



Technical Ammonium Nitrate Plant

Yara Pilbara Nitrates Pty Ltd

Ambient Air Quality Monitoring Report 2022-2023

JBS&G 65496 | 154,480 (Rev 0)

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We acknowledge the Traditional Custodians of Country throughout Australia and their connections to land, sea and community.

We pay respect to Elders past and present and in the spirit of reconciliation, we commit to working together for our shared future.

Caring for Country The Journey of JBS&G
Artist: Patrick Caruso, Eastern Arrernte



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Appendices

Appendix A	Results from Monitoring of Gases
Appendix B	Results from Monitoring of TSP
Appendix C	Results from Dust Deposition Monitoring

Abbreviations and Definitions

Term	Definition	Description and context for this report
µm	Micrometre	One millionth (0.000001) of a metre
CSIRO	The Commonwealth Scientific and Industrial Research Organisation	The Commonwealth Scientific and Industrial Research Organisation is an independent Australian federal government agency responsible for scientific research.
EPBC	Environment Protection and Biodiversity Conservation	Refers to the Australian Government EPBC Act of 1999
Insoluble fraction	Component of deposited dust that is not soluble in water	Deposited dust can comprise of aqueous soluble and insoluble materials depending on mechanisms and sources of dust emissions. The insoluble fraction is typically derived from crustal materials.
MicroVol	MicroVol 1100 low volume sampler	Low volume air sampling instrument for sampling of TSP, manufactured by Ecotech
NH ₃	Ammonia	Gaseous air pollutant from natural sources and industrial sources (including YPN TAN Plant)
NO ₂	Nitrogen dioxide	Gaseous air pollutant from combustion sources
OEMP	Operational Environmental Management Plan	Management plan prepared by YPN in accordance with Condition 7 of the EPBC Approval (as varied 24 March 2020)
Passive sampling	Ambient air sampling for gaseous substances involving passive samplers	Sampling technique whereby airborne gaseous pollutants are extracted from the air column onto an adsorbent material via a diffusive mechanism
PM ₁₀	Particulate matter (10 micrometre)	Dust particles which are present in ambient air with an equivalent aerodynamic diameter of 10 micrometres (µm)
Radiello® passive sampler	Sampler for gaseous substances in ambient air	Sampling devices manufactured by Sigma Aldrich under licence from Fondazione Salvatore Maugeri IRCCS for passively monitoring airborne concentrations of gases
SO ₂	Sulfur dioxide	Gaseous air pollutant from oxidation (combustion) of sulfur containing substances
Soluble fraction	Component of deposited dust that is soluble in water	Deposited dust can comprise of aqueous soluble and insoluble materials depending on mechanisms and sources of dust emissions. The soluble fraction is typically derived from marine aerosols
TAN Plant	Technical Ammonium Nitrate Plant	YPN plant on the Burrup for production of ammonium nitrate
TSP	Total suspended particulates	Dust particles which are present in ambient air with equivalent aerodynamic diameter of 50 micrometres (µm)
YPN	Yara Pilbara Nitrates	The operator of the TAN Plant

1. Introduction

Conditions 9 and 9A of EPBC Approval 2008/4546 (as varied 24 March 2020) for the Yara Pilbara Nitrates Pty Ltd (YPN) Technical Ammonium Nitrate (TAN) Plant require monitoring of various air quality parameters. Condition 3 of the EPBC Approval outlines reporting requirements, including an analysis of monitoring data from the monitoring program carried out under condition 9A. This report is provided in response to Condition 3(a) of the EPBC Approval for the monitoring period 1 July 2022 to 30 June 2023.

2. Scope of Monitoring Program

EPBC Approval 2008/4546 required baseline monitoring to be carried out for a period of not less than 24 months from the commencement of construction of the TAN Plant. YPN issued a report to the then Department of the Environment and Energy on 16 June 2017 in compliance with the requirements of Conditions 9(a), (b), (c) and (d) (YPN 2017).

Condition 9A of EPBC Approval 2008/4546 (as varied 24 March 2020) informed the scope of the ongoing monitoring program and is reproduced below (Figure 1).

9A. To protect the values of the Dampier Archipelago (including Burrup Peninsula) National Heritage Place, particularly the rock art sites, the person taking the action must ensure:

a) Ongoing air quality monitoring is undertaken within 30 days after this condition comes into effect (the date the relevant variation to conditions notice is signed) and until expiry of the approval.

b) Air quality monitoring parameters are monitored at the rock art sites: Site 5 (Burrup Road), Site 6 (Water tanks site) and Site 7 (Hearson Cove Road site) as shown in Attachment 2.

c) Monitoring of air quality at rock art sites is undertaken by a suitably qualified person (Air Quality)

The air quality monitoring parameters in the table below must be monitored at the frequencies indicated in the table below:

<i>Element of air quality to be monitored</i>	<i>Specific air quality parameter to be sampled</i>	<i>Minimum frequency of monitoring</i>
<i>Ambient air concentration of gases</i>	<i>NH₃ (ammonia)</i>	<i>Continuous monitoring for at least 14 consecutive days, every month</i>
	<i>NO₂ (nitrogen oxide)</i>	
	<i>SO₂ (sulfur oxide)</i>	
<i>Airborne particulate concentration</i>	<i>Total suspended particulates up to 50 µm (TSP)</i>	<i>Every 6 days</i>
<i>Deposited dust</i>	<i>Total dust deposition per month (Insoluble Fraction)</i>	<i>Quarterly</i>
	<i>Total dust deposition per month (Soluble Fraction)</i>	

Figure 1: Condition 9A of EPBC Approval 2008/4546 (as varied 24 March 2020)

Condition 3(a)i of the EPBC Approval requires (in part) publication of a report that includes “...an analysis of monitoring data required under Condition 9A...”.

On 24 March 2020, approval was granted to relocate monitoring Site 7 (Deep Gorge) to accommodate the development of a boardwalk at the Ngajarli heritage site (formerly known as Deep Gorge) by Murujuga Aboriginal Corporation (MAC).

Consequently, Site 7 was relocated to Hearson Cove on 8 April 2020. This site was referred to as 'Deep Gorge' in the report for 2020-2021; however, the site is now closer to Hearson Cove and is referred to as 'Hearson Cove' herein (including in graphs where data prior to April 2020 is from monitoring at the Deep Gorge site).

Note that earlier studies carried out by CSIRO included monitoring of gaseous nitric acid (HNO_3). The EPBC Approval does not require monitoring of this substance. However, as described in the Operational Environmental Management Plan (OEMP) prepared by YPN for the EPBC Approval, YPN has continued monitoring HNO_3 since the CSIRO studies concluded. This allows for direct comparisons of current deposition rates with the rates determined since 2003.

The following reports have been issued as required by the EPBC Approval:

- October 2018 for the period 2017-2018 (Strategen 2018);
- October 2019 for the period 2018-2019 (Strategen-JBS&G 2019);
- October 2020 for the period 2019-2020 (Strategen-JBS&G 2020);
- October 2021 for the period 2020-2021 (Strategen-JBS&G 2020); and
- October 2022 for the period 2021-2022 (Strategen-JBS&G 2020).

This report presents an analysis of monitoring data obtained for the monitoring period 1 July 2022 to 30 June 2023 (referred to herein as 2022-2023).

3. TAN Plant Operation

The TAN Plant (including the nitric acid, ammonium nitrate solution and prill plants) was in operation for the following dates during the 2022-2023 monitoring period:

- 1 July 2022 (start of monitoring period) to 5 July 2022;
- 6 July 2022 to 1 August 2022;
- 3 August 2022 to 4 August 2022;
- 5 August 2022 to 27 August 2022;
- 3 September 2022 to 28 January 2023;
- 31 January 2023 to 28 February 2023; and
- 26 May 2023 to 13 June 2023.

