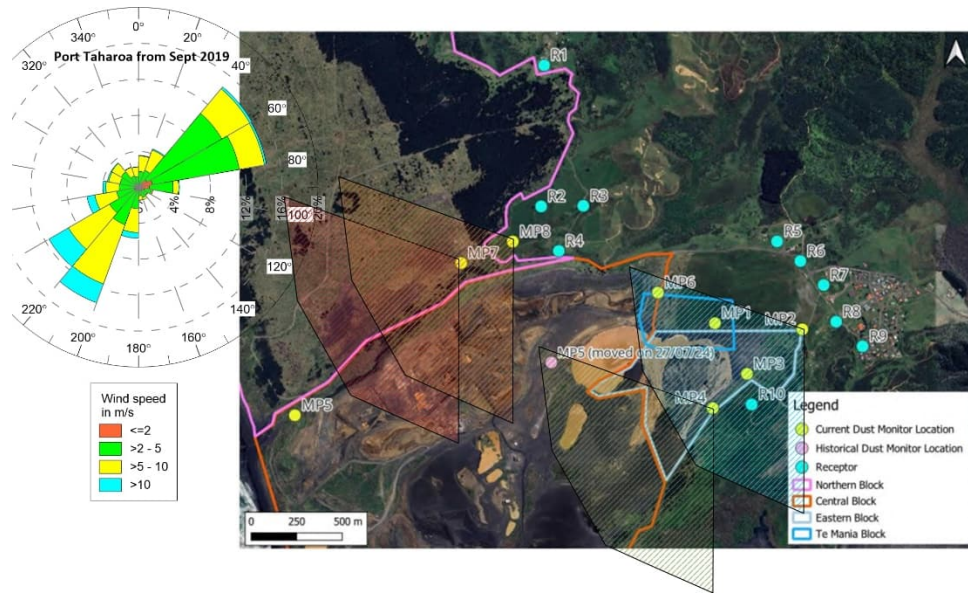


Figure 3. Windrose of 1-hour average wind speeds from Port Taharoa AWS overlaid on Figure 7 from PDP (2025); showing nominated onshore wind directions for air quality analysis at MP2, MP4, MP7 and MP8.

Note: Windrose appears slightly different to Figure 1 due to alignment of direction petals to the nearest 20 degrees.

49. In my opinion, visual assessment of the graphs shows the following:
- Clear correlation between high TSP concentrations (exceeding about $200 \mu\text{g}/\text{m}^3$ as a 1-hour average) at the monitors and wind speeds exceeding about 12 m/s (1-hour average) or 16 m/s (gust).
 - High TSP concentrations occur in short 'spikes' that usually last up to a few hours.
 - When high TSP concentration occur, these often occur at all monitors but not at the control site MP5.
 - The potential for high TSP concentrations to occur in high wind speeds appears to be lessened if there has been sufficient rain at the site in the last day or so.
 - There are a small number of occasions when TSP spikes occur without corresponding high wind speeds – for example 29 November and 2 December 2024, and 13-14 January 2025. I do not have an opinion on the reason for these TSP spikes but I note that in my experience nephelometers can produce false-

positive readings during high humidity/foggy events. I do not have any data to confirm if such environmental conditions were present at the time or whether these TSP concentrations related to specific mining activities close to those meters.

- f) Excluding the high TSP spikes, the vast majority of the 1-hour average TSP readings at each site are less than $40 \mu\text{g}/\text{m}^3$.
 - g) TSP concentrations measured at MP5, representing background, are higher than some of the downwind monitors in the 2026 data – this can be seen from the magnifying overlays provided on the graphs in Attachment C for the 2026 data.
50. From these data trends and my site visit observations, it is my opinion that high TSP concentration spikes measured at the monitors downwind of the mine and close to sensitive receptors are caused by short-term wind-driven erosion of surface particles at the mine, rather than day to day mining activities.

6.3 24-hour and annual average TSP

51. I calculated the 24-hour and annual averages of TSP for monitors MP2, MP4, MP7 and MP8. I included all wind directions in these calculations, but only calculated a 24-hour average if there were at least twelve 1-hour average data records for the day. I did not calculate rolling averages, only a midnight-midnight average which is consistent with the averaging period specified in the NESAQ for PM_{10} .
52. I did not calculate any statistics for the 2025 year, as only data for January 2025 was available.
53. I have listed the annual average TSP concentrations for each monitor for the 2020 – 2026 years (excluding 2025) in Table 2. My calculations agree with the annual averages listed in PDP (2026b) except for 2023, where I have calculated lower averages. I have not been able to reconcile what may have caused that difference.
54. I also note that the two annual averages for MP7 and MP8 (2024 and 2026) are both part years, with monitoring commencing in October

2024 and the dataset ending in early August 2026. Therefore, I do not have any full years of data for those two monitoring locations.

Table 2. Annual average TSP concentrations ($\mu\text{g}/\text{m}^3$) for each monitor for 2020 – 2026.

Year	MP2	MP4	MP7	MP8
2020	17.8	20.7	No data	No data
2021	19.4	20.3	No data	No data
2022	10.8	12.0	No data	No data
2023	10.8	12.4	No data	No data
2024	10.7	11.0	11.2 ^{Note 1}	9.4 ^{Note 1}
2025	Insufficient data			
2026 ^{Note 2}	4.6	4.8	8.6	14.0

Note 1: Data available for October – December only

Note 2: Data available for January – early August only.

55. For the 24-hour average TSP, I extracted the highest 24-hour average concentration for each monitoring site for each year, as well as the second, third, fourth, fifth and sixth highest concentrations. These are shown as graphs in **Attachment D**. I note that these concentrations include background sources of TSP, which may include natural or domestic sources other than the mine.
56. The graphs show that the highest one or two 24-hour average TSP concentration in any year at any monitor tend to be quite a bit higher than the rest of the concentrations. Concentrations from January to August in 2026 have been quite a lot lower than over the 2020-2024 period at MP2 and MP4. At MP7 and MP8, there is insufficient data to identify year-to-year trends.

6.4 TSP Alerts and Triggers

57. As described in PDP (2025), the site has four levels of alerts which respond to measured TSP concentrations. These are also detailed in the site's Draft Environmental Management Plan³ (**draft EMP**), along with a list of actions to be taken in the event that the various levels of alert are triggered. A copy of the table of triggers and responses from

³ Appendix T of the Substantive Application

PDP (2025) and the draft EMP is provided in **Attachment E** for ease of reference.

58. The draft EMP states that the triggers for wind only apply for wind blowing from the W, SW or S directions. I consider that wind blowing from WNW direction should also be included, due to the locations of receptors identified in PDP (2025) as R8, R9 and R10 (see Figure 3 for locations) potentially being downwind of the mine sources under WNW winds.
59. Further, the wind triggers only apply when the temperature is greater than 20°C. TIL confirmed at the site visit that this temperature condition is still active in the site protocols.
60. I agree with the analysis on page 15 of PDP (2026b) that the wind speed condition for Level 4 is reached quite infrequently. Considering my selected 'downwind' direction range of 180-290 degrees and only monitors TP2, TP4, TP7 and TP8, at least one of these monitors recorded a 1-hour average TSP concentration exceeding 240 µg/m³ for 1.7% of the available hours of data from September 2019 to August 2026. Considering only the more recent period from 1 January 2024 (since the draft EMP was established), the percentage drops to 0.7% however that data period is missing eleven months of 2025.
61. However, if that same data is filtered to remove all hours when the ambient temperature measured at Port Taharoa was ≤20°C, the frequency of time when conditions for the Level 4 trigger are met reduces to 0.7% of the available hours of data from September 2019 to August 2026, and just 1 hour in the period since 1 January 2024.
62. In my opinion, there is no valid reason to restrict the trigger alerts to only wind speeds greater than 20°C and I recommend that the requirement be removed.

7 EMISSION INVENTORY

7.1 Introduction

63. The Panel has requested the following:

Using published emissions factors for mining activities please calculate how much PM_{10} is likely to be discharged to air from the existing and proposed mining operations (in kg/day and tonnes/year) for each of the proposed stages of mining operations in the central and southern blocks.

In doing so, identify PM_{10} discharges to air from existing consented activities (Pit 1 and Te Mania Extension) separately.

64. With any mine site, there are many different sources of particle emissions. Sources of particle emissions from TIL operations potentially include the following activities:
- a) Topsoil and overburden removal and stockpiles.
 - b) Bulldozer operations.
 - c) Loading and handling of ironsand, overburden, tailings, rejected material ore.
 - d) Dust generated by the wheels of vehicles travelling on haul roads and unsealed surfaces (collectively referred to as “vehicle-tracked dust”).
 - e) Surface stabilisation, contouring and rehabilitation activities
 - f) Wind erosion from exposed surfaces including stockpiles and roads.
 - g) Product stockpiles (although I consider these to be a very minor potential for dust emissions due to the moisture content of the produce).
65. The collective list of these sources and the emission rates allocated to each source is called the “emissions inventory”. The emission inventory for the TIL mine will vary throughout the life of the mine, depending on the number of panels being worked at any one time, the progress with backfilling completed panels with tailings, progress with shaping and

rehabilitating completed areas, and whether actively mined areas are being mined using the Dry Mining Units (**DMUs**) or dredges.

66. I have based my emission inventory on the state of the mine as observed during my site visit on 24 September 2026, as well as a hypothetical future scenario where mining has been completed in the Central Block (with contouring and rehabilitation underway) and active mining has progressed into the Southern Block as well as the Te Mania Extension.
67. Emission factor publications are published references which define typical particle emission rates from different types of mining activities as a function of the intensity of the activity and source-specific variables. Emission factors are usually defined for TSP, PM₁₀ and PM_{2.5}⁴. The Panel has requested that I focus on PM₁₀ for the emission inventory, however I have also included an emission inventory for TSP to provide a basis for estimating possible PM₁₀ concentrations at the TSP monitor locations. I have not provided any emission inventory estimates for PM_{2.5} as this was not requested by the Panel, nor do I consider it would be necessary based on my experience.
68. For any mining operation, many input variables are needed to define the emission factors (EFs) and build the emission inventory. Some of these input variables can be easily quantified, and others require assumptions. Some particle sources are relatively inconsequential to the total emission inventory and therefore the inventory is insensitive to any assumptions needed to quantify their emission rates. Other sources may be relatively dominant, and the inventory is sensitive to those inputs.
69. In this report I detail the basis for all input variables that I have assigned for the emission inventory calculations, and identify those that the inventory may be particularly sensitive to. Whilst I was not able to gather all necessary data for a detailed emission inventory in the time available to me, I do not consider that to have been necessary given the strong relationship between wind-driven erosion and measured TSP downwind of the mine.

⁴ Particles with equivalent aerodynamic diameter less than 2.5 µm

70. EFs and relevant variables are discussed for each activity type in the following sections, with summary tables for the full emission inventory, as requested by the Panel, in **Attachment F**.
71. Whilst exhaust emissions from burning of diesel or petrol in vehicles and generators at the mine can be a source of TSP and PM₁₀ emissions, I did not include those in the emission inventory as I consider them to be a minor source compared to the other emissions.

7.2 Reference publications

72. The key reference publications that I rely on for these emission inventory calculations are listed in Section 12 and include:
- a) United States Environmental Protection Agency (**USEPA**)
Compilation of Air Pollutant Emissions Factors from Stationary Sources (**AP-42**).
 - b) Australian National Pollutant Inventory (**NPI**) emission estimation technique manuals.
 - c) Report by Katestone Environmental Pty Ltd in 2011 titled *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (Katestone, 2011).

7.3 Throughput assumptions

73. T+T (2025) states that the overall production rates are currently approximately 3 million tonnes (export volume) per annum, with an intention to increase this to an export volume of 5 million tonnes per annum (**TPA**) within the next 5 years. At the site visit, I queried how an increase in export volume would affect activity rates and exposed surfaces, from the perspective of how this might affect the emission inventory. Mr Coffey explained to me that TIL is already producing more than 4 million TPA, and the export volume depends mostly on the iron content of the ironsand that is mined (which varies across the site), and also the efficiency with which mining can be carried out – for example dredging being more efficient than dry mining. My understanding is that no increase in rate of removing overburden,

exposing and mining panels, and dry mining activities is needed for the increased throughput.

74. A production rate of 4 million TPA for export is equivalent to an average production rate of 11,000 tonnes per day (**TPD**). T+T (2025) states that mining occurs at a rate of approximately 45,000 TPD. Mr Coffey mentioned during the site visit typical production is 30,000 – 55,000 TPD. It is not clear to me whether the figures of 11,000 TPD and 45,000 TPD are actually referring to the same production rate but expressed at different moisture contents, or whether the figure of 45,000 tonnes per day includes handling of overburden and tailings.
75. Mr Coffey told me at the site visit that:
 - a) Only about 1% of the material removed from the ground becomes export ore.
 - b) Currently about 90% of the ironsand is mined using dry methods and the DMUs.
 - c) This will change in future to a higher percentage (approx. 50%) being mined by dredge due to the pending arrival of a larger dredging machine and greater access to the ironsand below the water table in the current mining working area.

7.4 Activities with high moisture content material

76. PDP (2025) states that the potential for dust discharges associated with mining activities undertaken below the water table is negligible as all material is saturated, and in this condition cannot give rise to dust.
77. I agree with this opinion, and consider that this also applies to all activities relating to ore processing from the point where the ironsand is combined with water to form a slurry in the DMUs. Therefore, I have not included any emission factors for these types of activities.

7.5 Definition of silt and moisture content of exposed surfaces

78. The silt content of a surface is a key parameter in the emission factor equations for some mining activities. The silt content is defined in AP-

42 Appendix C.2, Section C.2.3 as the percentage by mass of material passing a 200-mesh (75 µm or 0.075 mm) sieve.

79. PDP (2026a) described the collection and analysis of five surface samples from across the TIL mine for particle size distribution. The results from that testing are consistent with the definition of silt content in AP-42. I have provided the summary of results from this testing, from Table 1 of PDP (2026a), in **Attachment G** for ease of reference.
80. For four of the samples, the percentage of sample passing through a 0.075 mm sieve was 1%. These samples all appear to have been collected from exposed ironsand and tails areas, and it is not clear whether any of these samples were from overburden or areas where slimes or clay have been mixed with the tailings. At the processed stockpile, this percentage was 5%. It was pointed out to me during the site visit that the processed stockpile contains some residual clay that is suspended in the process water used to convey the ore to the stockpile, and I could see this as brown staining on the surface of the stockpiles. I suspect that this is the reason that the silt content measured in the sample from the processed stockpile was higher than the other samples.
81. Moisture content is also a key parameter. The definition of moisture content in AP-42 Appendix C.2, Section C.2.2 is the mass of water lost on drying, expressed as a percentage of the initial wet mass of the material. Water applied to a surface for dust control can be included in the estimate of moisture content, or accounted for in an emission reduction control factor for the source (but not both).

7.6 Overburden removal

82. Overburden refers to soils and clays that overlay the material that is to be extracted. This must be removed before the iron-rich sands can be accessed. Overburden is stockpiled for reuse later in rehabilitation, or disposed of in tailings disposal areas.
83. Regarding dust-emission potential, PDP (2025) states that *“The largest potential for dust emissions during this process is from the removal and stockpiling of the clay layer that is present in some locations generally*

overlaying rich ironsand deposits. When these clay layers are damp, they have a relatively low potential to generate dust, however as they dry, the potential for dust generation increases significantly, especially when these surfaces are disturbed by vehicles. As clays consist of almost entirely fine particles, the potential for dust from the handling of this material is significant." I agree with this statement.

