

REPORT ON FINDINGS

Geraldton Community Air Quality Monitoring Program

March 2012 to February 2013



A partnership project between MMG Ltd and
Geraldton Port Authority



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ATTACHMENT A – Air Quality Monitoring Program Plan

ATTACHMENT B – Air Quality Data

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1. Executive Summary

A 12 month community air quality monitoring program was established via a partnership arrangement with the Minerals Metals Group (MMG) and Geraldton Port Authority (GPA) commencing March 2012 and completing February 2013. The key purpose of the program was to confirm that bulk shiploading of lead, copper and zinc out of Geraldton Port poses no community health risk.

An analysis of data collected during the program shows that the average ambient air concentration of lead, copper and zinc was very low at all community monitoring sites. This indicates there is no health risk to the community associated with dust emissions from these metal concentrates loading at Geraldton Port.

2. Purpose

The purpose of this report is to review the results of the 12 month MMG/GPA community air quality monitoring program for lead, copper and zinc and provide recommendation on the project's future.

The objective of the community air quality monitoring program was to provide scientific data on air quality within the Geraldton community, in particular levels of copper, zinc and lead to determine whether there is potential for air quality impacts related to Geraldton Port operations.

An Air Quality Monitoring Plan was developed by MMG and GPA and is included as Attachment A. This plan outlines the scope and method of the air quality monitoring program.

3. Background

Under the *Environmental Protection Act 1986* Geraldton Port is a prescribed premise; Category 58 of Schedule 1 in the *Environmental Protection Regulations 1987* – “Bulk material loading or unloading: premises on which clinker, coal, ore, ore concentrate or any other bulk granular material is loaded onto or unloaded from vessels by an open materials loading system”. Accordingly, Geraldton Port operates under a licence for prescribed premises, licence number L4275/1982/14, issued by Department of Environment and Conservation (DEC).

In 2009, DEC amended license conditions, introducing a requirement to implement and report on an air quality monitoring program for the period of all ship loading events where metal concentrates are loaded. The licence has since been amended a number of times.

The current ambient air emission concentration limits and targets prescribed by the DEC licence are outlined in Table 1 and 2. These emission concentrates apply to the Geraldton Port boundary and add context to the results of the community air quality monitoring program.

Table 1 – Ambient air emission limit

Emission	3 month rolling average
Lead as TSP	0.5 µg/m ³

Table 2 – Ambient air emission targets

Emission	24 hour ambient concentrate
Copper as PM10	1.0 µg/m ³
Zinc as PM10	50 µg/m ³
Lead as PM ₁₀ (Berth 1, Lemmon Rd and Port Way stations)	0.5 µg/m ³
Lead as PM ₁₀ (Connell Road)	2.0 µg/m ³
Dust as PM ₁₀	50 µg/m ³
Dust as TSP	90 µg/m ³
Nickel as TSP	0.14 µg/m ³

Under the 2009 amended licence, the first shipment of lead concentrate from the Geraldton Port occurred in October 2010; approximately 5,000 tonnes were loaded. During this shipment one of the high volume (HiVol) monitors (representing the seaward, northern boundary of the Port), detected lead at an average concentration of 4.2 µg/m³ over a 24 hour sampling period. Monitors on the land side of the Port did not detect elevated levels. A formal investigation followed and a number of improvements were made to the loading method and operational practices.

To determine whether there had been any significant change in the level of lead and other metal levels within the community, a survey was conducted by the Department of Health (DOH), the DEC Pollution Response Unit and Department of Transport (DOT) in January 2011. A report on the findings was prepared by DOH; in summary the survey outcomes were:

- 31 community soil samples were taken from 23 locations; none were above Health Investigational Levels (HILs).
- 60 rainwater tank samples were taken from 27 domestic tanks, only one sample exceeded the Australian Drinking Water Guideline for lead and one sample for zinc – the Port was discounted as a source in both situations.
- 21 surface dust samples were taken from 21 locations; there was no evidence of accumulation over time.
- 11 soil samples were taken from 11 locations within the Geraldton Port operational area. Copper and zinc results were assessed against HILs for commercial industrial sites while lead results were assessed against HILs for residential sites. Exceedances for copper, lead and zinc were found in the immediate shiploading areas. No exceedances were found at the Port perimeter.
- Heavy metals detected in the community were well below respective health guidelines and do not pose a health risk to the residents.
- The levels of lead at the Port boundary had decreased with respect to a previous study in 2007 indicating improved hygiene practices at the port.