4. Air Quality Monitoring Program

4.1 Gases

4.1.1 Results of Monitoring

Monitoring of ammonia (NH_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and nitric acid (HNO_3) gases using Radiello passive sampling was carried out continuously throughout the 2022-2023 monitoring period at the three specified monitoring sites – Site 5 Burrup Road, Site 6 Water Tanks and Site 7 Hearson Cove.

A total of 24 fortnightly measurements were made of NH₃, NO₂, SO₂ and HNO₃ concentrations at each site during the monitoring period (1 July 2022 to 30 June 2023). Sampling commenced on 1 July 2022 when samplers deployed for the previous fortnight were replaced, and sampling concluded on 30 June 2023.

Tabulated results of the monitoring are shown in Appendix A. The concentrations for each parameter at the respective sites are illustrated in Figure 2 for NH₃, Figure 3 for NO₂ and Figure 4 for SO₂. The concentrations of HNO₃ are illustrated in Figure 5

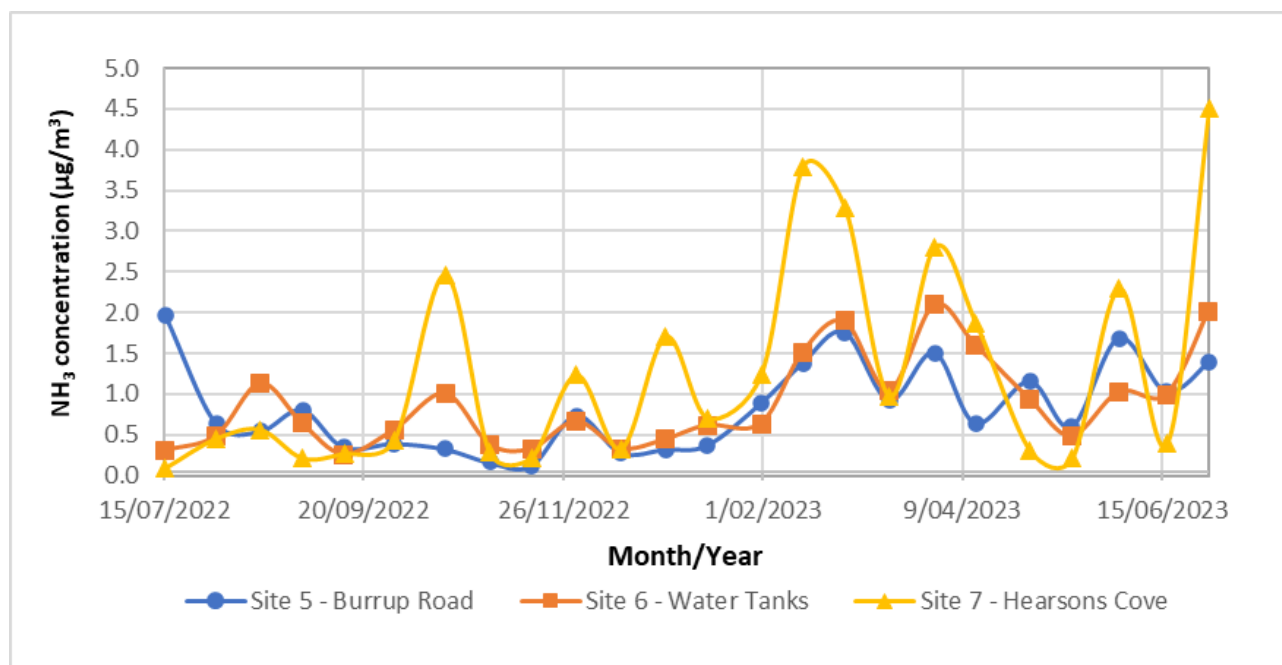


Figure 2: Measured NH₃ concentrations for 1 July 2022 to 30 June 2023

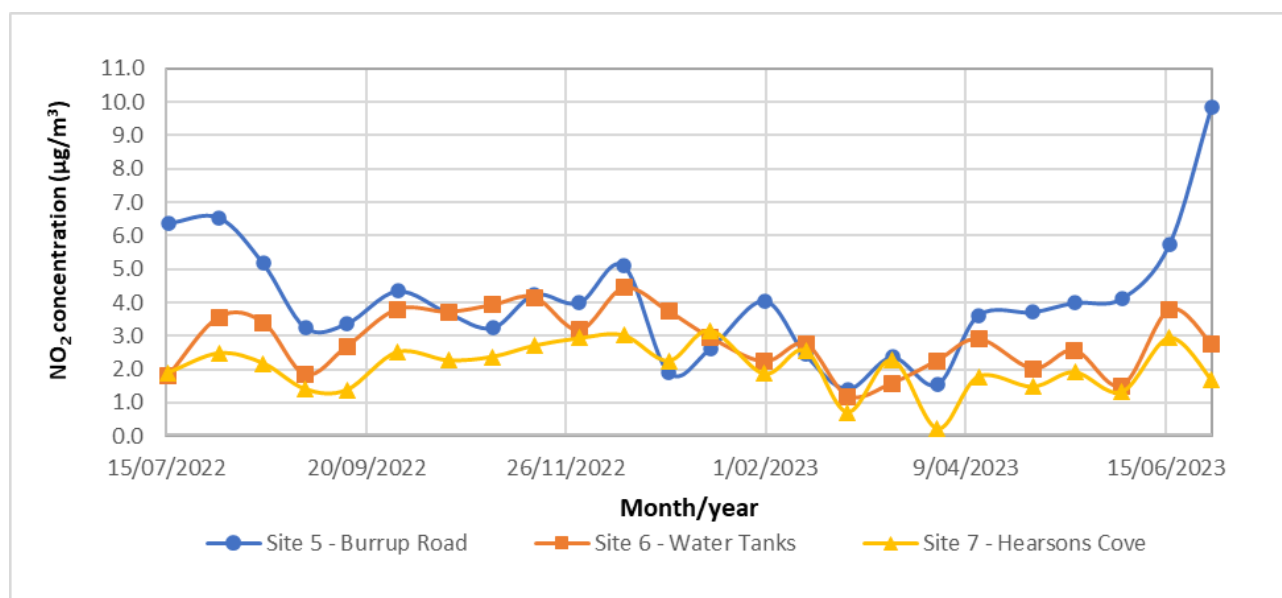


Figure 3: Measured NO₂ concentrations for 1 July 2022 to 30 June 2023

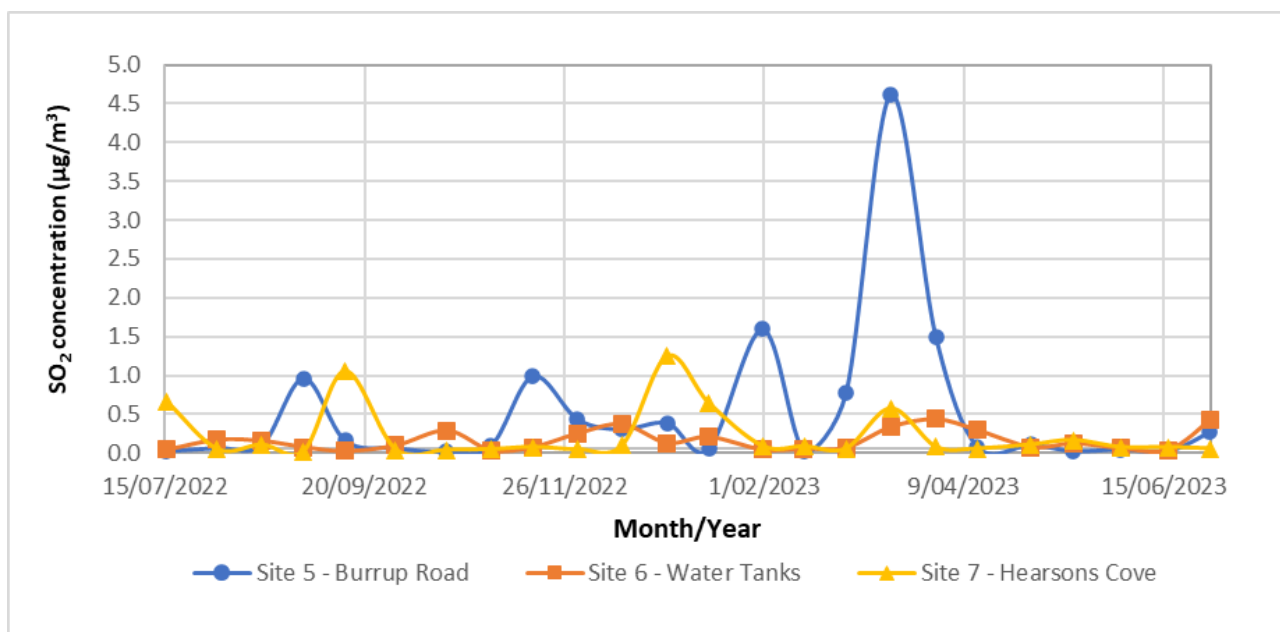


Figure 4: Measured SO₂ concentrations for 1 July 2022 to 30 June 2023

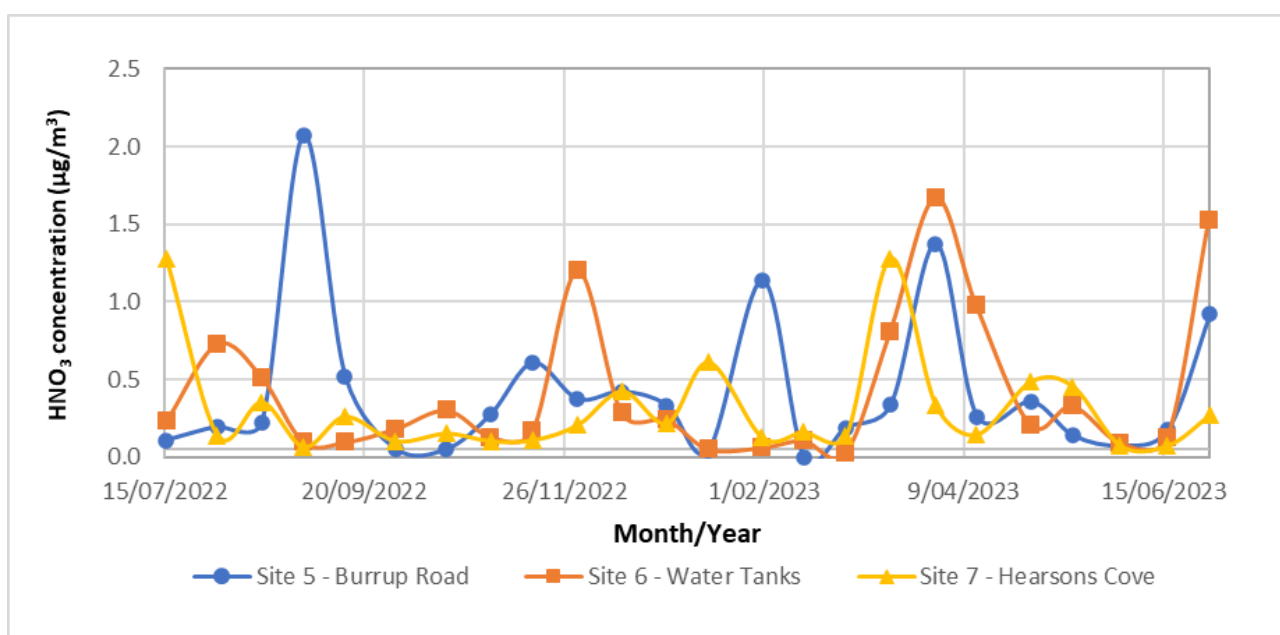


Figure 5: Measured HNO₃ concentrations for 1 July 2022 to 30 June 2023

4.1.2 Analysis of Data

Analysis of measured concentrations involved a comparison of descriptive statistics for the 2022-2023 monitoring period with those from monitoring carried out in the baseline study (YPN 2017). These statistics are shown in Table 1 for concentrations of NH₃, Table 2 for NO₂, Table 3 for SO₂ and Table 4 for HNO₃. Concentrations are calculated for the actual duration of exposure of the samplers, which were nominally 15 days but may vary a day on either side of that duration for logistical reasons.

Table 1: Descriptive statistics for NH₃ concentrations (2022-2023 and baseline)