84. At the site visit I observed bulldozers, excavators and trucks working on overburden removal. I will describe emission factors for each of these activities in the sections below.
85. In AP42 Chapter 11.9, Table 11.9-3 silt content for overburden ranges from 3.8-15.1%. I have assumed an average silt content of 8% for the overburden for bulldozer activities. This silt content is essentially an experienced guess, as I have no specific site data to base a long term average silt content on and the clay content will be variable. In-situ clay materials may have a high proportion of particles <75 µm; however, the potential for particulate emissions during disturbance of these materials is strongly dependent on material moisture and cohesiveness. The overall emission inventory is fairly insensitive to this silt content assumption.
86. Similarly, AP42 Chapter 11.9, Table 11.9-3 lists a moisture content range for overburden from 2.2 – 16.8%. I do not have any site-specific moisture content data for the overburden, and note that while the coastal environment and clay content of the overburden might help maintain moisture content, the sand content and wind speeds may increase the rate of loss of moisture from the surface. I also note the availability of water trucks to dampen surfaces if necessary. I have assumed an average moisture content for the surface of the overburden of 10%. The emission rate for bulldozer activities is more sensitive to this assumption than the silt content, but overall still fairly insensitive in the context of all emissions from the site.

7.7 Active mining areas

87. PDP (2025) identifies the main sources of dust for mining process activities above the water table as:

- a) Bulldozers moving material along the surface into the DMU, especially if the material is dry and contains a high percentage of silts and fine material; and
 - b) Dust being picked up and transported from exposed surfaces by strong winds.
88. I will address the potential for dust emissions under strong winds later in this report.
89. In addition to dozers moving material along the surface into the DMU, at the site visit I also observed excavators being used to load extracted material into haul trucks for transport to the DMU vicinity.
90. The amount of dust evolved from the active mining activities will vary on a daily basis depending on the amount of material being transported by trucks.

7.8 Bulldozers

91. The EFs for bulldozer activities are defined in NPI (2012b) and USEPA (1998):

	$EF_{TSP} = 2.6 \times s^{1.2} \times M^{-1.3} \text{ kg/h}$
	$EF_{PM_{10}} = 0.34 \times s^{1.5} \times M^{-1.4} \text{ kg/h}$
where	s = silt content (%) M = surface material moisture content

Equation 1

92. Katestone (2011) explains that particulate matter emissions occur as a result of the bulldozer movement and the effect of the tracks finely grinding the soil or coal. Emissions of particulate matter are enhanced by the airflow generated by the bulldozer's cooling fans and diesel exhaust and if the bulldozer repeatedly traverses the same ground. The emission rate of particulate matter due to bulldozing is directly related to the number of hours of operation and is not a function of bulldozer speed or travel distance.
93. In this case, bulldozers work on overburden, ironsand and tailings areas. Mr Coffey told me that the site has about a dozen bulldozers of varying sizes. The emission factor equation is not dependent on bulldozer size.

94. Where bulldozers are working on ironsand or tailings, the risk of the dozer tracks causing grinding of the sand particles into smaller sizes is probably quite low. I was able to observe bulldozers working in the dry mining areas during the site visit and did not notice any significant dust emissions arising from the bulldozers. However, I was not close enough to the machinery to notice more minor emissions.
95. For the emission inventory, I have assumed that all 12 bulldozers at the site are in operation 20 hours per day, 365 days per year, with 3 bulldozers working on overburden or road maintenance and 9 bulldozers working on ironsand/tailings.

7.9 Excavators and material handling

96. The EFs for excavators are defined in NPI (2012b) and USEPA (2006a) using generic equations for material handling:

$EF = k \times 0.0016 \times \left[\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \right] \text{ kg/tonne}$	
where	k = 0.74 for TSP, and 0.35 for PM₁₀ U = mean wind speed in m/s M = moisture content of material being handled, in percent by weight in natural state (ie. prior to addition of water for dust control)

Equation 2

97. Trucks dumping loads are also included under this material handling category.
98. The averaging period for the mean wind speed is not specified in the references, and is commonly taken to be the annual mean wind speed which is 5.4 m/s at Port Taharoa over the ten-year period 2016-2025.
99. The resulting emission factor must be multiplied by the material handling rate to obtain the emission rate. I do not have actual site data on the rate of material handling for either overburden or ironsand, but to illustrate the potential sensitivity of this activity for the emission inventory I have assumed that the rate of material handling by excavators and trucks is based on the following:
- a) 10 trucks, each carrying a payload of 30T one way (empty return journey)

- b) Trucks spend 50% of time travelling (either full or empty return journey), and the other 50% of the time waiting or being loaded.
 - c) Trucks operate 20 hours per day, averaging 1 km per one-way journey at an average speed of 20 km/h.
 - d) Therefore, each truck can carry 100 loads per day (3 minutes per load, 5 hours per day driving while loaded), at 30T per load yielding a total daily rate of material hauled of 30,000 TPD.
100. I also applied this material handling rate of 30,000 TPD to both the excavators and the dumping of material off the trucks at the end of their journey.
101. For the moisture content, I assumed a lower moisture content than for the overburden, given that the majority of the material handling is on ironsand and tailings which don't have a large silt content and are likely to dry out at the surface fairly quickly. I applied a nominal 7% moisture content.

7.10 Vehicle-tracked dust emissions

102. Emission rates from movement of vehicles on unsealed roads depend on the silt content of the road surface, the vehicle mass, and the number of kilometres travelled. The applicable EF formula from NPI (2012b) and USEPA (2006b) is shown in Equation 3.

$EF_{TSP} = \frac{0.4536}{1.6093} \times 4.9 \times \left(\frac{s}{12}\right)^{0.7} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45} \text{ kg/VKT}$ $EF_{PM_{10}} = \frac{0.4536}{1.6093} \times 1.5 \times \left(\frac{s}{12}\right)^{0.9} \times \left(\frac{W \times 1.1023}{3}\right)^{0.45} \text{ kg/VKT}$		
where	s =	silt content of road surface material (%)
	W =	vehicle mass (tonnes)

Equation 3

103. I made the following assumptions to determine the inputs for the EF calculation for vehicle-tracked dust from haul trucks:

- a) **Silt content of road:** USEPA (2006b) provides a wide range of typical silt contents for unsealed industrial haul roads from less than 2% to more than 20%. Specific data for a 'sand and gravel processing' site reported a mean silt content for plant road of 4.8%. However, this may be too high for the TIL mine where trucks travel

over ironsand deposits and tailing surfaces for which analysis has shown a silt content of about 1% (see paragraph 80). I have therefore nominally applied a silt content of 2% to the calculation of all haul truck vehicle-tracked emissions, which allows for some travel on other site roads which may have a higher silt content.

- b) **Vehicle mass:** Mr Coffey told me that TIL uses about ten 40T trucks to move ironsand and overburden around the site. I have assumed that this refers to the truck's payload capacity (mass the truck can carry), with an empty weight of about 30T yielding a loaded weight of 70T and a mean weight (combined loaded/unloaded return journey) of 50T.
- c) To estimate the **distance travelled by vehicles per year**, I applied the same rationale as for the material handling rates described in paragraph 99:
 - (i) 10 trucks, each carrying 100 loads per day, averaging 1 km per one-way journey at an average speed of 20 km/h.
 - (ii) Total distance travelled per day, per truck, equals 200 km.
 - (iii) Operation for 365 days per year.

104. Speed of the vehicle is not explicitly included in Equation 3. However, faster vehicles do generate more dust. It is common for industrial and construction sites to limit vehicle speeds on unsealed roads to 20-30 km/h. TIL requires a maximum speed limit of 30 km/h and I witnessed this being actively enforced during the site visit. I did not observe any wheel-generated dust from passenger vehicles or haul trucks complying with this speed limit on watered roads, but did notice dust generation from passenger vehicles on dry roads even at that speed limit.

105. Katestone (2011) reviews the available data for effectiveness of various control measures for suppressing dust emissions from unpaved haul roads. Limiting speeds to 30 km/h has a reported 50-85% effectiveness, and I have assumed a mid-range value of 70% for this site. Katestone (2011) lists watering as having a 50-75% effectiveness depending on the quantities of water applied. "Watering twice a day for

industrial unpaved road” has a reported effectiveness of 55%, and I have assumed this as the average effectiveness across the site.

106. In cases where more than one control measure is applied, the combined reduction factor is multiplicative. In this case with road watering used in conjunction with speed restrictions, the combined residual emission is $(1 - 0.55) \times (1 - 0.7) = 0.13$ of the uncontrolled emission (cumulative reduction factor of 87%).
107. Vehicle-tracked emissions are also generated by fuel and service trucks moving around the site, water tankers, and vehicles used by workers, visitors and contractors. However, I do not have sufficient data to quantify the movements from these vehicles and I consider that with the site-enforced speed limits and road watering, the frequency of movement and mass of these vehicles will result in an emission contribution that is negligible in the context of the overall inventory.

7.11 Wind erosion

108. Lift-off of particulate matter caused by wind erosion can develop in three stages as the surface wind speed increases (Katestone, 2011):
- a) Saltation: is the term adopted for the initial stage when particles begin to move on the surface prior to becoming airborne.
 - b) Minor lift-off: refers to the stage where very fine particles become airborne.
 - c) Major lift-off: refers to the stage where relatively large quantities of variable size particles become airborne.
109. The surface wind speeds that produce these stages of wind erosion depend on the nature of the erodible material. Materials that contain minimal amounts of finer particles or that have a large proportion of larger particles would tend to be more resistant to major lift-off as are materials that form a surface crust, whereas finer materials are characterised by relatively low surface wind speed thresholds for saltation, minor and major lift-off.
110. The **threshold friction velocity** is defined as the point at which wind erosion is initiated. The threshold friction velocity depends on the size

distribution of surface particles, such that the larger the particles, the lower the potential for emissions. If the wind speed near the surface of the erodible materials is less than the threshold friction velocity, particulate emissions would not occur. Conversely, if the wind speed is greater than the threshold friction velocity particulate emissions would occur.

111. The EF equation for TSP from wind erosion in NPI (2012b) is defined for active coal stockpiles, and the reference also states that the same emission estimation equation can be used for characterizing TSP emissions from other exposed areas:

	$EF(TSP) = 1.9 \times \left(\frac{s}{1.5}\right) \times 365 \times \left(\frac{365 - p}{235}\right) \times \left(\frac{f}{15}\right) \text{ kg/ha/y}$
where	s = silt content (%) p = number of days per year when rainfall is greater than 0.25 mm f = percentage of time that wind speed is greater than 5.4 m/s at the mean height of the surface. WRAP (2006) advised that f should be calculated from short term averages such as a 2-minute wind gust

Equation 4

112. Equation 4 is derived from earlier editions of USEPA (2006a) up to 1988 (for example USEPA (1983)) but is not included in later versions of that reference.
113. NPI (2012b) also recommends that the following default values be applied for Australian conditions in the absence of other information:
- a) 0.4 kg/ha/h for TSP
 - b) 0.2 kg/ha/h for PM₁₀.
114. The default EF_{TSP} of 0.4 kg/ha/h in NPI (2012b) comes from SPCC (1983). SKM (2005) explains that the SPCC (1983) factor was not based on measurements, but is likely an estimate using Equation 4 and typical Hunter Valley values with a silt content of 7%, number of rain days (80) and with 13.4% of the wind greater than 5.4 m/s. Therefore, the default value is highly specific to a location and ore type.
115. Instead of applying the default Hunter Valley values, location-specific values for s, p and f can be substituted into Equation 4:

- a) s - the silt content will vary across the TIL site depending on the type of surface. I discussed the potential silt content of exposed surfaces in Section 7.5 and assume an overall average silt content of 2% which includes roads, overburden surfaces, mining surfaces, and tailings.
 - b) p – the days per year with rainfall above 0.25mm measured at Port Taharoa AWS is about 160 for an average year at TIL.
 - c) f - the frequency of gust wind speeds exceeding 5.4 m/s at the Port Taharoa AWS is, on average, 70% of hours each year. These are speeds at the height of the anemometer, which is about 7 m above ground at the AWS location. Wind speeds at the 'mean height of the surface' as defined in Equation 4 will be somewhat lower than this, however most of the surfaces exposed to wind are at higher elevation than the AWS location.
116. Applying these values of s , p and f into Equation 4 yields an EF_{TSP} for wind erosion of 0.43 kg/ha/h.
117. NPI (2012a) recommends that for wind erosion, the default EF for PM_{10} should be 50% of the EF_{TSP} , citing advice in USEPA (2006c). NPI (2012a) also advises that if site-specific particle size data is available, this should be used instead.
118. In this case, we do have some particle size distribution analysis from surface samples. However, the percentage of those surface samples that is less than 10 μm in diameter is not the same as the percentage of TSP that would be in the PM_{10} range. Firstly, PM_{10} is defined as suspended particles having an aerodynamic diameter of less than 10 μm , which is a different measure than the actual physical diameter of particles. Putting that aside for the moment (and I will return to that later), the surface samples include a large portion of very large particles that would settle very quickly and not normally be measured as TSP at a downwind monitor. Therefore, I considered only the portion of the surface samples that might be regarded as TSP.
119. For the purposes of this assessment, I have adopted the definition of TSP as comprising particulate matter less than approximately 100 μm

in diameter, consistent with MfE (2016). The surface sample analysis reported by PDP (2026a) lists mass percentages of samples <150 µm and <90 µm, and I have taken the data for the <90 µm category as representing the portion that may become TSP. The data shows that across all five samples, approximately 1-2 percent of the total particulate mass was less than 90 µm.

120. Whilst this commentary illustrates the limited usefulness of the surface sample data for the emission inventory, and that only a small proportion of the surface samples are likely to become airborne for long enough to be detected at the monitors at or beyond the site boundary, it doesn't help to identify the proportion of the TSP driven by wind erosion at the site that may be in the PM₁₀ range. The particle size distribution method was not able to determine particle sizes less than 63 µm.
121. Therefore in the absence of site-specific data, I adopted the "50% of TSP is PM₁₀" default recommendation of NPI (2012) to prepare the inventory requested by the Panel.
122. The other key factor for the wind-driven erosion emission rate is the exposed area. I have estimated this by taking georeferenced aerial imagery from Google Earth and maps from the Substantive Application, and drawing the exposed areas based on the video I took during the helicopter trip at the site visit. This approach will give only an estimate of the exposed area, which will vary anyway from month to month. I estimated the exposed areas at the time of the site visit to be approximately as follows:
 - a) Southern Block: 1,426,700 m² (143 ha)
 - b) Central Block: 2,389,700 m² (239 ha)
 - c) Pit 1 (Northern Block): 175,500 m² (17.5 ha)
 - d) Eastern Block: 360,600 m² (36 ha)
123. Mining of Te Mania Extension has not started, and the block is currently covered in grass so not at risk of wind erosion. I estimated the potential future exposed area to be 94,300 m² (9.4 ha).

124. I did not apply any emission reduction for controls to the wind erosion emissions, because I had already reduced the effective exposed areas where vegetation is established or there are ponds.
125. While this method gives an estimate of long term (such as annual) emission rates from the surfaces, it doesn't demonstrate the relative contribution of wind-driven erosion on days with high wind speeds which is when the downwind monitors normally record elevated TSP concentrations. As the wind speed increases, particulate emissions increase rapidly, roughly in proportion with the cube of the wind speed increase (for example, if the wind speed increases 2-fold, the emission rate increases 8-fold) (Skidmore and Hagen, 1977).

7.12 Uncertainty

126. In the preceding sections I have identified assumptions needed to compile the emission inventory. Minute 25 required commentary on emission factor certainty ratings (with explanation) and estimates of robustness of emission calculations.
127. Many published emission factors have an associated emission factor rating (**EFR**) code. These EFR codes are based on rating systems developed by the USEPA. In USEPA AP-42, the EFR indicates the confidence in the actual emission factor, taking into account both the quality of the underlying tests and how representative those tests are of wider sources. It is not a direct measure of the accuracy of the emission estimate at any particular site.
128. The ratings and the definitions provided by USEPA are as follows⁵:
- **A = Excellent.** Emission factor is developed primarily from A and B rated source test data taken from many randomly chosen facilities in the industry population. The source category population is sufficiently specific to minimize variability.

⁵ Since 2018 EPA has introduced a more objective rating methodology rather than relying solely on A–E letters. The newer approach develops a Factor Quality Index based on test-report quality and the number of tests contributing to the emission factor, and categorises factors as Highly representative, Moderately representative, or Minimally representative. I have not used the new rating methodology as the AP-42 references that the emission factors are based on pre-date the new rating system.

