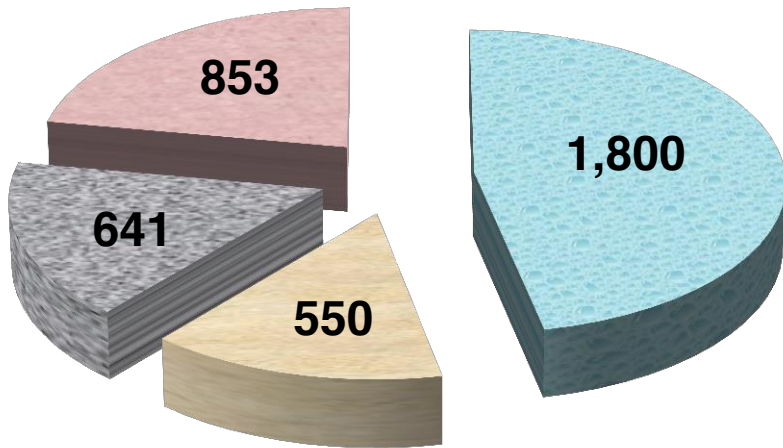


Impacts of dust from unsealed roads



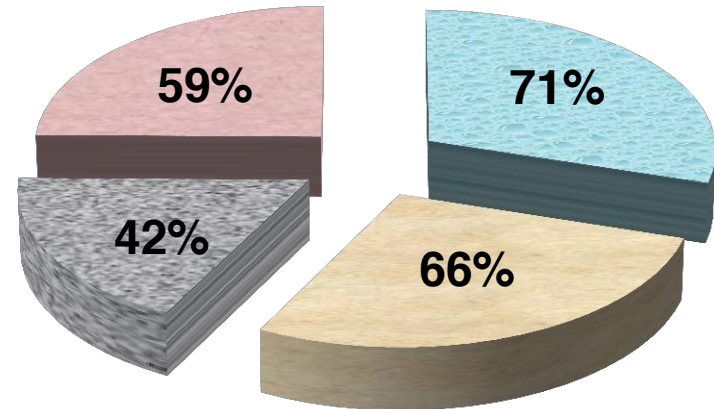
Context – The Unsealed Environment

Unsealed Roads (km)



- Far North District Council
- Wairoa District Council
- Marlborough District Council
- Hurunui District Council

Percent of Roads that are Unsealed



- Far North District Council
- Wairoa District Council
- Marlborough District Council
- Hurunui District Council



Dust from Unsealed Roads ?

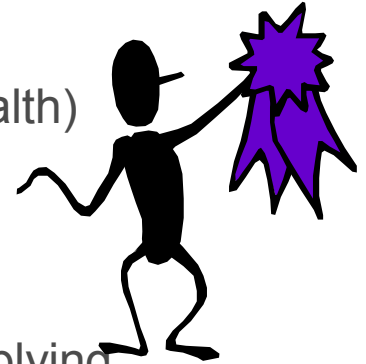
- What are the **RISKS** ?
- What are the options for **MITIGATION** ?
- What is the **BENEFIT/COST** of mitigations ?





Acknowledgements

- **NZTA:** Funding – Research project TAR14/31.
- **Project Steering Group:** Rob Hannaby (NZTA), Jon Cunliffe (Marlborough District Council), Frances Graham (Ministry for Health) Greg Haldane (NZTA) and Iain McGlinchy (Ministry of Transport)
- **Far North District Council:** for hosting the dust monitoring programme.
- **Transfield Services:** (Mike Grimshaw, Far North Branch) for applying the dust suppressant.
- **Air Quality Limited:** (Mark Bart and Paul Baynham) For commissioning and operation of the equipment and processing the monitoring data.
- **Dust Control Solutions:** (Anthony Stewart) for advice on dust suppressant type and for supplying the dust suppressant.
- **Equipment hosts:** Kaingahoa Marae (Jane Whiu), Tasha Whiu, Doug Boyd, Colin Pinkney for hosting the monitoring equipment on their Mataraua Road properties.
- **Northland Regional Council:** for assistance with clarifying the activity status of applying the dust suppressant





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Research objectives

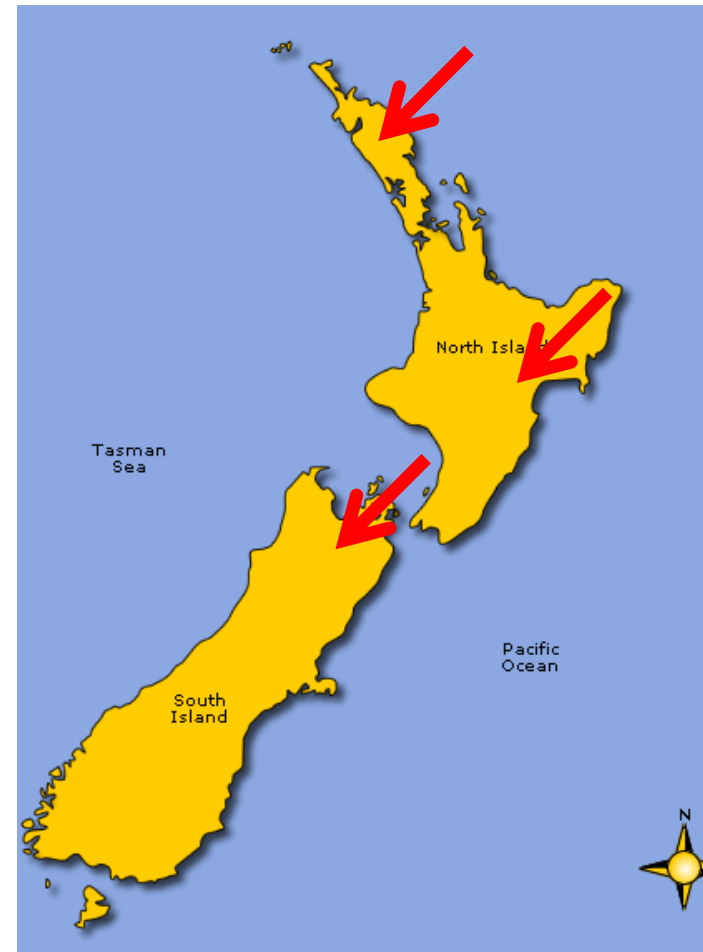
1. Describe and quantify the impacts of dust exposure from unsealed roads
2. Collect new data to characterise the dust and quantify the impacts of dust
3. Investigate dust mitigation measures.
4. Estimate the costs of the health impacts and the benefits of mitigating the dust
5. Tools to support decision making about mitigation options.





Monitoring Site Selection: Phase 1

- Unsealed roads trafficked by reasonably high volumes of vehicles including a significant number of heavy duty vehicles.
- A Territorial Local Authority (TLA) that was prepared to act as a host by assisting with site selection, provision of traffic data, and providing support with the logistics of monitoring.
- Be within a region that allowed the application of dust suppressants on unsealed roads.





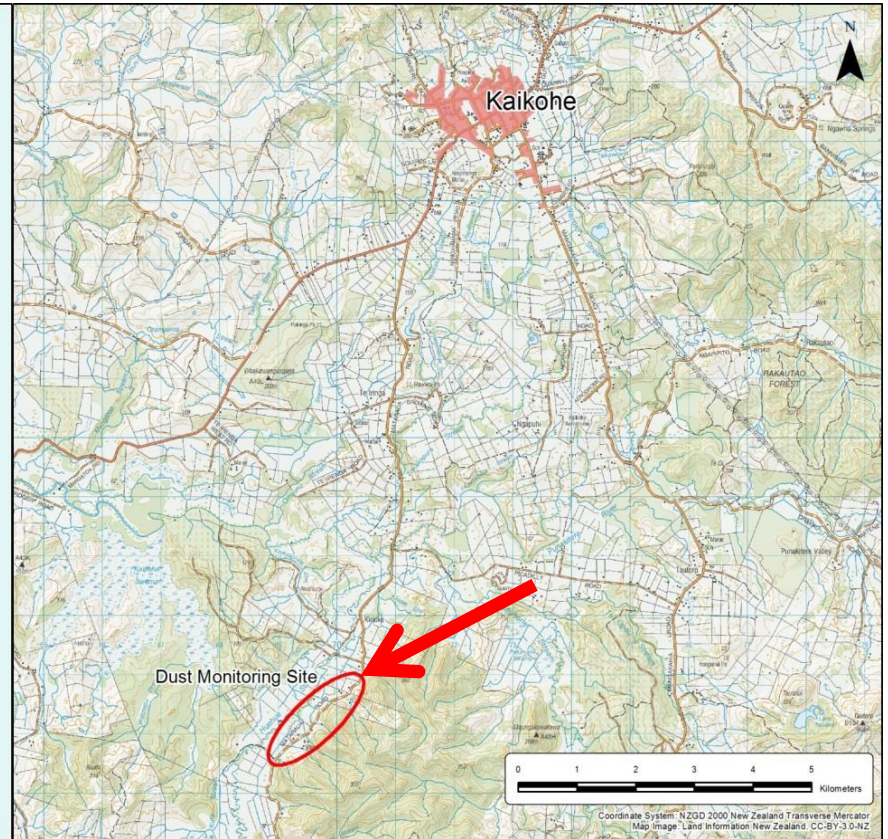
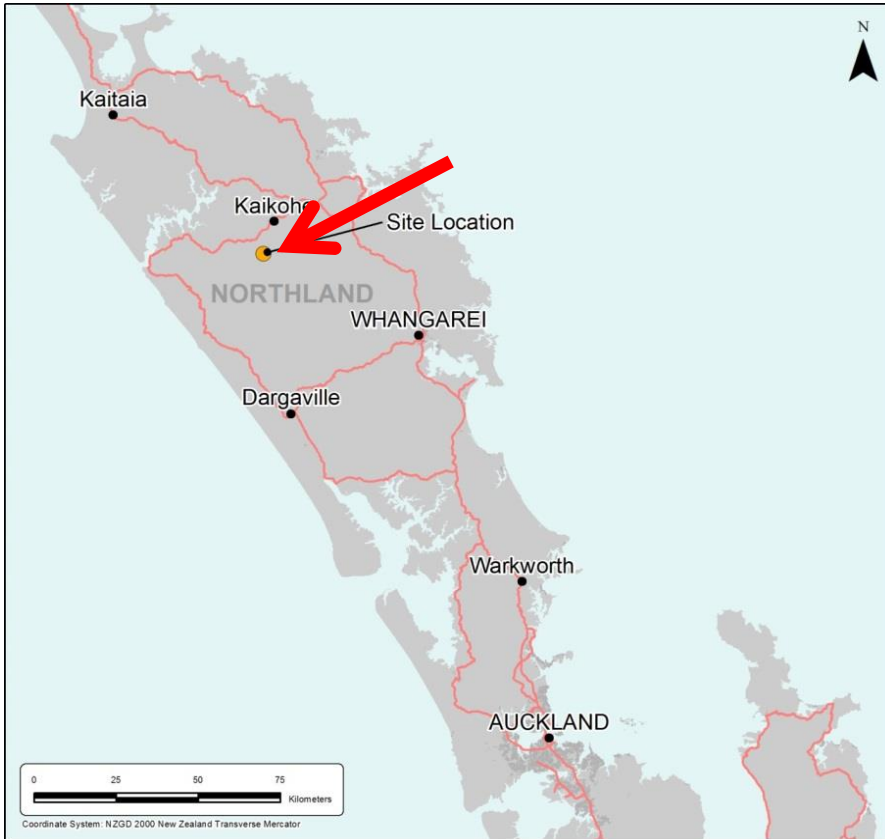
Monitoring Site Location: Phase 2

