MOTT MACDONALD

DESIGNING AND IMPLEMENTING AN ECOLOGICAL DUST MANAGEMENT FRAMEWORK FOR CONSTRUCTION PROJECTS

CLEAN AIR CONFERENCE 2026

Thank you to my co-authors

This work was developed collaboratively by the Western Program Alliance (WPA) which comprises VIDA Rail, McConnell Dowell, Arup, Mott MacDonald and Metro Trains Melbourne.

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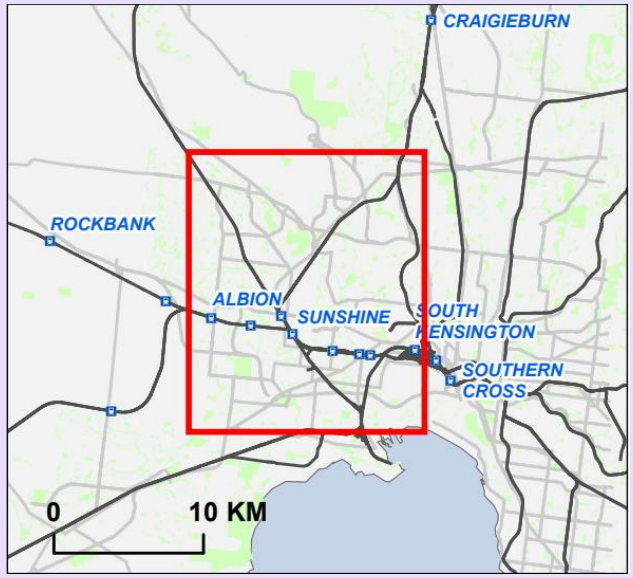
Introduction

Dust management was required during MAR Stage 1 Enabling Works adjacent to the Sunshine Triangle Ecological Site.

PROJECT

MAR Stage 1 Enabling Works



- Rail enabling works adjacent to the ecological site.
- Dust generating activities included earthworks, clearing, drilling and vehicle movements.

RECEPTOR

Sunshine Triangle Ecological Site

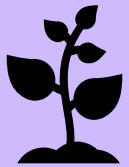
- Includes threatened grassland vegetation such as the Sunshine Diuris (MNES under the EPBC Act).
- Last known natural population occurs within this ecological area.

REQUIREMENT

Dust Management Plan

- Required under the Threatened Species Management Plan required under the EPBC Act.
- Required to identify dust generating activities, outline control measures, and establish monitoring requirements.

Methodology



CHALLENGE

Managing construction dust adjacent to sensitive ecological receptors where no established ecological dust tolerance levels exist.

APPROACH

1. Define dust tolerance levels
2. Develop the Dust Management Plan
3. Establish an interface with construction
4. Evaluate outcomes

Methodology

1. Dust tolerance levels

2. Dust Management Plan

3. Interface with construction

4. Outcomes

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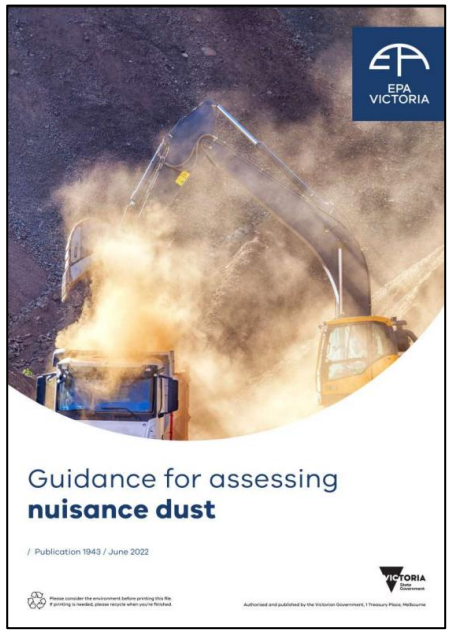
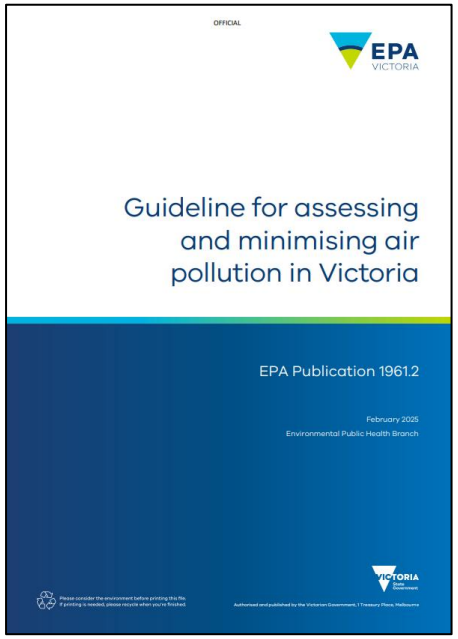
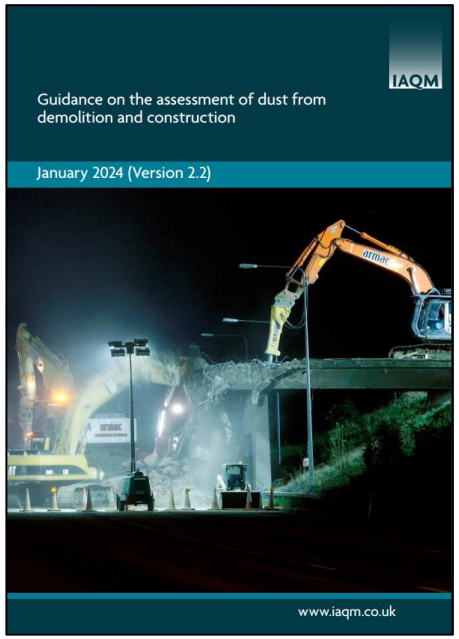
Guidelines and literature review

- Existing guidance supported construction dust assessment and control but did not define quantitative ecological triggers.
- Published responses were highly variable. Approximately 0.2 g/m²/day was identified as an indicative ecological benchmark, not a project trigger or regulatory limit.





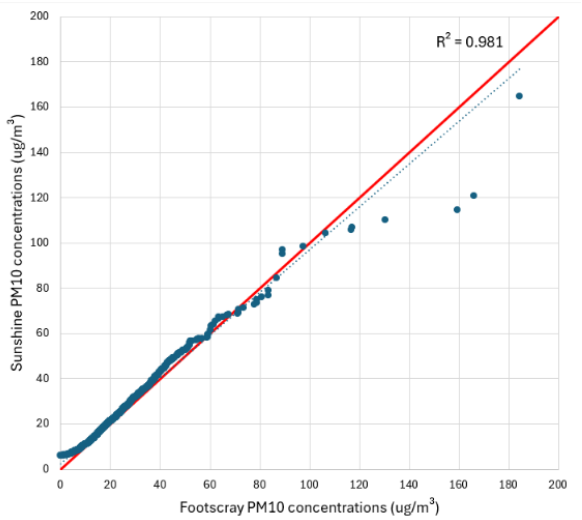


Baseline monitoring

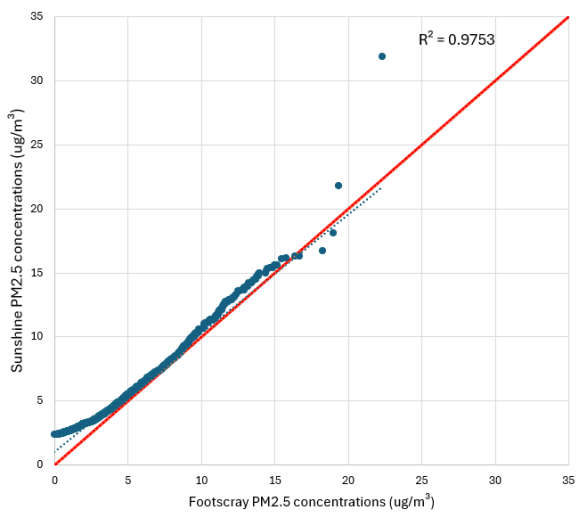
- Characterise existing dust and meteorological conditions prior to construction:
  - **Real time particulate monitoring:** Acoem Met One ES-405 Real-Time Particulate Monitor
  - **Meteorological monitoring:** Acoem Met One AIO 2 Sonic Weather Sensor
  - **Dust Deposition monitoring**
- Baseline: 29 October 2025 – 12 January 2026 (~2.5 months)
- Monitoring continuing throughout the construction phase

Extending the baseline using EPA Footscray data

- 2.5 month baseline monitoring period was insufficient to characterise the full range of dust concentrations.
- Comparison against the nearby EPA Footscray AQMS (~2.5 km east)
- The two monitors showed comparable temporal patterns, supporting the use of longer term Footscray data to characterise historical conditions.

