Upper Hunter Mining Dialogue

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Application Form for Consideration of Dialogue Project Proposals

Projects brought to the attention of the Upper Hunter Mining Dialogue's (Dialogue) Joint Advisory Steering Committee (JASC) for consideration will need to provide a detailed description of the project's background, a clear outcome being sought, and the resources required to support the proposal. Please note that the Dialogue will not support any sponsorship proposals seeking monetary support. Any sponsorship proposals are to be directed to the NSW Minerals Council.

Background / Key Issue(s)

Provide a brief description of the project, outlining the key issue or problem to be addressed. Detail how the project relates to the Dialogue's primary objective to address cumulative impacts of mining.

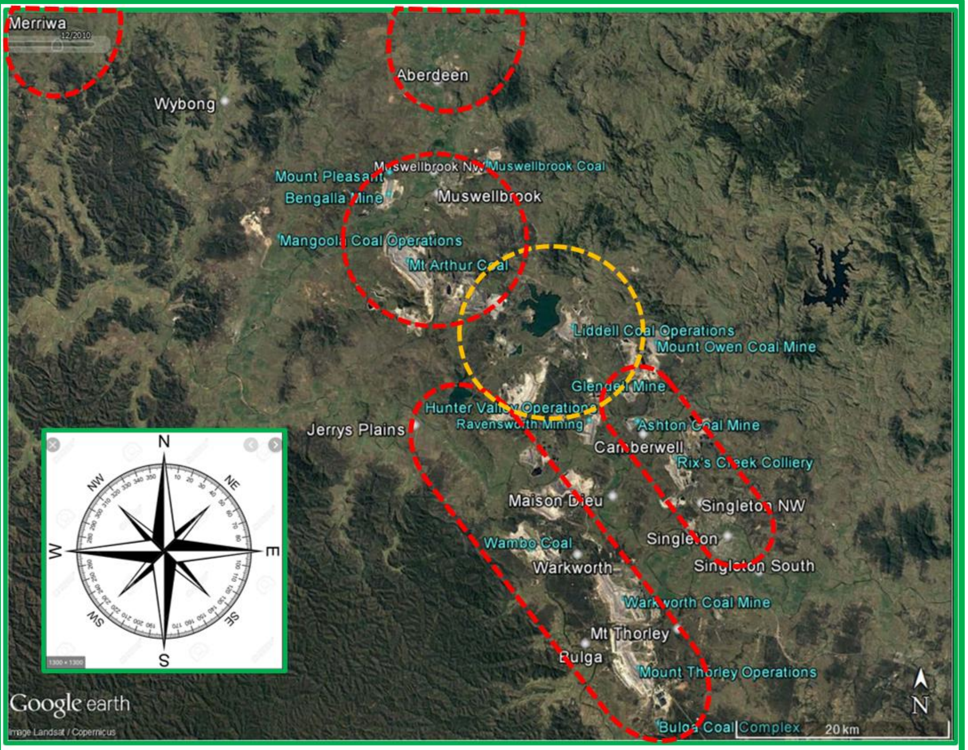
Prepared by Dr Neville Hodkinson PhD Mar- Sept 2019

"Coordinated Coal Mining Air Pollution Mitigation Controls, Options as WHO & NEPM Standards lower in the Hunter".

The focus of this Mining Dialogue// Project is to develop alternate Mining Industry Air Pollution Emission Mitigation Options that can be introduced over and above existing 2019 Mine Operating Practices (Dust Stop, Weather forecasting, Blast size & Stemming, etc) to firstly (Stage 1 by 2020) lower the Air Quality Particulate Matter Exposure experienced especially by Singleton Shire Residents to achieve the Feb 2016 National NEPM(Ambient Air Quality) Standards requirements. https://youtu.be/q4TojwxKVRQ

Secondly (Stage 2 by 2030), to progressively implement Mine Air Pollution Mitigation Protocols for yet further lowering below these 2016 NEPM Australian National Standards to minimum levels as guided by World Health Organisation initiatives since 2013; such as the provision for their further reductions foreshadowed under WHO PM Disease Review since 2016. This is especially so for the emerging Nanoparticle Disease Research of Combustion formed, and Diesel Particulate Exhaust Emissions from mining equipment now confirmed as present penetrating into Human Brains and Organ Tissues. Nano Diesel Particles currently would only be so far included as NEPM PM2.5 reducing goal in 2025. [NEPM - National Environment Protection (Ambient Air Quality) Measure Feb 2016]

This Mining Dialogue Project targets to identify over two Stages, a Suite of Mine Pollution evolving Mitigation Options, preferable targeting Pollution Emission Sources and their *Air Pollution Drifting Patterns and Cumulative Air Pollution Expanse influences* that daily expose Near Neighbour Residents: and thus provide the basis for Pollution Mitigation Strategies that can be progressively incorporated by Hunter Valley Mining Industry Companies over the next 25 Years to catch up with, and achieve the ever reducing and emerging Human Health Air Quality Standards as detailed by the United Nations, WHO and IARC since 2013 for Mortality, Morbidity, and Loss of Life Expectancy. (refer **Figure MD1** below)



2010 & 2016 UHAQMN review Dec 2016, Illustration of the Six Air Pollution Expanses

Background

In 2008 the Singleton Shire Concerned Residents Disease observations of the Hunter Valley Mining and Power Station Air Pollution Cocktail Drifting Patterns provided the layman's view and the basis (SSHEG 2010 Dec doc) for NSW Chief Health Officer's Expert Advisory Group investigations into Local General Practitioner Doctors and Resident's Disease associations of the Mining Industry Airborne Pollution; especially "Near Neighbours to Industrial Emission Sources of Air Pollution".

Community observations of hours and days of accumulated "Valley Haze and Mine Dust Drifting Patterns" remains at odds with the Atmospheric Dispersion EIS 25 Year Models that estimate only the Downwind Air Pollution Contaminants, as a "*form of concentration contours that merely reduce to reflecting Wind Rose information averaged over long Time Periods*". As early as 1985, ANU were investigating as a prelude to Industrial Development, a Risk Assessment Scheme for Air Quality in the Hunter Valley of NSW; proceeding from the identification of the Particle Pollution Sources, their transport Pathways from the Sources to Residents Sites, their eventual Environmental Impact from the transported Pollution Dose Exposure of Residents as well as their atmospheric stability conditions limitations that remain in use today; although refined by PAE Holmes et al since, through to 2010.

Resident's Hour by Hour Mine Drifting Air Pollution Exposure Disease Impacts are being encountered daily by Singleton GP's soon after these hourly Mine Pollution Exposures Camberwell and Maison Dieu UHAQMN SMS messaging Alerts and exceedances are glaring examples of these unacceptable Disease Impacts!

The Diurnal Variability, the Time of Day Air Drifting Patterns, Seasonal Weather

Patterns, the changing Landscape of working Mine Voids, Overburden Mountains and their Orientation over 25year Mine cycles are critical elements to the Dispersion of Mining Industry Air Pollution containment changes. Mine Air Pollution should otherwise be contained within the Mine Lease boundaries and by any Buffer Zones provided.

The Hunter Valley Coal development focus emerged shortly after the establishment of the Electricity Commission of NSW formed in 1950; taking over and managing Electricity Generation across the State, connecting to Snowy Mountains Generation, Coal and Generation in Central Coast by 1960's, and Liddell Power Station developed in association with Kurri Kurri Aluminium Smelter by 1971. Air Pollution Dispersion in the enclosed Hunter Valley then and now was fundamental to Community Health Protection.

In 1980 the role of Electricity Commission was extended to manage the use of Coal for the generation of Electricity or sell for profit; reduce the cost of Electricity Generation and Supply, and to promote and encourage research into the development of Coal Resources in NSW. The era of cheaper Open Cut Coal Mining emerged in the Hunter Valley, with Bayswater Power Station and Tomago Aluminium Smelter by 1985. Still today Tomago uses 12% of NSW Electricity Capacity, while Newcastle Port Exports up to 100 million Tons of Hunter Coal pa mostly from Open Cut Coal Mining in the Hunter Valley.

The continuation of Open Cut Mining currently without Population Protection Buffer Zones interspersed within Farming Localities, Villages and Towns of the enclosed Hunter Valley in 2019 depends entirely on more accurate Mining Air Pollution Dispersion Methodologies Mitigation Controls that can cater for existing and envisaged Hour by Hour Air Drifting Mine Pollution Dose Exposure of Residents; incorporating the "Near Neighbours Downstream Individual Disease Status Propensity" that lowers allowable PM10, PM2.5 (Fine) and PM10-2.5 (Coarse) hourly Limits of Mine Air Pollution Mitigation Controls.

Outcomes / Benefits

Provide a brief description of the goals, objectives and outcomes being sought for the project, including how this will benefit the Dialogue and the Upper Hunter community. E.g. seeking Dialogue support for an existing project, or to pursue a project through the Working Groups.

Project Goals, Objectives & Outcomes

- ✓ Develop alternate Mining Industry Air Pollution at Source-Emission Mitigation Options for Stage 1 by 2020 that can be introduced over and above existing 2019 Mine Operating Practices (Dust Stop, Weather forecasting, Blast size & Stemming, etc) to firstly lower the Air Quality Particulate Matter Exposure experienced especially by any Near Neighbour Residents that at any time are likely, or predicted by UHAQMN Air Pollution Drifting Patterns from other Sources, to exceed the Feb 2016 National NEPM (Ambient Air Quality) Standards requirements of below 50ug/m3 PM10 Daily Average and 25ug/m3 PM2.5 Daily Average.