- **B = Above average.** Emission factor is developed primarily from A or B rated test data from a moderate number of facilities. Although no specific bias is evident, is not clear if the facilities tested represent a random sample of the industry. As with the A rating, the source category population is sufficiently specific to minimize variability.
- **C = Average.** Emission factor is developed primarily from A, B, and C rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As with the A rating, the source category population is sufficiently specific to minimize variability.
- **D = Below average.** Emission factor is developed primarily from A, B and C rated test data from a small number of facilities, and there may be reason to suspect that these facilities do not represent a random sample of the industry. There also may be evidence of variability within the source population.
- **E = Poor.** Factor is developed from C and D rated test data from a very few number of facilities, and there may be reason to suspect that the facilities tested do not represent a random sample of the industry. There also may be evidence of variability within the source category population.
- **U = Unrated.** Emission factor is developed from source tests which have not been thoroughly evaluated, research papers, modeling data, or other sources that may lack supporting documentation. The data are not necessarily "poor," but there is not enough information to rate the factors according to the rating protocol.

129. USEPA (1998) explains the assignment of EFRs to emission factors for equipment operating at mines and open dust sources. USEPA (1998) is specifically written for surface coal mines in the western United States. The reference states that the emission factor equations should be derated one letter value (e.g. A to B) if applied to surface coal mines

in the eastern United States. The EFRs should also be derated if site-specific values for input variables such as silt content cannot be obtained – however it is unclear whether it is intended that EFR adjustments are applied cumulatively.

7.13 Overall Emission Inventory

130. I have collated the emission factors for each activity type (bulldozers, excavators, material dumping, vehicle-tracked dust, and wind erosion) into an emission inventory for two scenarios:

- a) **Scenario A:** Current activities as observed at site visit
- b) **Scenario B:** Future hypothetical scenario where:
 - (i) Pit 1 is completed and rehabilitated
 - (ii) Eastern Block rehabilitation is completed
 - (iii) Central Block and Te Mania Extension mining is finished with reshaping and contouring complete, and rehabilitation is 50% completed
 - (iv) Mining is underway in Southern Block with no rehabilitation completed.

131. For Scenario B, I had to make some assumptions about future activities:

- a) Bulldozer, excavator and haul truck activities compared to Scenario A: I assumed a 50% reduction in all equipment use due to mechanical equipment only being deployed in the Southern Block.
- b) Wind-erosion control effectiveness in rehabilitated areas: I assumed 80% effectiveness for Eastern Block and Pit 1 (i.e. planting well established and growing), and 30% effectiveness for the areas of Central Block and Te Mania Extension where replanted is finished (i.e. planting still getting established and/or small plants).

132. The emission inventories for both scenarios are provided in Attachment F and a summary of the PM₁₀ emission estimates as requested by the Panel is provided in Table 3. In Attachment F, I have also provided the published EFRs applicable to each emission factor.

Table 3. PM₁₀ emission inventory summary.

Source	Scenario A Emission Rates		Scenario B Emission Rates	
	kg/d	T/y	kg/d	T/y
Bulldozers on ironsand/tailings	2.4	0.89	1.4	0.49
Bulldozers on overburden	18	6.7	6	2.2
Excavators	9.3	3.4	4.7	1.7
Material dumping from trucks	9.3	3.4	4.7	1.7
Vehicle-tracked dust	84	31	42	15
Wind erosion – Central, Southern and Eastern Blocks	2,105	768	1,779	649
Wind erosion – Pit 1 and Te Mania Extension	88	32	51	19
Total – Central, Southern and Eastern Blocks	2,229	814	1,838	671
Total – Pit 1 and Te Mania Extension	88	32	51	19

133. The emission inventory shows that total emissions of PM₁₀ from the site are strongly dominated by wind erosion. PM₁₀ emissions generated by wheels driving on unsealed roads are the second largest contribution, but are still dwarfed by the wind erosion emission rate.
134. Even though the emission rates for bulldozers are associated with a poor or “E” EFR, the overall emission rate for bulldozers is low relative to the main sources and therefore the overall emission inventory is insensitive to the uncertainty associated with the bulldozing activity.
135. The PM₁₀ emission factors for wind erosion have quite a high degree of uncertainty because of the generally low silt content of the materials being worked at the mine except for clay/slimes which are mixed with the tailings to vary degrees. Published emission factors for wind erosion all assume that 50% of the TSP is in the PM₁₀ fraction, and there is no site-specific data to replace that assumption because the

results from surface samples at the site that were analysed for particle size distribution do not help to inform what percentage of the TSP would be PM₁₀. In addition, the actual exposed area not subject to any form of control is approximate, and the frequency and magnitude of high wind speeds is also a key influence. Therefore, I consider that the absolute magnitude of the total PM₁₀ emission rates from the mine listed in Table 3 has a high degree of uncertainty. Nevertheless, I still conclude that total emissions of PM₁₀ from the site are strongly dominated by wind erosion.

136. When mining transitions to a greater proportion of mining by dredge (see paragraph 75.c)), Mr Coffey told me that this will reduce the activity rates for bulldozers, excavators and haul trucks compared to the activity rates that I included in Scenario A. However, given the dominance of wind erosion in the inventory, any conclusions arising from the inventory calculations are not sensitive to those activity rates. Even in Scenario B, the largest source contributor is the PM₁₀ emission from wind erosion off Central Block due to the assumed early stage of established vegetation on that surface.
137. The emission inventories represented by Scenarios A and B are only a snapshot of the mine at that particular time as the mining operations are dynamic and change rapidly with mining progress, whether dry or dredge mining is predominant, and the advancement of rehabilitation.
138. Based on the descriptions provided to me by Mr Coffey during the site visit, it is my impression that the emission rates in the inventory in Scenario A are probably close to the highest that will occur over the remaining life of the mine activities included in this consent application as well as activities that are already consented. This is because rehabilitation of the Eastern Block is underway, and rehabilitation of the eastern and northeastern part of Central Block will begin in the coming months after mining around the ridgeline near the receptor identified in PDP (2025) as R4 (see Figure 3 for location) is finished.

8 POTENTIAL FOR ADVERSE HEALTH EFFECTS FROM PM₁₀ CONCENTRATIONS

139. The Panel has requested my opinion on potential for adverse health effects from daily and annual PM₁₀ concentrations at the nearest neighbours including in Taharoa village.
140. As directed by the Panel, I have considered the likelihood of exceeding the following air quality objectives:
- a) the NZ daily PM₁₀ standard of 50 µg/m³ as a 24-hour average with one permitted exceedance every 12 months,
 - b) the NZ ambient air quality guideline for PM₁₀ as an annual average of 20 µg/m³ (no permitted exceedances), and
 - c) the World Health Organisation guideline for PM₁₀ as an annual average of 15 µg/m³ (no permitted exceedances).
141. I have also addressed the instruction by the panel to consider the likely contribution of 'background' sources of PM₁₀ to daily and annual levels at these locations.
142. To respond to the question about likelihood of exceeding the 24-hour and annual average air quality objectives in paragraph 140.a), I considered the following factors:
- a) Coastal environment – background contribution likely to be significant (see also discussion on background monitoring at paragraph 152 onwards).
 - b) Low silt content of surface samples, but that doesn't tell us what proportion of the TSP is PM₁₀ (as discussed elsewhere in this report).
 - c) Clearly some potential for inhalable particulate as evidenced by the occupational health and safety sampling (roughly equating to PM₁₀ but with some distinctions as noted on page 117 of Attachment 1 of the TIL Request for Information Response dated 7 August 2026. However, we don't know:

- (i) What the TSP concentrations were that corresponded with these inhalable particulate measurements,
 - (ii) What the wind speeds were when the samples were taken,
 - (iii) How close the samplers were to localised dust sources, and what those dust sources were, and
 - (iv) How representative those samples are of exposure over a period of a month or year.
- d) PM₁₀ is a measure of equivalent aerodynamic diameter, not actual diameter of particles. The aerodynamic diameter is the diameter of a sphere that has the same aerodynamic behaviour as the particle in question. In other words, it describes how the particle behaves in air rather than simply how wide it is. Aerodynamic diameter also increases with particle density. For ironsand, which is relatively dense, this means that the physical particle corresponding to 10 µm aerodynamic diameter could therefore actually be considerably smaller than 10 µm.
- e) The TSP monitoring shows that spikes in short term (1-hour average) TSP concentrations are infrequent and of short duration (up to several hours).
- f) The overall emission inventory for the site is expected to decrease over coming months and years as rehabilitation of Pit 1, Eastern Block and the northeastern part of Central Block progresses.
- g) Most of the monitors are positioned at the boundary of the mine rather than at the location of sensitive receptors which are further downwind.
- h) 24-hour average TSP concentrations have been much lower in 2026 (to early August) than in 2020-2024.
- i) In 2024, after the implementation of the draft EMP, there were only 2-3 occasions at MP2 and MP4 where the 24-hour average TSP concentration exceeded 100 µg/m³.

143. Taking all these remarks into consideration, it is my opinion that it is very unlikely that PM₁₀ would comprise at least 50% of the TSP that has been measured at the monitors. Therefore, given the TSP concentrations that have been measured at MP2, MP4, MP7 and MP8 since the start of 2024, I think it is very unlikely that the 24-hour average air quality objective in the NESAQ of 50 µg/m³ with one permitted exceedance every 12 months would be exceeded at sensitive receptors in and around Taharoa. If it was exceeded, I consider that this would probably be due to a combination of background PM₁₀ sources (including marine aerosol or sea salt) plus emissions from the mine.
144. For consideration of annual average PM₁₀ concentrations, I note that annual average TSP measured at the site has been less than 15 µg/m³ at monitors MP2, MP4, MP7 and MP8 since 2022 (although limited sub-annual datasets for MP7 and MP8). Recognising that PM₁₀ will only be a portion of the total TSP, sensitive receptors are further from the mine site than the monitor locations, and these measured concentrations include background contributions, I conclude that it is very unlikely that annual average PM₁₀ concentrations at sensitive receptors would exceed either the NZ Ambient Air Quality Guideline or the WHO Air Quality Guideline for PM₁₀.
145. The Panel requested that I comment on the extent and degree of potential effects on people exposed to PM₁₀ under the scope described in paragraph 140 above (i.e. whether negligible, minor, moderate, or significant). I would not be able to provide an expert opinion on the extent and degree of potential effects if the exposure exceeded the standards and guidelines listed in paragraph 140, as I do not hold expertise in human health risk assessment. However, as detailed above I consider it very unlikely that the various PM₁₀ health criteria would be exceeded at sensitive receptors and therefore I conclude that the potential for adverse effects due to PM₁₀ exposure is no more than minor.

146. I support the initiatives proposed by the applicant via consent conditions for PM₁₀ monitoring at the Taharoa School, as this will provide definitive evidence to support the conclusions that I have expressed.

9 MITIGATION PRIORITIES

147. The Panel has requested my opinion on a rationale for, and ordered priority of, PM₁₀ emission sources for mitigation and/or rehabilitation in the event of any measured exceedance of the standard and guidelines referred to in paragraph 140.
148. In my opinion, there is only one mitigation measure that will really make a difference to the spikes in TSP concentrations (and potential PM₁₀ concentrations) measured at the monitors downwind of the mine near sensitive receptors. That measure is to reduce the extent of exposed surface available for wind erosion.
149. This is a long term mitigation measure. It is not something that the mine can implement in a matter of minutes or hours, such as in response to a Level 3 or Level 4 TSP trigger. I do not consider that there would be any benefit to the emission inventory responsible for downwind spikes in TSP if restrictions were to be placed on the rate of operation of mechanical equipment (such as bulldozers or haul trucks) on the site.
150. While prioritising surfaces closest to Taharoa and the isolated dwellings around the mine is important, it is also important to reduce the overall surface area available for erosion - particularly for the Eastern Block, Central Block and Pit 1 as these sources are all upwind of the sensitive receptors under strong onshore wind conditions.
151. I suspect that once the Central Block and associated areas are rehabilitated, even though that is some years away yet, TSP and/or PM₁₀ measured at the current monitors near residential dwellings will diminish significantly because the remaining dust sources are further south. At that point, some of the monitors may need to be relocated to capture potential dust plumes travelling over Lake Taharoa to houses

at the southern end of Taharoa (R8, R9 and R10) and nearby rural properties.

10 BACKGROUND MONITORING LOCATION

152. The Panel has requested my opinion on a suitable location for a 'background' PM₁₀ monitoring station to confirm background sources of PM₁₀ for future monitoring and compliance purposes.
153. 'Background' in this context means contributions to local air quality from primarily marine aerosols (sea salt) and natural coastal sand dunes.
154. The potential for marine aerosols to affect visibility during onshore winds was quite apparent at my site visit. On that day, wind speeds were not overly strong and skies were sunny and clear. Looking along the coastline, visibility was quite noticeably hazy and this haze extended inland for some distance (photos in **Attachment H**). However, I do not have any data from that day from the monitors operated by the mine to assess how the TSP concentrations were influenced by that haziness.
155. Background contributions to PM₁₀ could also include smoke from domestic home heating such as wood or coal-fired home fires, however such contributions would normally be easy to filter out from a monitoring dataset as they would occur under cold, evening conditions with light wind speeds which are not the same meteorological conditions that give rise to elevated TSP concentrations attributed to the mine.
156. I consider that the current monitor location for MP5 is appropriate to monitor background air quality during onshore winds. I would also be comfortable with the monitoring being moved to the new location near the accommodation block mentioned in PDP (2026b), provided that there is no interference from wind eddies and dust stirred up by the nearby helipad.
157. Of greater concern to me is the issue that I discussed earlier in this report (see paragraph 44), where TSP concentrations recorded at MP5 have changed significantly between the 2024 and 2026 datasets (with

no data available between February and December 2025). It is important to have confidence in the background dataset, and at the moment this data cannot be relied on due to the disparities.

158. I also consider that it would be useful to have a background monitor further inland, roughly at the same distance inland as the sensitive receptors around Taharoa village. The reason for this is that the contributions from marine and natural sand dunes may diminish with inland distance, particularly for larger particles that may drop out of the air flow over the 2-3 km distance between the coastline and the receptors over the variable terrain and surface roughness. My recommendation would be to consider a location somewhere on the Northern Block.

11 GENERAL COMMENTS ON MONITORING

159. I conclude my commentary with some observations and recommendations from my review of the monitoring described in the application documents and the monitoring data, that may assist with future assessment of PM₁₀ concentrations near sensitive receptors:

a) Remote logging

- (i) Some data loss has been reported (see footnote 10 of PDP (2025)) due to issues with telemetry communication between monitors and the datalogger – particularly for MP5.
- (ii) I recommend that TIL look at options for remote logging of data at the instrument sites, that can be manually downloaded on a regular basis if telemetry communication fails.

b) Source apportionment

- (i) There is uncertainty about contributions to TSP from mine sources versus background (particularly sea salt).
- (ii) I recommend that TIL install monitoring equipment capable of collecting gravimetric samples for source apportionment testing alongside the NES-compliant PM₁₀ meter. This

would tell us what percentage of the TSP (or PM₁₀ if the gravimetric sampler is fitted with a PM₁₀ head which would be my preference) is sea salt versus sand or clay. This testing should be done regularly – for example collecting a 24-hour duration sample every 6 days – until a clear trend can be concluded.

c) Nephelometer benchmarking

- (i) I also recommend that TIL operate a nephelometer permanently alongside the NESAQ-compliant PM₁₀ meter, and that the nephelometer in that position be rotated regularly (such as every three months) amongst the suite of instruments operated by TIL.
- (ii) This will provide data that would allow analysis of whether there are different biases between the various nephelometer instruments.

12 REFERENCES

Katestone Environmental Pty Ltd (2011). NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining. Final report prepared for Office of Environment and Heritage, reference KE1006953, June 2011.

Ministry for the Environment (2016) Good Practice Guide for Assessing and Managing Dust (MfE, 2016)

NPI (2012a). Emission Estimation Technique Manual for Fugitive Emissions, Version 2.0. January 2012.

NPI (2012b). Emission Estimation Technique Manual for Mining, Version 3.1. January 2012.

NPI (2001). Emission Estimation Technique Manual for Mineral Sands Mining and Processing, Version 1.0. April 2001.