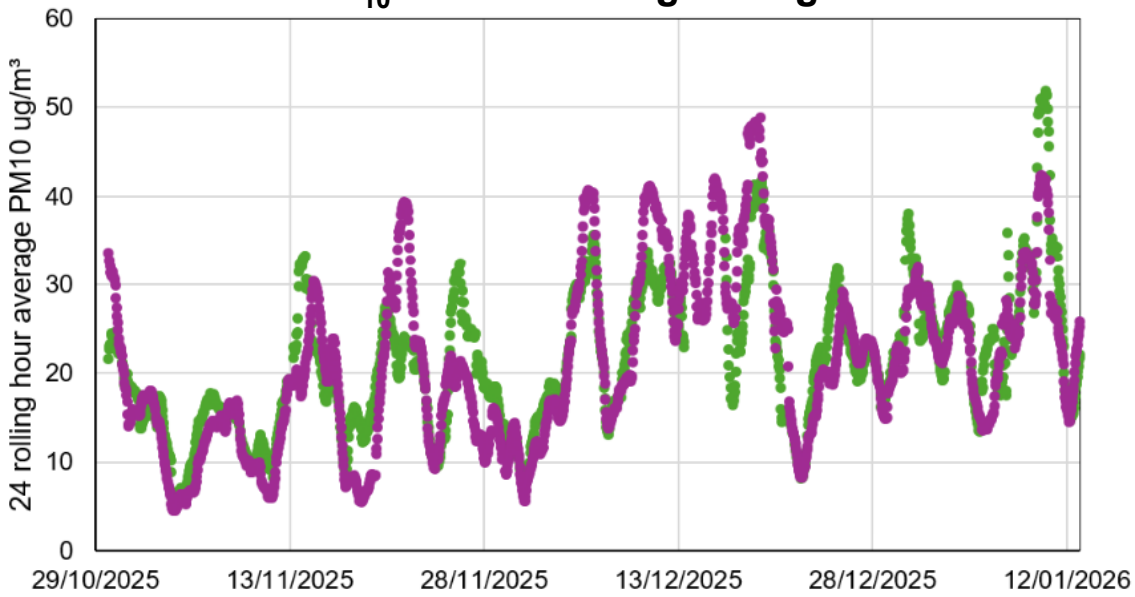


PM_{10} 1 hour Q-Q

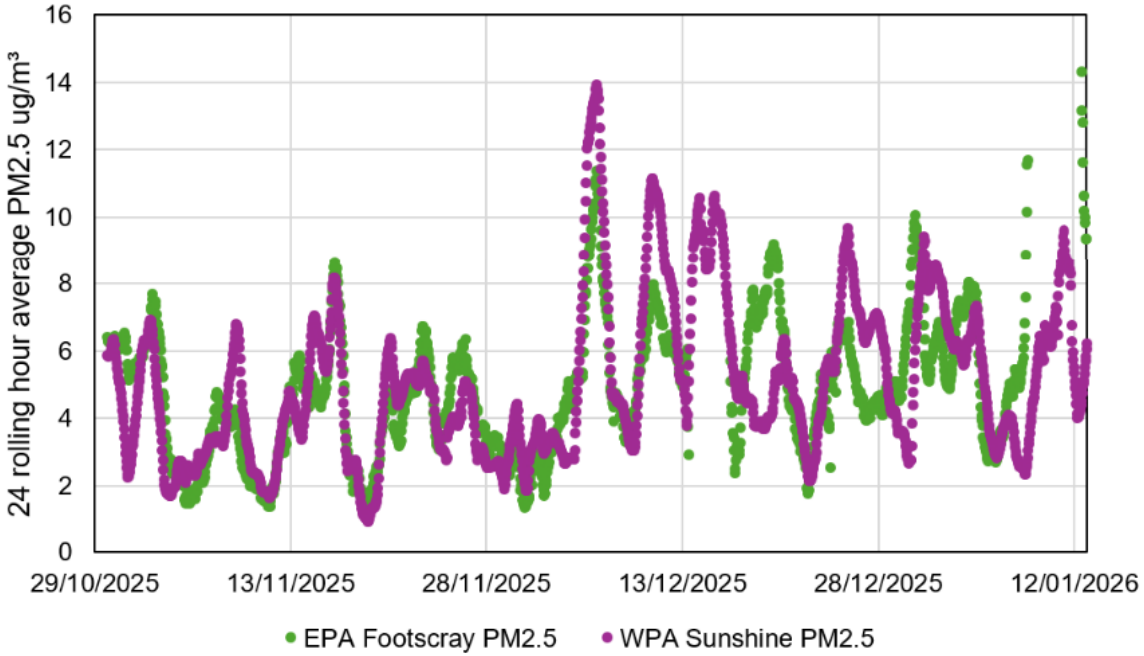


$PM_{2.5}$ 1 hour Q-Q

PM_{10} 24 hour rolling average



$PM_{2.5}$ 24 hour rolling average

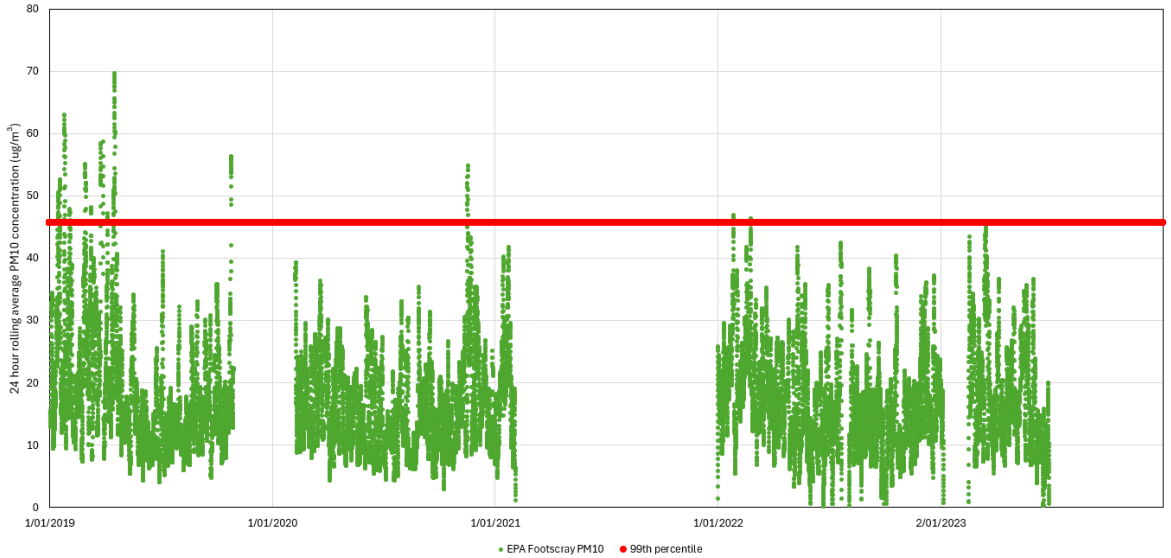


Determining dust tolerance levels

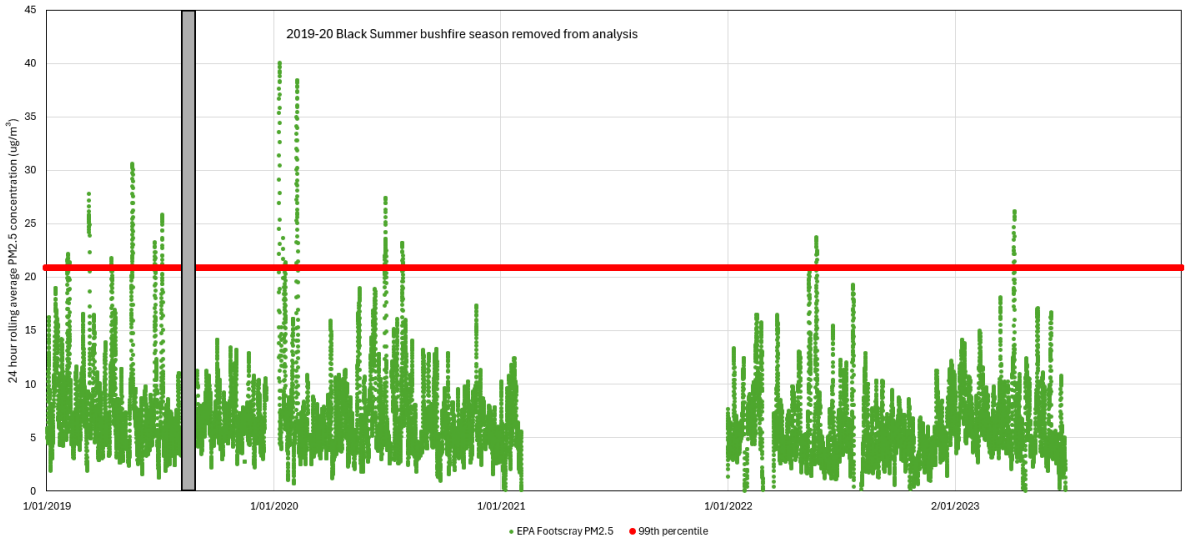
- Long term (2019-2023) EPA Footscray data were considered representative of historical exposure conditions.
- The 99th percentile was adopted as a high-end exposure based on U.S. EPA exposure assessment guidance.
- Adopted values were more conservative than Victorian ERS objectives for human health, providing an additional margin of protection.