- ✓ Develop an alternate Suite of Mining Industry Air Pollution Emission Mitigation Options for (Stage 2 by 2030) that can be introduced over and above Stage 1 2020 Mine Operating Practices, to progressively implement Mine Air Pollution Mitigation Protocols for yet further lowering below the 2016 NEPM Australian National Standards to minimum levels as targeted by World Health Organisation initiatives since 2013; preferable targeting the Pollution Emission Source and their Air Pollution Drifting and Dispersion Patterns that daily expose Near Neighbour Residents, and so as to achieve further reductions foreshadowed under WHO and IARC Particulate Matter Disease Review since 2016. This is especially so for the emerging Nanoparticle Disease Research of Combustion formed and Diesel Particulate Exhaust Emissions from mining equipment now confirmed as present throughout Human Brains and Organ Tissues.

- ✓ This Mining Dialogue Project Objective, focuses upon the implementation of effective Mine Pollution Mitigation Controls that are seen to recognise the Community Pollution Disease concerns as recently adjudged by the Centre for Air Pollution, Energy and Health Research summary status and references in June 2018 as illustrated above:-

  A Comparison of the Health Effects of Ambient Particulate Matter Air Pollution from Five Emission Sources

  - ✓ *Neil J. Hime,*[1,2,*] *Guy B. Marks,*[1,3,4] *and Christine T. Cowie*[1,3,4]
  - ✓ Int J Environ Res Public Health. 2018 Jun; 15(6): 1206.

Objectives Stage 1 by 2020

Priority 1

✓ Develop Hunter Valley Mine Blasting Protocols to "Eliminate Visible Mine Blasting Plumes into the Atmosphere" certainly as Visible Plumes rising above the Mine Working Void, by incorporating "Blast Hole Matrix Surface Disturbance" Video refinement that utilises (a) Smaller Blasts Volumes, (b) Improved Blast Hole Stemming Material & Depth by introducing Stemming effectual Calculation KPI's limits. (e.g. Oresome articles)

✓ Establish the Criteria that warrants Increased Evacuation Zones and specifically likely impacted Residents evacuation Zones around Mine Blast Localities for Designated Planned Blasts adjudged by Weather Conditions, Mine Safety, and Plume Propensity to drift as a Hot Toxic Gas Bubble rather than Disperse within the Mine Lease and Buffer Zones environs.

The practical alternate is to eliminate these Visible Blast Plumes.

Analyse for Hunter Valley Mines, Complaints and Compliance Reports 2008 – 2019 to establish the Environmental Air Dispersion Stability Conditions that existed at the time leading up to and the Blast Plume Air Drifting downstream paths and Near Neighbours associated directions impacted by Blast Plumes returning to Ground.

Currently, Blasting Plume Toxic Gases, Dust and Particulate Matter, and Some Colourless Rated Plumes that return to Ground are adjudged as Fume; while the reality is that since 2010 Residents, Individuals and Mine Workers have been Hospitalised within 2 – 5 Km of Mine Blasts; other Residents report to Local GP's they suffer severe Asthma attacks as close 2- 4 kms of Blast sites. Singleton and Muswellbrook Hospital Visits of breathing difficulties, same day or post 2 days of Blast complaints since 2007 identifies the Mine Blast Markers for this analysis.

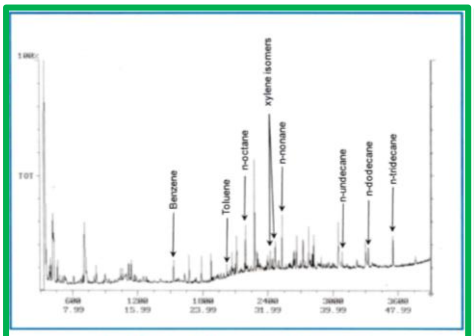


Figure 3-13. Example of a chromatogram of a plume sample

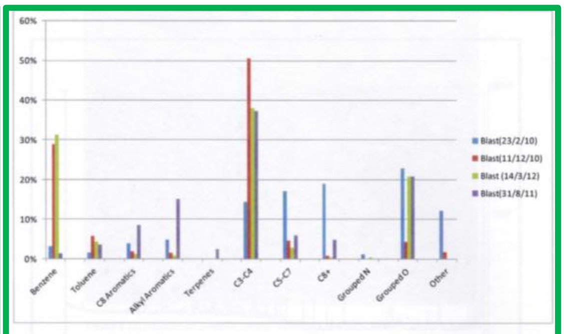
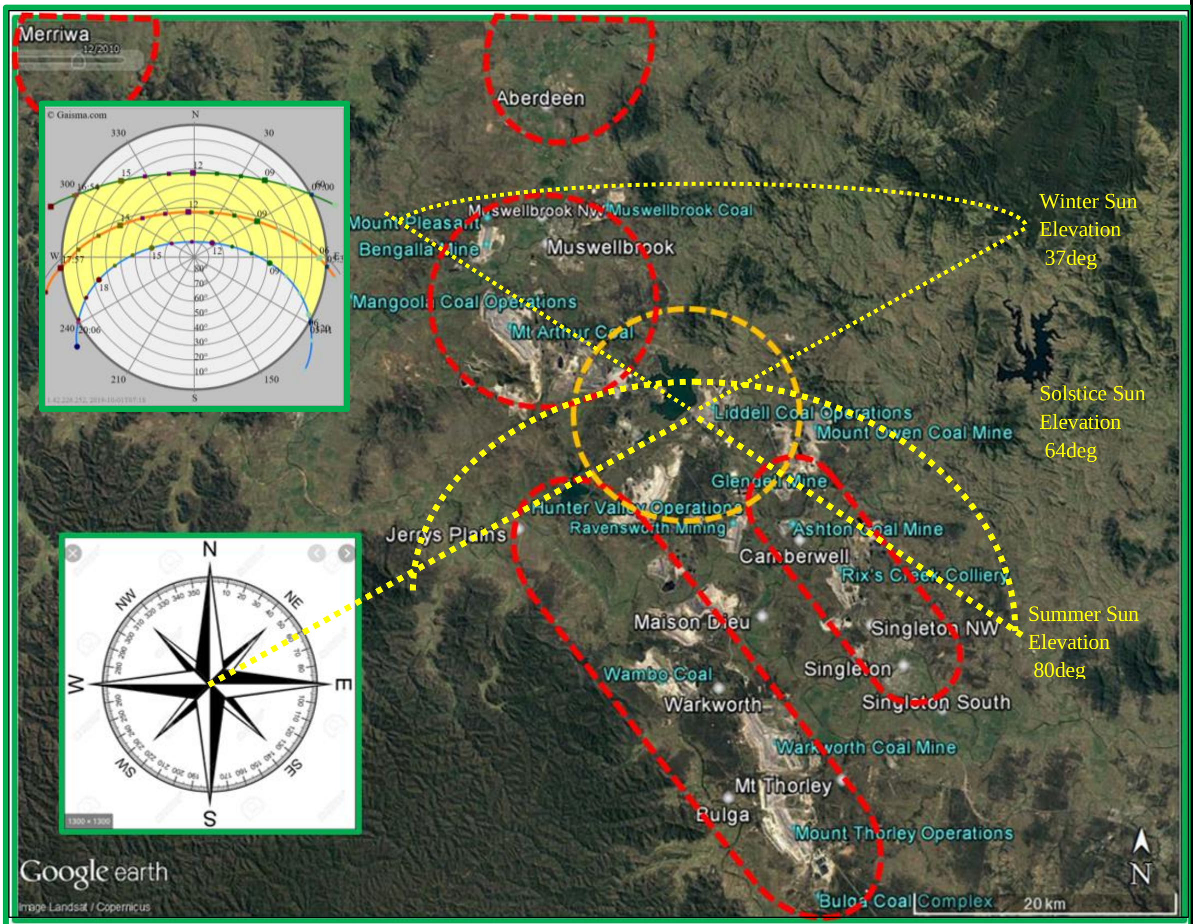


Figure 3-14. Relative concentrations of main compound groups found in the blast plume samples

ACARP Project C18034 Emissions from Blasting in Open Cut Coal Mining June 2013

✓ Expand the role of UHAQMN to provide a set of "*Air Pollution Mitigation Control Operations Displays*" that monitor, minute by minute and Alarm, the impending approach of *Accumulated Valley Air Pollution Expanse Pockets* **(Figure MD1&2)** to Mine Operations as they Drift towards Individual Mine Sites where elevated Resident's Exposures downstream of these Mines currently show as UNAQMN PM10 exceedances.



2010 & 2016 UHAQMN review Dec 2016, Illustration of the Six Air Pollution Expanses