Skidmore, E.L. and Hagen L.J. (1977). Reducing Wind Erosion with Barriers. Transactions of the American Society of Agricultural Engineers (Vol. 20, No. 5, 1977).

SKM (2005). Improvement of NPI Fugitive Particulate Matter Emission Estimation Techniques. Final report prepared for WA Department of Environment, May 2005.

USEPA (1983). AP-42 Third Edition Supplement 14 Chapter 11.2.3 Aggregate Handling and Storage Piles. May 1983.

USEPA (1998). AP-42 Fifth Edition Chapter 11.9 Western Surface Coal Mining. November 2006.

USEPA (2006a). AP-42 Fifth Edition Chapter 13.2.4 Aggregate Handling and Storage Piles. November 2006.

USEPA (2006b). AP-42 Fifth Edition Chapter 13.2.2 Unpaved Roads. November 2006.

USEPA (2006c). AP-42 Fifth Edition Chapter 13.2.5 Industrial Wind Erosion. November 2006.

Western Region Air Partnership (WRAP, 2006). Fugitive Dust Handbook. Prepared by Countess Environmental for Western Governors' Association, 7 September 2006.

**ATTACHMENT A –
Minute 25 issued by Panel**

MINUTE 25 OF THE EXPERT PANEL**Commissioning of Specialist Advice: Air Quality
Central and Southern Block Mining Project [FTAA-2512-1153]**

(3 September 2026)

- [1] The purpose of this Minute is to record the Panel's decision to commission a report pursuant to section 67(1)(b) of the Act on an issue relevant to the determination of the Substantive Application.
- [2] The matters that the report being commissioned by the Panel will address are as set out in Appendix 1 and relate to air quality (PM₁₀ discharges and associated health effects specifically).
- [3] The background to the Panel's decision to commission the report is as follows.
- [4] While the processing of the Substantive Application is otherwise suspended, the Panel has continued with its deliberations and decision writing process, in so far as it can pending receipt of the response to the Requests for Further Information addressed in the Panel's Minutes 22 and 24.
- [5] In relation to air quality matters and potential adverse health effects beyond the site, the Panel has reached a stage of its deliberations whereby the lack of information has become material, both as to the findings that the Panel must reach regarding the degree or significance of potential adverse air quality effects, and the nature of the conditions that should be imposed as necessary to manage those effects.
- [6] The Panel previously requested advice based on published emissions factors for mining activities to calculate how much PM₁₀ is discharged to air from the existing and proposed mining operations (in kg/ day and tonnes/year) from the proposed stages of mining operations in the Central and Southern Blocks.¹ The Applicant's air quality expert (Mr Curtis) declined to provide this information on the basis that, in his opinion, the published emissions factors would not provide a robust or useful basis for assessing potential air quality effects from PM₁₀.
- [7] The Panel disagrees, noting an estimate of robustness may be prepared from published emission factor certainty ratings. The Panel considers quantifying PM₁₀ emissions to be helpful for understanding the scale and significance of discharges to air from proposed operations.
- [8] Given that the information requested has not been received, the Panel must proceed as if the

¹ Panel's request for information dated 29 June, item 61.

request for further information had been declined (under s 67(6) of the Act).

- [9] The report being commissioned to address the matters covered in Appendix 1 is intended to remedy the Applicant's refusal to provide this requested further information, regarding what the Panel considers to be a material issue, and on which it does not yet have adequate information to complete its deliberative and decision-making functions.
- [10] Appendix 1 sets out required tasks and potential options for the independent air quality expert who would be retained to prepare the report. The Applicant is invited to select any preferred expert from this list and advise the EPA by 11.59 pm on Friday 4 September of its preference in that regard (if any).
- [11] The report being commissioned will be due on Wednesday 30 September and hence received at approximately the time previously directed for the Applicant's response to the further information requested in Minutes 22 and 24. The Applicant would of course be able to respond to any matters raised in the report as part of its right of reply as due on 6 October (with the in-person presentation scheduled for 13 October).

A handwritten signature in blue ink, appearing to read 'D Serjeant', with a stylized, cursive script.

Dave Serjeant

Central and Southern Block Mining Project Expert Panel Chair

Appendix 1 Independent Air Quality Expert Report

Tasks

1. Expert to undertake a site visit and review the following (non-redacted version) documents:

- Applicant's Substantive Application including:
 - Appendix G – Key issues table
 - Appendix J – Site Project Map
 - **Appendix S – Air Quality Assessment**
 - Appendix T – Draft Environmental Management Plan
 - Appendix N – Hydrogeology Assessment at Appendix B: Mining Sequence and Dredge Path Central Block (only)
- Comments by s53 parties:
 - Roy Wetini Trust s53 comments dated 20 May 2026 (including appendices)
 - WRC s53 comments including Appendix A – Memo from Peter Stacey
- Applicant's response to s53 comments including:
 - Memorandum of Counsel dated 22 June 2026
 - **Attachment J – Air Quality Response**
 - Attachment O – Updated set of conditions
- Applicant's response to RFI including:
 - Attachment 1 – TIL's response to the Panel's RFI Updated 23 July 2026
 - Appendix J – Aerial mining activities 2023-2025
- Presentation by Taharoa Lakes Trust during Hui at Aaruka Marae on 6 June 2026 (including video)

2. Expert to prepare a report for the Panel addressing the following:

Using published emissions factors for mining activities please calculate how much PM₁₀ is likely to be discharged to air from the existing and proposed mining operations (in kg/day and tonnes/year) for each of the proposed stages of mining operations in the central and southern blocks.

In doing so, identify PM₁₀ discharges to air from existing consented activities (Pit 1 and Te Mania Extension) separately.

Please include:

- summary table for all sources with key metrics² to inform scale and significance;

² e.g., hectares of non-tracked exposed ground, hectares of tracked exposed ground, km of sealed road, km unsealed road, tonnes of dry material moved, tonnes of stockpile loaded/unloaded, kg or tonnes per year PM₁₀ emitted.

- emission factor certainty ratings (with explanation); and
- estimates of robustness of emission calculations.

Considering the scale, extent and type of PM₁₀ emission sources and information from the above documents and site visit, provide an independent expert opinion on:

1. Whether there is potential for adverse health effects from daily and annual PM₁₀ concentrations at the nearest neighbours including in Taharoa village. This should explicitly address:
 - a. the likelihood of exceeding the NZ daily PM₁₀ standard,³ the NZ annual PM₁₀ guideline⁴ and the WHO annual PM₁₀ guideline⁵;
 - b. the likely contribution of 'background' sources of PM₁₀ to daily and annual levels at these locations; and
 - c. the extent and degree of potential effects on people exposed to PM₁₀ as determined under (a) and (b) (i.e. whether negligible, minor, moderate, or significant).
2. A rationale for, and ordered priority of, PM₁₀ emission sources for mitigation and/or rehabilitation in the event of any measured exceedance of the standard and guidelines referred to in 1(a).
3. A recommended location with rationale for a 'background' PM₁₀ monitoring station to confirm background sources of PM₁₀ for future monitoring and compliance purposes.

Suggested Experts

- **Air Matters** – Nigel Goodhue (Bay of Plenty): [REDACTED]
- **Air Quality NZ Ltd** – Duncan Backshall (Auckland): [REDACTED]
- **Jacobs** – Tracey Freeman (South Island): [REDACTED]

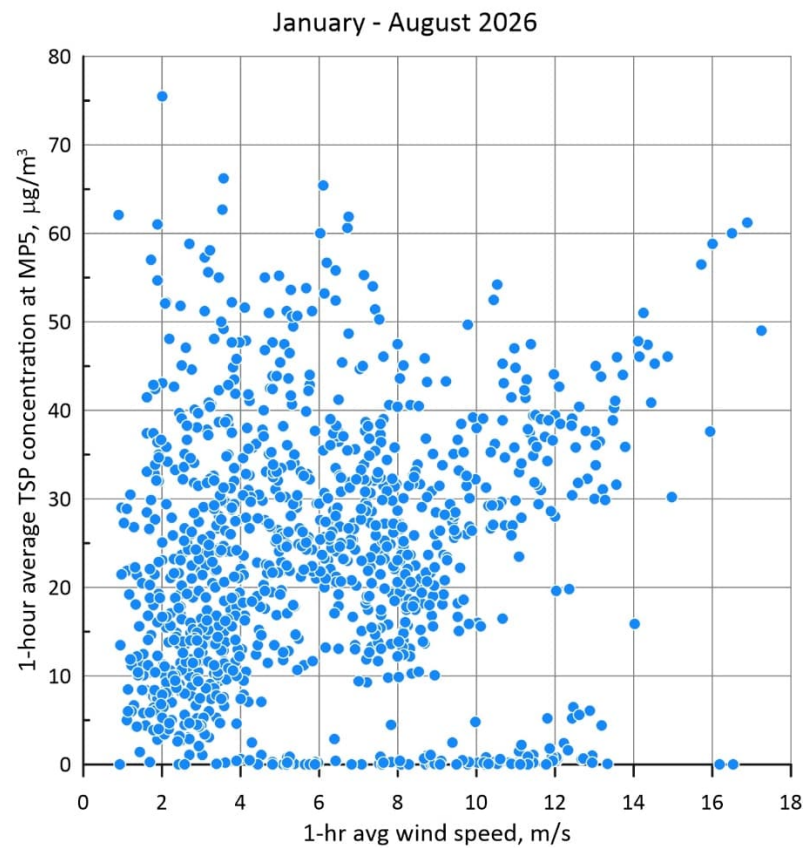
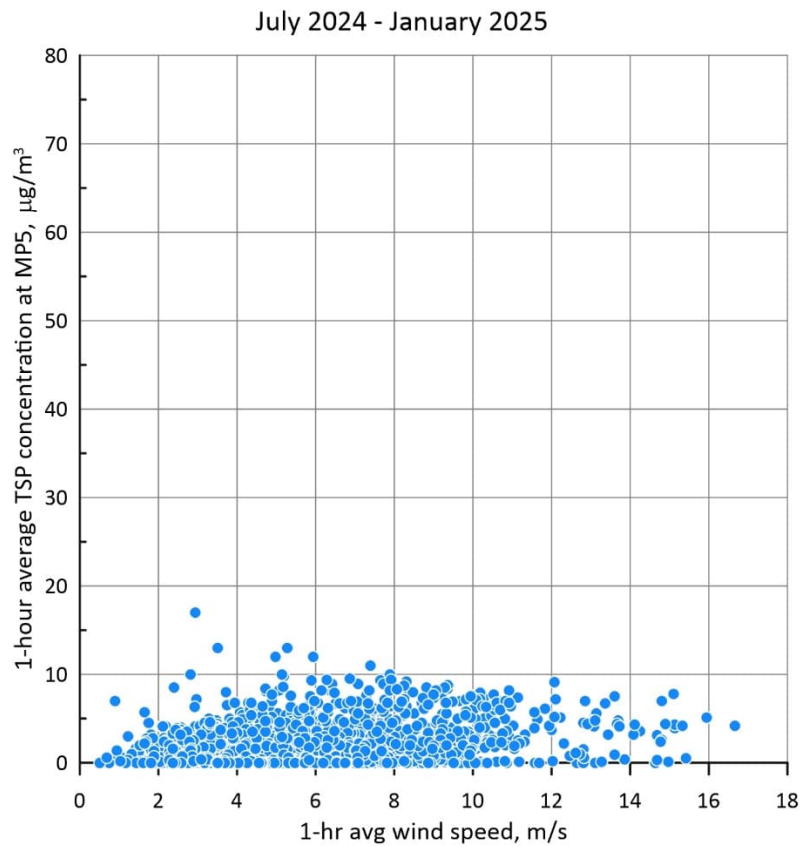
³ 50 µg/m³ with one permitted exceedance every 12-months

⁴ 20 µg/m³ with no permitted exceedances

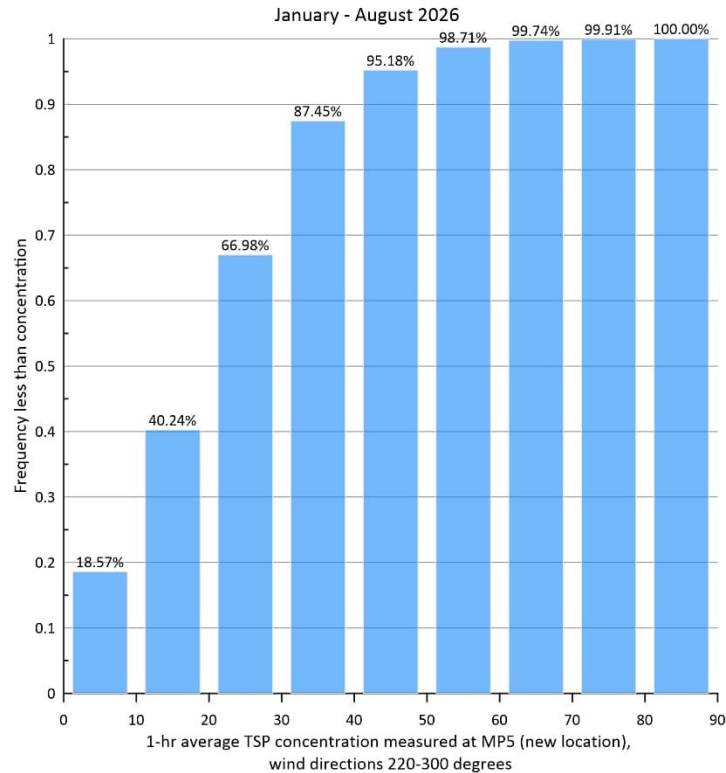
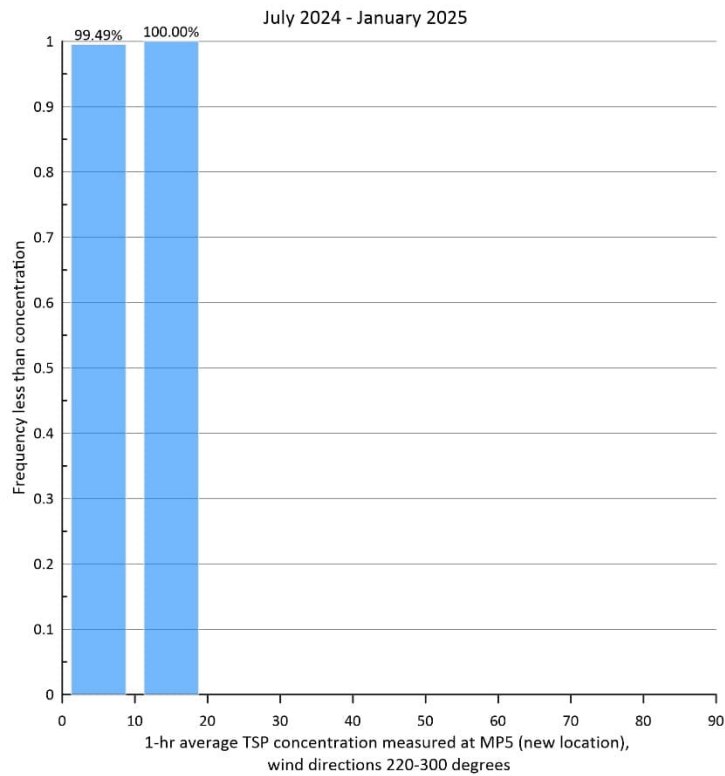
⁵ 15 µg/m³ with no permitted exceedances

ATTACHMENT B

Graphs showing relationship between wind speed and TSP concentration for the background data set from MP5