Ammonia concentration $\mu\text{g}/\text{m}^3$						
Statistic	Site 5 - Burrup Road		Site 6 - Water Tanks		Site 7 - Hearson Cove	
	2022-2023	Baseline	2022-2023	Baseline	2022-2023	Baseline
Minimum	0.12	0	0.26	0	0.09	0
Average	0.83	0.44	0.89	0.93	1.28	0.75
Maximum	1.97	1.2	2.10	3.97	4.51	4.35
Standard deviation	0.54	0.34	0.56	0.76	1.28	0.82

Table 2: Descriptive statistics for NO₂ monitoring (2022-2023 and baseline)

Nitrogen dioxide concentration $\mu\text{g}/\text{m}^3$						
Statistic	Site 5 - Burrup Road		Site 6 - Water Tanks		Site 6 - Water Tanks	
	2022-2023	Baseline	2022-2023	Baseline	2022-2023	Baseline
Minimum	1.41	0.38	1.19	0.31	0.21	0.4
Average	4.03	3.6	2.86	2.56	2.06	2.31
Maximum	9.85	6.53	4.44	5.27	3.17	4.12
Standard deviation	1.84	1.46	0.92	1.04	0.73	0.69

Table 3: Descriptive statistics for SO₂ monitoring (2022-2023 and baseline)

Sulfur dioxide concentration $\mu\text{g}/\text{m}^3$						
Statistic	Site 5 - Burrup Road		Site 6 - Water Tanks		Site 7 - Hearson Cove	
	2022-2023	Baseline	2022-2023	Baseline	2022-2023	Baseline
Minimum	0.02	0.07	0.02	0	0.02	0.13
Average	0.53	1.38	0.16	0.95	0.23	0.82
Maximum	4.62	3.09	0.44	3.5	1.24	2.01
Standard deviation	0.99	0.83	0.13	0.84	0.34	0.53

Table 4: Descriptive statistics for HNO₃ monitoring (2022-2023 and baseline)

Nitric acid concentration $\mu\text{g}/\text{m}^3$						
Statistic	Site 5 - Burrup Road		Site 6 - Water Tanks		Site 7 - Hearson Cove	
	2022-2023	Baseline	2022-2023	Baseline	2022-2023	Baseline
Minimum	0.00	0.00	0.03	0.00	0.07	0.00
Average	0.43	0.58	0.43	0.54	0.31	0.48
Maximum	2.07	1.55	1.67	1.81	1.28	1.42
Standard deviation	0.49	0.45	0.48	0.48	0.33	0.37

The concentrations from 2022-2023 have been compared with the baseline (for each location) via statistical analysis (t-test) to determine if differences in the average concentrations are statistically significant. The results are summarised in Table 5 and key findings from these data are summarised in Table 6.