Figure MD1 with Solar Exposure orientation

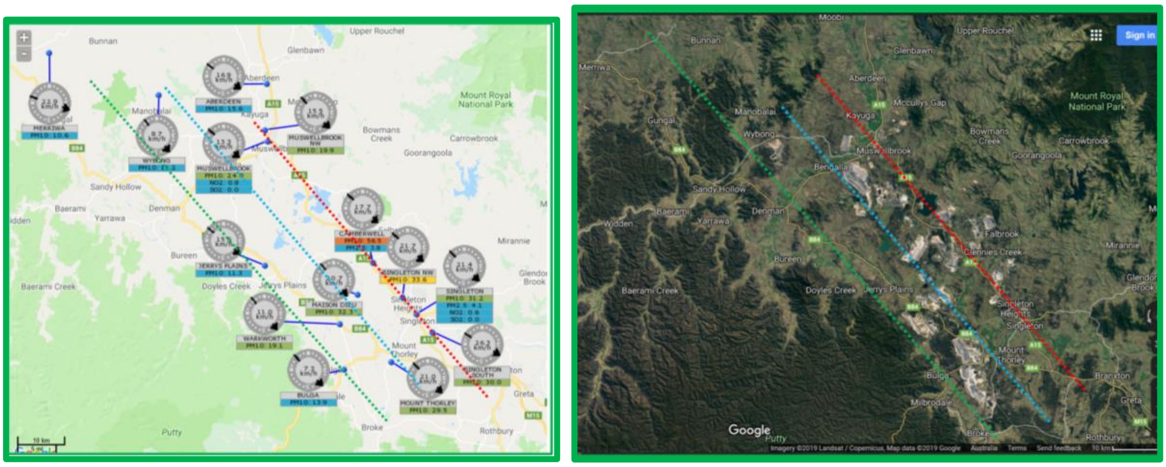
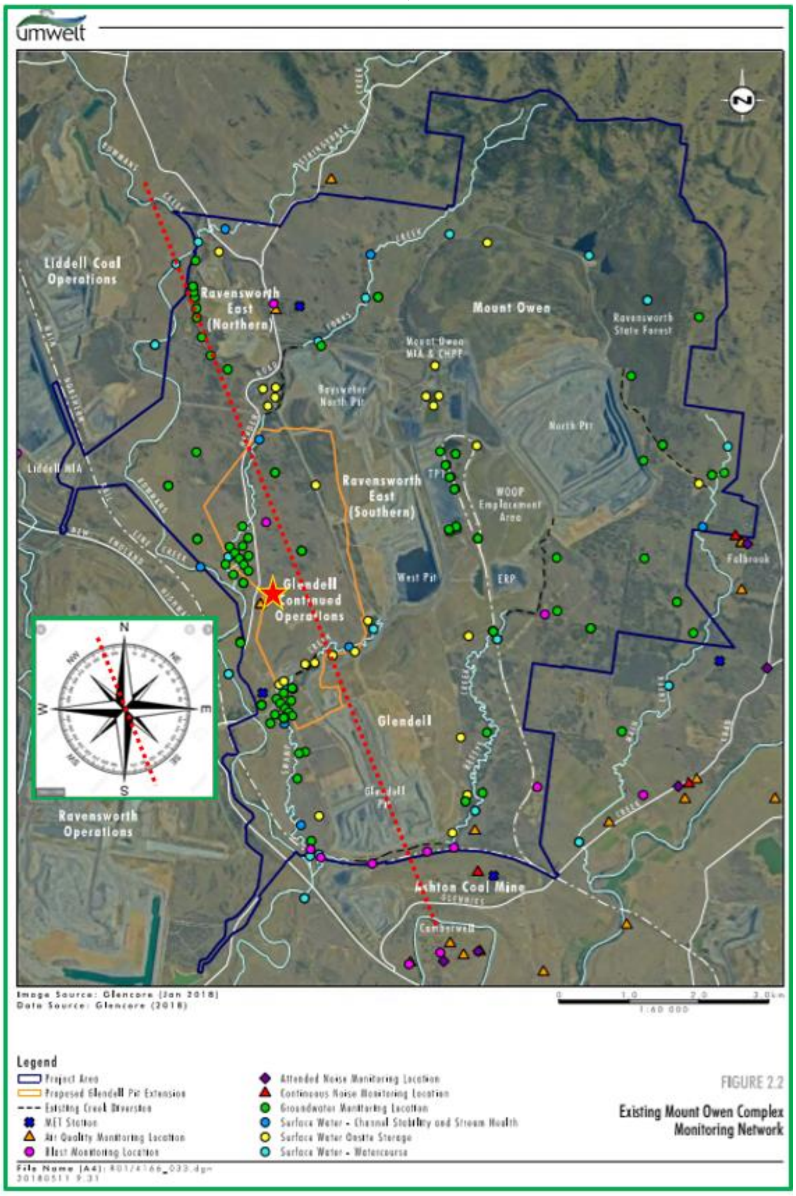


Figure MD2 Predominant North West – South East Valley Air Pollution Drifting Patterns

- ✓ Incorporate Mine Control Centre, Red, Amber & Yellow Alarms designed to alert Mine Controllers for the progressive Shutdown of Mining Operations as "*Valley Cumulative Air Pollution Expanses*" should they Drift across individual Operating Mines, that would yield at downstream UHAQMN Monitors Daily Average 50ug/m3 PM10 NEPM standard exceedances; and or exceed a 1 Hour Average of say 75ug/m3 PM10. Incorporate the "NEPM "Goal of reducing the 1 Year and 24 Hour PM2.5 Standard from 8 to 7ug/m3 and 25 to 20ug/m3, respectively by 2025".

- ✓ Expand the role of UHAQMN to provide Mitigation Control protection for Camberwell Resident's excessive UHAQMN PM10 & PM2.5 Exposure by the inclusion of a sigma theta composite Met Station, with PM10 & PM2.5 continuous Monitoring just North West of Glendell Mine to provide for Ravensworth, Mt Owen – Glendell Mines Progressive Shutdown Mitigation Controls. (also, Rixs Creek Mine South East of Camberwell)



- ✓ Provide All of Mine Region Pollution Mitigation Options to address Upper Hunter Valley Resident's Cumulative Pollution Exposures, including the Power Stations Plume Dispersion Stability contribution to the observed poor Pollution Dispersion UHAQMN Trends. The formation of *"Six Valley Haze and Mine Dust Drifting Pollution Expanse Pockets"* that Drift across Operating Mines, are evidenced as UHAQMN occasional Daily exceedances on Camberwell, Maison Dieu, Jerrys Plains and Singleton Residents, and their associated Disease Impacts.

- ✓ Standardise Individual Mine Air Quality Environmental Control Centres Facilities to continuously Monitor and Mitigate by responding to Three Stage Alarming – Red, Amber, Yellow to address Singleton Shire Resident's 2019 Concerns related directly to take into account the *Cumulative Disease Impact* from Open Cut Mining for each of the following Health Concerns in Priority Order: 1. Air Pollution at ground level Exposure & Disease, 2. Mine Low Frequency and Character Noise & Vibration with sleep disruption 3. Water Contamination incl Rainwater Tanks, and 4. Sense of Place & Social Impact and dislocation.

Objectives Stage 1 by 2020

Priority 2

- ✓ Develop Operational Alarms by the analysis of UHAQMN 2012-2019 1 Hour PM10 Data so that Mines can continuously trace their Air Pollution Drifting Patterns from their Emission sources, and understand the Air Pollution Drifting Patterns both entering and exiting their Mine leases, and especially Cease Operations where any Resident Localities impacted by these changing Air Pollution Drifting Patterns are exceeding NEPM guidelines.

  This extends The EPA Spring 2017 trial defined high dust risk as a 24 hour average increment of PM10 between Merriwa and Singleton of 25µg/m3 or more. Mines also recorded PM10 upwind and downwind of each mine site during the trial, and the mass of material moved at each mine on each day. This was a measure of the level of activity at each site. Mines will complete optimisation of mine-operated monitors by 1 September 2017, establishing continuous PM10 monitoring, unwind and downwind of mining activity.

- ✓ Establish Miners & Community Education Training Regime focusing upon Community Health and Individual Mine Mitigation connectivity to their Near Neighbour Resident's Exposure to Drifting Mine Air Pollution associated WHO Human Disease Propensity "KPI's", with PM10 the indicator of Mine Dust intensity; PM10-2.5 (Coarse) from Blasting, Fugitive Emissions, Draglines, Shovels & Dump Trucks with WHO Disease Impacts; PM2.5 (Fine) WHO Disease Impacts; PM2.5 – PM1 – PM0.1 Diesel Exhaust & Aerosols WHO Disease Impacts; PM0.1 Nano Diesel Particles Disease Impact; Gases, CO, NOx, SOx, O3, PAH's, etc; Vapours, Moulds & Spores.

  Minerals Council Air Video https://youtu.be/q4TojwxKVRQ

Some references suggest the following PM size distribution of Airbourne Particulate matter from Mining is associated with certain pathway penetration Health Risks.

	Airbourne Dust Size Distribution		Dust Mass Distribution	
PM size	PM %	Pathway Penetration	Mass %	Mass Size umetres
PM50	55%	Inhalable fraction	90%	90.4 (PM90)
PM10	20%	Fine fraction	50%	21.4 (PM20)
PM4	5%	Respirable fraction	10%	4.5 (PM4)
PM2.5	1%	High risk, children & CNSLD suffers		

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✓ Develop Pollution Mitigation Strategies to address the Community Representative Report:-

" Air Quality and living with coal mines: insights from the Bulga community"

• Mr Krey the Community Member of Upper Hunter Air Quality Advisory Committee reported in the 22nd November 2018 meeting:

- The main objective of air quality management is to protect human health and it is a basic human right to breathe clean air and live in a healthy environment.
- Coal mining is the main source of air particles in NSW. PM10 levels increased at most Upper Hunter sites during the past three years. Annual PM2.5 is consistently above the benchmark in Muswellbrook and is nearing the benchmark in Singleton.
- Mines seem unwilling to accept responsibility for Hunter air quality, Local government should be more vocal in raising concerns about air quality. State government is not trusted to regulate air quality. The Upper Hunter Mining Dialogue has not produced results. OEH's categorisation of air quality is misleading because there is no safe level of particulate matter.
- Mr Krey suggested that the committee be more active in making recommendations on how to reduce air pollution in the Hunter Valley. He suggested debating and making recommendations on the following issues: • Local EPA compliance officers. • Using drones for mine surveillance. • Mine and power station expansion. • Complaint responses. • Involvement of mining representatives to recommend ways to reduce pollution. • Increased mine rehabilitation. • Back-filling mine voids.

Days above benchmark concentrations

There was were 29 days over the PM_{10} benchmark in winter 2018, with sites closer to mines recording the highest number of days. There were two days over the $PM_{2.5}$ benchmark in winter 2018.

Table 1 Number of days above the relevant national benchmarks – winter 2018

Station type*	Station	PM_{10} daily [50 µg/m³ benchmark]	$PM_{2.5}$ daily [25 µg/m³ benchmark]	SO_2 hourly [20 pphm benchmark]	SO_2 daily [8 pphm benchmark]	NO_2 hourly [12 pphm benchmark]
Population centre	Aberdeen	0	-	-	-	-
Population centre	Muswellbrook	4	2	0	0	0
Population centre	Singleton	3	0	0	0	0
Smaller community	Bulga	1	-	-	-	-
Smaller community	Camberwell	19	0	-	-	-
Smaller community	Jerrys Plains	0	-	-	-	-
Smaller community	Maison Dieu	9	-	-	-	-
Smaller community	Warkworth	1	-	-	-	-
Smaller community	Wybong	2	-	-	-	-
Diagnostic	Mount Thorley	15	-	-	-	-
Diagnostic	Muswellbrook NW	1	-	-	-	-
Diagnostic	Singleton NW	6	-	-	-	-
Background	Merriwa	1	-	-	-	-
Background	Singleton South	3	-	-	-	-

µg/m³ = microgram per cubic metre and pphm = parts per hundred million by volume (i.e. parts of pollutant per hundred million parts of air)
- = not monitored * For explanation, refer to the end of the report Definitions: Upper Hunter monitoring station types

There was were 13 days over the PM_{10} benchmark in autumn 2019, with all sites recording days over the benchmark. There were no days over the $PM_{2.5}$ benchmark in autumn 2019.