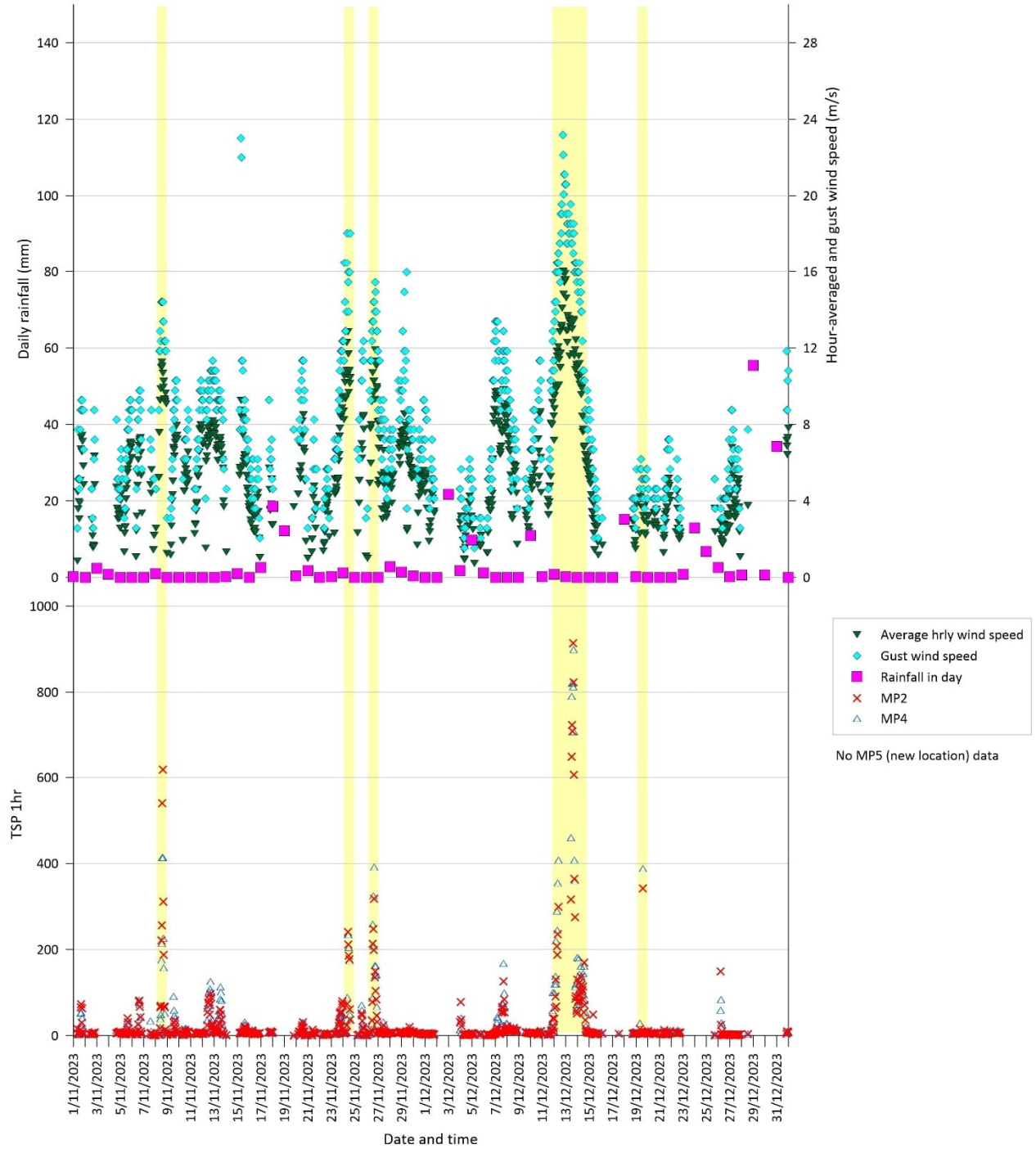
Scatter graphs of 1-hour average wind speeds and TSP concentrations measured at MP5 (new location) for onshore winds



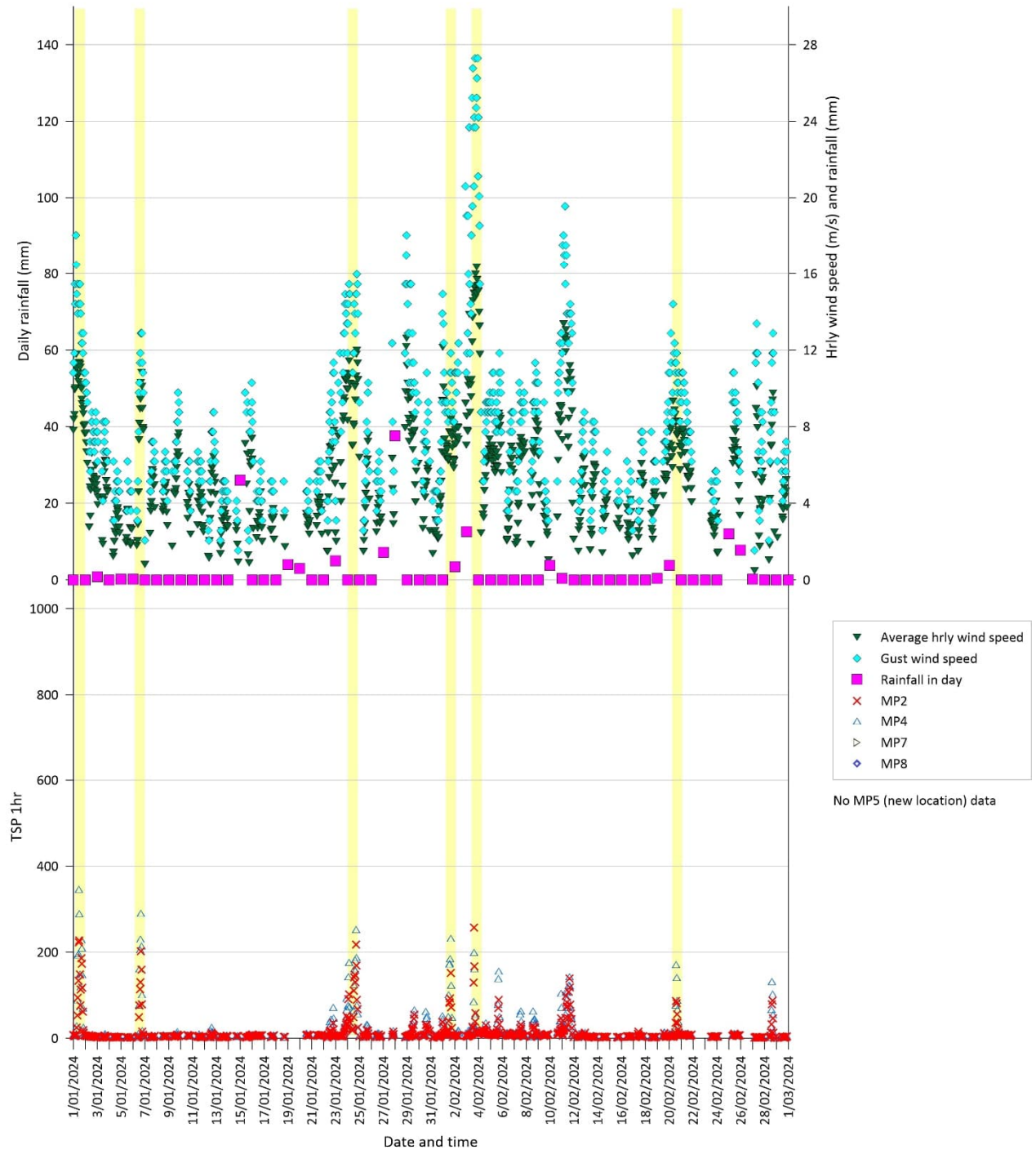
Cumulative frequency of 1-hour average TSP concentrations measured at MP5 (new location) for onshore winds

ATTACHMENT C

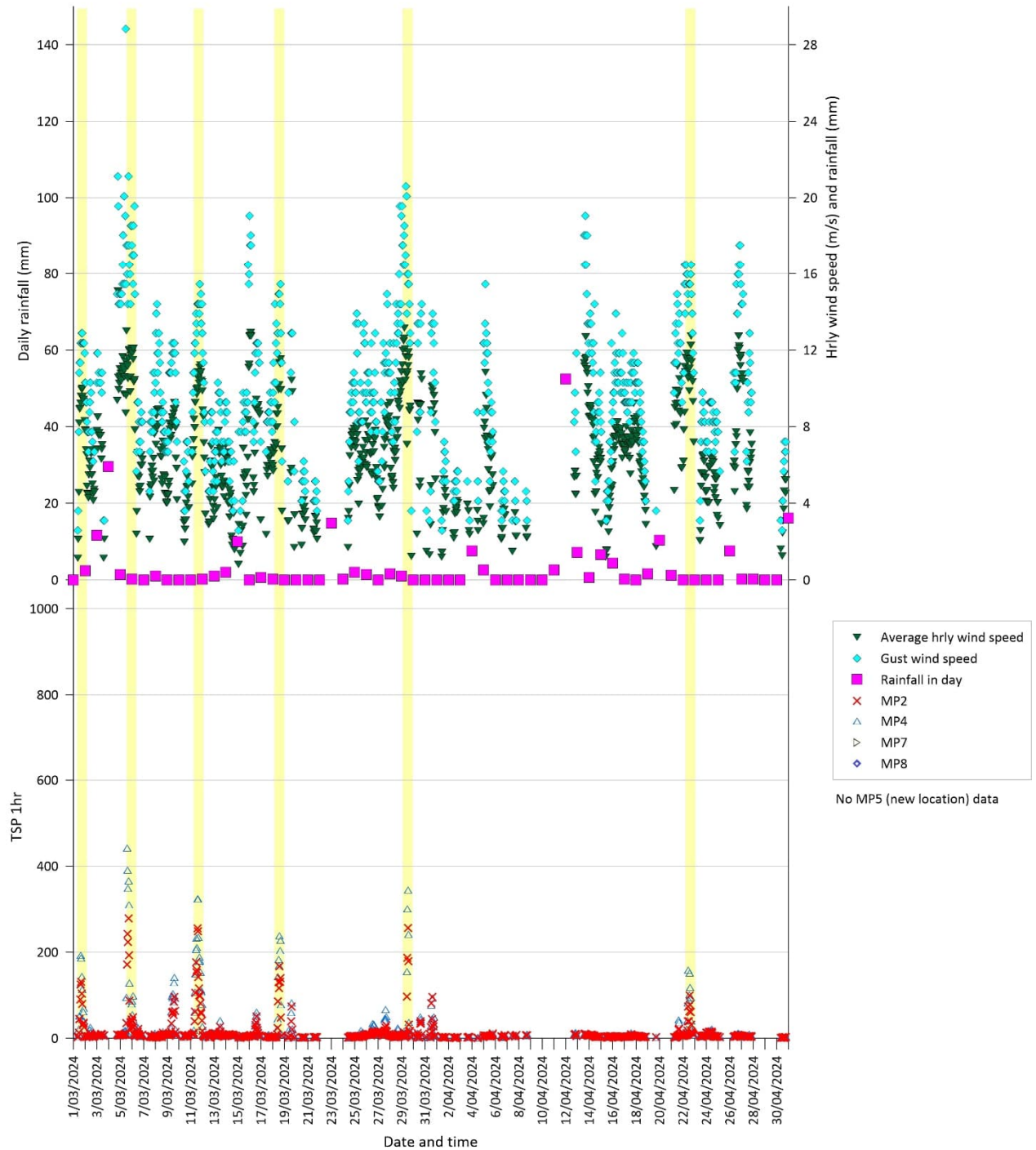
Graphs showing concurrent records of TSP concentrations, wind speed and daily rainfall at each monitor