Table 5: T-test results for comparison of 2022-2023 and baseline NH₃, NO₂, SO₂ and HNO₃ concentrations

Parameter	Monitoring period	Statistic	Site 5 - Burrup Road	Site 6 - Water Tanks	Site 7 - Hearson Cove
NH ₃	2022-2023	Average	0.83	0.89	1.28
	baseline	Average	0.44	0.93	0.75
		P value	2.51x10 ⁻⁰³	0.82	0.08
NO ₂	2022-2023	Average	4.03	2.86	2.06
	baseline	Average	3.60	2.56	2.31
		P value	0.35	0.202	0.20
SO ₂	2022-2023	Average	0.53	0.16	0.23
	baseline	Average	1.41	0.95	0.82
		P value	8.46x10 ⁻⁰⁴	2.21x10 ⁻⁰⁸	8.57x10 ⁻⁰⁷
HNO ₃	2022-2023	Average	0.43	0.43	0.31
	baseline	Average	0.58	0.54	0.48
		P value	0.23	0.36	0.07

Table 6: Analysis of NH₃, NO₂, SO₂ and HNO₃ concentration data

Parameter	Site	Finding
NH ₃	Burrup Road	The (higher) average NH ₃ concentration from 2022-2023 monitoring compared with baseline monitoring at this site is statistically significant.
	Water Tanks	The (lower) average NH ₃ concentration from 2022-2023 monitoring compared with baseline monitoring is not statistically significant
	Hearson Cove	The (higher) average NH ₃ concentration from 2022-2023 monitoring compared with baseline monitoring is not statistically significant
NO ₂	Burrup Road	Differences in the NO ₂ concentrations from 2022-2023 compared with baseline monitoring are not statistically significant.
	Water Tanks	
	Hearson Cove	
SO ₂	Burrup Road	The (lower) average SO ₂ concentrations from 2022-2023 monitoring compared with baseline monitoring are statistically significant at all three monitoring sites.
	Water Tanks	
	Hearson Cove	
HNO ₃	Burrup Road	The (lower) average HNO ₃ concentrations from 2022-2023 monitoring compared with baseline monitoring are not statistically significant.
	Water Tanks	
	Hearson Cove	

The average concentrations of NH₃ detected at Water Tanks and Hearson Cove during 2022-2023 were determined to be statistically insignificant from the baseline dataset. The average NH₃ concentrations measured at Burrup Road, however, were determined to be statistically significantly higher than the baseline.

The differences in average concentrations of NO₂ at the three monitoring sites recorded during 2022-2023 and baseline were not statistically significant.

Continuing from previous years, statistically significant decreases in the SO₂ concentrations recorded during the 2022-2023 monitoring period compared with the baseline study were determined for all three monitoring sites (Table 5). The reasons for the apparent decrease in average SO₂ concentrations since the baseline data were recorded are not known but may reflect a reduced frequency of flaring at the gas plants on the Burrup Peninsula or the use of lower sulfur fuels in ships that visit the Port of Dampier.

The decrease in the HNO₃ concentrations recorded at all sites during the 2022-2023 monitoring period relative to the baseline study is statistically insignificant.

4.1.3 Dry Deposition Rates – Gases

Annual (total) dry deposition rates were calculated from the gas sampling at the three monitoring sites for the duration of the baseline and ongoing monitoring program. Total annual deposition rates were calculated from the combined rates for NH₃, NO₂, SO₂ and HNO₃. The results for total annual dry deposition are illustrated in Figure 6.

Monitoring periods are from the start of July to the end of June in the following year, except for the 2013-2014 monitoring period, which is reported from September 2013 to August 2014 and, therefore, overlaps with the 2014-2015 period to represent an entire 12-month period.

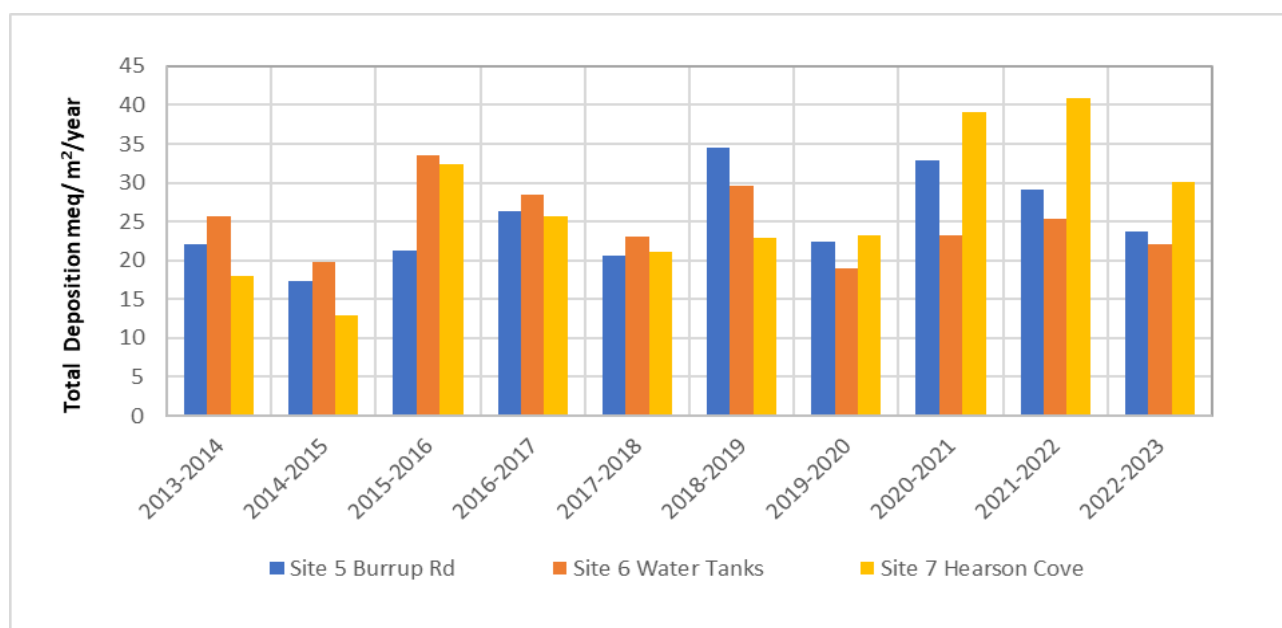


Figure 6: Annual deposition rates from measured gases (2013-2023)

The results are summarised in Table 7. Investigation levels were derived from the average of rolling monthly annual deposition rates from the baseline period plus three standard deviations (as described in the OEMP).

Table 7: Annual dry deposition rates

Year	Annual deposition rates meq/m ² /year		
	Site 5 Burrup Rd	Site 6 Water Tanks	Site 7 Hearson Cove
2013-2014	22.1	25.6	17.9
2014-2015	17.3	19.8	12.9
2015-2016	21.3	33.6	32.4
2016-2017	26.3	28.5	25.6
2017-2018	20.7	23.0	21.0
2018-2019	34.5	29.7	23.0
2019-2020	22.4	19.0	23.2
2020-2021	32.9	23.3	39.1
2021-2022	29.1	25.4	40.9
2022-2023	23.8	22.0	30.1
Investigation level	25.5	42.2	51.8

During 2022-2023, dry deposition rates of gas species have remained within the levels observed in previous years. At Site 7, which was relocated from Deep Gorge to Hearson Cove in April 2020, the results are within the levels previously detected at Hearson Cove. Levels detected at Hearson Cove are elevated compared to previous annual dry deposition results from the Deep Gorge site; likely due to the change in location to a more exposed position.

All sites were determined as remaining below the respective investigation levels in 2022-2023. The composition of the total deposition at each site is illustrated in Figure 7 to Figure 9.