Table 1 Number of days above the relevant national benchmarks – autumn 2019

Station type*	Station	PM_{10} daily [50 µg/m³ benchmark]	$PM_{2.5}$ daily [25 µg/m³ benchmark]	SO_2 hourly [20 pphm benchmark]	SO_2 daily [8 pphm benchmark]	NO_2 hourly [12 pphm benchmark]
Population centre	Aberdeen	2	-	-	-	-
Population centre	Muswellbrook	3	0	0	0	0
Population centre	Singleton	2	0	0	0	0
Smaller community	Bulga	2	-	-	-	-
Smaller community	Camberwell	8	0	-	-	-
Smaller community	Jerrys Plains	2	-	-	-	-
Smaller community	Maison Dieu	3	-	-	-	-
Smaller community	Warkworth	4	-	-	-	-
Smaller community	Wybong	2	-	-	-	-
Diagnostic	Mount Thorley	10	-	-	-	-
Diagnostic	Muswellbrook NW	3	-	-	-	-
Diagnostic	Singleton NW	5	-	-	-	-
Background	Merriwa	3	-	-	-	-
Background	Singleton South	4	-	-	-	-

µg/m³ = microgram per cubic metre and pphm = parts per hundred million by volume (i.e. parts of pollutant per hundred million parts of air)
- = not monitored * For explanation, refer to the end of the report Definitions: Upper Hunter monitoring station types

Objectives Stage 2

Priority by 2030

- ✓ Develop Mitigation Controls for all Mining Operations to meet evolving WHO Guidelines & NEPM Standards using a "*Mine Surrounding PM10 & PM2.5 Networks Day & Night Patrols alongside Noise Alarm Patrols*" for each Near Neighbour Resident's Protection, or otherwise at 30degree quadrants. Specifically, cater for the 1 Year & 24 Hr PM2.5 Standards lowering from 8 to 7 ug/m3 and 25 to 20 ug/m3 respectively by 2025.

- ✓ Evaluate Mine and Valley Cumulative Air Pollution consecutive days of accumulated "Valley Haze and Mine Dust Drifting Expanses" by Analysis for the 2012 – 2019 Years of UHAQMN 10 Minute to 1 Hour PM10 & PM 2.5 Data Patterns, and establish Mine Mitigation Options by Prediction and Reactive Mitigation Control coordinated across all Mining Sites to achieve Valley wide NEPM Standards Compliance. Pollution Expanse Pockets already considered are: NW Valley Cassilis to Merriwa, NE Valley Scone to Aberdeen, North Muswellbrook Region, Central Power Station Region, SE Corner Camberwell to Singleton South, and SW Corner 5 Mines Region. (**Figure MD1**)

- ✓ Develop detailing for Mine Control Centre Alarm Displays (15 Minute based) at Individual Mines referencing the Location Direction and Distances of their Near Neighbours Residents, Wind Drifting Pathways, Dispersion Stability, with three stage Pollution Mitigation Alarms based on the extent that PM10 values exceed 50ug/m3 PM10 and 25ug/m3 PM2.5 for any contiguous 24 Hr period at Residents localities throughout the Upper Hunter Valley; Analysis of Particulate Monitors 1 Hour and Rolling 24 Hour Particulate Matter of the UHAQMN 2012 – 2019 Years and all other individual Mine Particulate Monitors.

- ✓ Evaluate the Mine Mitigation Option for Mines to continuously at 5 or10 Minute intervals, Pathway Trace and Control by reducing their Air Pollution Drifting Patterns at Mine Emission Sources; their Air Pollution Dispersion Patterns both entering and exiting their Mines; and especially Cease Operations where at any Resident Localities they are known to be impacted for one hour by any changing Air Pollution Drifting Patterns that exceeding say 75ug/m3 PM10 one hourly Average exiting the Mine.

- ✓ Expand the role of UHAQMN to provide Mitigation Control protection for the entire Upper Hunter Valley impacted by Coal Mining and Coal fired Power Stations by the inclusion of a sigma theta composite Met Stations, with PM10 & PM2.5 continuous Monitoring at all sites; adding Cassilis, Scone, Denman, Broke, Glendon Brook and Cessnock for Residents Air Quality protection. Incorporate Singleton (Defence), Cessnock & Scone Airports, Merriwa (Roscommon), Murrurundi Gap, and Mt Pleasant Public-School Met Stn. Sites.

✓ Develop Modern Dispersion Visualisation Real Time Displays and Dispersion Parameter Studies to reintroduce the Data Intelligence to the Movement of Mine Pollution from Sources to Dispersion, and to provide the basis for the development of Real Time Air Pollution Dispersion Characterisation Studies.

Hunter Valley Coal Mining Air Pollution Dispersion (Concept)

Air Pollution Dispersion	HIGH A D	Medium	LOW G	Instability A Neutral D Stability G
SEASON	SUMMER Nov Dec Jan	Feb Mar Apr Oct Sept Aug	WINTER May June July	
Time of Day DST +4Hr	3Pm Noon 7pm 4Pm		Night	Diurnal
Air Temperature	45°C 38°C		Day Minimums	
Solar Radiation	A HIGH Mid afternoon	Medium D	LOW G Cloudy	Sunrise – Sunset TOD
Sun Elevation	Summer 80 deg	Solstice 64 deg	Winter 37 deg	North facing
Local Wind Speed	>5m/sec Horiz. Dispersion	D 2-3m/sec	Still/ CALM G	Modelling limited at low Wind F
Turbulent Boundary Layer	A Therm Updraft 1000m Layer		Near Ground 100m Layer	Mixing Height Determinate
Recent Rain Events	DRY		➢ mm/Hr in last 8 Hr	
Elevation Gradient	Deep Mines Valleys & Cliffs	Stockpiles Orientation to N	Flat Plains	Complex Terrain limitations
Surface Drifting	>6m/sec Horiz Dispersion		CALM	
Air Stability Class	Instability A	Neutral D	Stability G	Horiz./Vertical Drift Balanced in Class D

✓ Expand the role of UHAQMN to provide NSW Health Disease Risk Evaluation at Muswellbrook, Singleton and Cessnock for Ozone, and PM1.0 with PM2.5 referenced continuous Monitoring and Particle Filter Particulates Microscopy and Composition, especially for Diesel Particle Emissions, Elementary Carbon, Nanoparticles and Substance Type Analysis.

Diesel exhaust particles are primarily composed of elemental carbon, with a smaller proportion of organic carbon and toxins (such as PAH and nitro-PAH, aldehydes, ketones and heavy metals) ad/ab-sorbed to the primary (amorphous elemental carbon) particles. Many of these components are created through incomplete fuel combustion and unburned engine lubricating oil. Particulate matter PAH's, aldehydes and ketones are implicated as major contributors towards diesel exhausts carcinogenic effects.

Application of Modern Technology & Science to Dispersion

Our Holistic investigations into the establishment of Power Stations and Open Cut Coal Mining in the Hunter Valley – a decision in 1981 related to the expanded role of NSW Electricity Commission in exploiting of Coal Resources for sale and to reduce the Cost of Electricity Generation in NSW.

Unearthed in the investigations was the need for the Australian University to show that Mining, Power Stations and Aluminium Smelters Air Pollution could be Dispersed upward into the atmosphere in the somewhat enclosed Hunter Valley. While this USEPA based Air Pollution Dispersion Modelling is still used for Mine Approvals and Residents Acquisition Rights, the understanding has not progressed beyond that approach.

Modelling however is based upon their Fixed location Meteorological reference Data, which has little provision for the subsequent horizontal downwind Drifting Air Dynamics that unfolds as Pathways across the contours of mine leases and over Near Neighbour properties.

Certainly, the use of Minute to Minute Real Time Mine Air Pollution Drifting Visualisation is much closer to the reality of the Pathways that result; seen in Resident's Complaints, and even a casual inspection of the UHAQMN Maps over time – exposes that "Dispersion into the Atmosphere" is indeed the heart of the problem.

Stability class is used to determine the rate at which the Air Pollution "Plume" disperses by growth by the process of Turbulent Mixing.

Modern Dispersion Visualisation Displays and Dispersion Parameter Studies in Real Time proposed here would reintroduce the Data Intelligence to the Movement of Mine Pollution from Sources to Dispersion. i.e. Actual Measurements compared to Modelling!!!

What has been gleened so far from UHAQMN Data and OEH Reports since 2011?

Traditionally Mines rely upon Air Pollution Dispersion updraft by Thermals into the Atmosphere or Buffer Zones for Horizontal Dispersion; however without Buffer Zones the UHAQMN Data indicates that Dispersion occurs Horizontally across Near Neighbours downwind and/or Accumulates in Still and/or Sunless Conditions.

Proposed here are Mine Control Displays that Monitor and Alarm for High, Medium and Low Mine Dispersion Status Conditions based on each of the following Parameters for example:- Season, Time of Day Diurnal, Air Temperature Diurnal, Local Wind Speed, Solar Radiation Flux, Recent Rain events, Topography, Emission Source Elevation and Turbulent Boundary Layer.