One of the recommendations made in the report was for air quality monitoring for metals outside the Port in community areas.

As a result of this recommendation MMG and GPA formed a partnership community monitoring program with the intention of gathering ambient air quality data for an initial period of 12 months with a review at that time as to the merits of continuing the program.

4. Metal Concentrates Handled at Geraldton Port

Tables 3 and 4 show copper, zinc and lead products handled through Geraldton Port from March 2012 to February 2013. It should be noted that ship loading may not have been continuous during the ship loading days.

It should be noted that nickel commenced loading through Geraldton Port for the first time in November 2012; some nine months after the community monitoring program commenced. This product was not considered for inclusion in the project scope due to its timing and not being an MMG product.

Table 3 – Metal Concentrates Handled at Geraldton Port - March 2012 to February 2013

Product	Product Owner	Loaded by Berth 4 Shiploader	Loaded via Container	No of Vessels Loaded with this Cargo
Heavy Precious Metals (lead)	MMG	ü		5
Copper concentrate	MMG	ü		12
Copper concentrate	IGO	ü		4
Copper concentrate	Sandfire Resources		ü	6
Copper direct shipping ore (DSO)	Sandfire Resources		ü	5
Zinc concentrate	MMG	ü		8
Zinc concentrate	IGO	ü		9

Table 4 – Number of Days Copper, Zinc and Lead Loaded - March 2012 to February 2013

Month	Copper	Zinc	Lead
March 2012	5	4	4
April 2012	6	1	
May 2012	6	2	1
June 2012	4	2	1
July 2012	6	4	
August 2012	5	2	
September 2012	12	4	3
October 2012	8	3	
November 2012	10	3	2
December 2012	24	2	1
January 2013	2	1	
February 2013	8	3	

Note: More than one product may have loaded in the same 24 hour period, hence Table 4 and Figure 1 totals differ

Figure 1 shows the approximate number of days concentrate ships were loaded in Geraldton Port for the monitoring period. It should be noted that this chart shows ships loaded for all product owners, not just MMG vessels.

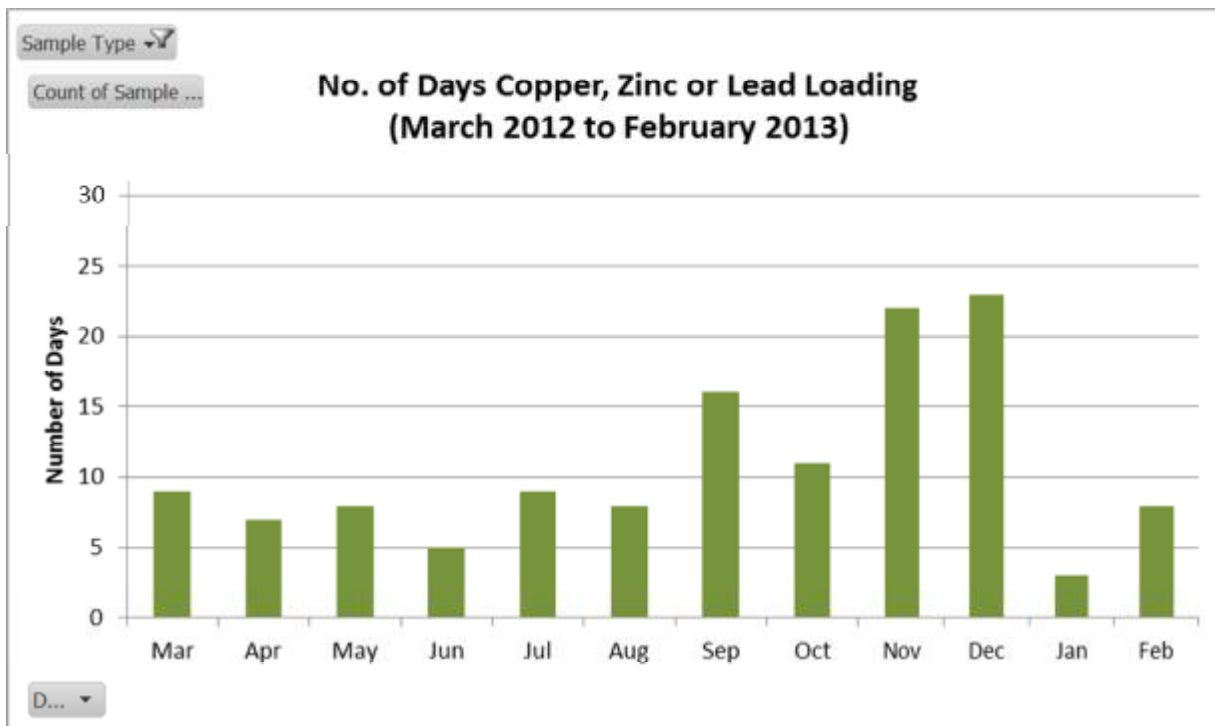


Figure 1 – Number of Days Copper, Zinc or Lead Loading at Geraldton Port

5. Dust Monitoring Data

Four community air quality monitoring sites were established as shown in Figure 2. The Durlacher Street site is a reference site and the other three sites are intended to represent impact sites.