Pollutant	24 hour dust tolerance (µg/m³)
PM_{10}	46
$PM_{2.5}$	21

EPA Footscray PM_{10} 24 hour average

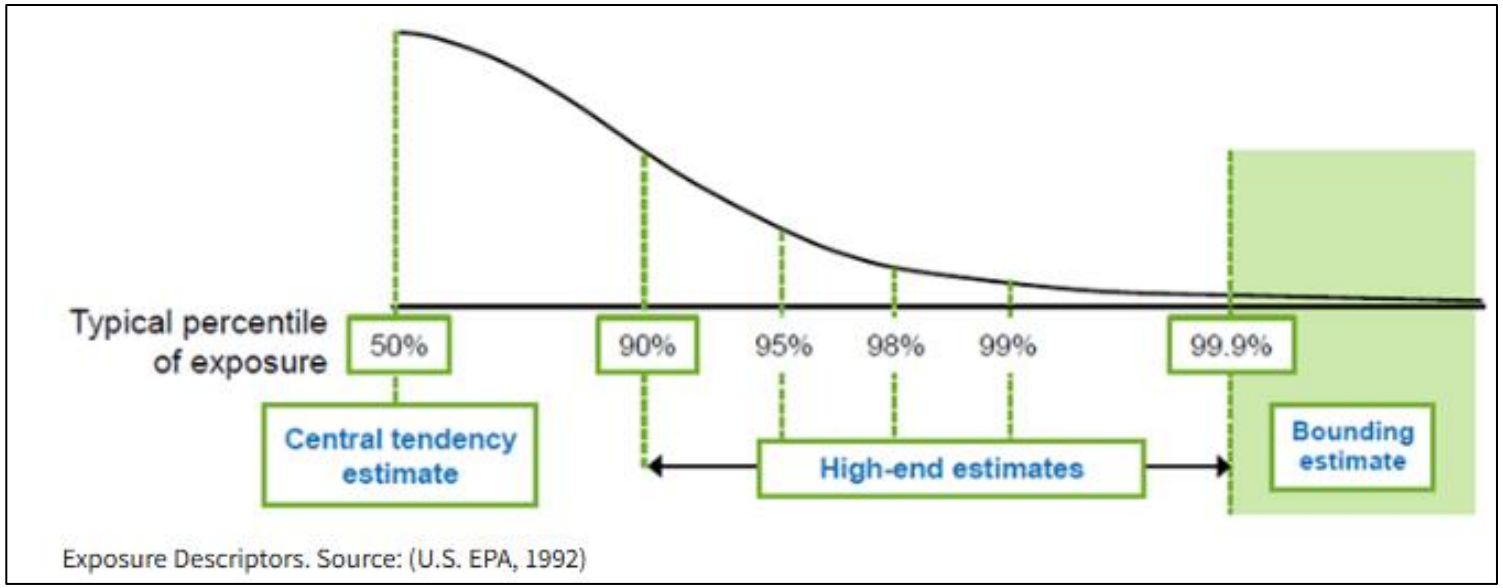


EPA Footscray $PM_{2.5}$ 24 hour average



Why the 99th percentile was selected

- Selection of the 99th percentile is consistent with the U.S. EPA concept of a reasonable maximum exposure, representing a high-end yet plausible exposure condition within the observed distribution.
- This approach avoids the use of unrealistically conservative bounding estimates while providing a precautionary benchmark for identifying potential incremental dust impacts associated with construction activities.



Exposure Descriptors. Source: (U.S. EPA, 1992)

Methodology

1. Dust tolerance levels

2. **Dust Management Plan**

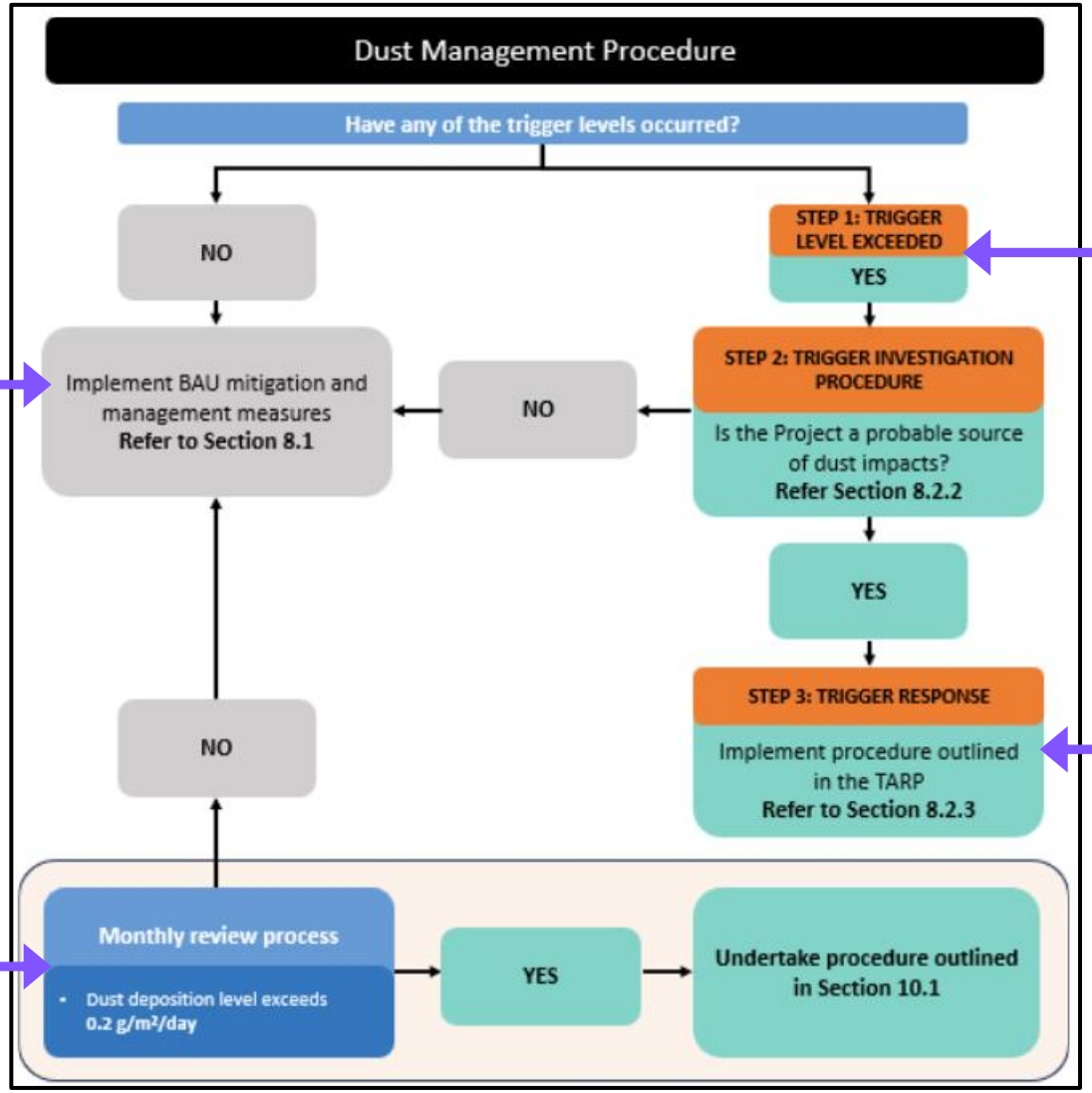
3. Interface with construction

4. Outcomes

Developing the Dust Management Procedure

1. Assess dust risk and define BAU controls
Identify construction activities and establish routine, business as usual controls.

2. Develop real time trigger levels
Define monitoring thresholds that identify when additional controls may be needed.



3. Define TARP framework
Establish progressively stronger, source specific, controls for initial and persistent trigger conditions.

4. Establish a monthly review process
Review dust deposition, real time triggers and control performance to support continuous improvement.