Dispersion physical parameters that are measured directly by instrumentation and can be Displayed and Alarmed, include Surface and Air temperature, dew point, wind direction, wind speed at 10m, cloud cover, cloud layer(s), ceiling height, visibility, current weather, precipitation, Diurnal cycle, Sunrise to Sunset Solar Radiation, Night and cloud cover, Seasonal variations- Low May to July, and High Nov to Jan.

"*Higher, more positive values of surface heat flux (classes A to C) indicate the presence of upward thermal air currents, which aid a real dispersion.*

Comparably lower and negative values of surface heat flux (classes E to G) prevent the particulate plume from rising into the atmosphere and restrict areal dispersion".UK Appleton 2006

Air Pollution, Emissions and Health Background

World Health Organisation Precautionary Guidelines for Human Exposure to Air Pollution Disease Impacts, emerged after 40 years of Medical Research in October 2013 – "*There is no evidence of a safe level of exposure or a threshold below which no adverse health effects occur- it is necessary to reduce health risk to a minimum*"; while in the Hunter Valley Mining Companies and the Community were being advised since 2005 that there was "*No Convincing Evidence*".

Five Years later in 2018, NSW Authorities now spruik these WHO, IARC and Lancet Carcinogenic and Minimisation relationships between Air Quality Particulate Matter and Community Diseases associations; and now as more targeted Research occurs, the WHO review since 2016 is expected to further lower their Precautionary Guidelines which will challenge Hunter Valley Mining Operations that are imbedded within Populated Rural Localities.

The Air Pollution Particulates and Combustible Gasses Toxic Emissions Mix Dispersion rely upon suitable Atmospheric Stability in the somewhat enclosed Rural Hunter Valley; namely for Power Station Stack Emissions & Fly Ash Particulates, Open Cut Mining Blast Plumes, Diesel Exhausts, Operational Dust, Fugitive Emissions, Windblown Emissions, Highway & Railway Emissions, and the Aerobiological Calendar, all setting this area aside from all other Urban Pollution Mixes.

In the last ten years the Overall Specific Hunter Valley Air Pollution Studies, along with the WHO associated Disease Propensity References, listed below, provides the focus here for better Emission Source Minimisation Controls. Consequently, Mines will need to accept greater responsibility for the Cumulative Particulate Pollution exiting their Mines as they drift downwind at ground level over Resident's Localities.

- NSW Chief Health Officer Expert Panel Investigations of SSHEG 2009 submission
- **World Health Organisation 2013, "***Health Effects of Particulate Matter***",** No evidence of a safe level … it is necessary to reduce Health Risk to a Minimum**.**
- **ACARP 2013, "**Emissions from Blasting on Open-Cut Mining**",** CSIRO Energy Technology, C18034 S.Day et al, June 2012 -Blasting Plume Emissions Composition; and C22025 "*Real Time Monitoring and Prediction of Open Cut Blast Fumes*".
- **NSW Health, OEH 2013**, "*Upper Hunter Valley Particle Characterization Study*", Hibbard & Cohen CSIRO & ANSTO, 17 Sept 2013.
- **IARC Vol 105 2014**, "*Diesel and Gasoline Engine Exhausts and some Nitroarenes*", IARC Monographs on the evaluation of Carcinogenic Risks to Humans.
- **NSW EPA 2014**, "*Upper Hunter Air Particle Model*" 9 Oct 2014; Pacific Env. Ltd, 2012 UHAQMN with Wind Speed, Mine & Diesel Emissions - CALPUFF.
- **Hunter New England Population Health, NSW Health Nov 2014** *"Investigating the Health Impacts of Particulates associated with Coal Mining in the Hunter Valley"*, CB Dalton, DN Durrheim, G Marks, CA Pope III, Air Quality and Climate Change Volume 48 No 4. Nov 2014 Pg. 39-43.

- SSHEG “*Rural Health Study Review July 2015*”, SSHEG to NSW Health 11 Aug 2015 including Mining Dialogue Review May 2015.

- **NSW Health, EPA 2015, “**Review of the health impacts of emission sources, types and levels of particulate matter air pollution in ambient air in NSW”, Woolcock Institute of Medical Research, Centre for Air Quality and Health Research and Evaluation (CAR); Neil Hime, Christine Cowie, Guy Marks, Dec 2015.
- **NSW EPA 2018**, “*Review of Coal Fired Power Stations Air Emissions and Monitoring*”, and EPA Licences Attm B, March 2018.
- **M. Power Thesis 2002**, “*Air Pollution Dispersion within the Tamar Valley TAS*”.
- **Uni Newcastle 2018**, “*The Health Burden of Fine Particle Pollution from Electricity Generation in NSW*”, Dr Ben Ewald Nov 2018.
- **Woodcock Institute 2018**, *“A Comparison of the Health Effects of Ambient Particulate Matter Air Pollution from Five Emission Sources” (with listed Reference Research Table 1 & 3 illustrated)*

✓ Neil J. Hime,[1,2,*] Guy B. Marks,[1,3,4] *and* Christine T. Cowie[1,3,4.] ; Int J Environ Res Public Health. 2018 Jun; 15(6): 1206.

✓ **Extract related to Source Specific Health Impacts Page 16**: “*This review has a focus on epidemiological studies that compare different PM emission sources. However, toxicological studies in humans and research animals will help to inform the likely health effects of exposure to source-specific PM. Unlike epidemiological studies, toxicological studies have the advantage of being able to associate effects with precise exposures. Their disadvantage is that they lack the “real-world” conditions within which population relevant exposures occur. It is likely that no one study type will be able to determine the relative health effects of PM from different sources, and that only the cumulative evidence from a range of study types, each with different strengths and limitations, will provide some clarity in this area.*

Research described in this review has linked a variety of health effects to source-specific PM. However, more advanced approaches to modelling, measurement, and statistics will be required to more precisely quantify health effects attributable to exposures in the multi-pollutant atmosphere. Determination of the relative health effects of different source-specific PM will help to inform policy and regulatory strategies to reduce the public health burden of ambient PM. Enhanced understanding of these relative health effects offer the potential for better targeted public health protection than the current recommended practice of minimising exposure to total PM mass, regardless of the source”.

Table 1. Conclusions from previous reviews of the differences in the health effects of different components and sources of PM air pollution.

Reference	Study Conclusions in Relation to Health Effects of Source-Specific PM Air Pollution
[38]	The black carbon, for which vehicles and particularly diesel vehicles are a major source in urban areas, in PM might make PM from those sources the most harmful. The relative toxicity of wood smoke compared with vehicle exhaust emissions is unclear.
[29]	Current evidence does not allow a precise differentiation to be made as to which constituents or sources of PM are most closely related to specific health outcomes. However, three components, black carbon, secondary organic aerosols, and secondary inorganic aerosols may be important contributors to PM toxicity.
[39]	Current knowledge does not allow precise quantification or definitive ranking of the health effects of PM from different sources. However, some results suggest that a range of serious health effects are more consistently associated with traffic-related PM and specific metals and elemental carbon in PM.
[40]	There is a lack of information by which to differentiate the toxicity of different components of PM.
[41]	Evidence suggests that carbon components and several metals in PM are associated with health effects however it is unclear whether these components are responsible for health impacts or they are surrogates for other pollutants.
[31]	Cardiovascular health effects may be associated with $PM_{2.5}$ from crustal or combustion sources, including traffic, but at this time, no consistent relationships have emerged. Collective evidence has not yet isolated factors or sources that would be closely and unequivocally related to specific health outcomes.
[42]	There is evidence that metals within PM affect health but considerable uncertainties about causality remain.
[43]	Evidence relating to the toxicity of inorganic components of $PM_{2.5}$ is not consistent. Crustal components of $PM_{2.5}$ are not likely, by themselves, to be a significant health risk.
[44]	Public health will likely be better protected by reduction of various vehicular emissions than by regulation of total $PM_{2.5}$ mass as if all $PM_{2.5}$ is equitoxic. However, the knowledge base is incomplete.
[45]	There is little support for the idea that any single major or trace component of PM is responsible for the adverse health effects of PM.

From previous reviews of the differences in the health effects of PM from different sources it is unclear if there is a hierarchy in the harmfulness of PM from different sources. Therefore, this current review was undertaken with the following objectives:

Table 3

Summary of PM emission sources and reported health and physiological/toxicity effects (physiological/toxicity effects includes animal studies).

Specifically traffic PM	all-cause, respiratory and cardiovascular mortality, cardiovascular, stroke and heart failure morbidity [54,55,56,57,58,70,71,72] cardiovascular toxicity and various cardiovascular effects [50,60] cytotoxicity, pulmonary inflammation [62,63]
Coal-fired power stations	all-cause, cardiovascular, respiratory, ischaemic heart disease, pneumonia, lung cancer mortality [19,34,57,58,69,70,71] respiratory morbidity [48,49,65,66,67,68,72] cardiovascular morbidity [48,49,68]
Diesel exhaust	respiratory mortality [54] lung and oesophageal cancer mortality [84,85] allergic inflammation, asthma symptoms, lung cancer [79,81,82,83] cardiovascular morbidity [72,89] cardiovascular changes indicative of increased coronary event risk, changes in lung function, nose and throat irritation [48,49,90] atopy and susceptibility to infection [98,99,100] effects on offspring from exposure during pregnancy [101,102,103]
Domestic wood combustion heaters (studies of outdoor exposure to heater emissions)	respiratory symptoms and exacerbations [109,110,111,112,113,114] cardiovascular morbidity [72] respiratory morbidity [115] compromised lung immunity, airway inflammation [112,116,117,118]
Crustal dust	all-cause and cardiovascular mortality [120,121,122,123,124] respiratory mortality(>75 years of age) [141] respiratory and COPD morbidity [127,137,138] asthma exacerbation [125,132,133,134,135,136] reduced lung function in children [151] pneumonia [142,143] lung inflammation [147,148] infectious disease [144,145,146]

Resources required

Provide a brief description of the resources required from the Dialogue to facilitate the project's success. For example, time, personnel, target groups. Detail any external financing or in-kind contributions sought.