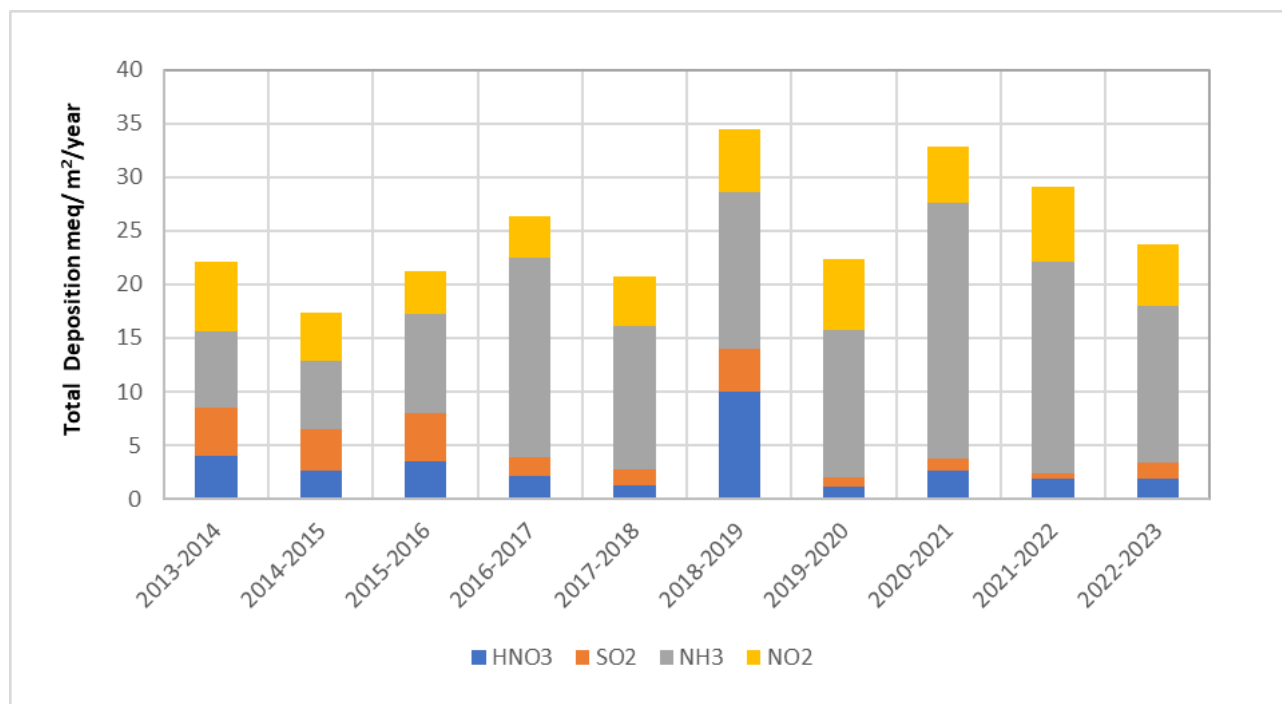


Figure 7: Burrup Road dry deposition composition

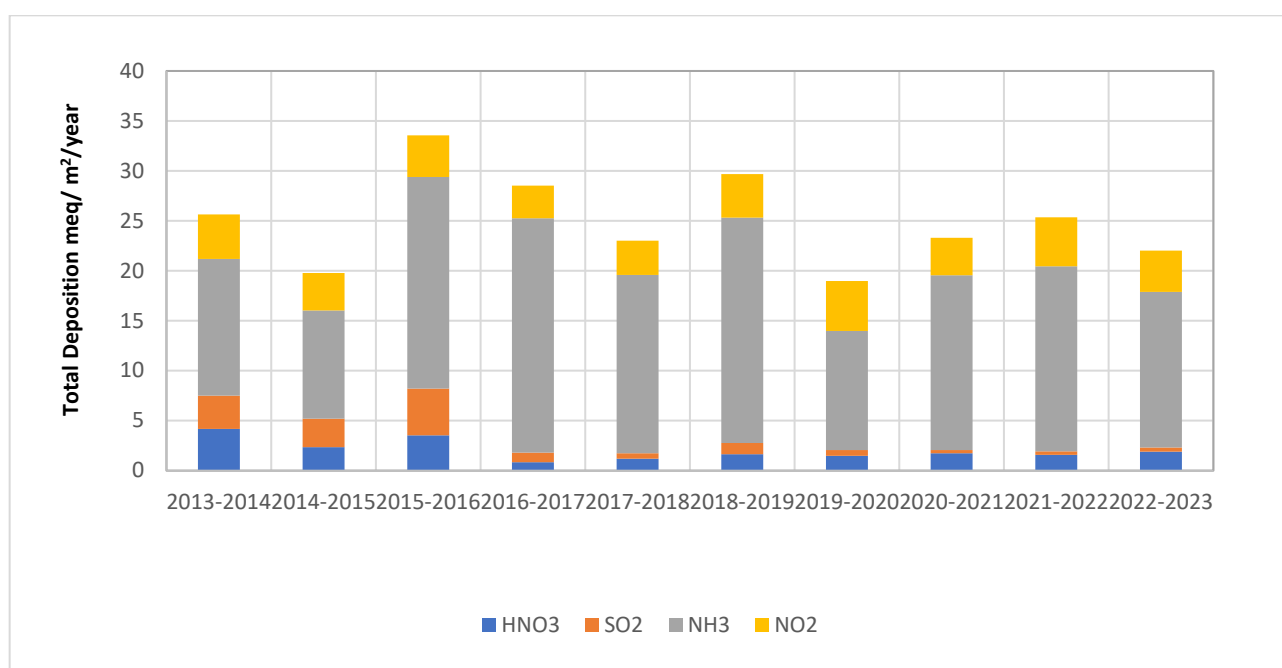


Figure 8: Water Tanks dry deposition rates

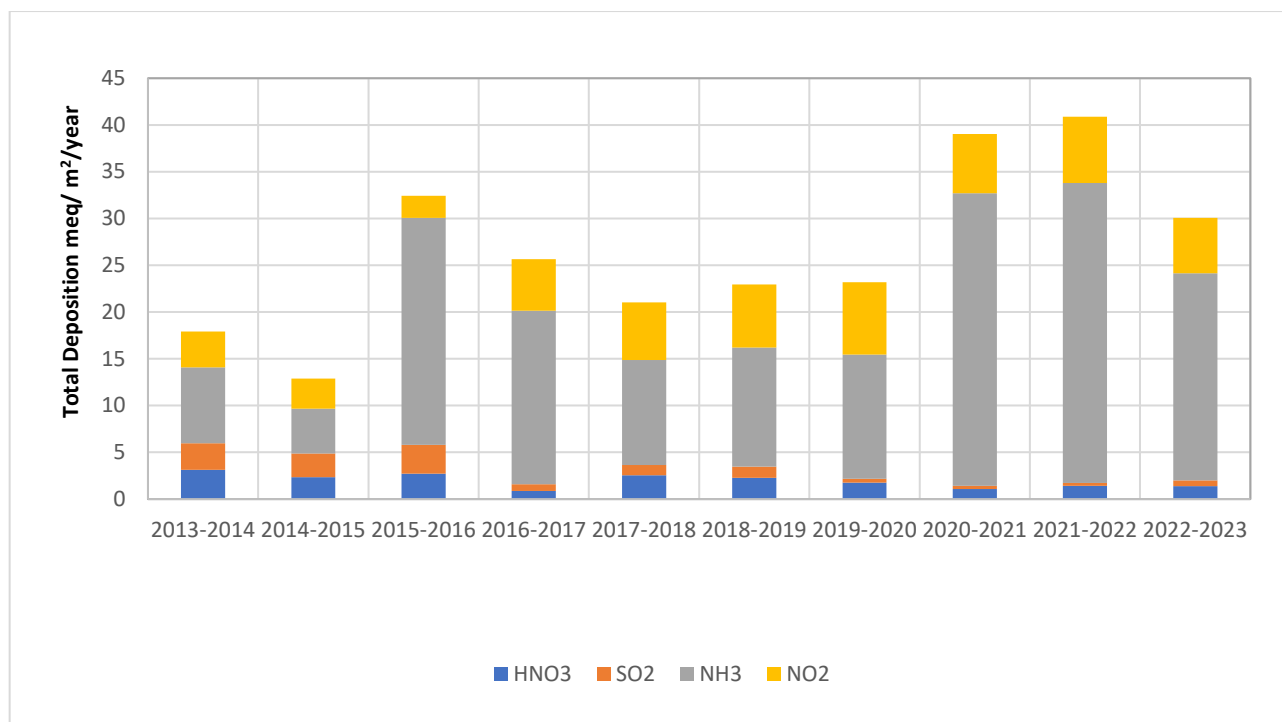


Figure 9: Hearson Cove dry deposition rates

4.2 Total Suspended Particulates

4.2.1 Results of TSP Monitoring

Monitoring for total suspended particulates (TSP) using MicroVol samplers was carried out at the three monitoring sites. Monitoring occurred for 24 hours every six days from the period 4 July 2022 to 29 June 2023. Valid data was collected at all sites throughout the monitoring period.

Similar trends in the concentrations from the three monitoring sites are typically observable across the year (Figure 10). This suggests the monitoring data reflects TSP trends in the Burrup airshed rather than direct impacts from individual local sources. The exception is Burrup road during March when TSP concentration detected at this site were elevated. Prevailing winds during March were from a westerly and west north westerly direction. Construction works at the Pluto plant, to the northwest of the