Two HiVol air samplers are located at each site; one with a TSP inlet to collect total suspended dust particles and one with a PM10 size selective inlet to collect the fraction of equivalent aerodynamic diameter (EAD) of less than 10µm.

Sample periods were 24 hour periods commencing at 12 noon as follows:

- background monitoring – every six days (or alternated if metal concentrarte loading is taking place);
- ship loading event – daily when MMG or IGO concentrate shipments loaded;
- post-shipment monitoring – the day after an MMG or IGO concentrate ship finishes loading.

Results are outlined in section 6 of the report.

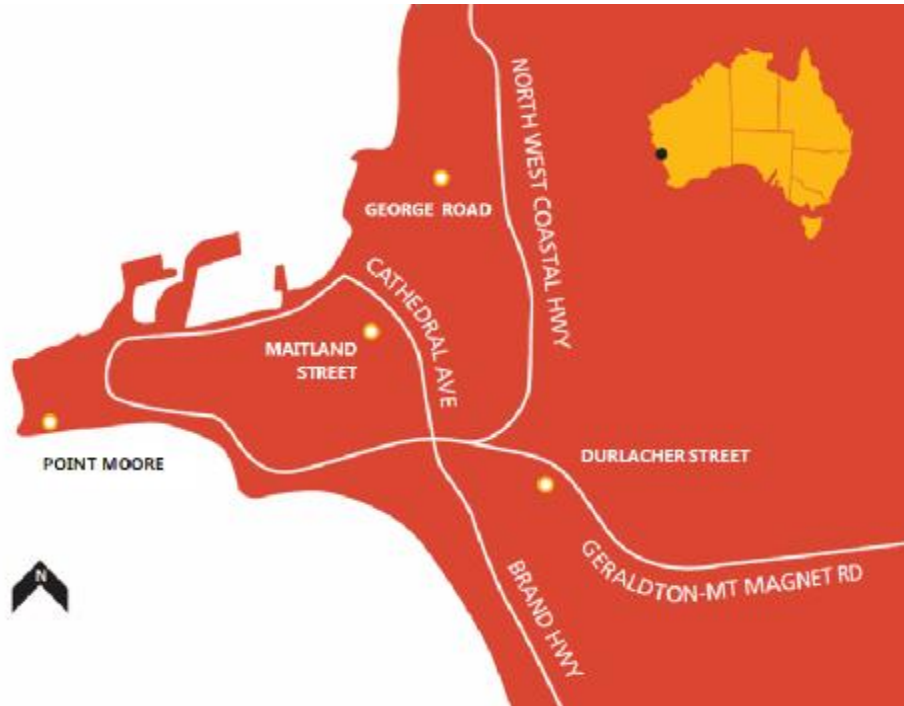


Figure 2 – Community Air Quality Monitoring Sites

6. Results

All results are for the period 1 March 2012 to 20 February 2013 and are based on 24 hour averages (noon to noon).

Filters from each community monitoring site were analysed by Australian Reference Laboratory (ARL), a NATA accredited laboratory, for dust, lead, copper and zinc as TSP and PM₁₀. The limit of reporting for all metals is 0.01 µg/m³. Where the result was lower than the limit of reporting, it is recorded at half the limit of reporting (0.005 µg/m³) for the purpose of assisting analysis and graphing.

Results are summarised in this section of the report and raw data is available in Attachment B.

6.1 Lead as TSP

The National Environment Protection (Ambient Air Quality) Measure (NEPM) establishes a national air quality standard for lead of 0.50 µg/m³ averaged over one year. Results for lead as TSP averaged over a 24 hour period are summarised in Table 5 and detailed in Figure 3.