- **Project Duration**:- Intended as a two year Dialogue Project :
  One year of draft preparation of forward-thinking strategy,
  Second year of Implementation Trial and review.
- **Target Groups:-** Dialogue team with the appropriate UHAQMN involvement and knowledge, and Mine Operational Environmental Control Centre involvement for Screen Display Trials of three Stage Alarms and Dispersion outcomes.
- **Project Benefit:-** Project relates directly to the integration the Mine Operational Centre Strategy to Lower the overall Air Pollution Levels, fewer UHAQMN Exceedances, and Recognition of Community Health improvements by Local GP's.
- **Requires**
  - Initial Minerals Council and Mining Dialogue agreement in principle, and
  - Connects directly with the Cumulative Health Impacts of "*Air Quality and Emissions and Health*"; as discussed and detailed at 2018 Annual UHMD Forum Report.

Other information

Other Information

SSHEG and Health Concerned Residents as "Near Neighbours to Open Cut Mines" are asking the Question: -

"***Why after 10 years of Community detailing the observed Diseases impact of sudden exposure to Mine Air Pollution; three years NSW Health, CSIRO & ANSTO Research 2010 -2013; WHO Air Pollution & Disease Declarations Oct 2013; eight years Upper Hunter Mining Dialogue, Mines, EPA & OEH initiatives 2011- 2017; after all this combined effort; why are Singleton GP's again reporting worsening Community Disease in 2019*?**

SSHEG 10year review concludes that each individual Mine now operate, targeting not to exceed their Daily 24 Hr Average PM10 at midnight of 50ug/m^3(Compliance), however their "*actual Cumulative 1&24 Hr Average PM10 that Residents are exposed too*" often range from 70 - 150ug/m^3, because the Valley inflow PM10 from other upstream Mines has been conveniently ignored as inconsequential somehow! **The Cumulative Polluted Air is the so-called Healthy Air we Breathe criteria!**

Independently the World Health Organisation Scientific Advisory Committee and Expert Reviewers on Air Quality in October 2013 declared "*There is a linear Dose-Response Relationship between Particle Levels and Human Disease with No Threshold that is Safe*"; having previously in June 2012 declared "*Diesel Engine Fumes can cause Lung Cancer and belong in the same potentially deadly category as asbestos, arsenic and mustard gas*".

It is clear that insufficient Mine Industry Pollution Mitigation Controls has adopted the precautionary guidelines of the World Health Organisation Air Pollution and Human Disease associations. Additionally, the Community identified Priority Air Quality Action List summarised in 2014 in Tables 1 & 2, has been mostly ignored.

What the Community of Singleton Shire is asking of the Mining Industry is that at all times for Resident's PM10 not to exceed the NEPM 50ug/m3 limit, and that Mine further operate well below this upper limit to "*Minimise the PM10 and PM2.5 Rate of Rise frequency*" at UHAQMN Continuous Monitoring localities where Residents are being excessively exposed to Mine Air Pollution Drifting Patterns.

Therefore, both PM10 and PM2.5 Monitoring of known Mine Blast Fume & Odour Resident Localities, and other Near Neighbour Air Pollution localities now, and in the future, will become mandatory for Community Disease Protection.

What are the SSHEG 2014 Priorities

(a) Elimination of Mine Blasting Plumes into the Atmosphere

(b) "Near Neighbours to Mining "as "Occupationally Exposed Persons".

(c) Air Quality Particulate Matter as 15 Minute Avg STEL based.

(d) Holistic Air Quality Toxicity – Gases, Vapours, PM's, as STEL.

(d) Air Quality Australian Standards – SSHEG Rural Zones Proposal

SSHEG	PM10	Annual Avg 12ug/m3,	Daily Avg 25ug/m3
Proposal	PM2.5	Annual Avg 6ug/m3,	Daily Avg 15ug/m3
(Rural)	PM10-2.5	Annual Avg 8ug/m3,	Daily Avg 20ug/m3

(e) Scientific Biological versus Air Pollution Asthma Study

- Pollens, Spores, Fungi, Vapours, Fragrances etc
- Bushfires & Backburning, Forests, Grasslands, Biomass Smoke etc
- Domestic Heaters, WoodSmoke

Mining Dialogue Meeting 17 Feb 2019

- **Australian Air Quality Standards were subsequently lowered**

Following much review and consultation, the Air NEPM, which had been last updated in 2003, was amended on 4 February 2016 with the following changes:

- The $PM_{2.5}$ standards were upgraded to performance standards from their previou status as advisory reporting standards.
- A standard for 1-year average PM_{10} of 25 µg/m³ was added. This complements the existing standard for 24-hour average PM_{10} of 50 µg/m³.
- The allowance for exceedance of the PM standards on a maximum of 5 days pe year was replaced by an 'exceptional event rule'. An exceptional event is a fire c dust occurrence that adversely affects air quality at a particular location; causes an exceedance of 1-day average standards in excess of normal historical fluctuations and background levels, and is directly related to bushfire, jurisdictior authorised hazard reduction burning or continental-scale windblown dust.
- A goal was added of reducing the 1-year and 24-hour $PM_{2.5}$ standards from 8 to 7 µg/m³ and 25 to 20 µg/m³, respectively, by 2025.
- A $PM_{2.5}$ population exposure metric was added, to be reported on annually from June 2018. Development of this metric is still in progress, but a nationally consistent approach will be used for evaluation and reporting based on agreement by participating jurisdictions.

The jurisdictions (6 states and 2 territories) monitor air quality at about 75 locations across Australia. These stations are in the major metropolitan areas and some regional centres, and are sited to measure air quality that is representative of that likely to be experienced by the general population in the region. **Jurisdictions report annually on their compliance with the Air NEPM based on the data from their monitoring networks.[4] Some jurisdictions hav additional monitoring networks, such as the NSW Upper Hunter Air Quality Monitoring Network (OEH 2016), but results from these stations are not included in the above compliance reports.**

Particles in ambient air range in diameter from approximately 0.001 micrometres (μm) to about 30 μm. Figure 2-1 shows the size range of typical particles and gas dispersoids (Lapple, 1961).

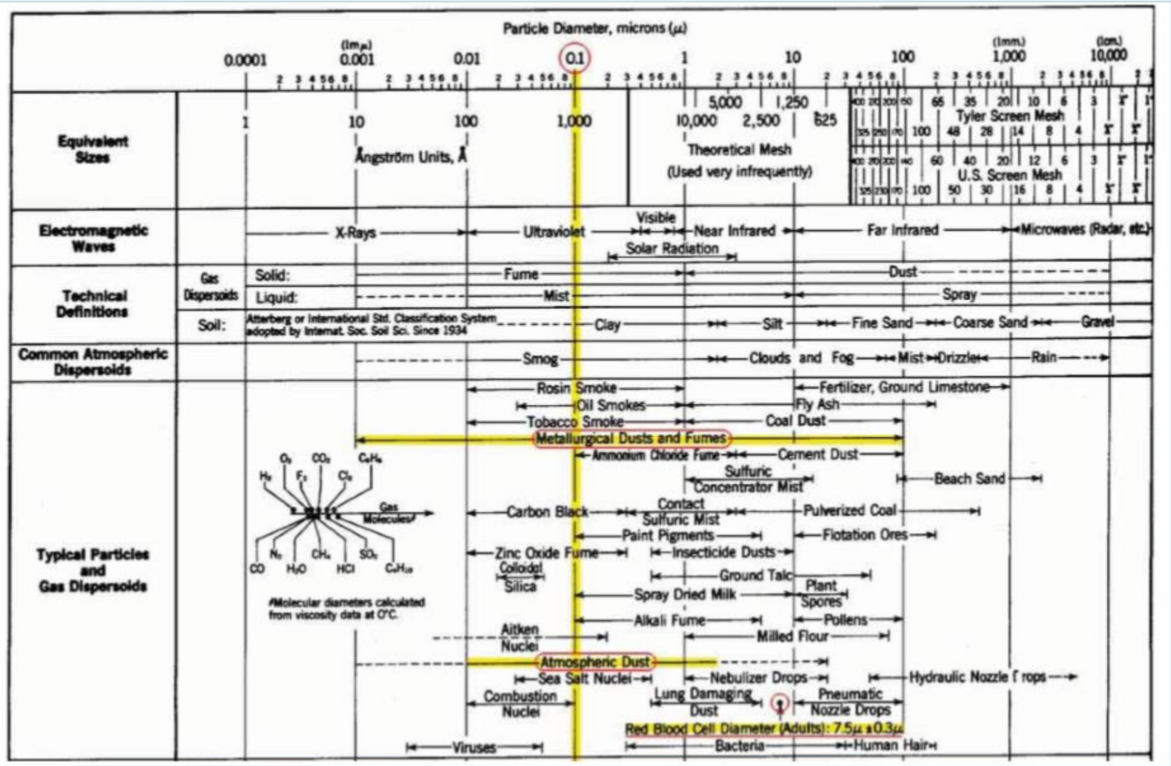


Figure 2-1: Characteristics of typical particles and gas dispersoids

NSW Annual Air Quality Statement 2018

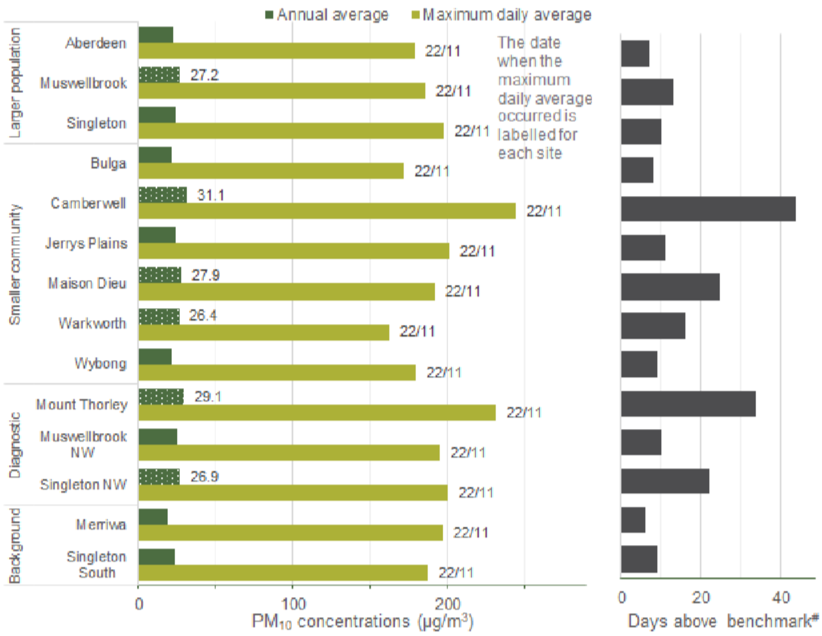


Figure 11 Summary of PM_{10} levels in the Upper Hunter – 2018

Note: Annual average values above the benchmark are shown against applicable sites.
Days above the benchmark have not been divided into exceptional and non-exceptional events, as the NEPM goals do not apply to these sites.