Developing the Dust Management Procedure

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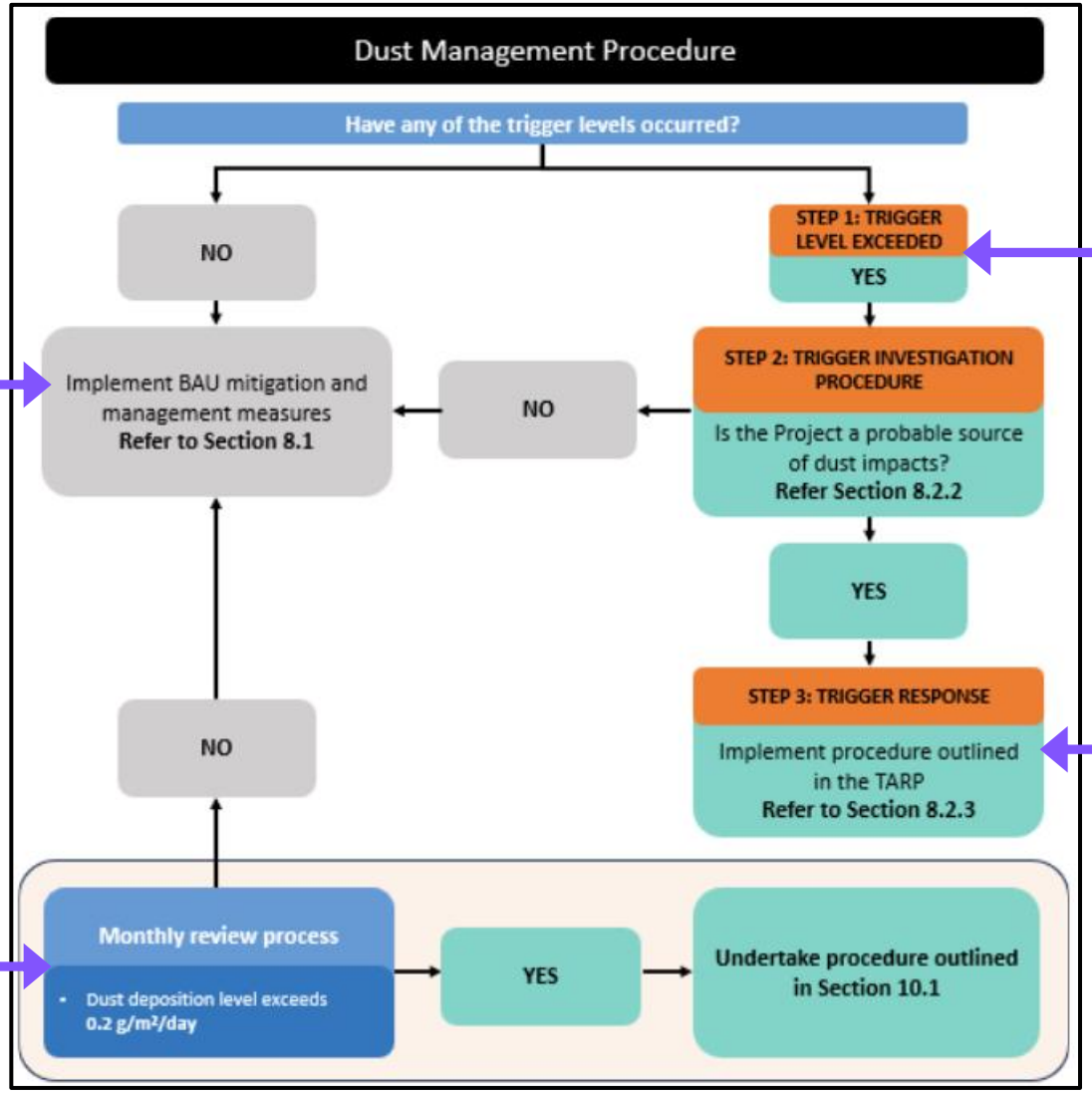

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Developing real time trigger levels

- 24 hour dust tolerance was not suitable for operational construction management.
- Project specific 1 hour trigger levels were developed using the proportional relationship outlined in EPA Victoria Publication 1961.2.
- Real time particulate monitoring alongside visual dust observations were adopted as trigger conditions.
- The 1 hour trigger levels were checked against baseline conditions before implementation to assess appropriateness

Averaging period	Concentration (µg/m³)			Notes
	EPA PM_{10}	Project PM_{10}	Project $PM_{2.5}$	
24 hour	50	46	21	Project 24 hour dust tolerance levels
1 hour	80	**74**	**34**	Adopted Project 1 hour trigger levels
30 minute	120	110	50	Alternative averaging periods considered but not adopted
15 minute	150	138	63	
10 minute	165	152	69	

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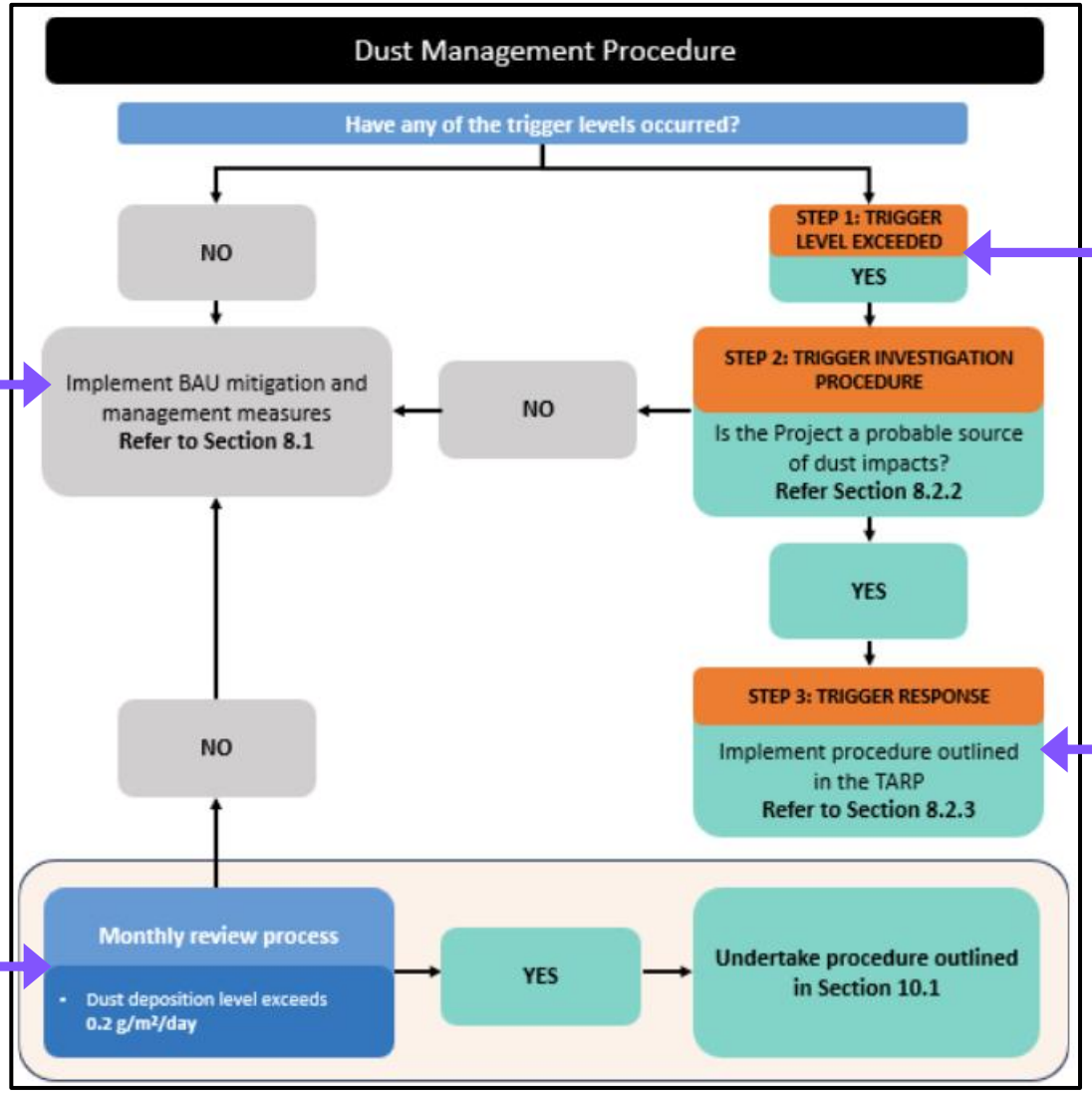