Table 5 – Lead as TSP Summary Results

	Point Moore	Maitland Street	George Road	Durlacher Street (reference site)
Average	0.008 µg/m ³	0.006 µg/m ³	0.006 µg/m ³	0.006 µg/m ³
Minimum	0.005 µg/m ³	0.005 µg/m ³	0.005 µg/m ³	0.005 µg/m ³
Maximum	0.130 µg/m ³	0.060 µg/m ³	0.030 µg/m ³	0.010 µg/m ³

The average result for lead at all impact sites over the program period was between 0.006-0.008 µg/m³. Average results for impact sites were consistent with the reference site apart from Point Moore which was slightly above. The highest annual average result (Point Moore) was less than 2% of the NEPM national air quality standard for lead of 0.50 µg/m³ averaged over one year.

The highest result for Point Moore of 0.13 µg/m³ on 6 July 2012 represents an outlier in the data. Removal of this result from the data set would provide an average of 0.007 µg/m³. Refer to section 6.6 for discussion.

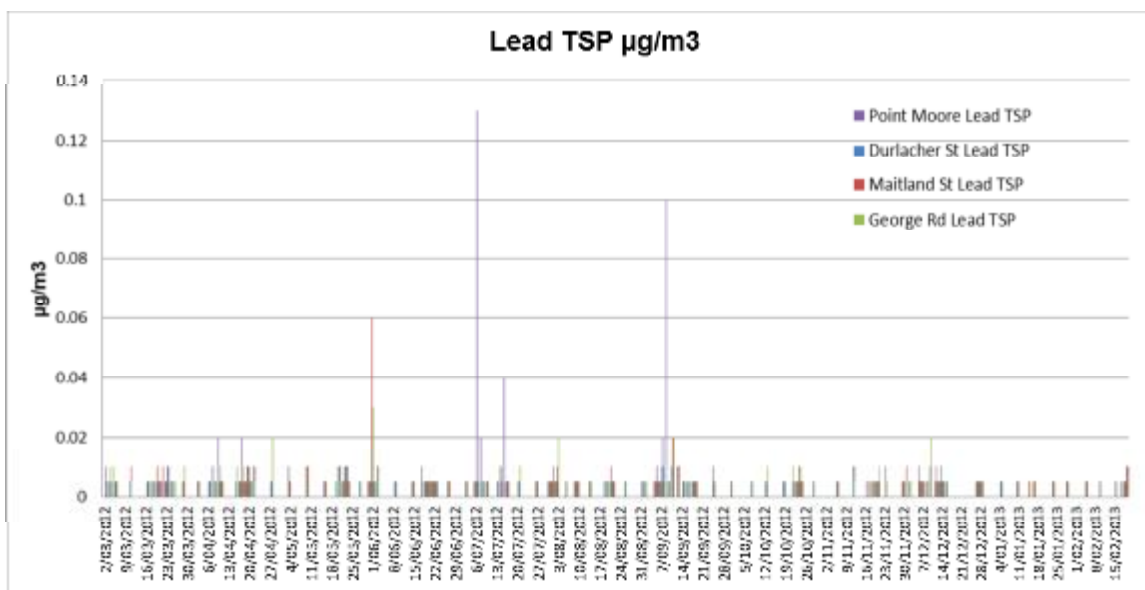


Figure 3 – Lead Results

6.2 Copper as PM₁₀

There is no NEPM air quality standard for copper. As a guide DEC has set a target boundary emission of 1.0 µg/m³ PM₁₀ over a 24 hour average period as part of the GPA's environmental licence conditions. Results for copper as PM₁₀ are summarised in Table 6 and Figure 4.

Table 6 – Copper as PM₁₀ Summary Results

	Point Moore	Maitland Street	George Road	Durlacher Street (reference site)
Average	0.009 µg/m ³	0.007 µg/m ³	0.008 µg/m ³	0.007 µg/m ³
Minimum	0.005 µg/m ³	0.001 µg/m ³	0.005 µg/m ³	0.005 µg/m ³
Maximum	0.130 µg/m ³	0.040 µg/m ³	0.040 µg/m ³	0.040 µg/m ³

The average copper result for all impact sites over the program period was between 0.007-0.009 $\mu\text{g}/\text{m}^3$ as PM_{10} . Results for impact sites are consistent with results for the reference site, except for one elevated result on 6 July 2012 (see section 6.6).

The highest result for Point Moore of 0.13 $\mu\text{g}/\text{m}^3$, 6 July 2012, represents an outlier in the data. Removal of this result from the data set would provide an average of 0.008 $\mu\text{g}/\text{m}^3$. Refer to section 6.6 for discussion.