Burrup Road site, occurred during the reporting period and could have contributed to TSP concentrations measured at Burrup Road being elevated compared to the other two monitoring sites.

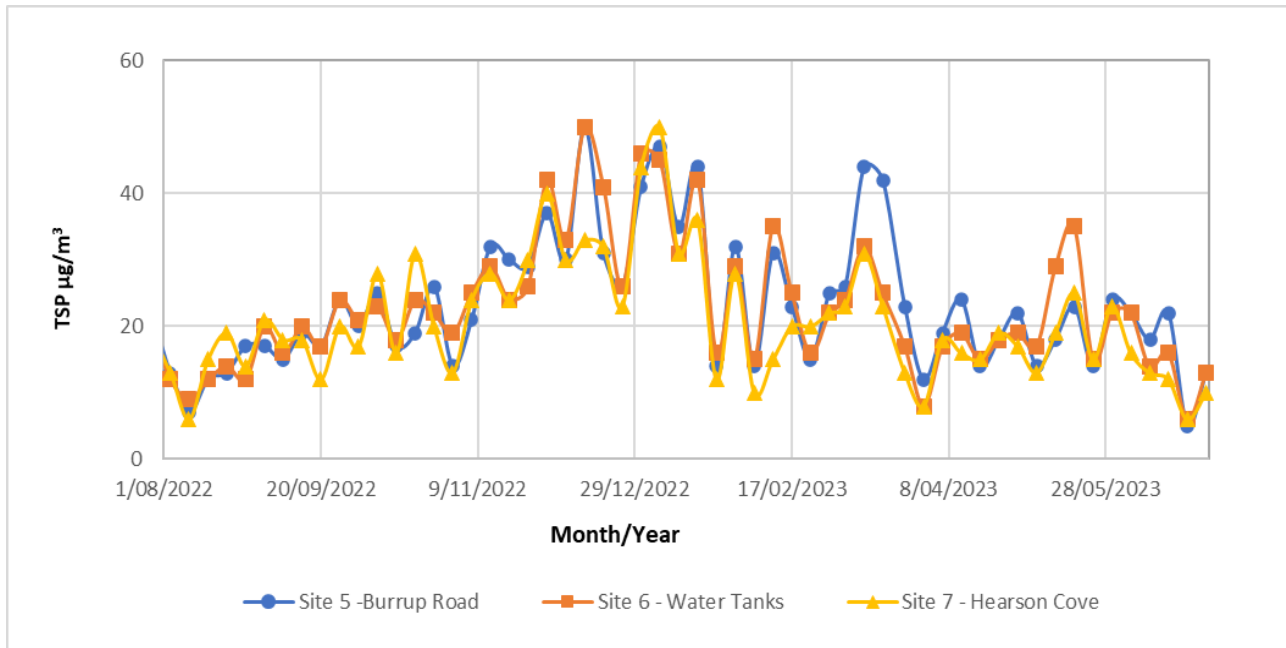


Figure 10: Measured TSP concentrations for 2022-2023

The baseline dataset was derived from direct TSP measurements as well as from estimates calculated from measured PM₁₀ concentrations as described in the baseline report (YPN 2017). Furthermore, the measured baseline dataset for Water Tanks was impacted by local activities associated with the construction of the TAN Plant, resulting in an over-representation of background levels at that site. The ongoing measured average concentration data are consequently compared to both the measured and calculated datasets for baseline (Figure 11).

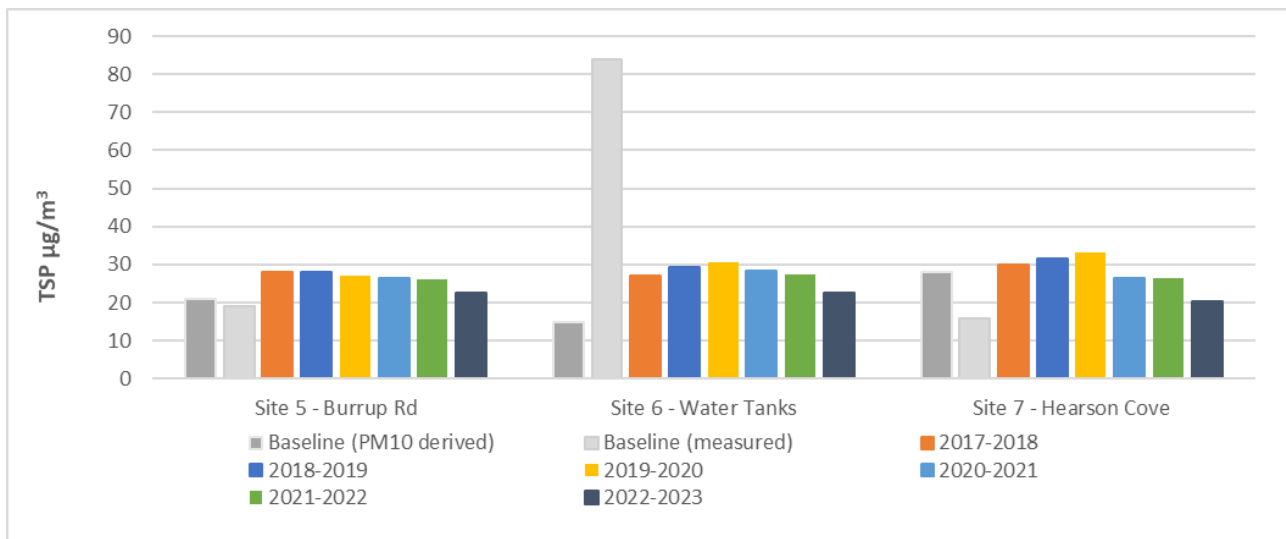


Figure 11: Comparison of average TSP concentrations for 2022-2023 with previous years and baseline data

Descriptive statistics for 2022-2023 TSP monitoring at all three sites are shown in Table 8 to Table 10 alongside the monitoring data for previous years.