- **Number and type of vehicles** passing the site each day
 - Number of **nearby dwellings**
 - **Topography and meteorology** (maximum frequency of cross-road winds).
 - **Cell phone coverage** (ability to telemeter the data from site).
 - **Suitable locations to install equipment** on roadside (requires permission from private land owners).
 - **Power supply available** for equipment (solar powered equipment more expensive to install and problematic to run).
- Potential sites in the Far North District
 - Ngapipito Road
 - Pipiwai Road
 - Mataraua Road
 - Piccadilly Road



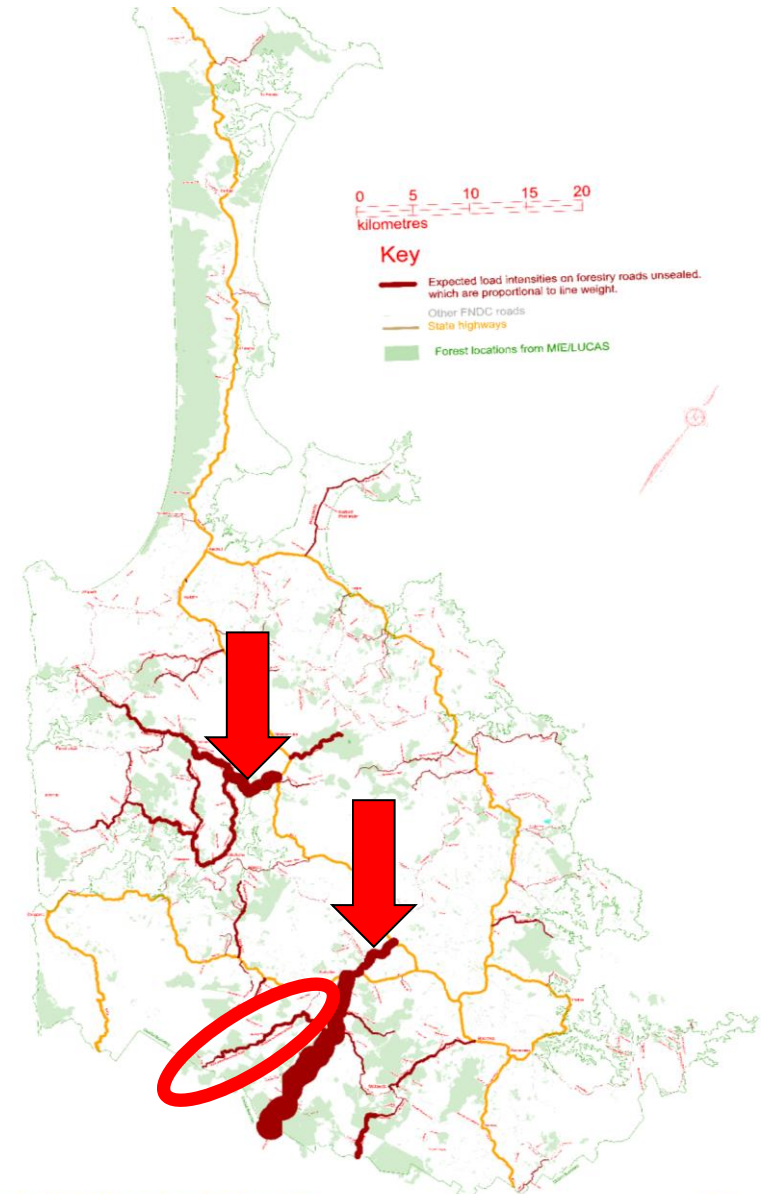


Monitoring Site Location



Site geology, roadway construction and traffic

- Base geological material is **sedimentary rock**
- The **design and construction** is **typical of other unsealed roads** within the Northland Region.
- The **maintenance schedule** is **typical** of other unsealed roads in the FNDC.
- **Metal** used to cover the road bases in Northland **varies from road to road** with metals being supplied from close by sources.
- Logging **truck numbers** are **relatively high**





Monitoring equipment – Meteorology



December 2, 2015



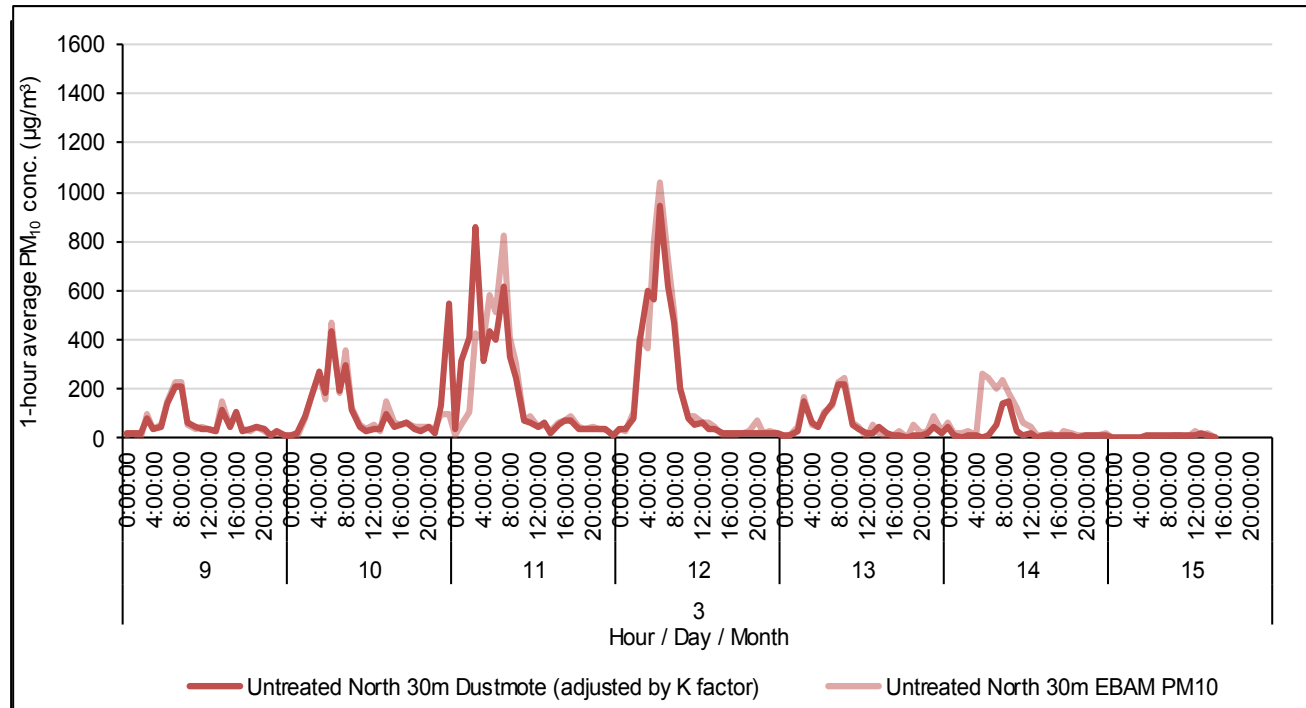
Monitoring equipment - Dust





Dust monitoring was not NES compliant

- NES compliant monitoring
 - BAM
- Campaign monitoring
 - Dust Mote
- Dust mote data is
 - **NOT** NES compliant
 - Converted to BAM equivalent
 - Good indicative data
 - Fit for the purpose of this project