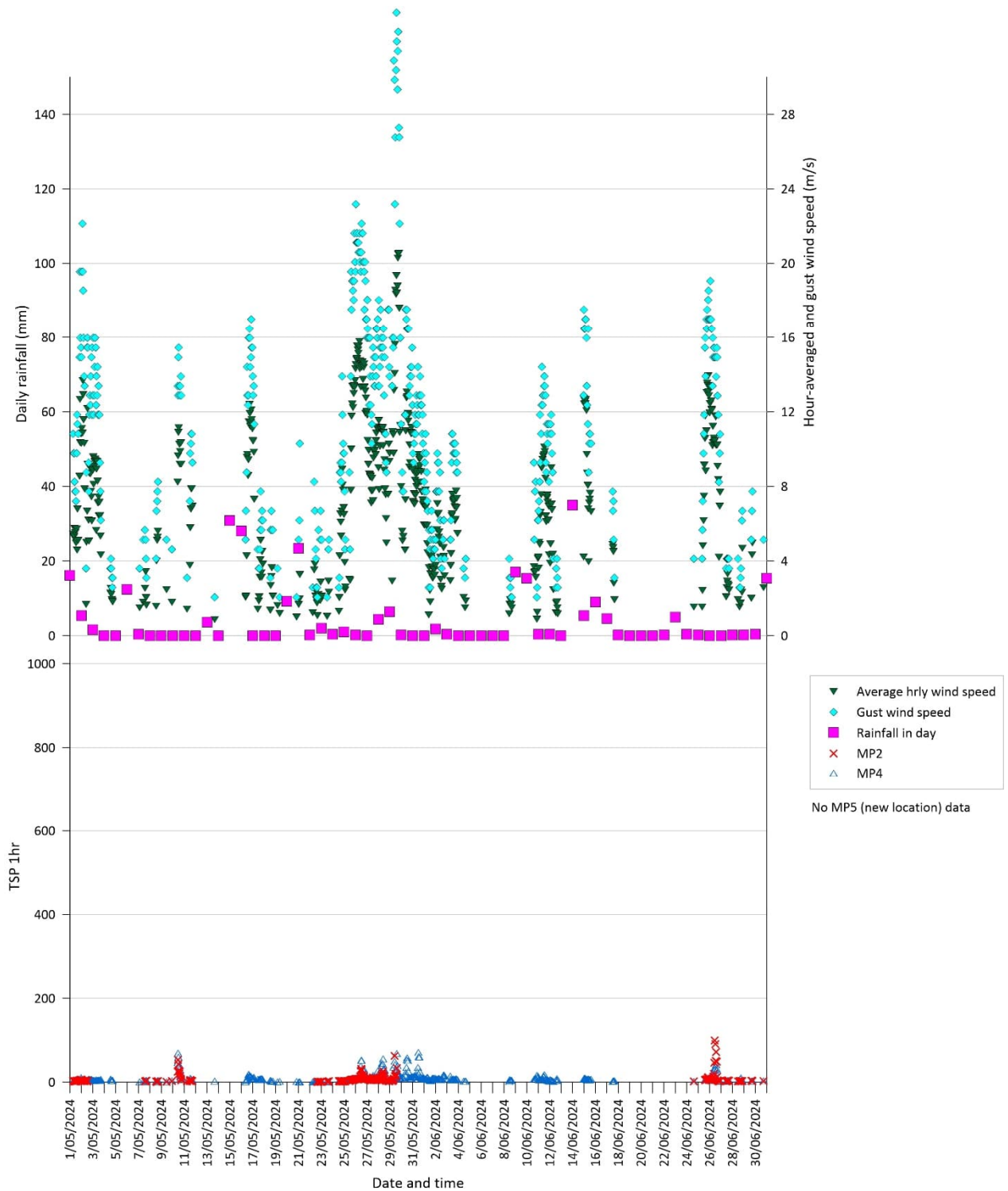
Nov-Dec 2023



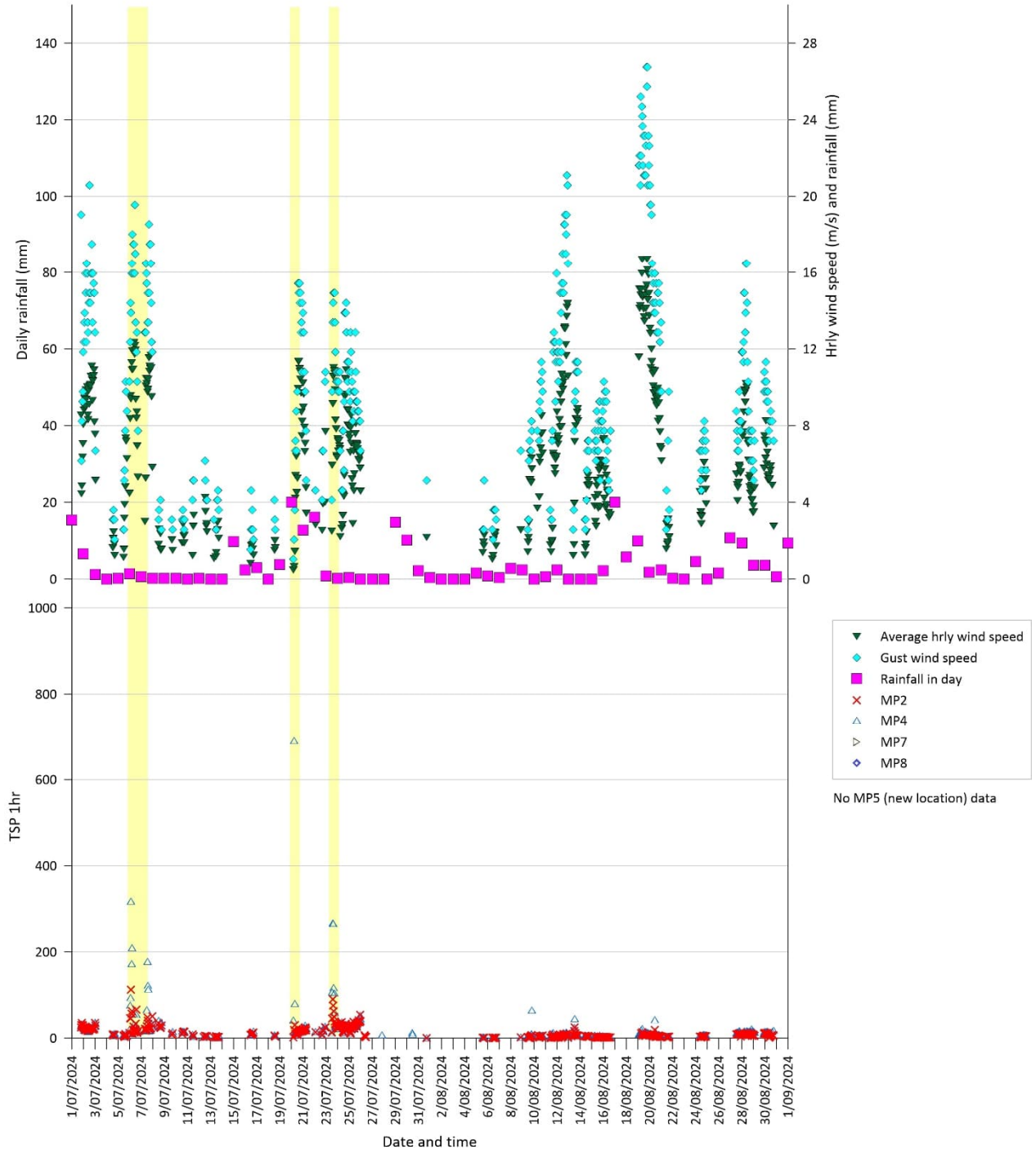
Jan-Feb 2024



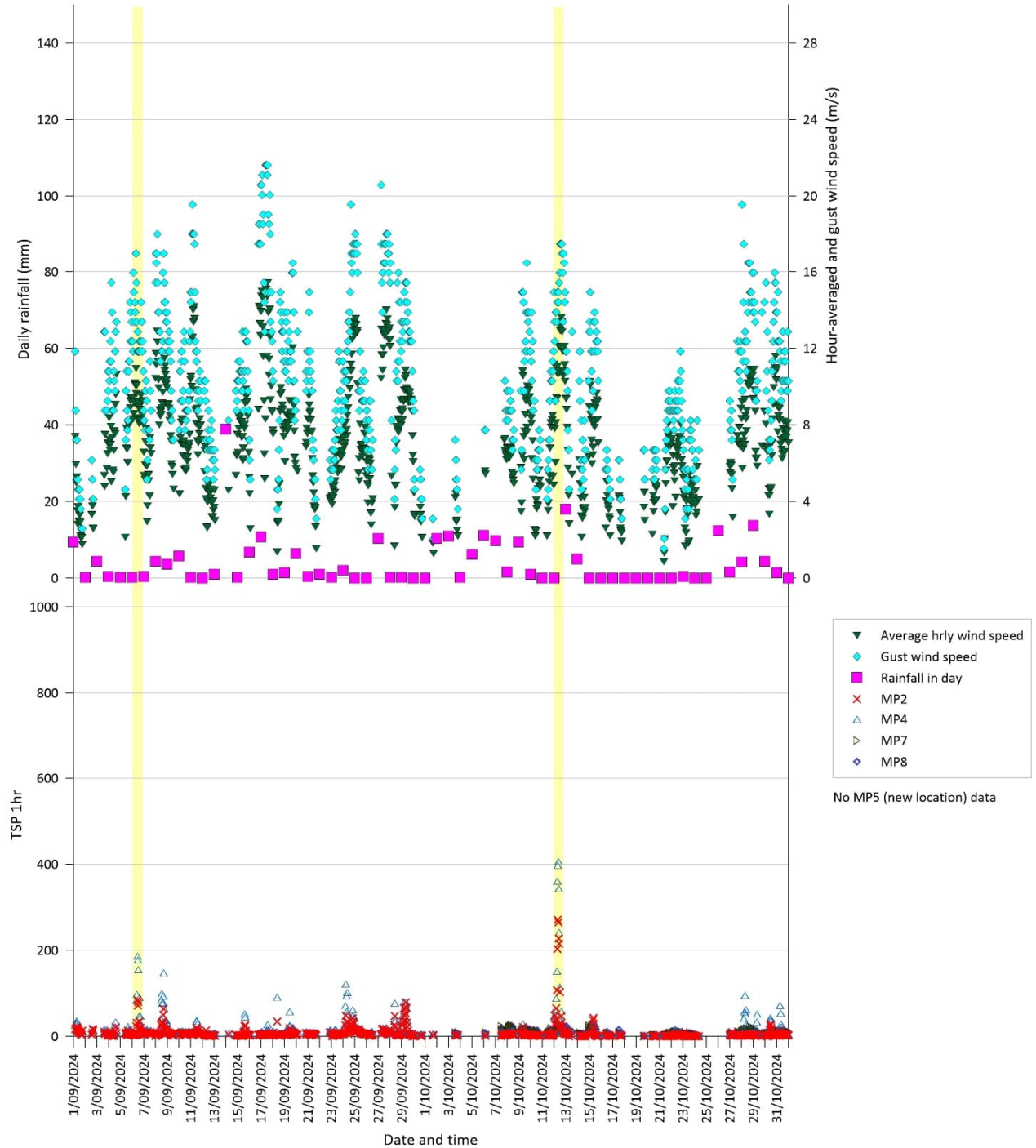
Mar-Apr 2024



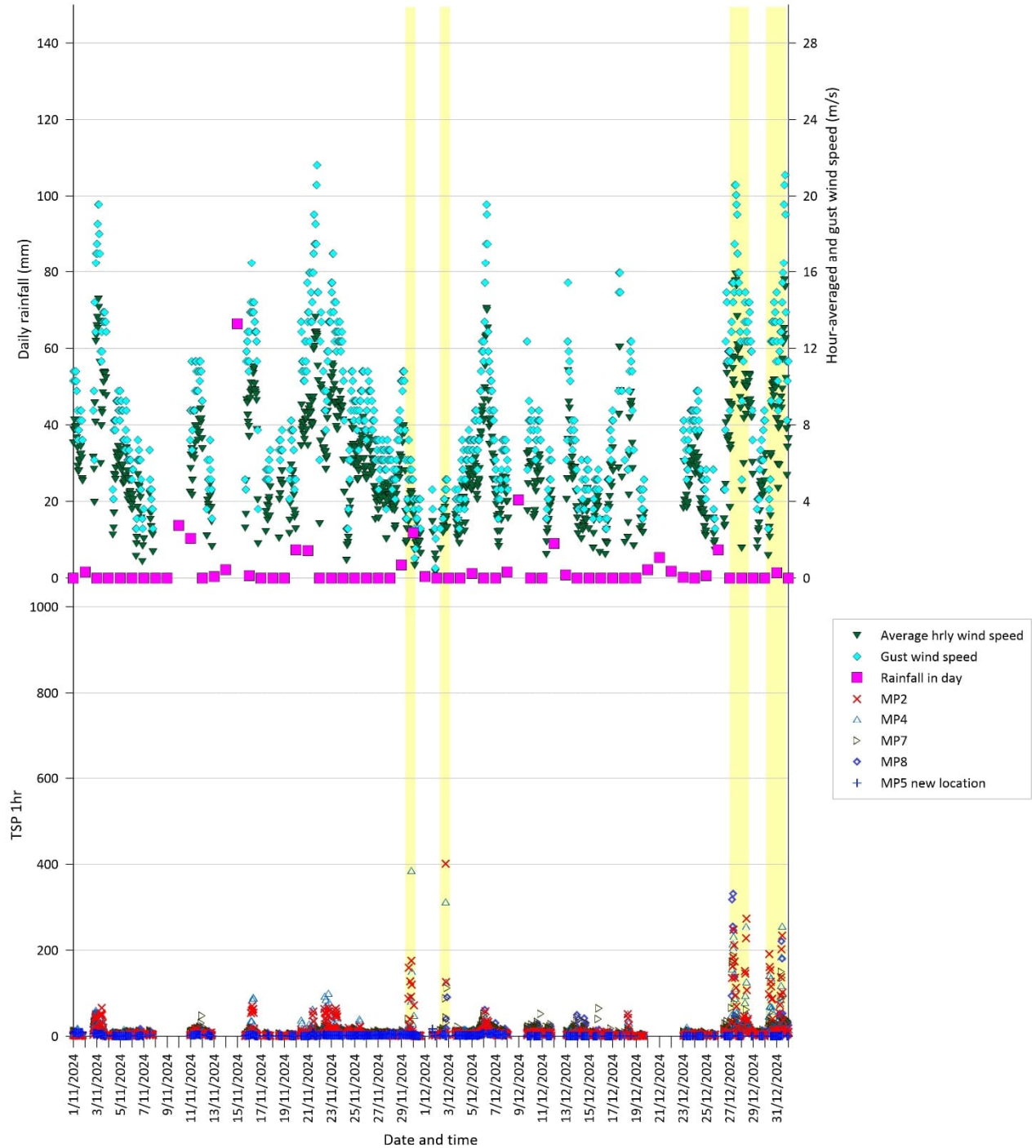
May-Jun 2024



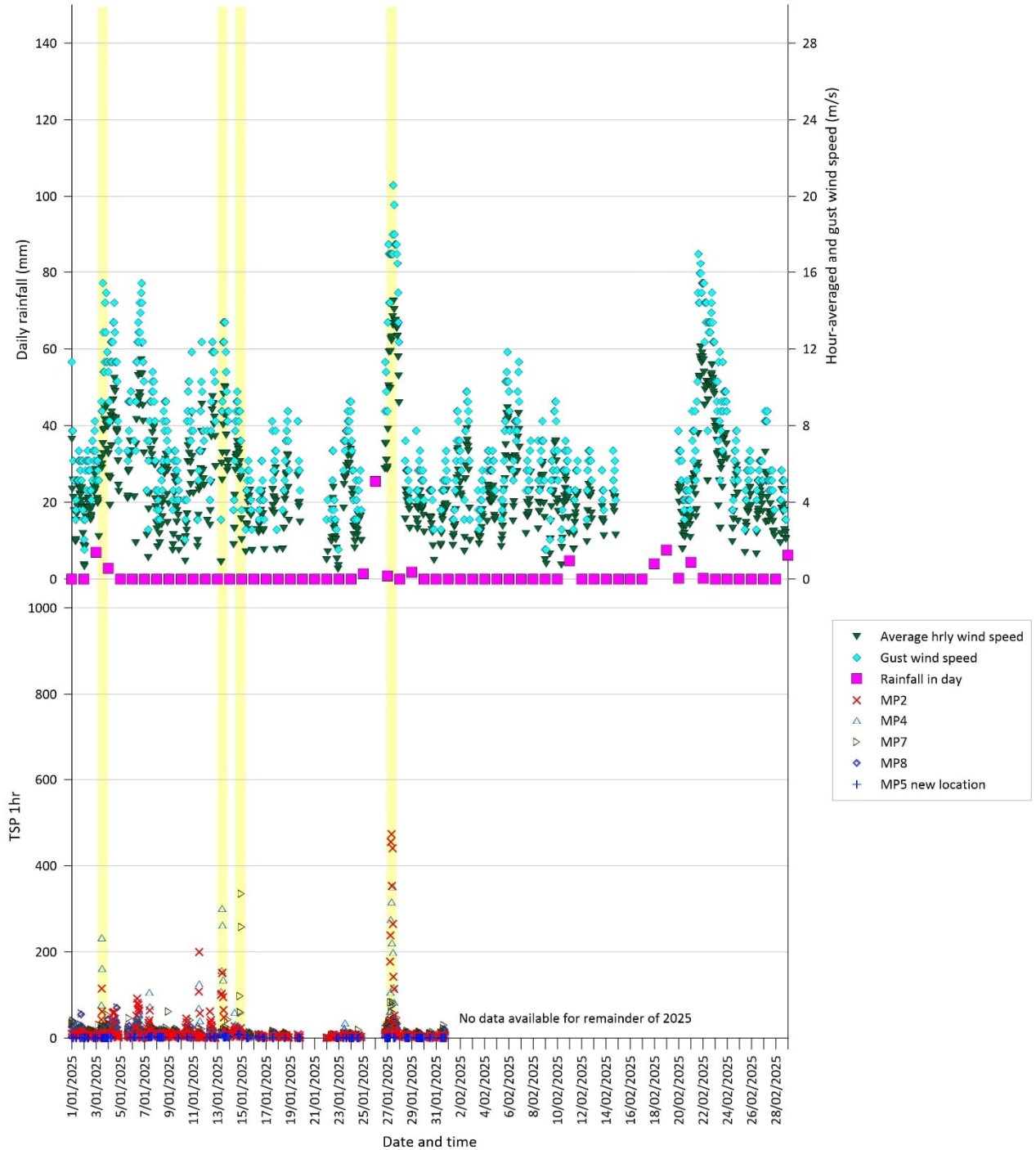
Jul-Aug 2024



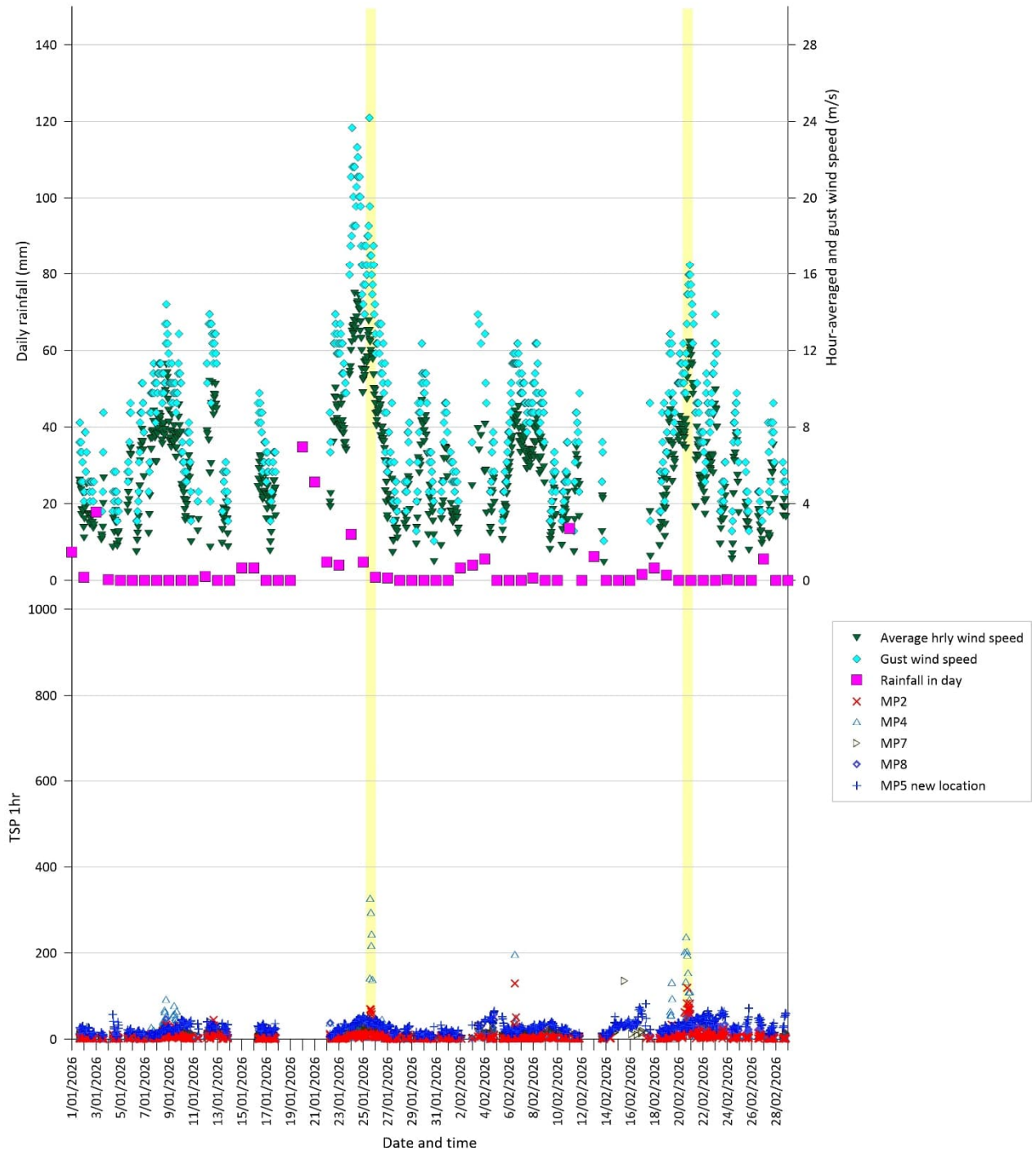