Table 8: Descriptive statistics for TSP monitoring 2018 to 2022 – Burrup Road

TSP concentration $\mu\text{g}/\text{m}^3$						
Statistic	Site 5 - Burrup Rd					
	2022-2023	2021-2022	2020-2021	2019-2020	2018-2019	2017-2018
Minimum	5	8	5	8	2	6
Average	23	26	27	27	28	28
Maximum	50	76	78	77	66	76
Standard deviation	10	13	14	15	14	13

Table 9: Descriptive statistics for TSP monitoring 2018 to 2023 – Water Tanks

TSP concentration $\mu\text{g}/\text{m}^3$						
Statistic	Site 6 - Water Tanks					
	2022-2023	2021-2022	2020-2021	2019-2020	2018-2019	2017-2018
Minimum	6	8	5	9	8	6
Average	22	28	28	31	29	27
Maximum	50	89	79	141	63	76
Standard deviation	10	14	15	22	13	12

Table 10: Descriptive statistics for TSP monitoring 2018 to 2023 – Hearson Cove

TSP concentration $\mu\text{g}/\text{m}^3$						
Statistic	Site 7 - Hearson Cove					
	2022-2023	2021-2022	2020-2021	2019-2020	2018-2019	2017-2018
Minimum	6	7	7	8	8	11
Average	20	26	27	33	32	30
Maximum	50	89	67	148	67	79
Standard deviation	9	15	14	23	15	15

A comparison of the mean TSP concentrations measured during the five monitoring periods after the baseline study shows the average TSP concentration for 2022-2023 is lower than the previous years (Figure 11 and Table 8 to Table 10). Levels were slightly above the measured baseline at Burrup Road and Hearson Cove.

The levels monitored at Water Tanks in the five years after the baseline study have persisted lower than the baseline measured data and are comparable to the levels recorded at other sites. This continues to support the hypothesis that the baseline measurements at the Water Tanks site were affected by construction activities.

The 2022-2023 data were compared to the previously measured datasets to determine if there was any significant change in the recorded ambient TSP levels. The 2022-2023 dataset was determined to be statistically significantly different from previous reporting years at Water Tanks and Hearson Cove. At Burrup Road, the 2022-2023 dataset was statistically significantly different to the 2017-2018 and 2018-2019 dataset but not significantly difference to the three more recent datasets.

4.3 Dust Deposition

4.3.1 Results from Monitoring Deposited Dust

Results of dust deposition monitoring at the three sites are shown in Table 11. Values with a less than (<) prefix indicate the measured deposition rates were below the method detection limits, with the value indicating the limit.

Table 11: Results of dust deposition monitoring 2022-2023

Date deployed	Date collected	Site 5 - Burrup Road		Site 6 - Water Tanks		Site 7 – Hearson Cove	
		Soluble solids	Insoluble solids	Soluble solids	Insoluble solids	Soluble solids	Insoluble solids
		g/m ² /month	g/m ² /month	g/m ² /month	g/m ² /month	g/m ² /month	g/m ² /month
1/07/2022	1/08/2022	<0.7	<0.8	0.9	<0.8	0.9	<0.8
1/08/2022	30/08/2022	<0.7	0.9	1.8	<0.8	1.2	<0.8
30/08/2022	30/09/2022	0.7	1.6	1.1	1.4	<0.7	1.6
30/09/2022	1/11/2022	0.9	2	<0.7	1	0.8	0.9
1/11/2022	30/11/2022	<0.7	1.3	1.2	1.2	<0.7	1.4
30/11/2022	30/12/2022	0.9	1.2	0.8	1.5	<0.7	1.5
30/12/2022	30/01/2023	1.9	2.7	1.3	1.7	0.9	1.8
30/01/2023	28/02/2023	1.9	3	2	1.2	1.5	2.1
28/02/2023	31/03/2023	0.8	1.5	1.6	1.1	0.7	1.1
31/03/2023	1/05/2023	<0.7	1.5	<0.7	<0.8	0.9	0.8
1/05/2023	31/05/2023	<0.7	0.8	0.7	1.5	<0.7	1.1
31/05/2023	30/06/2023	0.7	0.9	<0.7	<0.8	<0.7	<0.8

4.3.2 Analysis of Dust Deposition Data

A comparison of the dust deposition data from 2022-2023 with the baseline data (insoluble fraction only) is shown in Table 12.

Table 12: Descriptive statistics for dust deposition monitoring 2022-2023 and baseline study

Statistic ⁽¹⁾	Burrup Rd (g/m ² /month)			Water Tanks (g/m ² /month)			Hearson Cove (g/m ² /month)		
	2022-2023		Baseline	2022-2023		Baseline	2022-2022		Baseline
	Soluble	Insoluble	Insoluble	Soluble	Insoluble	Insoluble	Soluble	Insoluble	Insoluble
Minimum	0.4	0.4	0.0	0.4	0.4	0.0	0.4	0.4	0.0
Average	0.8	1.5	0.9	1.0	1.0	0.8	0.7	1.1	1.1
95 th percentile	1.9	2.8	1.8	1.9	1.6	1.9	1.3	1.9	2.3
Maximum	1.9	3.0	2.0	2.0	1.7	2.1	1.5	2.1	5.0

(1) Half method detection limit deposition rates for non-detect results were used for calculations of statistics.

Average deposition rates for the insoluble fraction are slightly higher than baseline across all three monitoring sites. The differences between the baseline and 2022-2023 datasets were not statistically significant at Hearson Cove and Water Tanks (determined by t-test P values >0.05), and the average measured insoluble fraction is within the range seen in other years (Figure 12). Burrup Road was the exception with a statistically significant difference compared to the baseline and an average deposition rate exceeding previous monitoring periods. When the Burrup Road 2022-2023 data was compared, by t-test, to the previous year (2021-2022), the difference was not statistically significant.

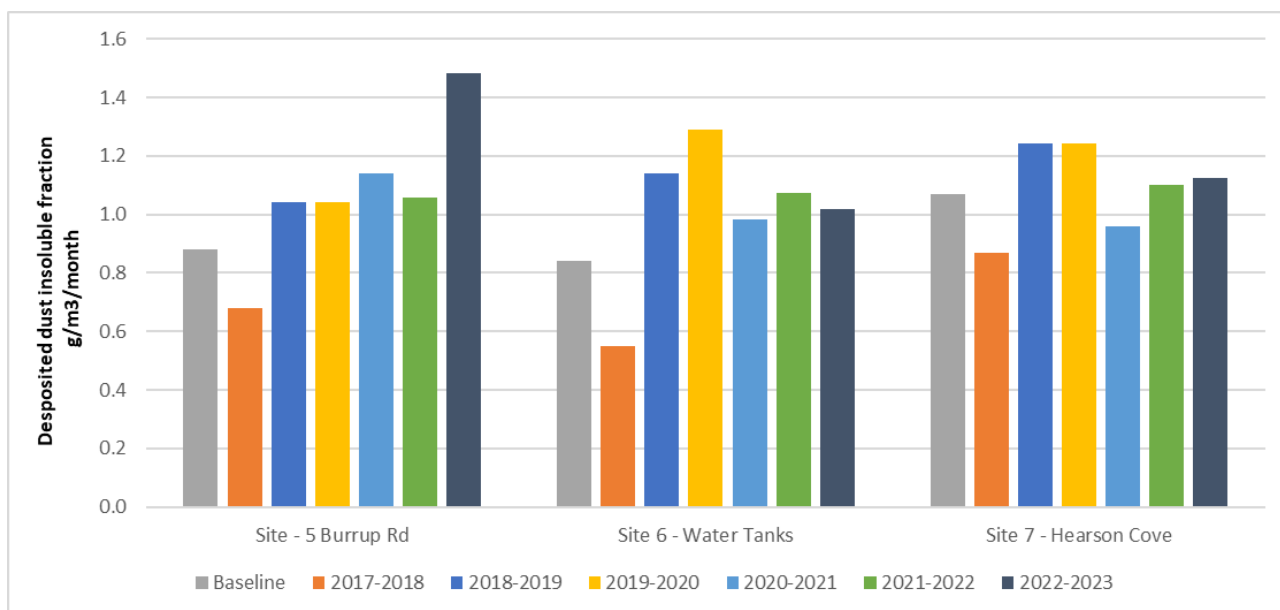


Figure 12: Deposited dust average insoluble fraction Baseline to 2022-2023

Similar trends in the insoluble deposition rates were observed at the three sites across most of the monitoring period (Figure 13). The deposition of insoluble material at Burrup Road trended above the other sites, most notably during January and February 2023. Note that these comparisons reflect the use of non-detect deposition rates of half the detection limits. The actual deposition rates below detection limits may be lower or higher than the half detection rates.