TARP framework

LEVEL 0 Normal conditions	LEVEL 1 Initial trigger exceedance	LEVEL 2 Persistent or high risk
TRIGGER		
• No visible dust leaving construction activity boundaries • PM_{10} < 74 µg/m³ (1 hour) • $PM_{2.5}$ < 34 µg/m³ (1 hour)	• Visible dust observed leaving the activity boundary or • PM_{10} > 74 µg/m³ (1 hour) or • $PM_{2.5}$ > 34 µg/m³ (1 hour)	• Visible dust impacting ecological receptors or • PM_{10} > 74 µg/m³ (4 consecutive hours) or • $PM_{2.5}$ > 34 µg/m³ (4 consecutive hours)
RESPONSE		

• Continue normal construction activities
• Maintain routine dust suppression controls
  • e.g., dust barriers, routine water suppression
	• Investigate likely dust source
	• Implement Level 1 activity specific controls
	  • e.g., additional watering/misting, windbreaks or covers reduced vehicle speeds
	• Maintain controls until conditions improve
	• Review ongoing BAU controls
		• Investigate likely dust source
		• Implement Level 2 activity specific controls
		  • e.g., stop identified activity
		• Maintain controls until conditions improve
		• Review ongoing BAU controls

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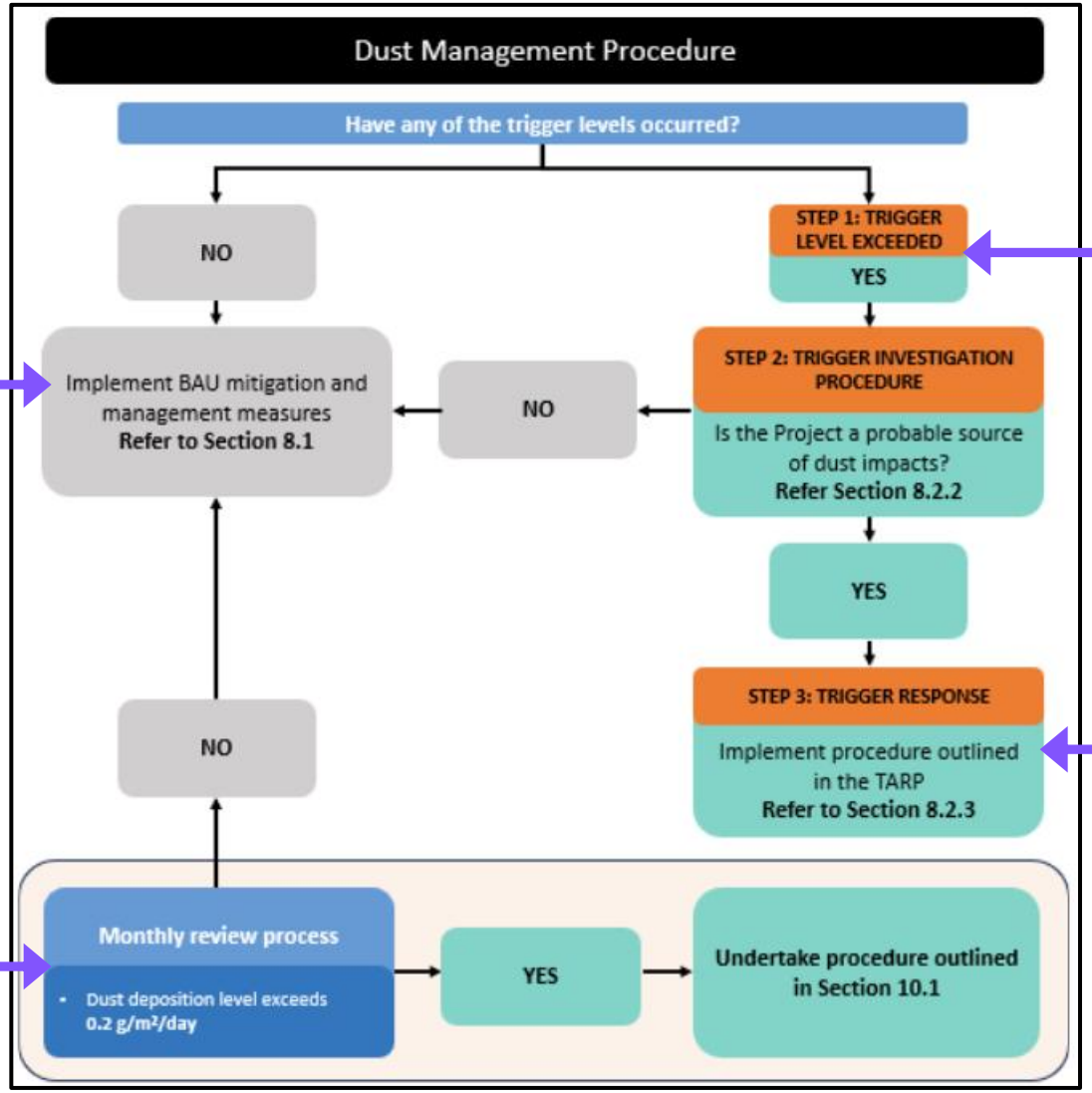


Monthly review process

- Monthly dust deposition was reviewed against the indicative ecological benchmark of 0.2 g/m²/day.
- Reviews considered:
  - Deposition trends and real-time trigger frequency
  - Wind conditions and upwind activities
  - BAU control performance and TARP implementation
- Findings informed any required changes to controls, the Dust Management Plan or trigger values.

Example: installation of bog mats on unsealed access tracks

Dust management procedure

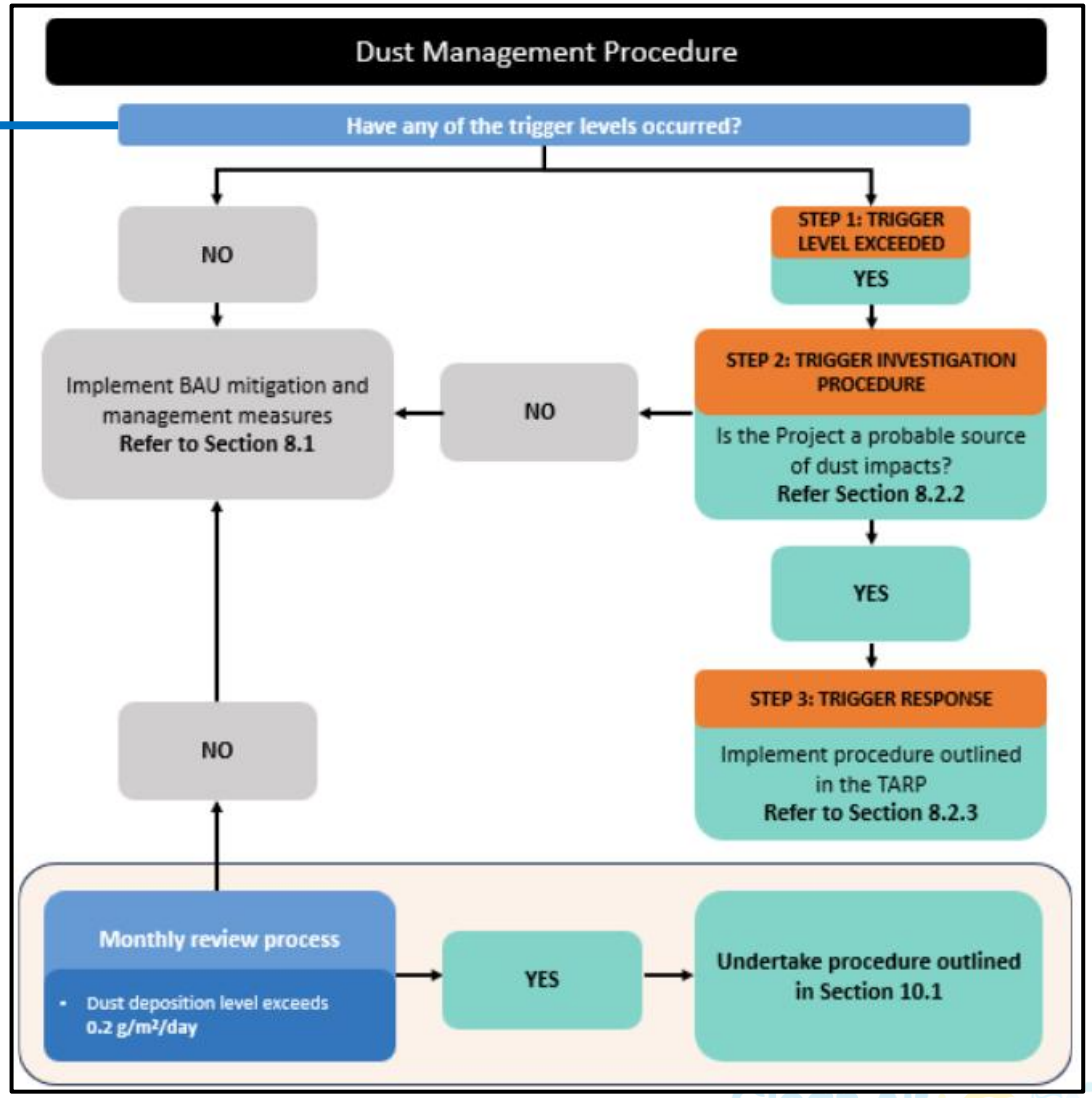
TRIGGER LEVELS

Level 1:

- Site staff observe visible dust leaving construction activity boundaries
- Real time PM_{10} monitoring exceeds limit of **74 µg/m³** over a 1-hour averaging period
- Real time $PM_{2.5}$ monitoring exceeds limit of **34 µg/m³** over a 1-hour averaging period

Level 2:

- Site staff observe visible dust leaving construction activity boundaries, impacting ecological receptors
- Level 1 triggers for PM_{10} and/or $PM_{2.5}$ are exceeded for four consecutive hours



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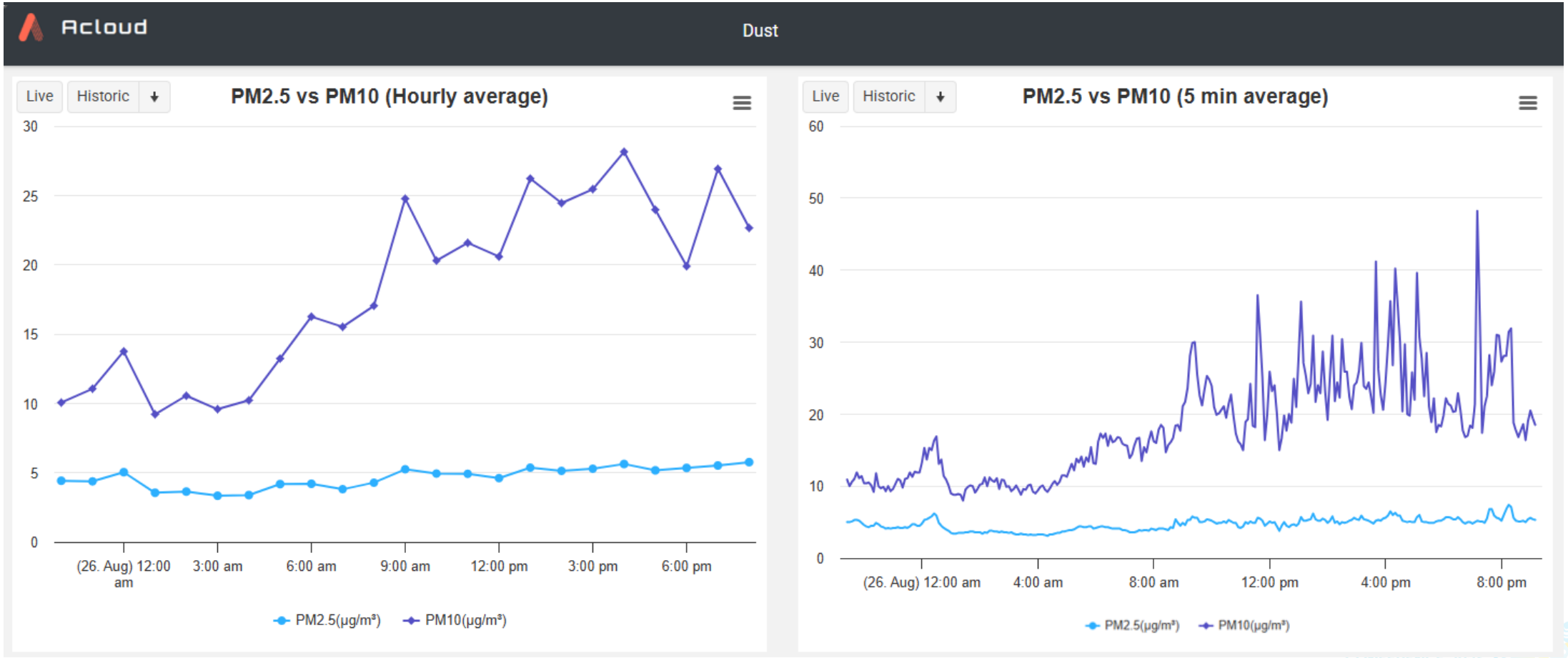
Trigger alert system

Subject: PM10 Level 1 exceedence 74 ug/m3 (1 hour)

The following alarms have been RAISED :
Station : WPA Sunshine Solar ES405 (Alarm notification) Rule : PM10 Level 1 exceedence Description : Channel 1 [PM10] is above maximum of 74.00

Time : 5/02/2026 10:00:00
Broken Conditions :
Channel 'PM10' value 80.10 is above maximum of 74



Notifying site

Two types of notification emails were established when a real time dust trigger occurs:

Action required:

- Sent only when all of the following occur:
  - ✓ Elevated concentrations at the site monitor
  - ✓ Monitor is downwind of site works
  - ✓ EPA Footscray/Brooklyn are NOT elevated

Dust advice:

- Concentrations are elevated at the site monitor
- BUT the overall evidence does not clearly point to site works, because only one supporting indicator aligns. e.g.,
  - ✓ Concentrations are elevated at the site monitor
  - ✗ The monitor is downwind of construction activities
  - ✗ Footscray and Brooklyn are also elevated

Subject: Dust action required - Sunshine monitor

Hi Sanmay,

We received two alerts for PM_{10} at the Sunshine monitor for the hours 12-1pm and 1-2pm which have been investigated.

Between 12-1pm there were fair PM_{10} levels reported at Footscray. However, between 1-2pm concentrations at Footscray and Brooklyn were reported as good. Therefore, the elevated concentrations appear to be isolated to the site and action is required.

Can you please contact the site team to confirm conditions on site and ensure that dust control measures are in place?

The wind direction is tending southeasterly.

Kind regards,

Subject: Re: Dust action required - Sunshine monitor

Thank you for the heads up.

I have been in contact with the site team and can confirm that a water cart is being dispatched for additional water suppression to address the elevated PM10 concentrations.

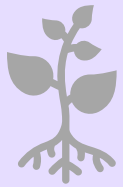
We will continue to monitor conditions on site and ensure dust control measures remain in place.

Please let me know if you need anything further.

Trigger log

ID	Investigation trigger	Time period being investigated	Detail of investigation	Summary of finding	Outcome	Investigation completed by	Investigation date	Link to investigation
1	PM10 level 1 exceedance of 74 ug/m3 (1 hour) from 7am - 8am, with a peak value of 151 ug/m3 (1 hour). Alert received 9.20am 3/2/26	7-8am on 3 Feb 2026	Logged into Acoem Acloud system to assess concentrations, wind speed and wind direction during the time leading up to the alerts. Checked Vic EPA AirWatch PM10 concentrations at nearby stations (Footscray, Brooklyn and Kingsville) to determine whether concentrations are localised or regional.	Elevated concentrations at Footscray between 7-8 am, but not to the same levels as Sunshine. Elevated concentrations at Brooklyn, but given the wind direction, and distance of Brooklyn from Sunshine, unlikely to be regional event. Wind directions blowing N, NW during periods of elevated concentrations indicating site works are a likely cause of dust.	Email sent to S Khanvikar and C Soleman informing of investigation and likely cause of dust (site works). C Soleman called superintendent. A hose was used to control dust, with a water cart deployed as an additional control (Level 1)	A Schmidt	03.02.2026	See 03.02.26 tab
2	PM10 level 1 exceedance of 74 ug/m3 (1 hour) from 8am - 9am, with a peak value of 107 ug/m3 (1 hour). Alert received 10am 4/2/26	8-9am on 4 Feb 2026	Logged into Acoem Acloud system to assess concentrations, wind speed and wind direction during the time leading up to the alerts. Checked Vic EPA AirWatch PM10 concentrations at nearby stations (Footscray, Brooklyn and Kingsville) to determine whether concentrations are localised or regional.	Elevated concentrations at Footscray and Brooklyn during the same time period indicate regional worsened air quality. However, concentrations slightly worse at Sunshine (102.3 ug/m3 compared with 88.2 and 76.7 at EPA stations). North westerly wind conditions indicate that site works may be worsening conditions.	Email sent to C Soleman informing of investigation and likely influence of site works. C Soleman went on site and confirmed that a water cart has been deployed (see tab for evidence). Noted that adjacent site across the rail corridor is contributing to significant dust generation.	A Schmidt	04.02.2026	See 04.02.26 tab
3	PM10 level 1 exceedance of 74 ug/m3 (1 hour) from 10am-11am, with a peak value of 207 ug/m3 (1 hour). Alert received 12.20pm 5/2/26	10-11am on 5 Feb 2026	Logged into Acoem Acloud system to assess concentrations, wind speed and wind direction during the time leading up to the alerts. Checked Vic EPA AirWatch PM10 concentrations at nearby stations (Footscray, Brooklyn and Kingsville) to determine whether concentrations are localised or regional.	Elevated concentrations at Sunshine between 10-11am which were heading down after 11am. Elevated concentrations were not experienced at nearby EPA stations during the same time period, indicating project works (or nearby works) are the likely cause. Wind direction was predominantly ESE over the investigated time period. Unlikely that works in the hardstand area would be the cause – but there may be some contribution if the access track to the east of the monitor is being used.	Email sent to C Soleman informing of investigation and likely influence of site works. C Soleman onsite from 10:15 to 11:30, reporting low levels of dust on site, with minor stir ups from haulage trucks and observed use of water carts.	A Schmidt	05.02.2026	See 05.02.26 tab
4	PM10 level 1 exceedance of 74 ug/m3 (1 hour) from 6am-8am, with a peak value of 105.8 ug/m3 (1 hour). 2 alerts received 8.15 and 9.15am 11/2/26	6-8am on 11 Feb 2026	Logged into Acoem Acloud system to assess concentrations, wind speed and wind direction during the time leading up to the alerts. Checked Vic EPA AirWatch PM10 concentrations at nearby stations (Footscray, Brooklyn and Kingsville) to determine whether concentrations are localised or regional.	Elevated concentrations experienced at Sunshine between 6 and 8 am, peaking at 6 am. Elevated concentrations not experienced at Footscray or Kingsville, but elevated at Brooklyn from 7-9am. Wind direction was north westerly, indicating that site works are likely contributing to concentrations.	Email sent to C Soleman informing of investigation and possible influence of site works. C Soleman confirmed that site works did not commence until after 7.30am, indicating that works are not the cause of elevated concentrations.	A Schmidt	11.02.2026	See 11.02.26 tab