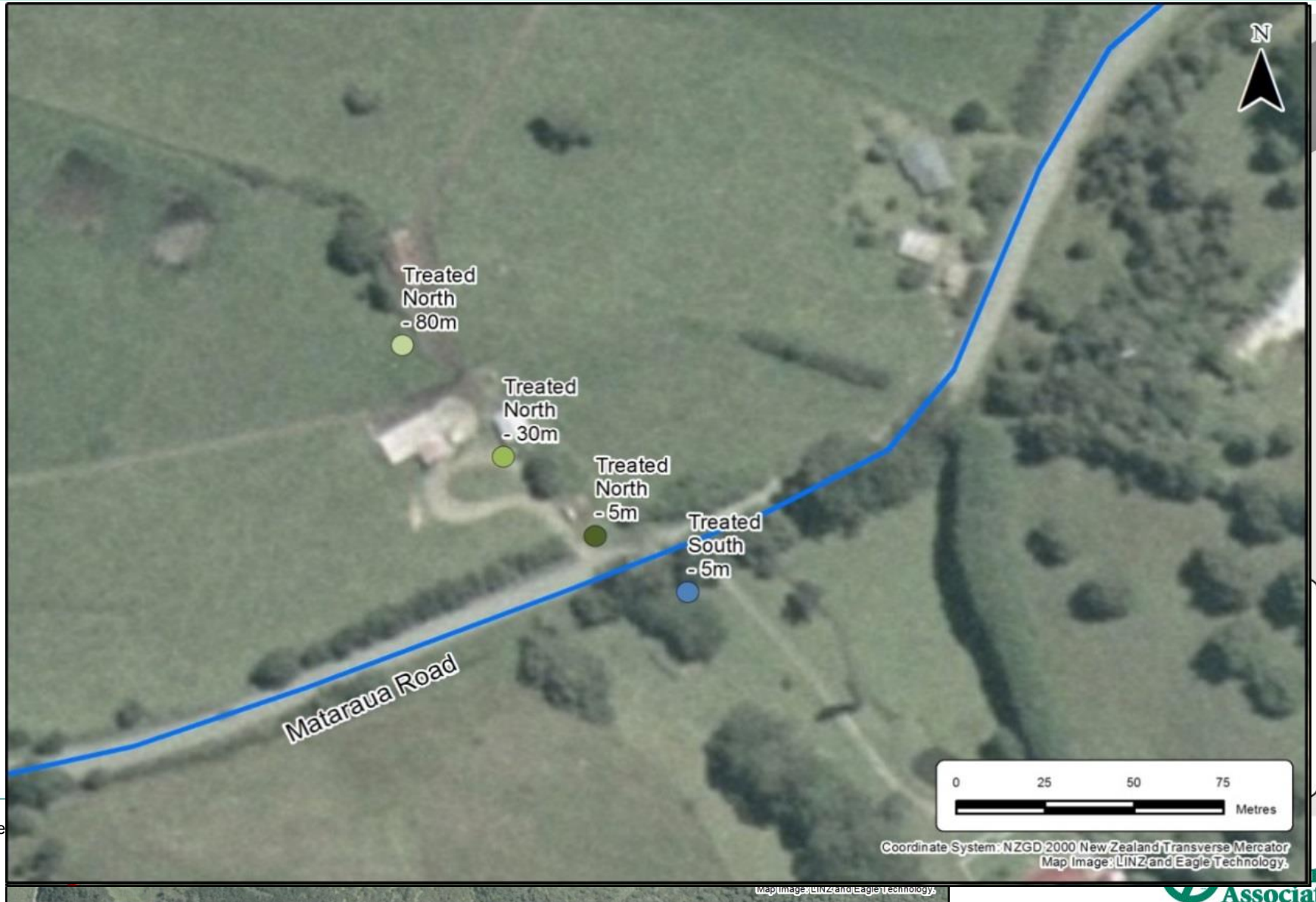


Dust Suppression





Monitoring site layout and equipment network



Dece

Map Image: LINZ and Eagle Technology



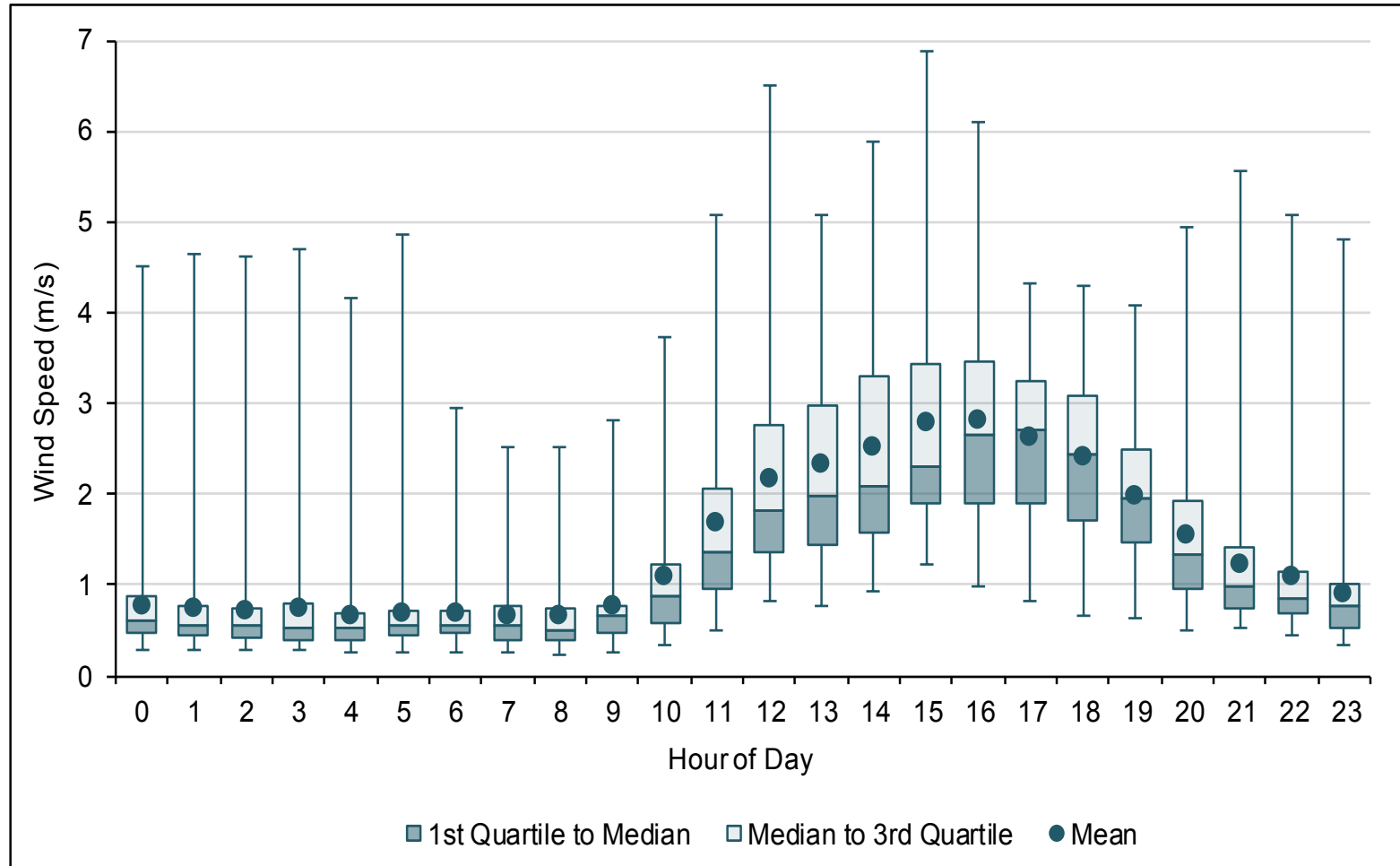
Limitation on results presented

- Results presented:
 - Have not fully completed the peer review process
 - Are subject to change
- Results will be finalised when the NZTA report is published.