Sep-Oct 2024



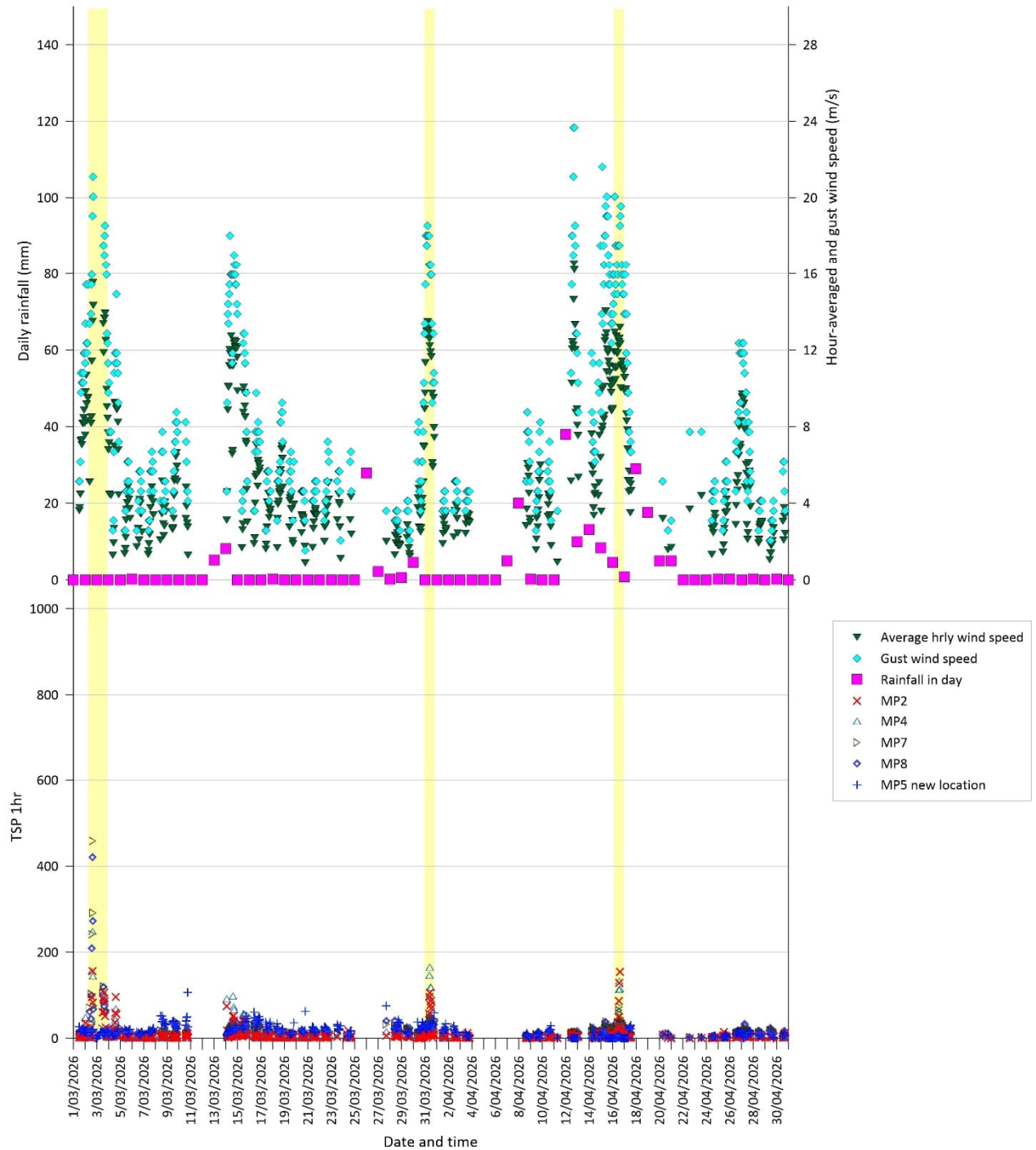
Nov-Dec 2024



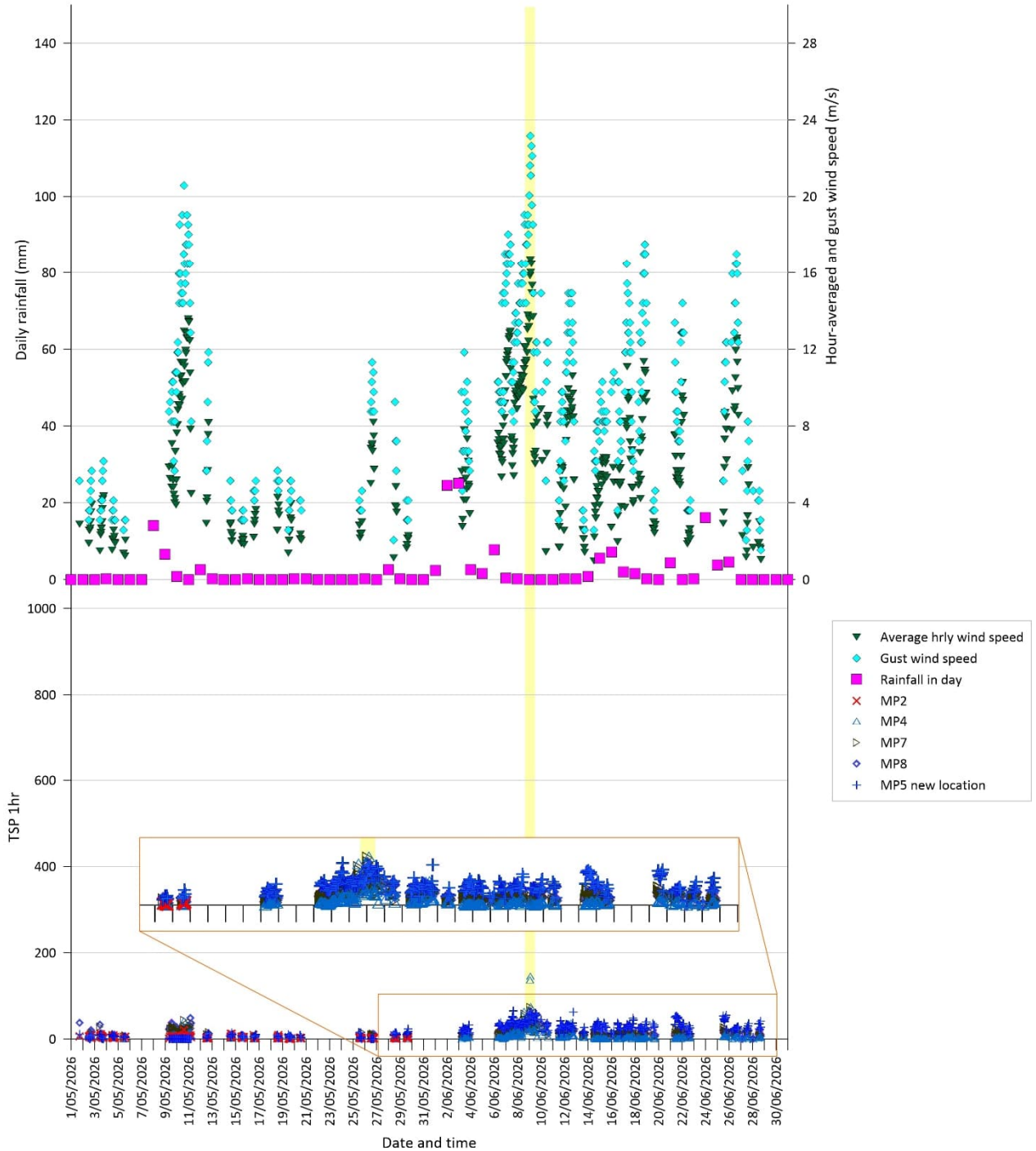
Jan-Feb 2025



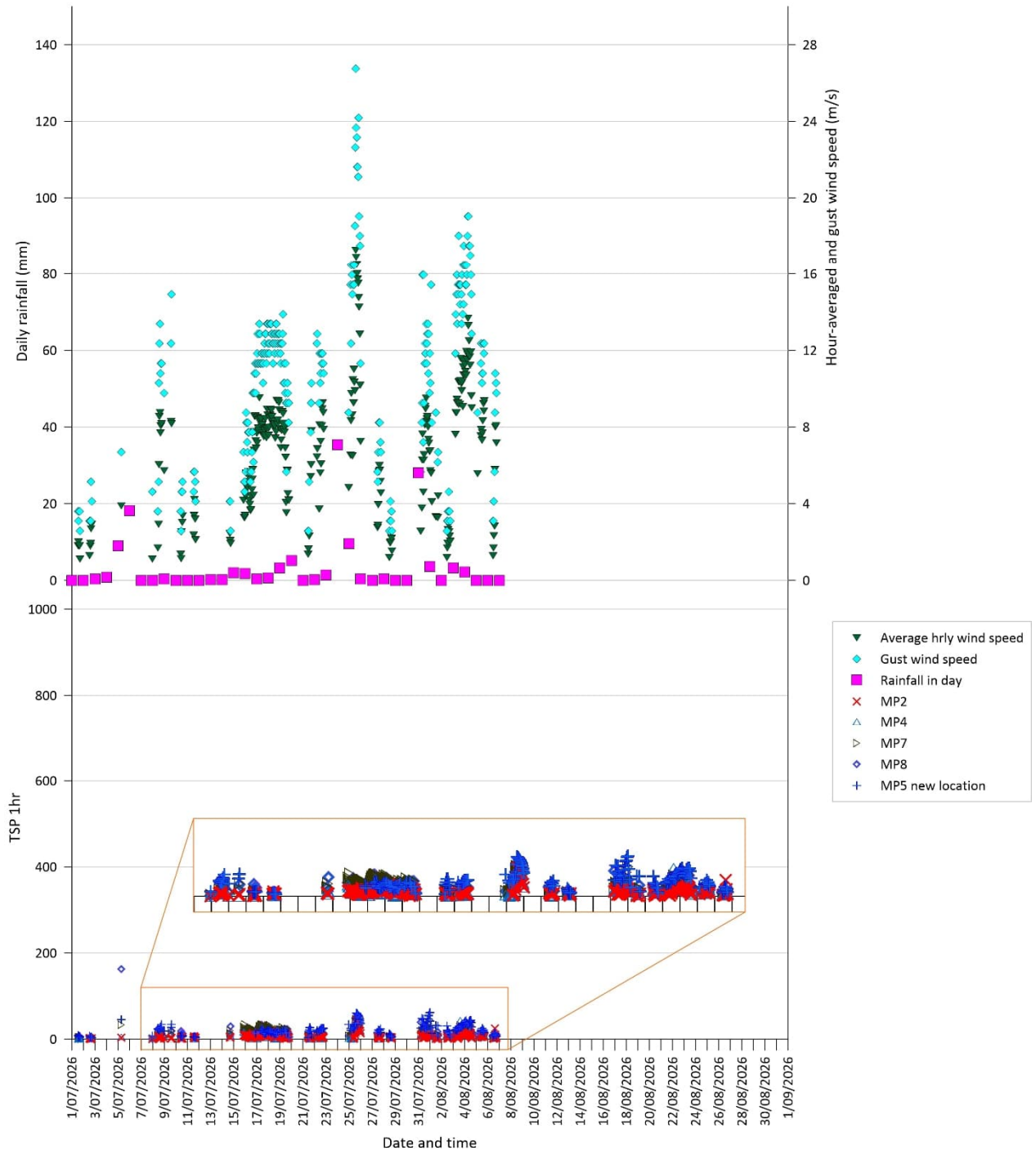
Jan-Feb 2026



Mar-Apr 2026



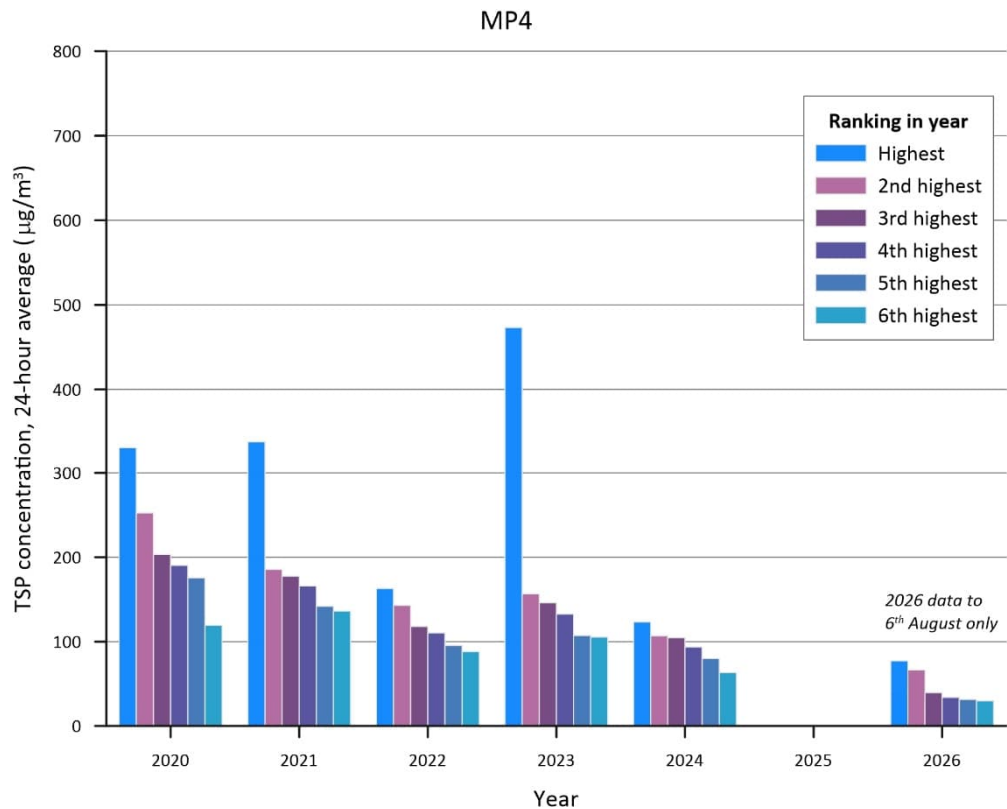
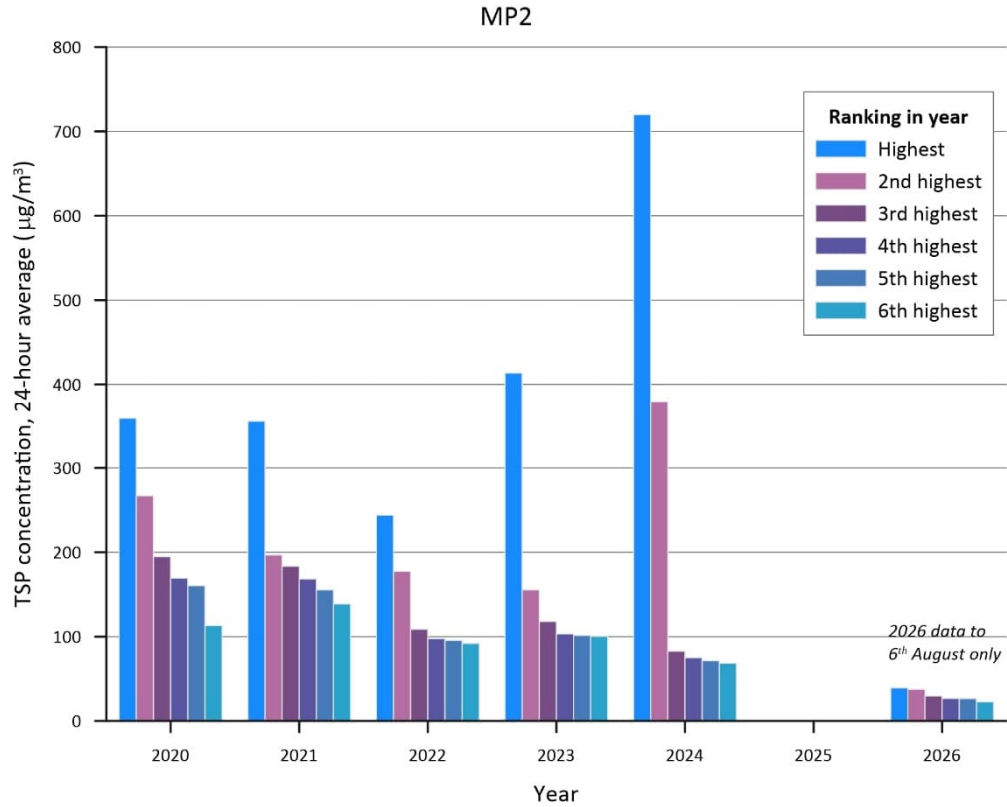
May-Jun 2026