Methodology



1. Dust tolerance levels

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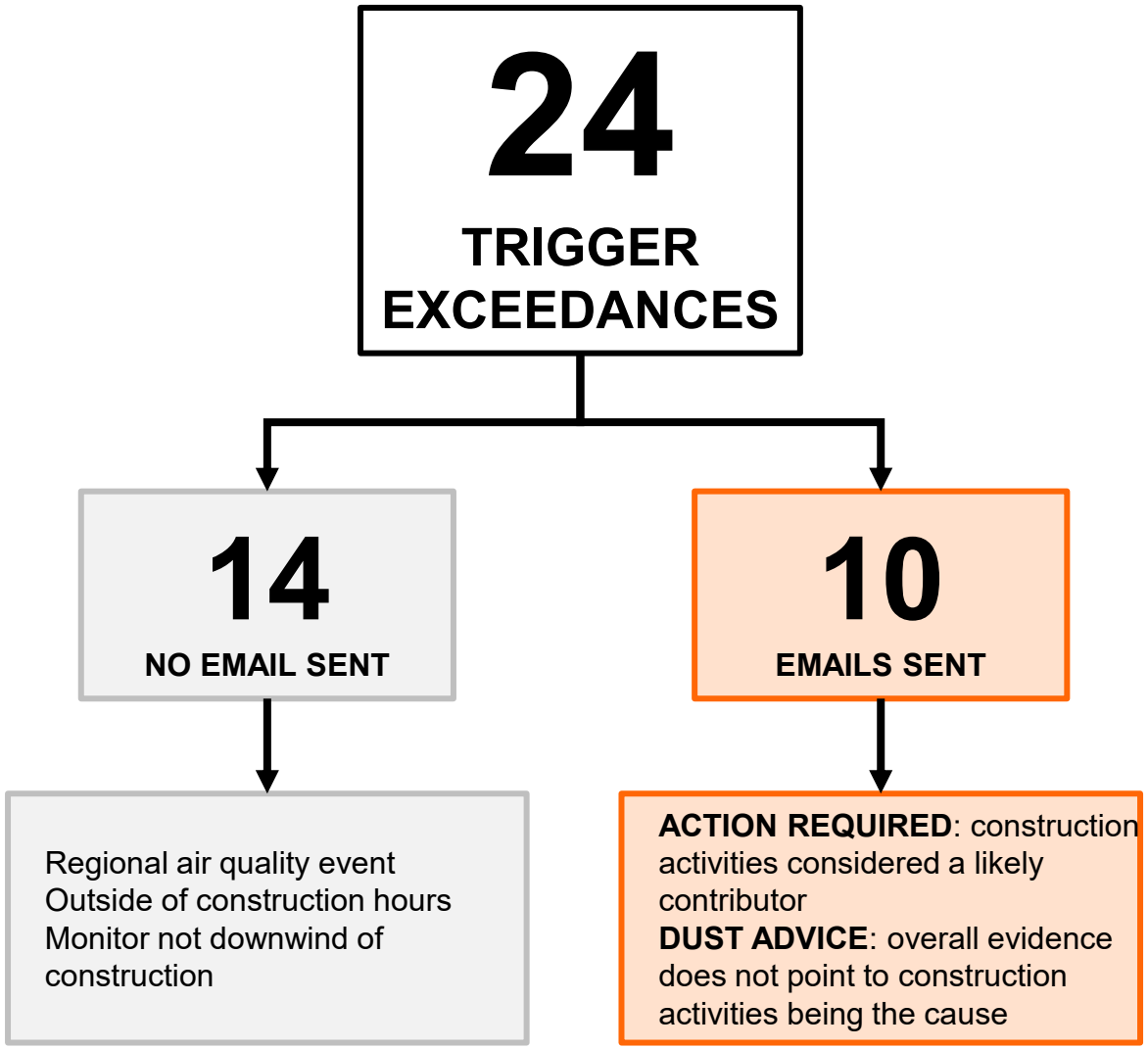
Outcomes – construction interface



RESPONSE TIME STATISTICS	
Number of emails	10
Action required	8
Dust advice	2
Average response time	34 min
Minimum response time	6 min
Maximum response time	79 mins*

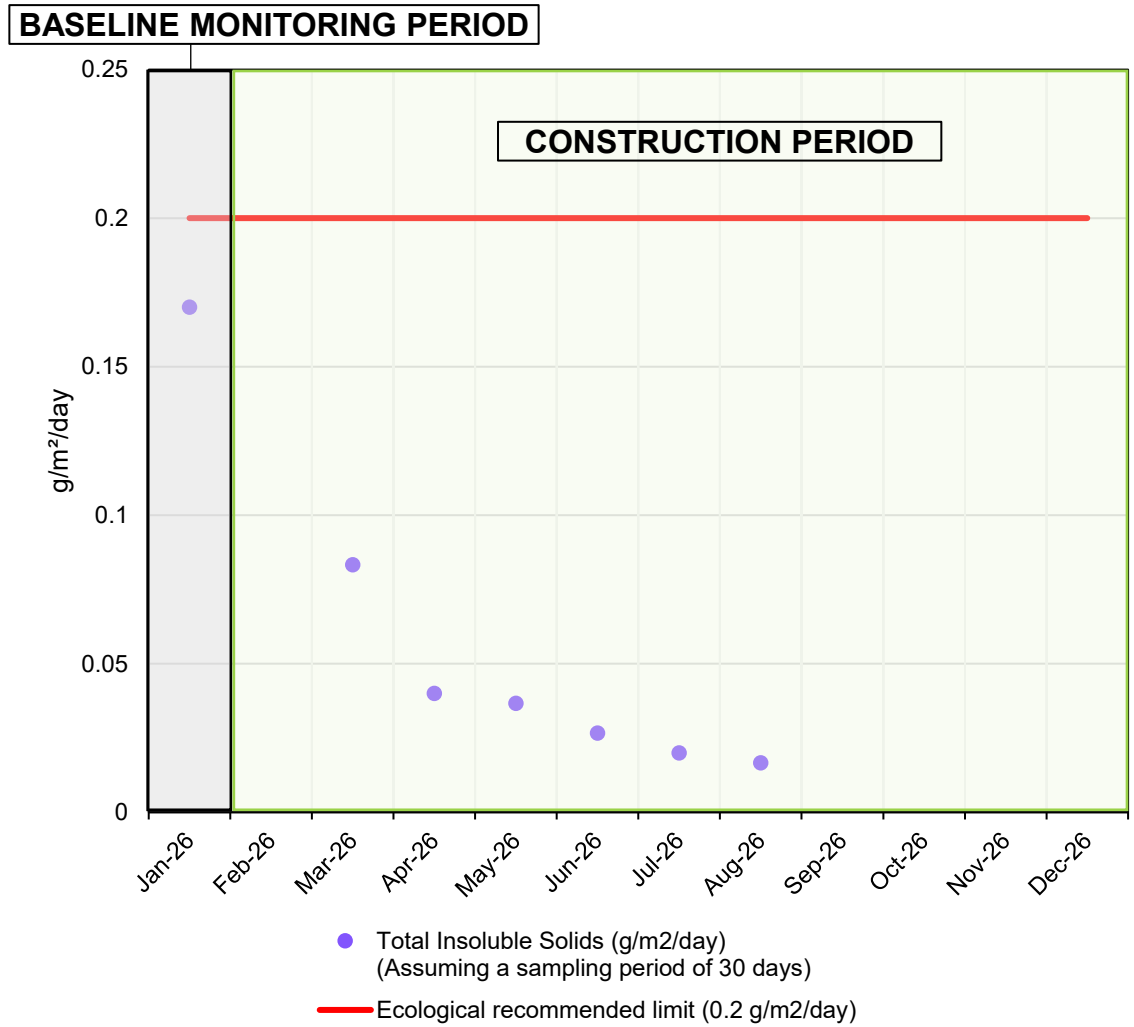
*Environmental Manager was on site doing a site walk over when email was sent