ICC 8 - 4 FRASER ET AL.: VARIATION IN COMPOSITION OF DIESEL PARTICLE EMISSIONS

Table 5. Molecular Composition of Organic Particulate Matter Emitted From Four Diesel Vehicles Under Load and for a Composited Idle Sample[a]

Compound	HEB 7242	HEB 7238	Idle	Metro	School
n-Alkanes					
n-heptadecane	420	480	680	3560	1120
n-octadecane	430	650	1240	3260	2100
n-nonadecane	960	820	2210	6160	4740
n-eicosane	1820	1500	3670	6300	11910
n-heneicosane	2750	2850	5950	6610	12500
n-docosane	2400	2860	4290	5750	7060
n-triacosane	1410	1760	2390	4260	3410
n-tetracosane	950	1210	1420	3250	1730
n-pentacosane	760	870	940	2510	1100
n-hexacosane	nd[b]	200	460	1480	400
n-heptacosane	nd	nd	290	950	150
n-octacosane	nd	nd	200	730	nd
n-nonacosane	nd	nd	160	450	nd
n-tricontane	nd	nd	nd	380	nd
Petroleum Biomarkers					
18α(H)-22,29,20-trisnoneohopane	210	200	140	110	160
17α(H),21β(H)-29-norhopane	850	760	430	240	720
17α(H),21β(H)-hopane	650	550	310	310	540
22R + S, 17α(H),21β(H)-30-homohopane	330	280	150	nd	190
22R + S, 17α(H),21β(H)-30-bishomohopane	240	210	110	nd	150
20R + S, 5α(H),14β(H), 17β(H)-Cholestane	80	90	90	70	210
20R, 5α(H),14α(H), 17α(H)-cholestane	50	30	40	60	120
20R + S, 5α(H),14β(H), 17β(H)-ergostane	50	60	20	40	110
20R + S, 5α(H),14β(H), 17β(H)-sitostane	70	70	60	50	190
Oxygenated PAH					
9(H)-fluoren-9-one	150	150	110	830	170
9H-xanthen-9-one	30	20	40	100	80
Polycyclic Aromatic Hydrocarbons					
Fluoranthene	87	115	43	525	53
Acephenanthrylene	18	31	1	4	4
Pyrene	214	283	71	471	130
Benzo[ghi]fluoranthene	16	15	8	24	18
Benz[a]anthracene	12	13	91	137	70
Chrysene/triphenylene	24	28	117	161	100
Benzo[k]fluoranthene	11	7	153	160	128
Benzo[b]fluoranthene	8	7	134	168	113
Benzo[e]pyrene	2	nd	4	15	4
Benzo[a]pyrene	8	8	142	179	125
Benzo[ghi]perylene	9	8	177	284	161

[a]Compound emissions are in ng compound per mg OC.
[b]The abbreviation nd stands for not detected.

Compound Emissions (ng per mg OC)

Real-World Particulate Matter and Gaseous Emissions

Table 5. Emission Factors from LD and HD Vehicles of Key Species from IMPROVE Samplers Along with Regression Uncertainty

Species	LD Emissions ± SE (μg/mi)	HD Emissions ± SE (μg/mi)
Hydrogen	2,090.38 ± 1079.05	9,367.45 ± 4,835.43
Sodium	3,834.55 ± 337.84	−660.72 ± −58.21
Magnesium	467.31 ± 285.34	819.71 ± 500.52
Aluminum	875.11 ± 650.56	−124.71 ± −92.71
Silicon	1,188.34 ± 1,197.10	1,407.12 ± 1,417.49
Sulfur	1,881.85 ± 1,067.94	430.14 ± 244.10
Chlorine	899.05 ± 791.57	3,782.46 ± 3,330.27
Potassium	443.17 ± 593.33	834.52 ± 1,117.27
Calcium	449.83 ± 258.28	1,127.95 ± 647.65
Titanium	83.29 ± 36.31	402.00 ± 175.23
Vanadium	11.99 ± 8.53	14.23 ± 10.13
Manganese	644.04 ± 200.52	4,454.68 ± 1,386.93
Iron	335.06 ± 145.40	3,194.28 ± 1,386.13
Copper	23.70 ± 29.56	141.62 ± 176.63
Zinc by XRF	73.23 ± 49.07	219.86 ± 147.34
Mercury	2.75 ± 0.72	18.03 ± 4.71
Lead	17.74 ± 12.28	59.75 ± 41.37
Selenium	17.72 ± 9.44	−78.12 ± −41.60
Bromine	−1.22 ± −1.08	25.51 ± 22.60
Strontium	−3.13 ± −1.05	60.79 ± 20.48
NH_3	55.13[a] ± 29.21[a]	42.62[a] ± 22.58[a]
EC	5.32[a] ± 1.91[a]	296.17[a] ± 106.47[a]
OC	4.55[a] ± 1.75[a]	179.84[a] ± 69.13[a]

[a] Measured in mg/mi.

Glenda Project – Weatherpak Ground Station

Coastal Environmental Wireless HazMat Weather Station

Sigma Theta Overview

Frank Pasquill took the next step, and determined levels of Sigma Theta for differing degrees of atmospheric stability. He created a seven tiered system from "A" to "G", where Class "G" reflects the most stable atmospheric condition, to Class "A" which reflects the highest level of atmospheric in-stability.

His results are shown in the table below:

Stability Class		Description	Definition
1	A	Extremely Unstable	$22.5 \leq \sigma_\theta$
2	B	Moderately Unstable	$17.5 \leq \sigma_\theta < 22.5$
3	C	Slightly Unstable	$12.5 \leq \sigma_\theta < 17.5$
4	D	Neutral	$7.5 \leq \sigma_\theta < 12.5$
5	E	Slightly Stable	$3.8 \leq \sigma_\theta < 7.5$
6	F	Moderately Stable	$2.1 \leq \sigma_\theta < 3.8$
7	G	Extremely Stable	$\sigma_\theta < 2.1$

Based on this Stability Class table, we can now make determinations of atmospheric stability based on ground station data and not have to rely on balloon launched radiosondes, or rocket launched payloads.

Table 8. DEFINITION OF THE PASQUILL ATMOSPHERIC STABILITY CATEGORIES

Surface wind speed at 10 m (m/s)	Day: Incoming solar radiation			Night	
	Strong	Moderate	Slight	Thinly overcast or ≥4/8 low cloud cover	≤3/8 Cloud cover
<2	A	A-B	B		
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
>6	C	D	D	D	D

SOURCE: Pasquill, 1961.

Note: Types a, b, and c are associated with strong, moderate, and slight instability, respectively; type d corresponds to a neutral lapse and should be assumed for overcast conditions during day or night; and types e and f are associated with slight and moderate inversions, respectively.

each stability class corresponding to the six classes defined by Pasquill (1961). The surface roughness is also considered. It is expected that this parameterization is more appropriate than the Pasquill values for distances between 1 and 50 km. The horizontal dispersion coefficient, σy (m), for rural conditions is calculated for the downwind distance, x (m), using the formula

$$\sigma_y = \alpha x (1 + 0.0001x)^{0.5} \quad \text{(II-4)}$$

The vertical dispersion coefficient, σz (m), for rural conditions is calculated using the formula