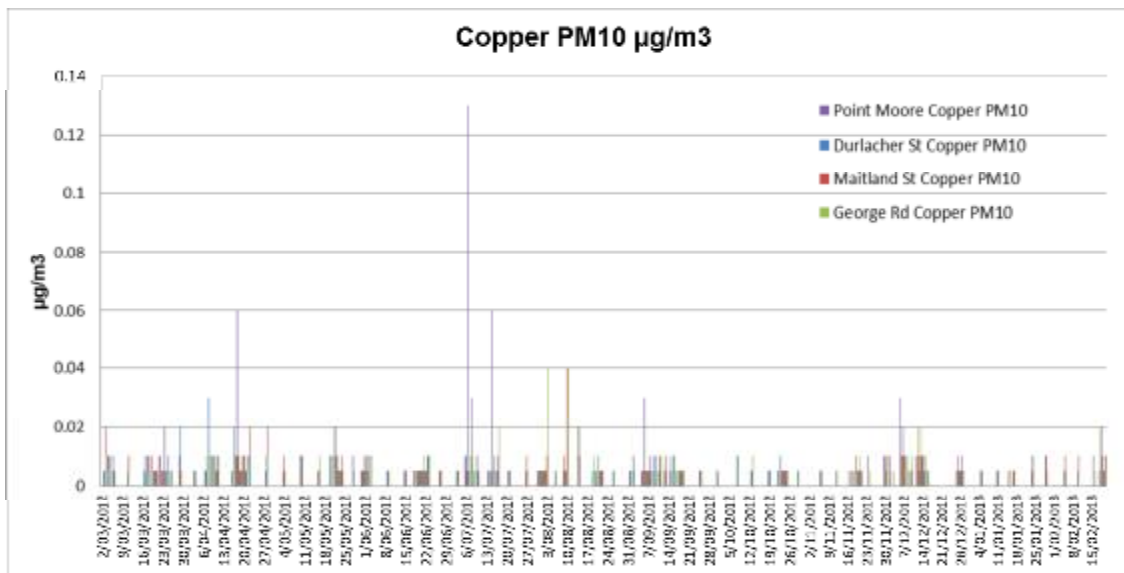


Figure 4 – Copper Results

6.3 Zinc

There is no NEPM air quality standard for zinc. As a guide, DEC has set a target boundary emission of 50 $\mu\text{g}/\text{m}^3$ PM_{10} over a 24 hour average period as part of the GPA's environmental licence conditions. Results for zinc as PM_{10} are summarised in Table 7 and Figure 5.

Table 7 – Zinc as PM_{10} Summary Results

	Point Moore	Maitland Street	George Road	Durlacher Street (reference site)
Average	0.017 $\mu\text{g}/\text{m}^3$	0.007 $\mu\text{g}/\text{m}^3$	0.008 $\mu\text{g}/\text{m}^3$	0.008 $\mu\text{g}/\text{m}^3$
Minimum	0.005 $\mu\text{g}/\text{m}^3$	0.001 $\mu\text{g}/\text{m}^3$	0.005 $\mu\text{g}/\text{m}^3$	0.005 $\mu\text{g}/\text{m}^3$
Maximum	0.960 $\mu\text{g}/\text{m}^3$	0.060 $\mu\text{g}/\text{m}^3$	0.090 $\mu\text{g}/\text{m}^3$	0.050 $\mu\text{g}/\text{m}^3$

The average zinc result for all impact sites over the program period was between 0.008-0.017 $\mu\text{g}/\text{m}^3$ as PM_{10} . Average results for Maitland Street and George Road impact sites are slightly lower than results for the reference site. The average for Point Moore was elevated compared with the reference site but remains low at 0.017 $\mu\text{g}/\text{m}^3$.

The highest result was 0.96 $\mu\text{g}/\text{m}^3$ at Point Moore station for the period noon 6 July 2012 to noon 7 July 2012. During this 24 hour period, MV Cape Scott was being loaded at Berth 4 with MMG zinc concentrate. This product contains between 30-60% zinc. Refer to section 6.6 for further discussion.