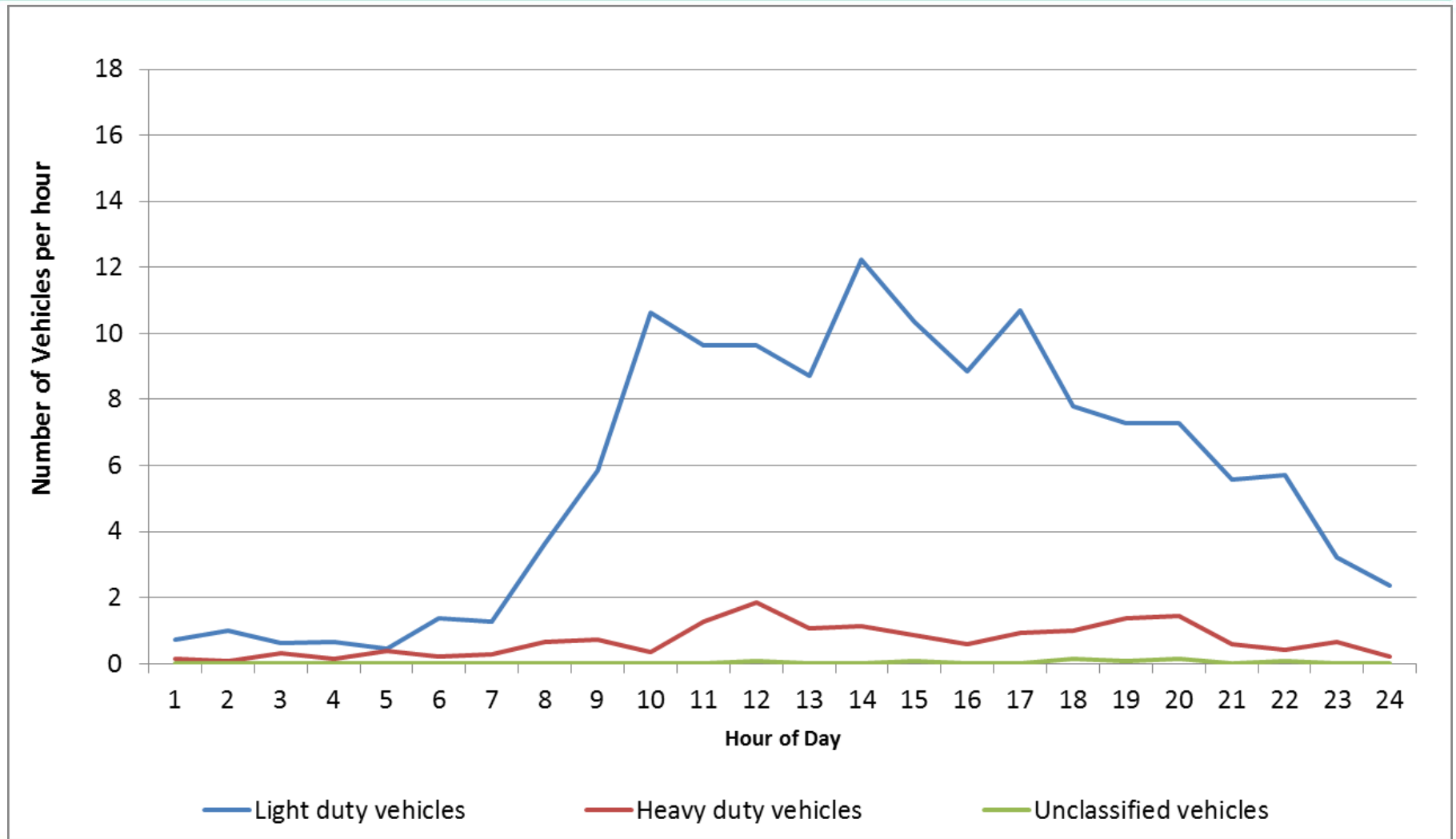


Meteorology of the site





Vehicle movements





Total suspended particulates and PM₁₀

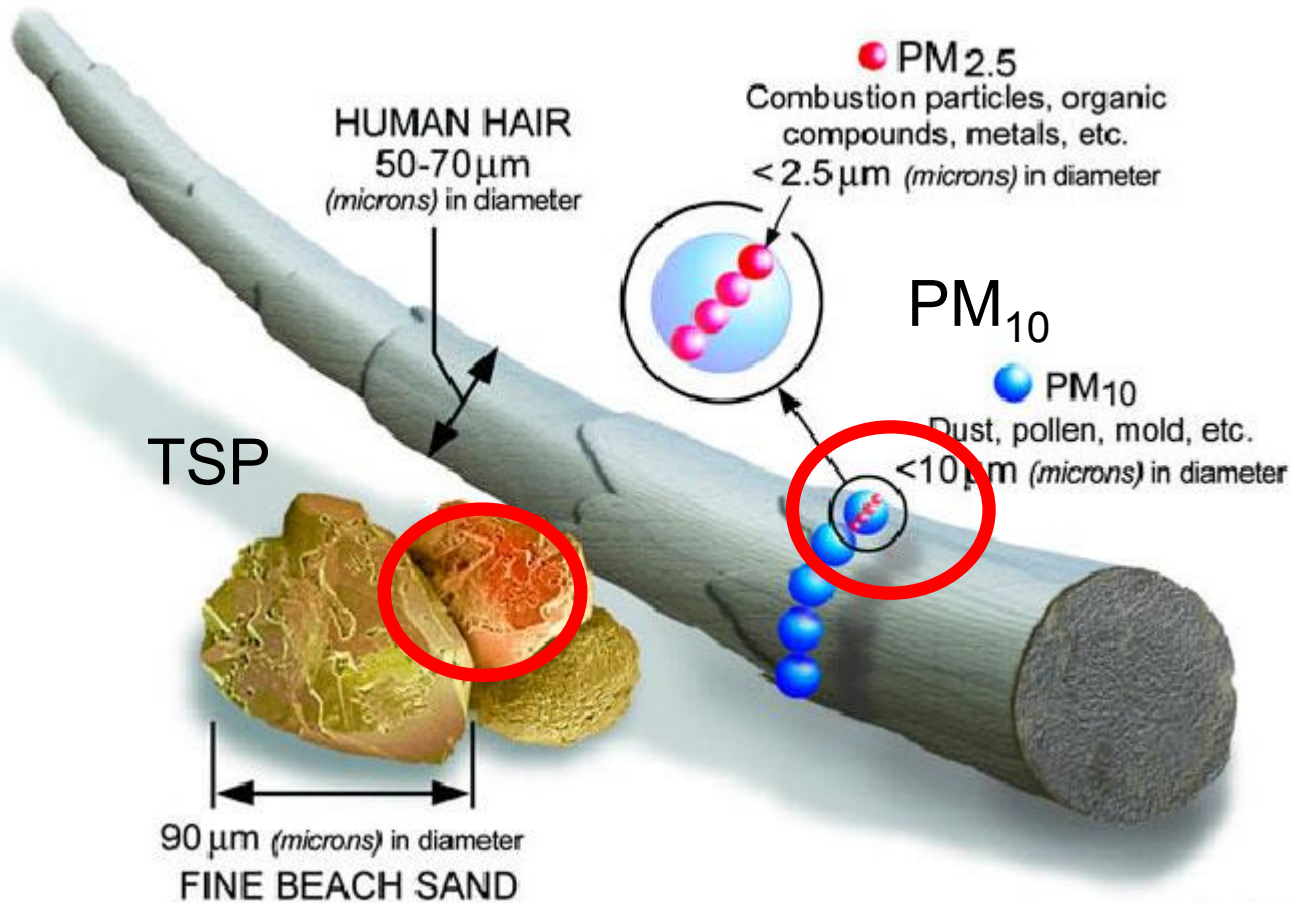
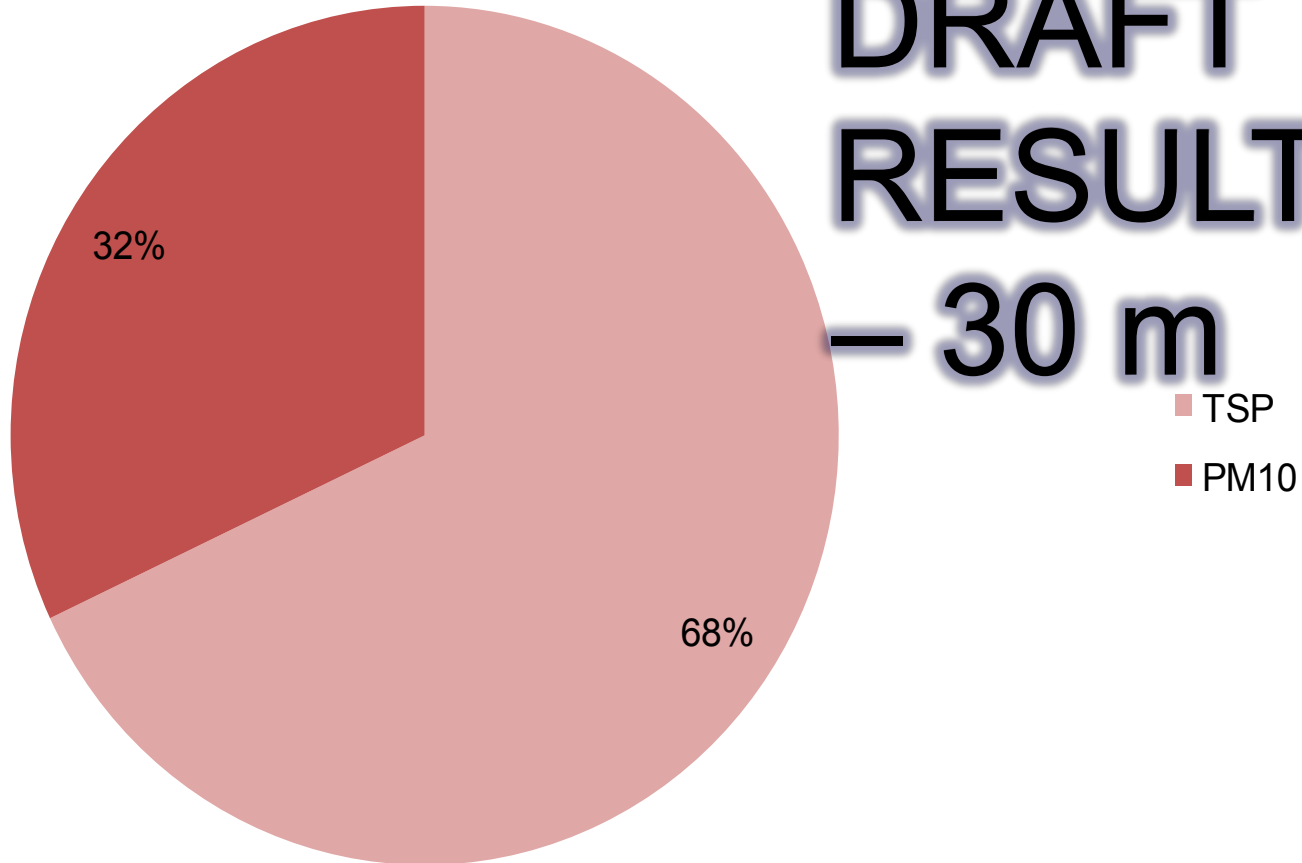