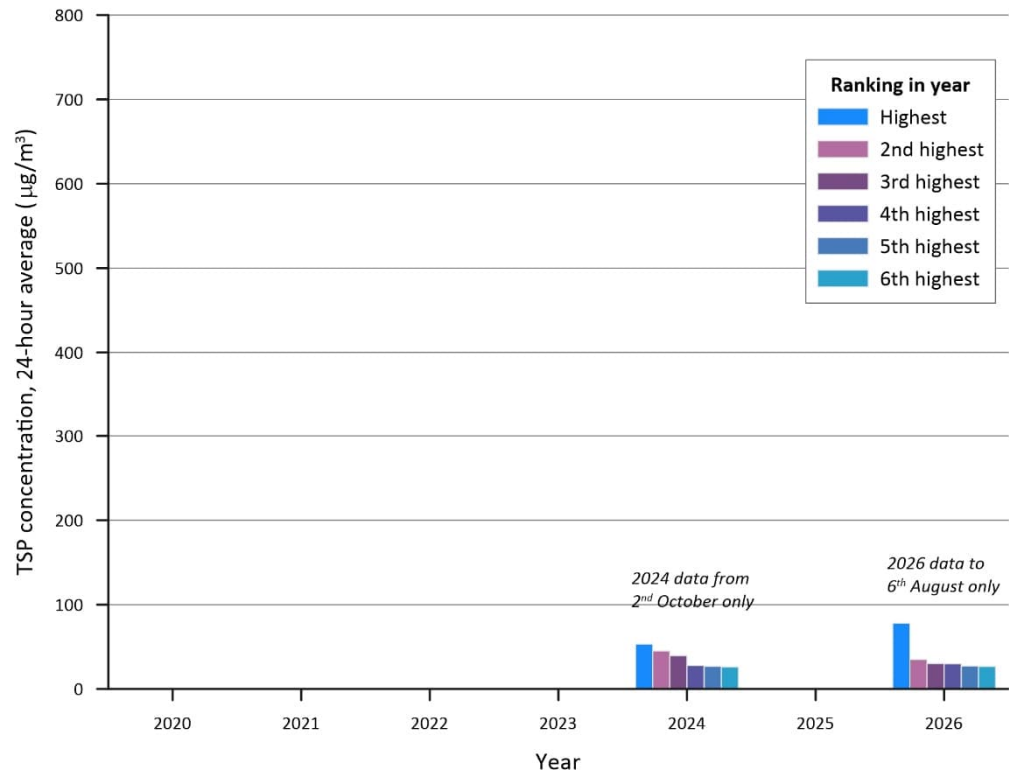
Jul-Aug 2026

ATTACHMENT D

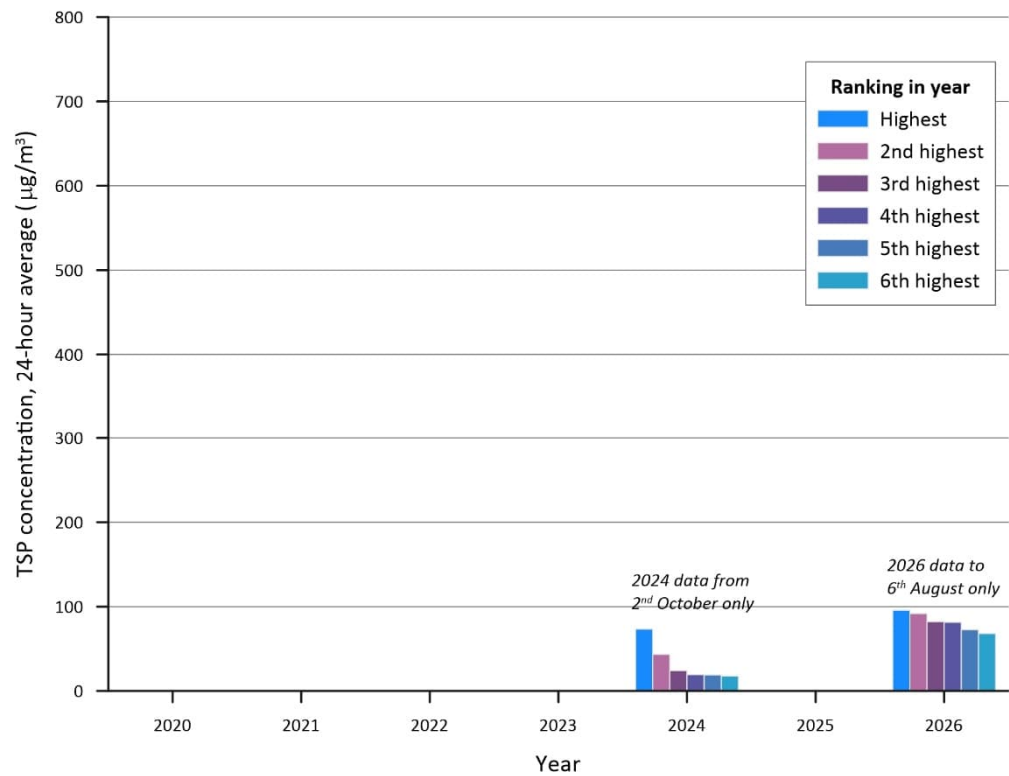
Graphs showing six highest ranked 24-hour TSP concentrations at each monitor by year



MP7



MP8



ATTACHMENT E

Table of TSP triggers from PDP (2025)

Table 4: Alert Level Framework					
Alert Level	Wind	Rainfall (last 24 h)	Temperature (°C)	TSP /Averaging Time	Operations
1	<5 m/s	No	>20 °C	<80 µg/m ³	Normal
	<10 m/s	Yes	>20 °C	Rolling 24 hour average	
	>10 m/s	Raining	>20 °C		
2	<10 m/s	No	>20 °C	<160 µg/m ³ 1 hour average	Alerted
3	>10 m/s	No	>20 °C	<240 µg/m ³ 1 hour average	Modified
4	>20 m/s	No	>20 °C	>240 µg/m ³ 1 hour average	Cease work that has the potential to generate dust or application of water for dust control. Recommence works when the TSP is less than 160 µg/m ³ and monitor continually.

ATTACHMENT F

Emission Inventory Summary Tables

SCENARIO A																		
Activity	TSP emission rate, kg/y	PM10 emission rate, kg/y	Intensity	Intensity units	Silt content (%)	Surface moisture content (%)	Number of units operating	Mean annual wind speed (m/s)	Average vehicle mass (T)	Control 1	Control 1 effectiveness	Control 2	Control 2 effectiveness	Combined control effectiveness	EFTSP equation	EFPM10 equation	EFR in AP-42	
Bulldozers on ironsand/tailings	8,561	889	7,300	hours per year	1	10	9								$EF_{TSP} = 2.6 \times s^{1.2} \times M^{-1.3} \text{ kg/h}$	$EF_{PM_{10}} = 0.34 \times s^{1.5} \times M^{-1.4} \text{ kg/h}$	E - see Note 1	
Bulldozers on overburden	34,604	6,707	7,300	hours per year	8	10	3										E - see Note 2	
Excavators	7,212	3,411	10,950,000	total tonnes per year			7	5.4							$EF = k \times 0.0016 \times \left\{ \left(\frac{U}{2.2} \right)^{1.3} \left(\frac{M}{2} \right)^{1.4} \right\} \text{ kg/tonne}$ k = 0.74 for TSP, and 0.35 for PM10		B - see Note 3	
Material dumping from trucks	7,212	3,411	10,950,000	total tonnes per year			7	5.4									B - see Note 3	
Vehicle-tracked dust	143,896	30,783	73,000	km per year per vehicle	2		10		50	Watering	0.55	Speed restriction		0.7	0.865	$EF_{TSP} = \frac{0.4536}{1.6093} \times 4.9 \times \left(\frac{s}{11} \right)^{0.7} \times \left(\frac{W \times 1.1023}{3} \right)^{0.45} \text{ kg/VKT}$	$EF_{PM_{10}} = \frac{0.4536}{1.6093} \times 1.5 \times \left(\frac{s}{11} \right)^{0.9} \times \left(\frac{W \times 1.1023}{3} \right)^{0.45} \text{ kg/VKT}$	B
Wind erosion																		
Southern block	537,409	262,456	142.67	Area (ha)						None					0.43 kg/ha/h	0.21 kg/ha/h	C - see Note 4	
Central block	900,152	439,609	238.97	Area (ha)						None					0.43 kg/ha/h	0.21 kg/ha/h	C - see Note 4	
Eastern block	135,831	66,336	36.06	Area (ha)						None					0.43 kg/ha/h	0.21 kg/ha/h	C - see Note 4	
Pit 1	66,107	32,285	17.55	Area (ha)						None					0.43 kg/ha/h	0.21 kg/ha/h	C - see Note 4	
Te Mania extension	-	-	9.43	Area (ha)						Grassed	100%			100%	0.43 kg/ha/h	0.21 kg/ha/h	C - see Note 4	
Totals																		
Southern, Central and Eastern Blocks																		
tonnes/year	1,775	814																
kg/day	4,863	2,229																
Pit 1 and Te Mania Extension																		
tonnes/year	66	32																
kg/day	181	88																

SCENARIO B																		
Activity	TSP emission rate, kg/y	PM10 emission rate, kg/y	Intensity	Intensity units	Silt content (%)	Surface moisture content (%)	Number of units operating	Mean annual wind speed (m/s)	Average vehicle mass (T)	Control 1	Control 1 effectiveness	Control 2	Control 2 effectiveness	Combined control effectiveness	EFTSP equation	EFPM10 equation	EFR in AP-42	
															$EF_{TSP} = 2.6 \times s^{1.2} \times M^{-1.3} \text{ kg/h}$	$EF_{PM_{10}} = 0.34 \times s^{1.5} \times M^{-1.4} \text{ kg/h}$	E - see Note 1	
Bulldozers on ironsand/tailings	4,756	494	7300	hours per year	1	10	5										E - see Note 2	
Bulldozers on overburden	11,535	2,236	7300	hours per year	8	10	1								$EF = k \times 0.0016 \times \left[\left(\frac{U}{2.2} \right)^{1.3} \left(\frac{M}{2} \right)^{1.4} \right] \text{ kg/tonne}$		B - see Note 3	
Excavators	3,606	1,705	5475000	total tonnes per year			7	5.4									B - see Note 3	
Material dumping from trucks	3,606	1,705	5475000	total tonnes per year			7	5.4									B - see Note 3	
				km per year											$k = 0.74 \text{ for TSP, and } 0.35 \text{ for PM}_{10}$		B - see Note 3	
Vehicle-tracked dust	71,948	15,392	36500	per vehicle	2		10		50	Watering	55%	Speed restriction	70%	87%	$EF_{TSP} = \frac{0.4536}{1.6093} \times 4.9 \times \left(\frac{s}{11} \right)^{0.7} \times \left(\frac{W \times 1.1023}{3} \right)^{0.45} \text{ kg/VKT}$	$EF_{PM_{10}} = \frac{0.4536}{1.6093} \times 1.5 \times \left(\frac{s}{11} \right)^{0.9} \times \left(\frac{W \times 1.1023}{3} \right)^{0.45} \text{ kg/VKT}$	B	
Wind erosion																		
Southern block	537,409	262,456	142.67	Area (ha)						None					0%	0.43 kg/ha/h	0.21 kg/ha/h	C - see Note 4
Central block - contoured and planted	315,053	153,863	119.485	Area (ha)						Planting	30%				30%	0.43 kg/ha/h	0.21 kg/ha/h	C - see Note 4
Central block - contoured no planting	450,076	219,805	119.485	Area (ha)						None					0%	0.43 kg/ha/h	0.21 kg/ha/h	C - see Note 4
Eastern block	27,166	13,267	36.06	Area (ha)						Planting	80%				80%	0.43 kg/ha/h	0.21 kg/ha/h	C - see Note 4
Pit 1	13,221	6,457	17.55	Area (ha)						Planting	80%				80%	0.43 kg/ha/h	0.21 kg/ha/h	C - see Note 4
Te Mania extension	24,865	12,143	9.43	Area (ha)						Planting	30%				30%	0.43 kg/ha/h	0.21 kg/ha/h	C - see Note 4
Totals																		
Southern, Central and Eastern Blocks																		
tonnes/year	1,425	671																
kg/day	3,905	1,838																
Pit 1 and Te Mania Extension																		
tonnes/year	38	19																
kg/day	104	51																

Note 1: Down-rated from "D" due to silt content being lower than applicable range for equation (USEPA 1998); already at lowest possible rating even before adjusting for site type not being a western surface coal mine.

Note 2: Down-rated from "D" due to site type not being a western surface coal mine.

Note 3: Down-rated from "A" due to moisture content not being determined from site-specific testing (USEPA 2006a).

Note 4: Equation 4 is rated "C" in USEPA (1983) for application in the sand and gravel industry, and "D" for other industries.

ATTACHMENT G

Particle size distribution test results from PDP (2026a)

Table 1: Particle Size Distribution								
Sample	Percentage of Sample (%)							
	< 4.75 mm	< 2 mm	< 0.6 mm	< 0.3 mm	< 0.15 mm	< 0.09 mm	< 0.075 mm	<0.063 mm
Northern Ridge	-	-	100	92	14	1	-	-
Unprocessed DMU3	-	100	100	78	16	2	1	1
Eastern Block Tails	-	-	100	75	10	1	1	-
Southern Block Tails	-	100	100	87	14	1	1	-
Processed Stockpile	100	99	98	97	68	9	5	3

ATTACHMENT H

**Photographs from site visit on 24 September 2026
showing ambient haze**



Photo taken at 1:30pm from helipad, looking north



Photo taken at 2:15pm from entrance to mine, looking northeast



Photo taken at 2:45pm from Whakapirau Rd looking north towards Kawhia