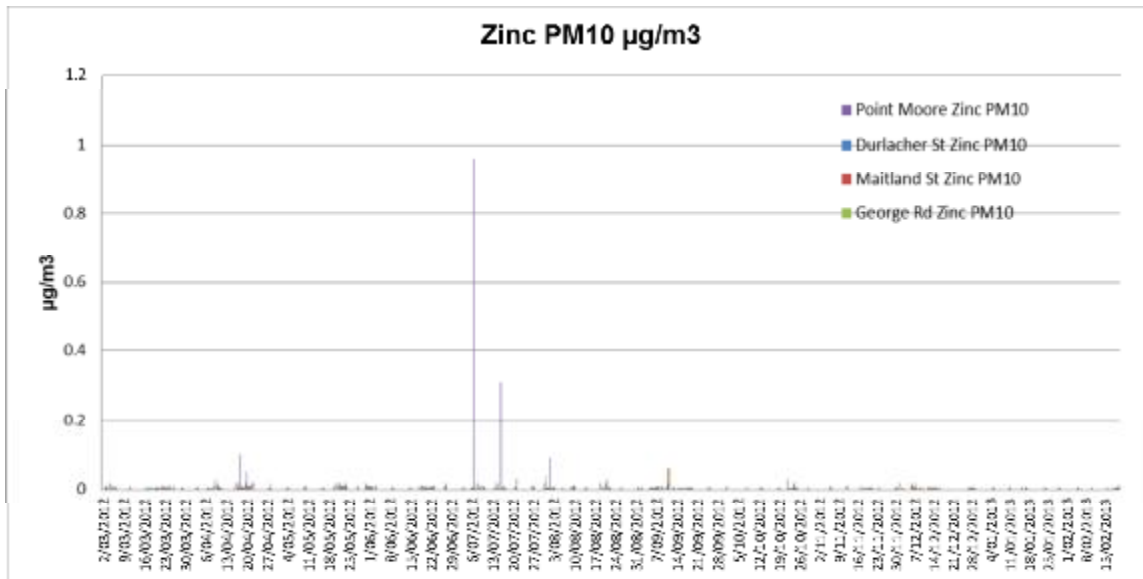


Figure 5 – Zinc Results

6.4 Dust as PM₁₀

The NEPM standard for dust as PM₁₀ is 50 µg/m³ averaged over a 24 hour period. Results for dust as PM₁₀ are summarised in Table 8.

Table 8 – Dust as PM₁₀ Summary Results

	Point Moore	Maitland Street	George Road	Durlacher Street (reference site)
Average	42 µg/m ³	23 µg/m ³	21 µg/m ³	19 µg/m ³
Minimum	5 µg/m ³	5 µg/m ³	5 µg/m ³	5 µg/m ³
Maximum	100 µg/m ³	110 µg/m ³	110 µg/m ³	60 µg/m ³

The lowest results were from Durlacher Street with an average of 19 µg/m³ and a maximum of 60 µg/m³. The highest 24 hour result was obtained from Maitland Street and George Road sites with 110 µg/m³. The highest average was at Point Moore (42 µg/m³) which recorded 27 days of results above 50 µg/m³.

The source of elevated dust could be from a number of sources including Port operations, the sandy coastline surrounding the Point Moore site from the SE to the NW, localised dust (for example mowing) and background dust during strong winds. Results above 50 µg/m³ are shown in Table 9 including whether or not a concentrate ship was loading. There does not appear to be an obvious trend linking elevated PM₁₀ dust results to metal concentrate shiploading at the Port.

Table 9 – Dates with Results over 50 µg/m³

Date	Concentrate ship loading?	Point Moore PM ₁₀ 24 hour average	Durlacher Street PM ₁₀ 24 hour average	George Road PM ₁₀ 24 hour average	Maitland Street PM ₁₀ 24 hour average
4/3/2012	Yes	60			
3/4/2012	No	90			
7/4/2012	Yes	60			
11/4/2012	No	70			

Date	Concentrate ship loading?	Point Moore PM ₁₀ 24 hour average	Durlacher Street PM ₁₀ 24 hour average	George Road PM ₁₀ 24 hour average	Maitland Street PM ₁₀ 24 hour average
23/5/2012	Yes	91			
28/5/2012	No	52			
21/7/2012	No	80			
2/8/2012	Yes	60			
2/9/2012	No	70			
16/9/2012	Yes	60			
17/9/2012	Yes	60			
18/9/2012	Yes	80			
19/9/2012	No	60			
25/9/2012	No	60			
1/10/2012	No	70			
2/12/2012	Yes				70
3/12/2012	Yes	80			
8/12/2012	Yes	100			60
9/12/2012	Yes	70			
10/12/2012	Yes	60			
12/12/2012	Yes	60			
29/12/2012	No	70			
5/01/2013	No	90	60		
11/01/2013	Yes				60
29/01/2013	No	60			
10/02/2013	No	60			
18/02/2013	Yes	80			60
19/02/2013	Yes	90		110	110
20/02/2013	Yes	90			

6.5 Dust as TSP

There is no NEPM air quality standard for dust as TSP. As a guide, the DEC has set a target boundary emission of 90 µg/m³ over a 24 hour average period as part of the GPA's environmental licence conditions. Results are summarised in Table 10.