Image courtesy of the U.S. EPA



Total suspended particulates and PM₁₀

**DRAFT
RESULT -
- 30 m**





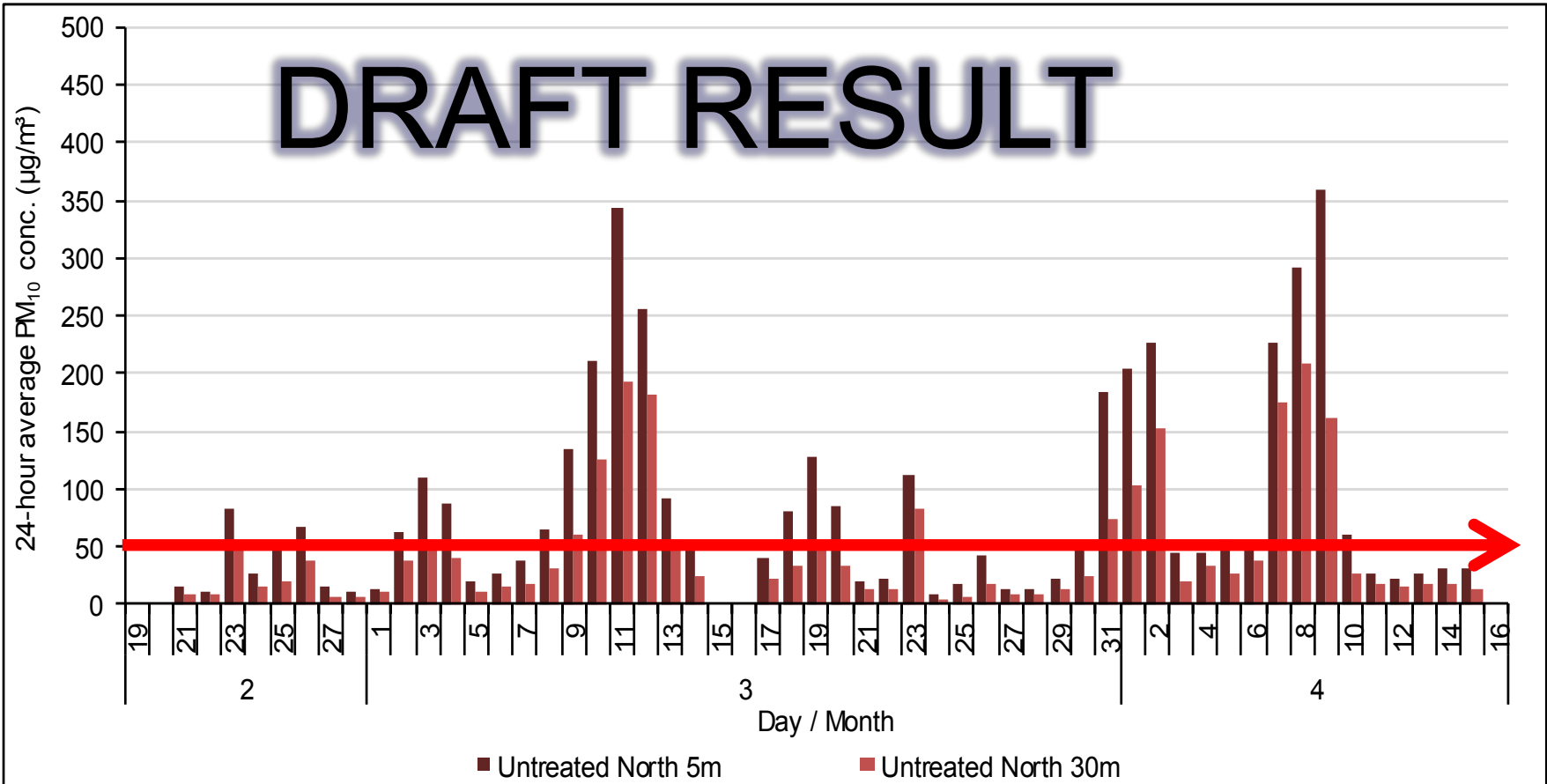
Untreated section of road





PM₁₀ concentrations - untreated

DRAFT RESULT





PM₁₀ concentrations - untreated

Table 4-1 Summary statistics for daily average PM₁₀ monitoring - untreated section of the road

Site	Number of days with data	Number of days with PM ₁₀ concs. >50 µgm ⁻³	Campaign average PM ₁₀ conc. (µgm ⁻³)
Untreated north - 5 m	52	25	83
Untreated north - 30 m	52	15	47
Untreated south - 5 m	45	19	101

- Non-NES compliant monitoring method
 - Results indicative rather than definitive
- PM₁₀ NES exceeded one day in two on the non-treated section of the road at the roadside
- PM₁₀ NES exceeded on one day in three the non-treated section of the road at typical exposure locations

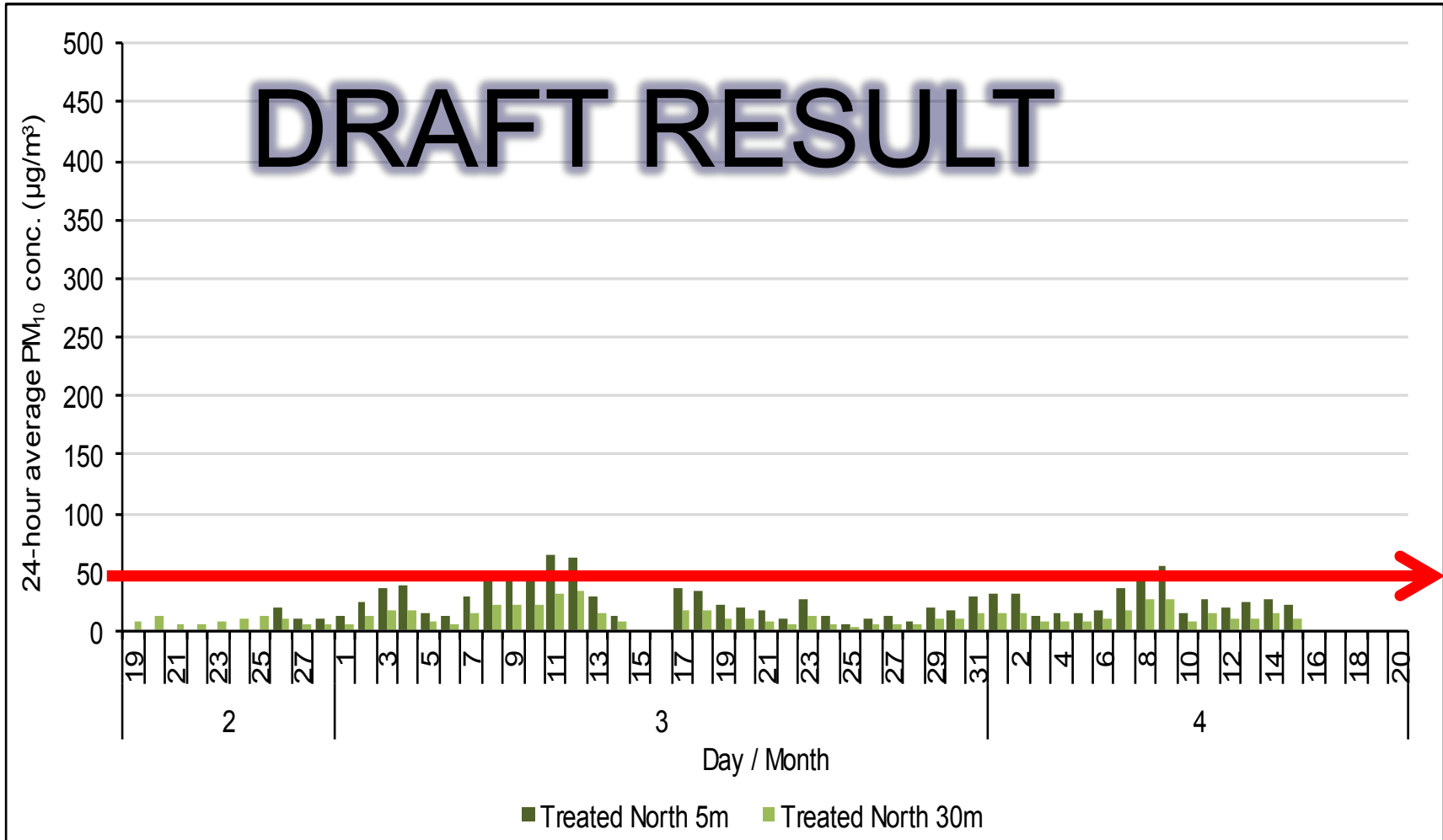


Treated section of road





PM₁₀ NES Concentrations - treated





PM₁₀ concentrations - treated

Table 4-2 Summary statistics for daily average PM₁₀ monitoring - treated section of the road

Site	Number of days with data	Number of days with PM ₁₀ concs. >50 µgm ⁻³	Campaign average PM ₁₀ conc. (µgm ⁻³)
Treated north - 5 m	47	3	24
Treated north -30 m	55	0	12
Treated south - 5 m	47	4	26

- Non-NES compliant monitoring method
 - Results indicative rather than definitive
- PM₁₀ NES were exceeded at the roadside of the treated section of the road infrequently, one day in 15
- PM₁₀ NES is not exceeded on the non-treated section of the road at typical exposure locations