CONSTRUCTION OUTCOMES

Prompt site verification: Site inspections and dust checks confirmed site conditions and control effectiveness.
Additional suppression implemented: Water carts, manual hosing and water spraying deployed where required.
Proportionate response: No further action where controls were effective, no visible dust was observed, or construction was not contributing.

Outcomes – monitoring performance

- Monthly reviews assessed dust deposition trends, trigger exceedances, meteorological conditions and the effectiveness of BAU controls and TARP responses.
- All construction period dust deposition results remained below the 0.2 g/m²/day ecological benchmark
- The highest result (0.17 g/m²/day) occurred during baseline monitoring, prior to construction commencing, and was likely influenced by regional bushfire activity.
- Reviews confirmed that the dust management framework remained effective, with no changes to trigger values or response actions required during the monitoring period.



Outcomes – ecological receptors

- Monthly ecological inspections undertaken throughout construction.
- No observable decline in ecological condition attributable to construction dust.
- Condition of threatened flora and associated habitat remained stable throughout the monitoring period.
- Some areas showed ecological improvement over time, although these changes were not necessarily related to dust management.
- No evidence that implementation of the Dust Management Procedure resulted in adverse ecological outcomes.

Conclusions

- Local baseline monitoring, longer term regional data and published evidence were combined to establish site specific dust tolerance levels.
- The DMP and TARP converted these levels into practical responses, progressing from BAU controls to targeted intervention and stopping works where necessary.
- A structured notification pathway linked air quality investigations with timely and proportionate construction responses.
- The approach provides a transferable framework for managing construction dust near sensitive ecological receptors.

References

- Environment Protection Authority Victoria (EPA Victoria) 2021, *Guidance for assessing and minimising air pollution*, Publication 1961.2, EPA Victoria, Melbourne.
- Environment Protection Authority Victoria (EPA Victoria) 2014, *Guidance for assessing nuisance dust*, Publication 1943, EPA Victoria, Melbourne.
- Environment Protection Authority Victoria (EPA Victoria) 2021, *Victorian Environment Reference Standard*, EPA Victoria, Melbourne.
- Farmer, A.M. 1993, 'The effects of dust on vegetation: a review', *Environmental Pollution*, **79**(1):63–75.
- Institute of Air Quality Management (IAQM) 2024, *Guidance on the assessment of dust from demolition and construction*, IAQM, London.
- United States Environmental Protection Agency (U.S. EPA) 1992, *Guidelines for exposure assessment*, EPA/600/Z-92/001, U.S. EPA, Washington, DC.

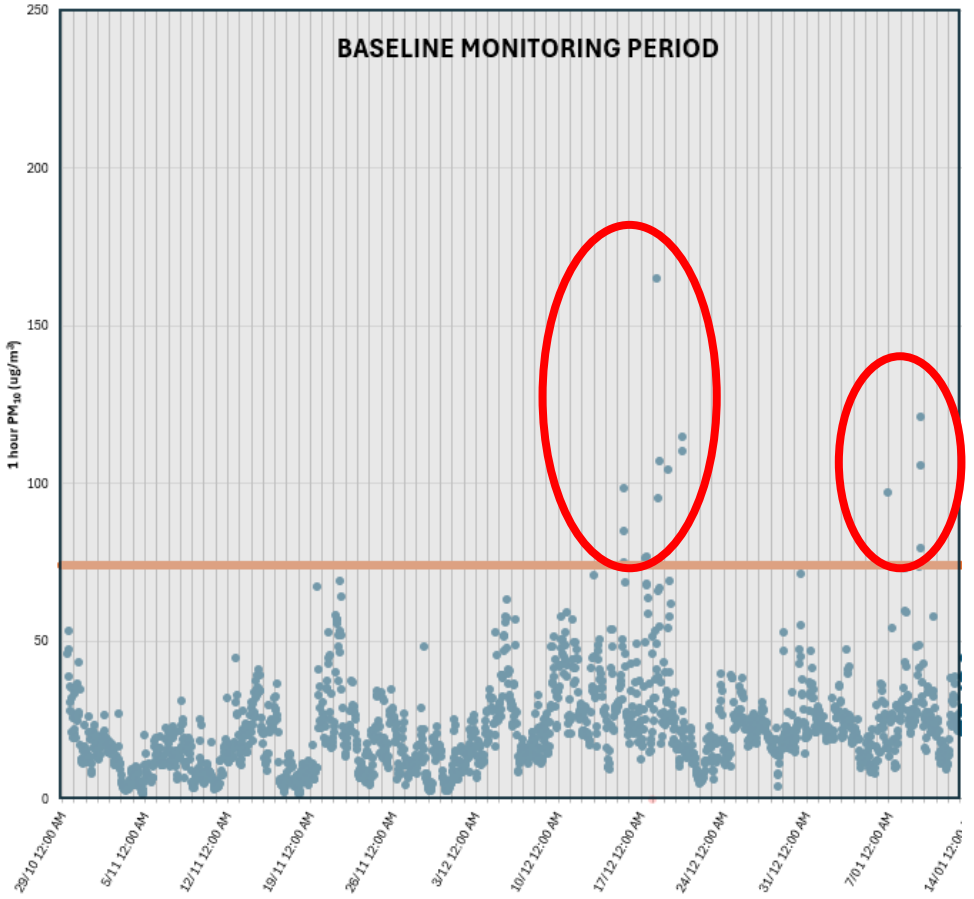
MOTT MACDONALD

THANK YOU

Evaluation of trigger levels

During the baseline period, there were 15 exceedances of the 99th percentile Level 1 trigger for PM_{10} and no exceedances of the Level 1 99th percentile $PM_{2.5}$ trigger. No Level 2 triggers were exceeded.

74 ug/m³ (99th percentile of concentrations measured at EPA Footscray AQMS (2019-2023)



During baseline period:

Hours exceeding PM10 74 ug/m3 (99th percentile)

15/12/2025 13:00	
15/12/2025 14:00	
15/12/2025 15:00	
17/12/2025 11:00	
17/12/2025 13:00	
18/12/2025 9:00	
18/12/2025 11:00	
18/12/2025 14:00	
19/12/2025 8:00	
20/12/2025 12:00	
20/12/2025 13:00	
7/01/2026 0:00	Bushfires
9/01/2026 16:00	Bushfires
9/01/2026 17:00	Bushfires
9/01/2026 18:00	Bushfires

ID	Date	Alert type	Outcome	Response recorded?	Response time (minutes)	Notes
1	3-Feb-26	Action required	Site contacted, hose and water cart deployed	Yes	13	
2	4-Feb-26	Action required	Site inspected, water cart confirmed	Yes	23	
3	5-Feb-26	Action required	Site inspection completed, dust controls already in place	Yes	79	Environmental Manager was on site doing a site walk over when email was sent
4	11-Feb-26	Action required	Site confirmed works had not commenced during exceedance period	Yes	13	min
6	24-Feb-26	Dust advice	Site supervisor contacted, water spraying commenced	Yes	34	min
13	16-Apr-26	Dust advice	Watercart spraying and manual hosing	Yes	49	min
15	24-Apr-26	Action required	Site requested to check visible dust and implement controls	Yes	23	min
16	28-Apr-26	Action required	Site checked, no visible dust, no further action required	Yes	37	min
20	12-May-26	Action required	Additional water suppression measures implemented	Yes	6	min
23	9-Jul-26	Action required	Dust controls implemented and water cart deployed	Yes	59	min