Table 10 – Dust as TSP Summary Results

	Point Moore	Maitland Street	George Road	Durlacher Street (reference site)
Average	81 µg/m ³	41 µg/m ³	39 µg/m ³	33 µg/m ³
Minimum	10 µg/m ³	5 µg/m ³	5 µg/m ³	5 µg/m ³
Maximum	260 µg/m ³	150 µg/m ³	110 µg/m ³	100 µg/m ³

Consistent with other data, the results for Point Moore were the highest; the average result was 81 µg/m³ with a maximum of 260 µg/m³ on 18 September 2012. The other three sites averaged 33-41 µg/m³ over a 24 hour period.

6.6 Anomaly on 6 July 2012

An unusually high result for copper and lead was recorded at the Point Moore station on 6 July 2012. Zinc was also elevated compared with usual results. This monitoring period was from noon on 6 July 2012 to noon on 7 July 2012. During this 24 hour period, MV Cape

Scott was being loaded at Berth 4 with MMG copper concentrate and MMG zinc concentrate. The copper concentrate contains between 16-28% copper and less than 10% lead sulphide. The zinc concentrate contains between 30-60% zinc and less than 10% lead sulphide.

A wind rose for this 24 hour period is show in Figure 6 and shows that the predominate wind was from the ENE quadrant. The Point Moore site is approximately downwind for winds from this direction.

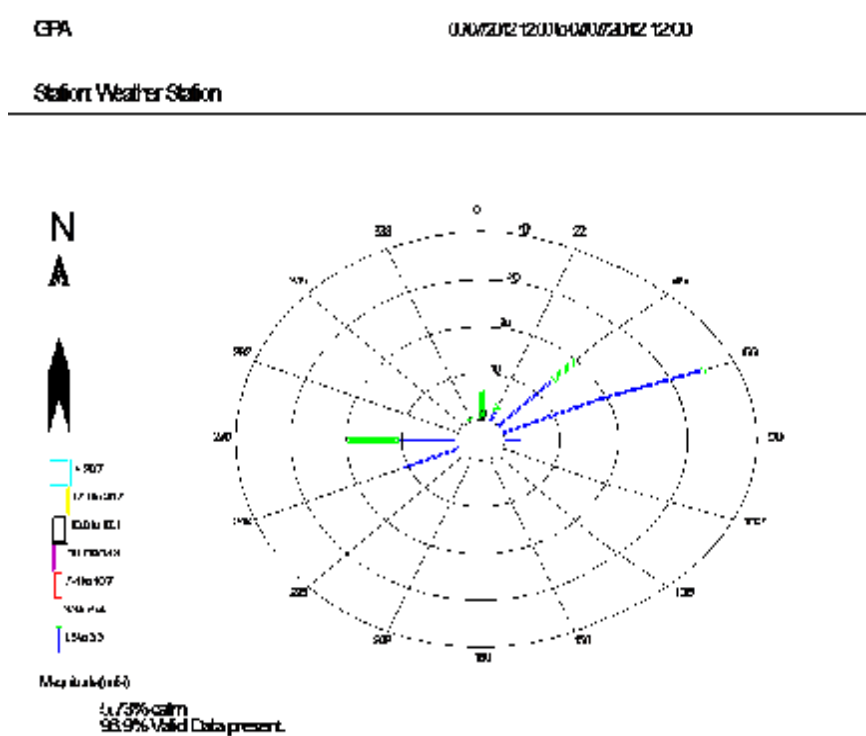


Figure 6 – Wind Rose Noon 6/7/2012 to noon 7/7/2012

7. Incidents

There were several vandalism incidents associated with the Durlacher Street reference site as listed in Table 11, eventually culminating in a decision to decommission this reference site prematurely.