Extent of dust plume impact – Background PM₁₀

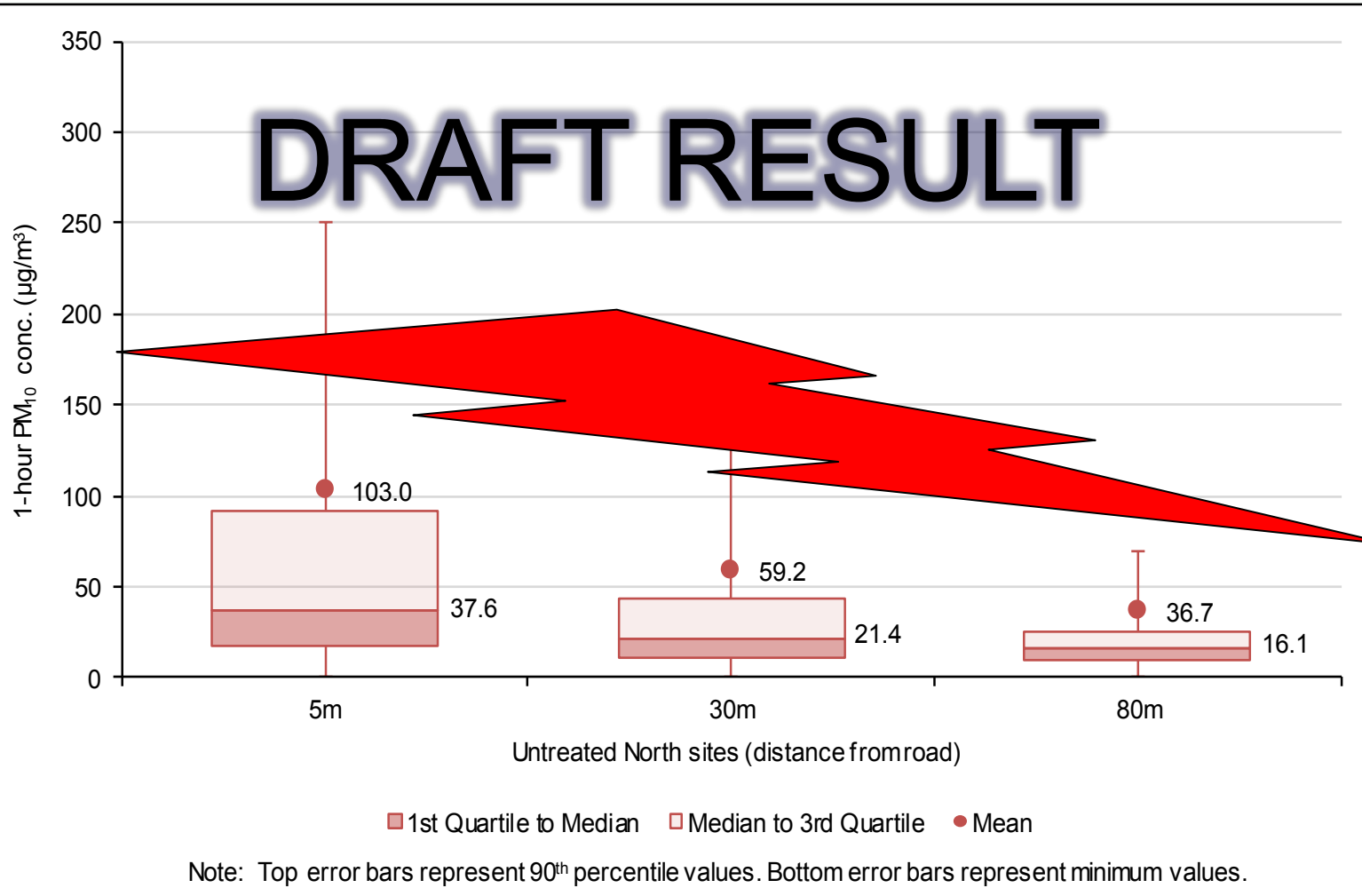
DRAFT RESULT





Extent of dust plume impact - Untreated

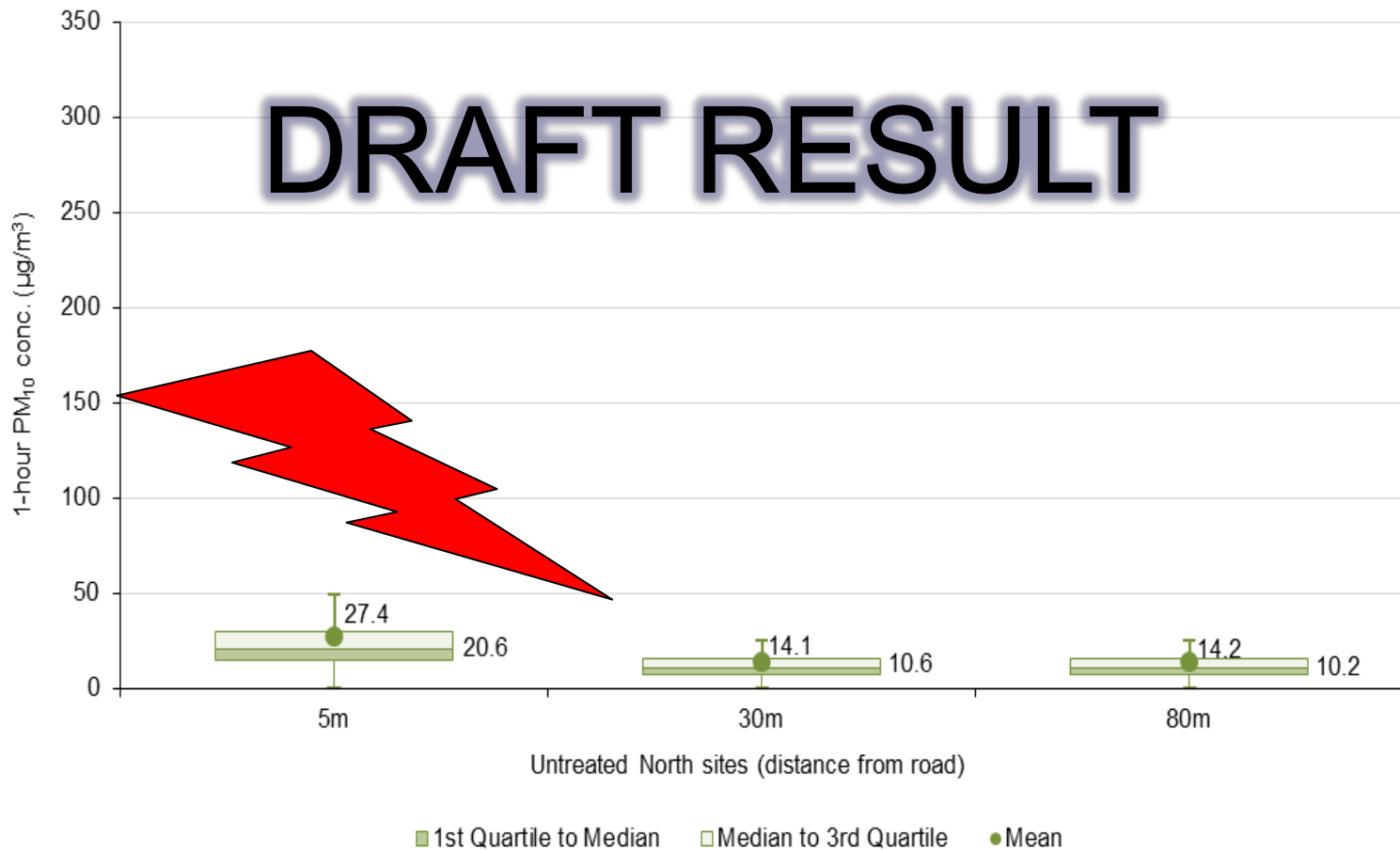
DRAFT RESULT





Extent of dust plume impact - treated

DRAFT RESULT



Note: Top error bars represent 90th percentile values. Bottom error bars represent minimum values.



Vehicle speed as a dust mitigation measure

DUST NUISANCE
PLEASE DRIVE SLOWLY

Table 4-3 Comparison of vehicle speeds for period of 20 and 50 km speed limits

Vehicle Speed categories (km/hr)	Percentage of Vehicles in each category	Percentage of Vehicles in each category	Percentage increase (+) or decrease (-) in last 2 weeks
	Average first 6 weeks	Average last 2 weeks	
0-30	16.9%	17.2%	0.37%
31-40	15.6%	15.0%	-0.60%
41-50	29.9%	28.4%	-1.44%
51-60	26.4%	26.9%	0.49%
61-65	5.7%	6.9%	1.15%



Dust deposition

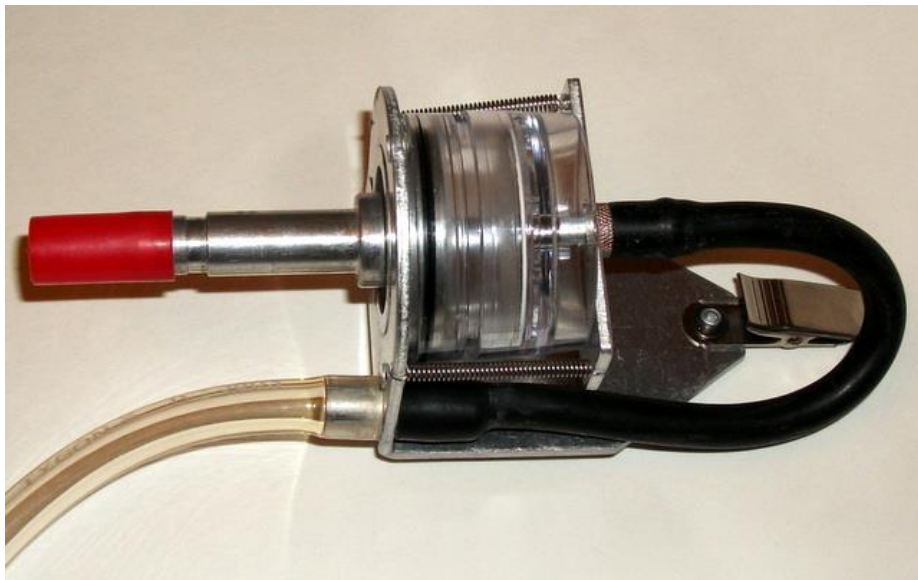


- Deposited dust adjacent to the untreated section of the road was **much higher** than the MfE trigger level of 4 g/m²/30 days
- A large variation was observed in the two results from the untreated section of the road (12 to 48 g/m²/month)
- The deposited dust adjacent to the treated section of the road was **no greater than background levels** and consistent over both measurement periods