$$\sigma_z = p x (1 + qx)^r. \quad \text{(II-5)}$$

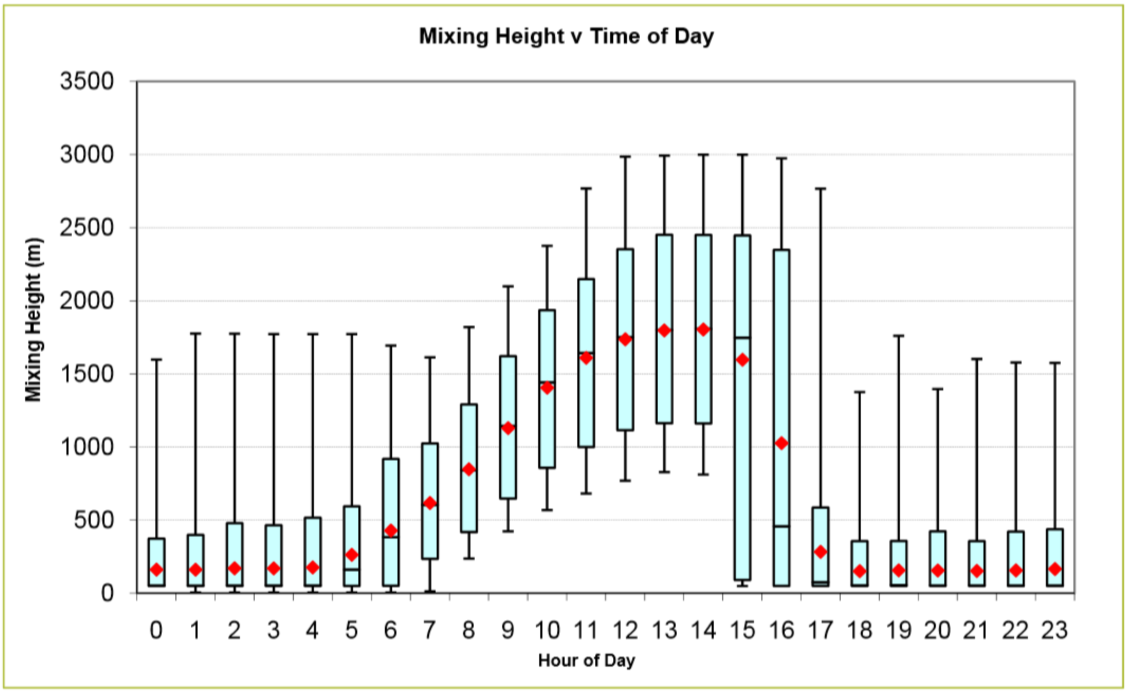
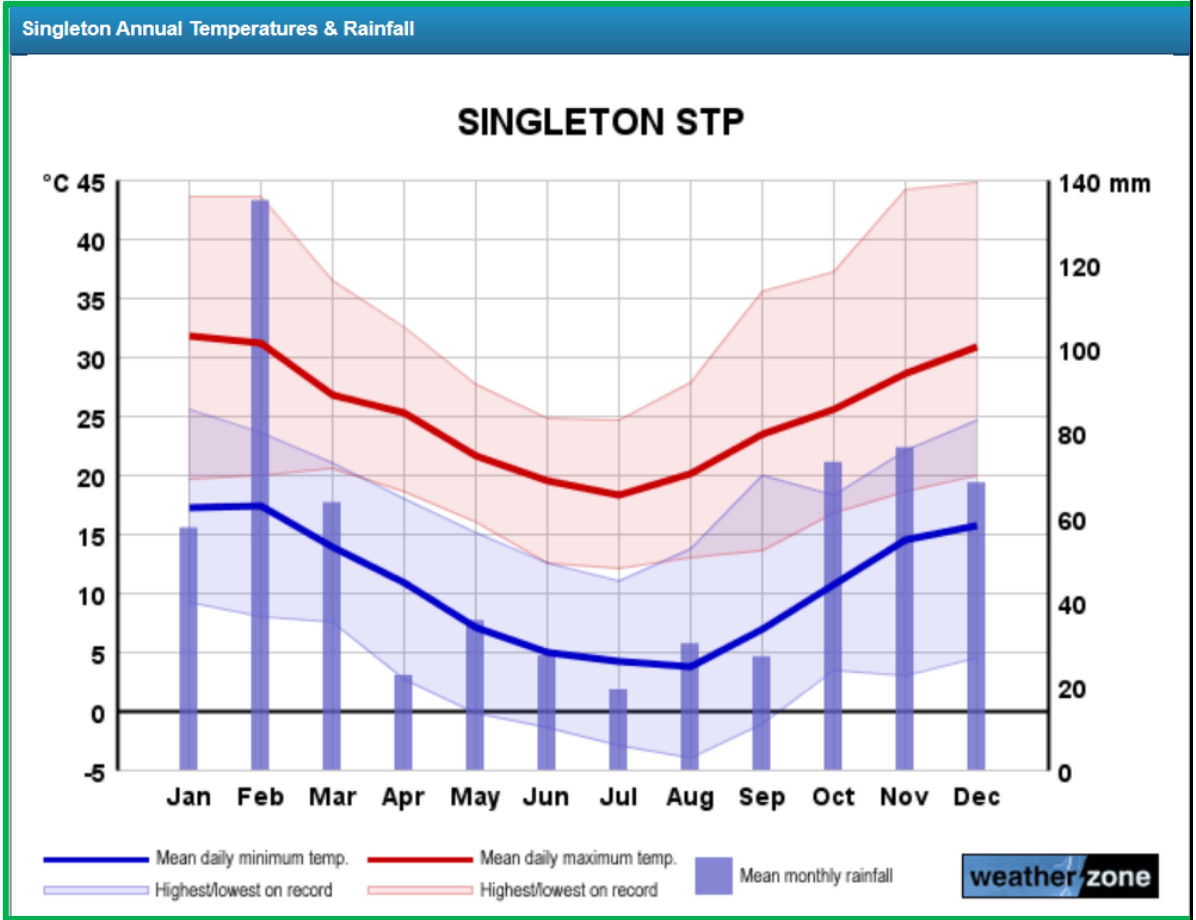


Figure 5.5: Mixing Height by Hour of the Day (generated by CALMET)

Maules Creek PAE Holmes 2011



2002 to 2017 Records

Table 7 provides an abbreviated summary of stack test results for select pollutants, reviewed for the period 2011-2016. A full summary table of results is included in section 3 of Attachment C.

Table 7: Maximum and average reported results of air pollutants from stack sampling reports (2011-2016)

		Solid Particles (Total) (mg/m^3)	Total Fluoride (mg/m^3)	Sulfuric Acid Mist (H_2SO_4 as SO_3) (mg/m^3)	Mercury (mg/m^3)	NOx (as Equivalent NO_2) (mg/m^3)	Hydrogen Chloride (mg/m^3)	Chlorine (mg/m^3)
Bayswater	Licence Limit	*100*	*50*	*100*	*1*	*1500*	*100*	*200*
	Average	15	13	13	0.0014	659	13	19
	Max	68	**54**	55	0.0053	940	24	200
Liddell	Licence Limit	*100*	*50*	*100*	*1*	*1500*	*100*	*200*
	Average	24	11	9	0.0004	724	14	0.04
	Max	58	17	58	0.0015	930	28	0.20
Mount Piper	Licence Limit	*50*	*50*	*100*	*0.2*	*1500*	*100*	*200*
	Average	11	6	21	0.0010	767	1	1.3
	Max	39	11	**120**	0.0019	1200	2	13
Eraring	Licence Limit	*50*	*50*	*100*	*0.2*	*1100*	*100*	*200*
	Average	9	10	11	0.0010	415	4	0.40
	Max	19	32	68	0.0022	593	13	1.8
Vales Point	Licence Limit	*100*	*50*	*100*	*1*	*1500*	*100*	*200*
	Average	2	3	15	0.0012	881	4	1.1
	Max	7	12	42	0.0078	1099	8	3.8

Notes:

- **Cells in bold text exceeded the EPL concentration limit.**
- **Emission limits in italics.**

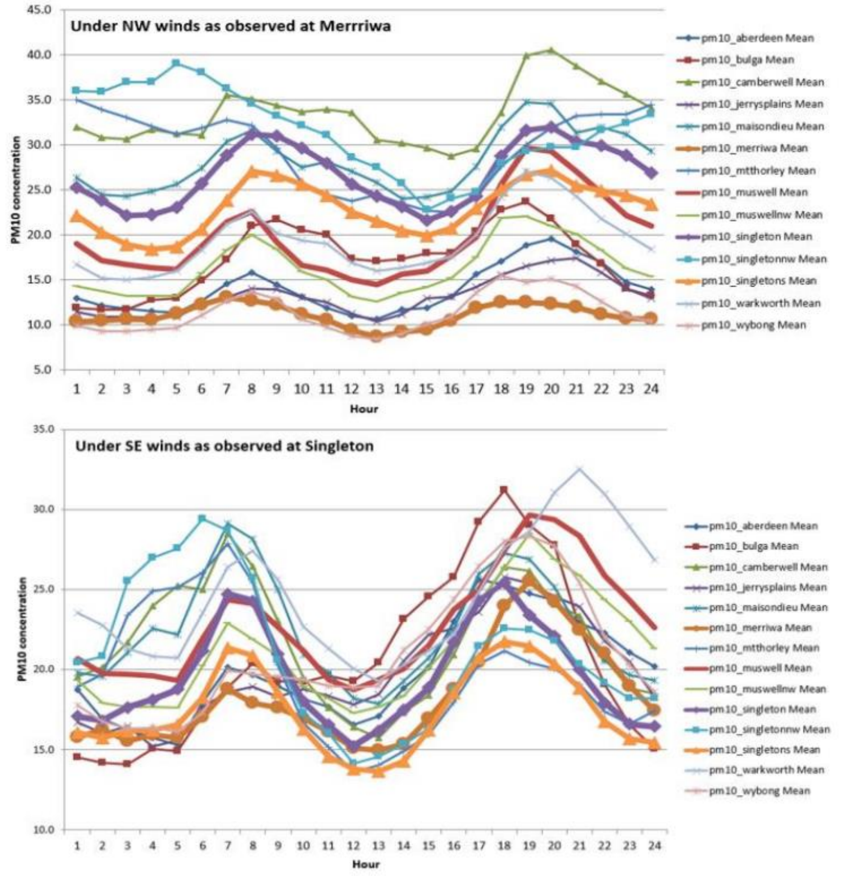


Figure 25: Diurnal variations of PM_{10} concentrations by site under NW and SE wind conditions. The curves for Singleton, Singleton South (singletons), Muswellbrook (muswell) and Merriwa are highlighted with thicker lines

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Real Time Air Quality Triggers

This section refers to Real Time air quality trigger levels. The real time air quality monitors have been setup to record directional dust sources. Alarms have been set up to trigger when one the following criteria is exceeded. The criteria are summarised below:

- Yellow Dust Alarm
  - Short Term Trigger is a site specific contribution 30 mins rolling average greater than 80 µg/m^3;
  - Long Term Trigger is a site specific contribution 24-h rolling average greater than 40 µg/m^3;
- Orange Dust Alarm
  - Short Term Trigger is a site specific contribution 1-h rolling average greater than 80 µg/m^3; or
  - Long Term Trigger is a site specific contribution 24-h rolling average greater than 45 µg/m^3.
- Red Dust Alarm
  - Short Term Trigger is a site specific contribution 1-h rolling average greater than 200 µg/m^3; or
  - Long Term Trigger is a site specific contribution 24-h rolling average greater than 50 µg/m^3.