Table 11 – Recorded Incidents

Date	STEMS Ref. #	Incident Description	Impact on Program
25/9/12	1536	<ul style="list-style-type: none"> The power to both high volume dust monitors was switched off. Deflector plate stolen from both high volume samplers. Power leads stolen. 	<ul style="list-style-type: none"> Minimal inconvenience/impact. 1 x 24 hour data period lost
19-22/10/12	1568	<ul style="list-style-type: none"> Power had been turned off on both high volume samples. PVC fittings stolen from both samplers. A radio antenna and cap for 	<ul style="list-style-type: none"> Units were not operational for 17 monitoring days until security fence could be constructed. Delays and costs to install

Date	STEMS Ref. #	Incident Description	Impact on Program
		other GPA equipment stolen.	an additional (second) 2.4 metre security fence around the monitoring site. <ul style="list-style-type: none"> Over \$1,150 worth of damage to other GPA equipment.
12/11/12	1592	<ul style="list-style-type: none"> Hi-vol inlet plate, wire mesh and deflector plate were stolen (recovered 2 weeks later). 	<ul style="list-style-type: none"> Monitors were not operating due to the incident on 19-22/10/2012; awaiting fencing to be constructed.
18/1/13	1696	<ul style="list-style-type: none"> Newly installed fence was cut in two places – see Figure 7. Hi-vol PVC fittings were stolen. PM10 inlet, power leads, antenna and temperature gauge damaged and/or stolen. 	<ul style="list-style-type: none"> It was decided not to undertake any further background sampling at this reference site to avoid further damage to equipment. Due to the long lead time involved in locating an alternate site, no further data was collected from a reference site.



Figure 7 – Damage by vandals at Durlacher Street monitoring site

8. Conclusion

The average ambient air concentrate of lead, copper and zinc was very low at all community monitoring sites indicating there is no risk to the community from loading of metal concentrates containing lead, copper or zinc at Geraldton Port. Results at Point Moore were noted to be consistently higher than the other three monitoring sites.

9. Recommendation

The following recommendations are made:

1. As there is no evidence to suggest a risk to the health of the community from loading of lead, copper or zinc products at Geraldton Port it is recommended that the MMG/GPA community monitoring partnership program be finalised.
2. A copy of the report to be provided to the Department of Environment and Conservation and the Department of Health for their records.

ATTACHMENT A

Community Air Quality Monitoring Program Plan

ATTACHMENT B

Air Quality Data

Date 24 hr Sample Commenced @ 12 noon	Sample Type	Point Moore Dust PM ₁₀	Durlacher St Dust PM ₁₀	Maitland St Dust PM ₁₀	George Rd Dust PM ₁₀	Point Moore Dust TSP	Durlacher St Dust TSP	Maitland St Dust TSP	George Rd Dust TSP	Point Moore Copper PM ₁₀	Durlacher St Copper PM ₁₀	Maitland St Copper PM ₁₀	George Rd Copper PM ₁₀	Point Moore Zinc PM ₁₀	Durlacher St Zinc PM ₁₀	Maitland St Zinc PM ₁₀	George Rd Zinc PM ₁₀	Point Moore Lead TSP	Durlacher St Lead TSP	Maitland St Lead TSP	George Rd Lead TSP	
5/1/2013	Background	90	60		50	160		100	70	0.005	0.005		0.005	0.005	0.005		0.005	0.005		0.005	0.005	
11/1/2013	Concentrate			60	50			90	80			0.005	0.005			0.005	0.005				0.005	0.005
15/1/2013	Background	50		20	10	110		50	30	0.005		0.005	0.005	0.005		0.005	0.005	0.005		0.005	0.005	
17/1/2013	Background	50		40	40	90		80	70	0.01		0.005	0.01	0.005		0.005	0.005	0.005		0.005	0.005	
24/1/2013	Background	50		40	40	90		60	60	0.01		0.01	0.005	0.005		0.005	0.005	0.005		0.005	0.005	
29/1/2013	Background	60		40	40	90		70	70	0.005		0.01	0.005	0.005		0.005	0.005	0.005		0.005	0.005	
5/2/2013	Background	40		40	30	70		60	50	0.005		0.01	0.005	0.005		0.005	0.005	0.005		0.005	0.005	
10/2/2013	Background	60		40	40	130		70	60	0.01		0.005	0.005	0.005		0.005	0.005	0.005		0.005	0.005	
16/2/2013	Background	50		40	30	80		60	50	0.005		0.01	0.02	0.005		0.005	0.005	0.005		0.005	0.005	
18/2/2013	Concentrate	80		60	50	130		90	110	0.02		0.01	0.005	0.005		0.005	0.005	0.005		0.005	0.005	
19/2/2013	Concentrate	90		110	110	160		150	100	0.005		0.01	0.01	0.005		0.01	0.01	0.01		0.01	0.01	
20/2/2013	Concentrate	90		50	40	150		80	70	0.01		0.005	0.03	0.005		0.001	0.09	0.005		0.005	0.01	