Respirable silica

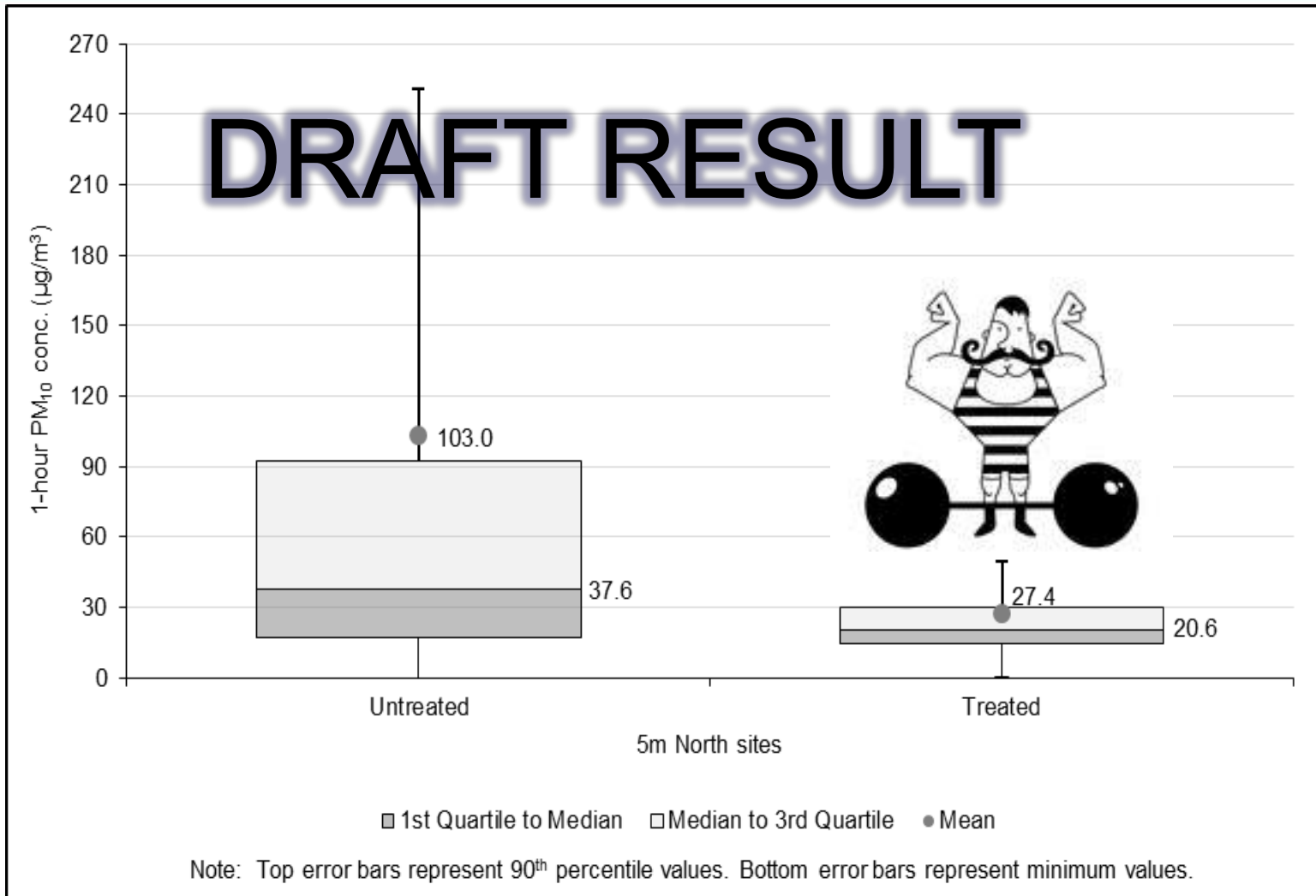
- Potentially hazardous components of road dust
- Sampling undertaken at untreated, north 5 m site
- Simple pump and filter set up

- Mass of respirable silica were below the detection limit
- Preliminary conclusion - residents of Mataraua Road are unlikely to be exposed to annual average concentrations of greater than $5 \mu\text{g}/\text{m}^3$.
- To confirm this conclusion, a more detailed monitoring programme of longer duration would be required.



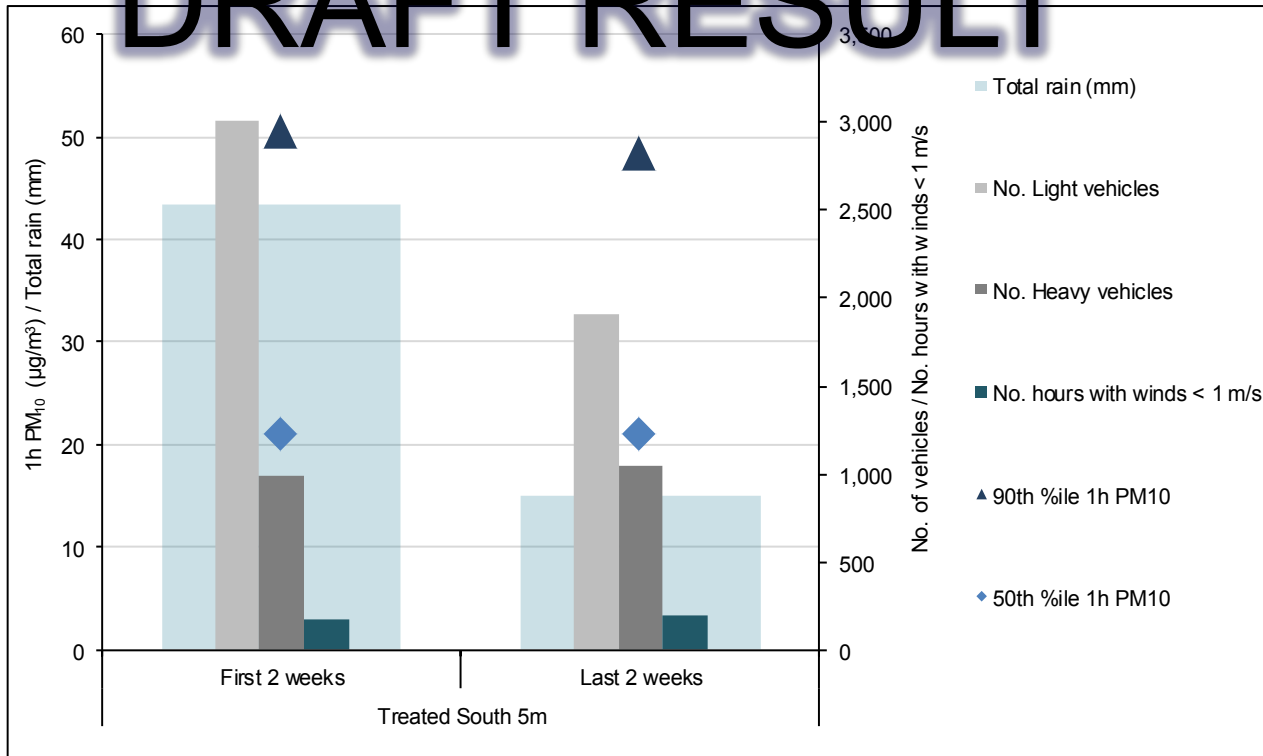


Dust mitigation 1: Effectiveness of dust mitigation



Dust mitigation 2: Longevity of dust mitigation

DRAFT RESULT



- No sign of reduced effectiveness of suppressant over the life of the monitoring programme.
- Qualitative assessment (multivariate statistics could be employed)



Method to Assess health impacts of changes in PM₁₀ concentrations

- Assess annual PM₁₀ exposure (Mataraua Road data)
 - Untreated road (Baseline)
 - Treated road
 - Sealed road
- Calculate the health cost of dust exposure (HAPINZ)
 - Untreated road (Baseline)
 - Treated road
 - Sealed road
- Calculate the health benefits of mitigation
 - Baseline cost - Treated road cost
 - Baseline cost - Sealed Road cost







Calculating the costs of mitigation

- Baseline (untreated an unsealed road)
 - Maintenance (grading and metal)
- Treated road
 - Chemical suppressant
 - Maintenance (grading and metal)
- Sealed road
 - Sealing
 - Maintenance





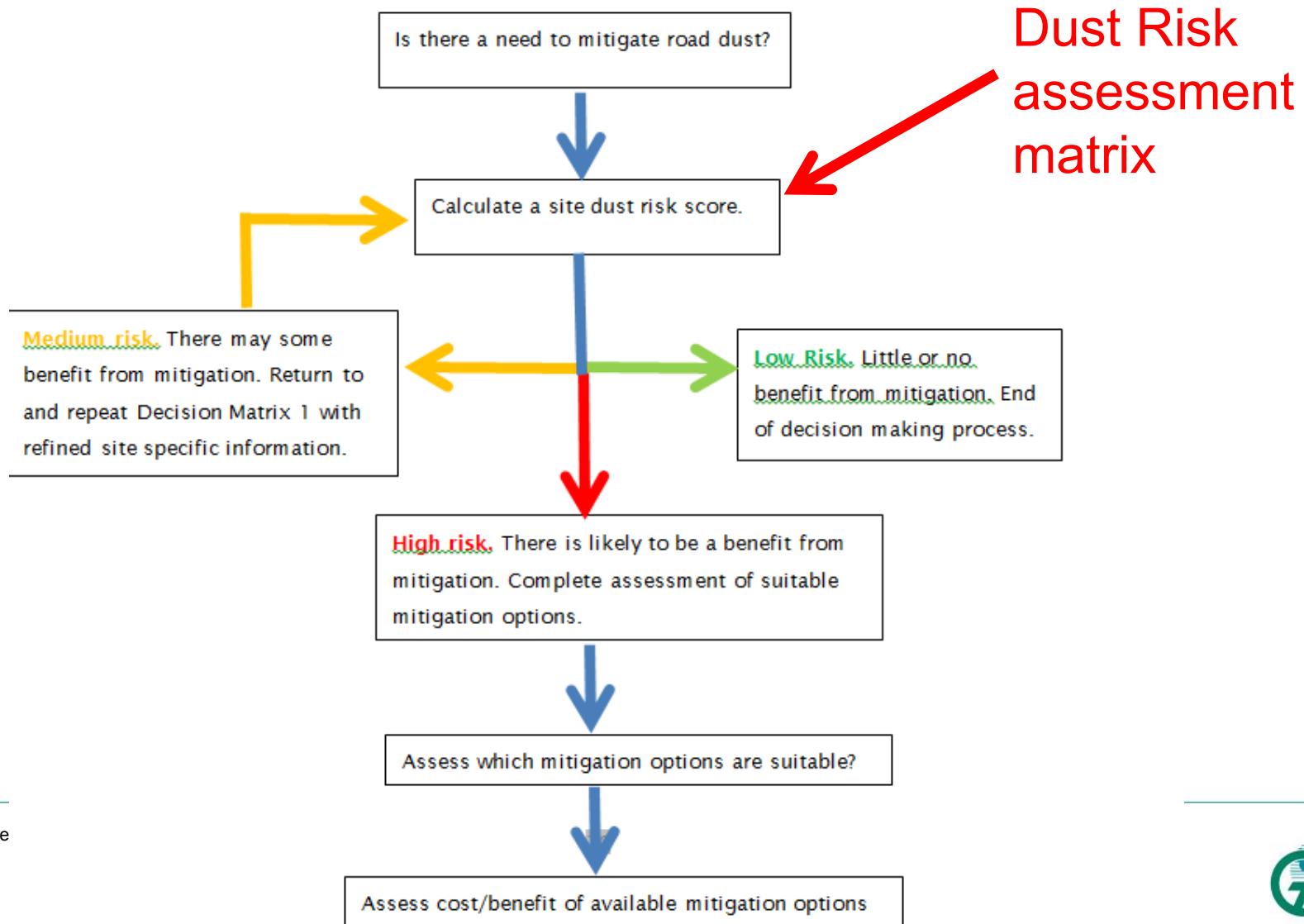
Benefit to cost to ratio of dust mitigation

Scenario	Annual average PM ₁₀ conc. (µg/m ³)	Total annual health cost of PM ₁₀	Annual health benefit of PM ₁₀ mitigation	Annual cost of mitigation	Annual benefit to cost to ratio
Road treated with chemical suppressant				 <small>shutterstock - 65916643</small>	TBC
Sealed road surface (40 year life)					TBC
Sealed road surface (10 year life)					TBC



Dust mitigation - decision making process

Figure 7-1 Dust mitigation - decision making process





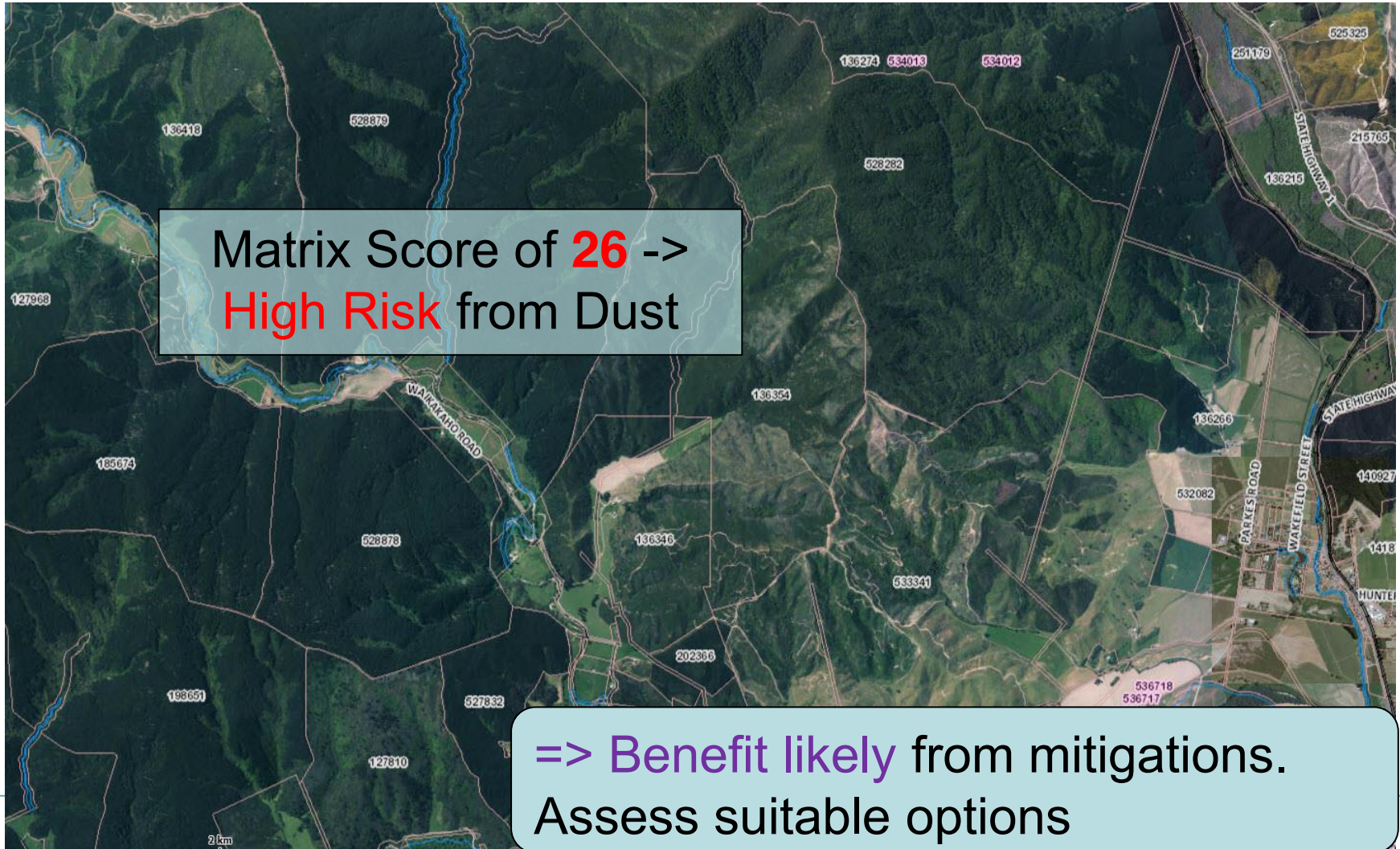
Example – Dust Risk Assessment Matrix



Risk Factor/Score	0	1	2	3	4	Waikakaho Valley	
5 day AADT of HDVs	Less than 5	05-Oct	Oct-25	25-50	More than 50	60	4
Longevity of logging route use	Not a logging route	1 year or less	2 years or less	3 years or less	Longer than 3 years	1	1
Speed of HDVs				20 km/hr limit	50 km/hr limit or greater	30	3
Number of dwellings within 80 m of roadway (houses/km)	none	1	02-Apr	05-Aug	More than 8	15	4
AADT of LDVs	Less than 50	50-100	100- 200	200-400	More than 400	60	1
Speed of LDVs		Less than 50 km/hr	50-70 km/hr	Greater than 70 km/hr		70	2
Location of roadway			Open plains or costal area	Some land features likely to slow winds	Inland enclosed valley		4
Frequency of rain days (>5 mm)	More than 3 per week	More than 2 per week	More than 1 per week	Less than once per week	Less than once per month		3
Other locations where people are likely to be exposed. (e.g. schools, marae, or hospitals)	None		1 location	2 locations	3 or more locations		0
Ecologically sensitive areas such as rare species habitats or wetlands	None		1 sensitive areas	2 sensitive areas	3 or more sensitive areas		0
Nuisance effects for residents	No complaints	1 – 2 complaints total	More than 2 complaints per year		More than 6 complaints per year	20	4
Horticultural sensitive areas such as fruit orchards	No		1 sensitive areas	2 sensitive areas	3 or more sensitive areas		0
Total							26



Waikakaho Valley Example - Result





Recent Dust Mitigations in the Waikakaho

- 2014 - carried out prior to this research project
- 2.5 km of road treated
- In response to public concerns
- First water: – 90 days @\$1000/day; \$36,000 per km
- Then Otta Seal: (2.5km) @ \$270,000; \$68,000 per km
- [Suppressant at Mataraua Road: (MgCl₂): \$20,000 per km (pa)]



Recommendations for future investigations

■ Enhancing future monitoring programmes

- Time of year
- Greater use of BAMs to validate dust mote data
- Effect of speed
- Other sites
 - Road type
 - Road Construction
 - Vehicle fleet and numbers
 - Meteorology
- Respirable particulate

■ Additional data analyses

- Refine plume extent
- Investigate the effect of vehicle type (HDV vs LDV), on dust concentrations
- Investigate the effect of meteorology (high and low wind speeds) on dust concentrations
- Effect of rainfall on dust concentrations
- Dust emission factors
- Dust exposure model
- Analysis of video



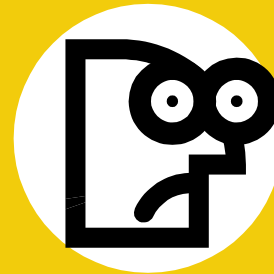
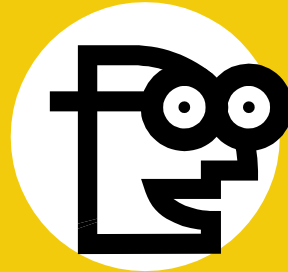
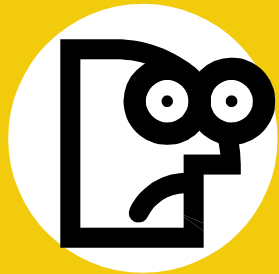
Where to from here?

- Complete the peer review process (end of November)
- Workshops
 - NZ Transport Agency / NZIHT Conference (Paihia 2 Nov)
 - Far North District Stakeholders (Kaikohe 4 Nov)
- Finalise report (before Christmas)
- NZTA publish report – new year





Questions?



It's QUESTION TIME !!