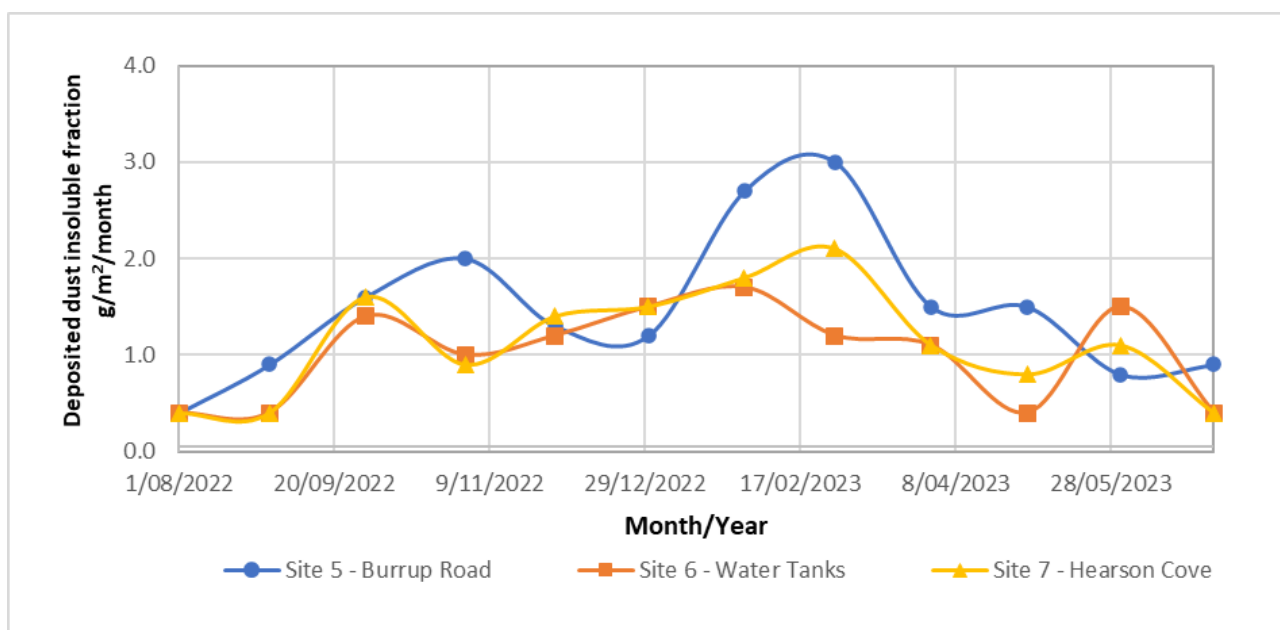


Figure 13: Deposited dust insoluble fraction 2022-2023

The soluble fraction was not determined in samples collected for the baseline study as the EPBC Approval at the time (dated 14 September 2011) only required measurements of TSP and “dust”. The latter requirement was interpreted to mean the insoluble fraction of deposited dust. The amended approval of 12 September 2017 required both insoluble and soluble fractions of deposited dust to be monitored. In the absence of baseline data, the data for the 2022-2023 soluble fraction is compared to the data collected for the 2017-2018, 2018-2019, 2019-2020, 2020-2021 and 2021-2022 monitoring periods.

The average soluble fraction measured from the deposited dust collected in 2022-2023 is within the range seen from monitoring carried out across previous years at all sites (Figure 14).

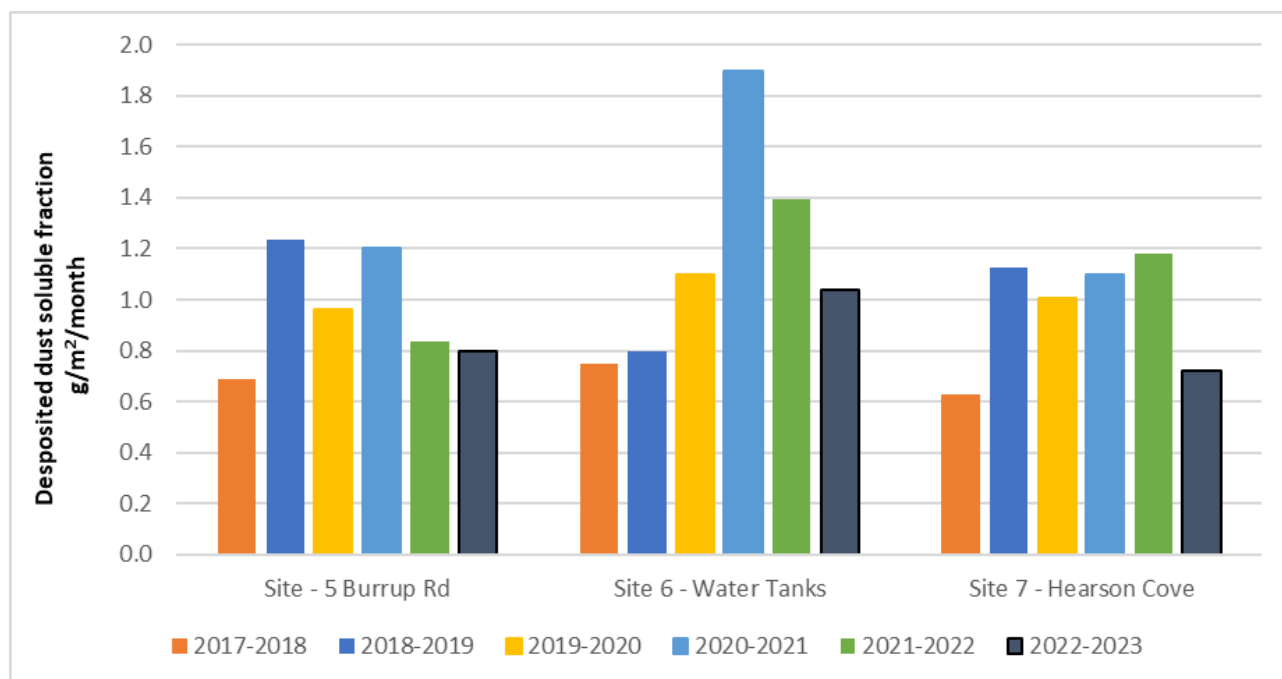


Figure 14: Deposited dust average soluble fraction baseline to 2022-2023

Similar trends in the soluble deposition rates were observed at the three sites across most of the monitoring period (Figure 15). More variability in the monthly data for the soluble fraction of deposited dust across the three monitoring sites during the first half of the 2022-2023 period is evident.

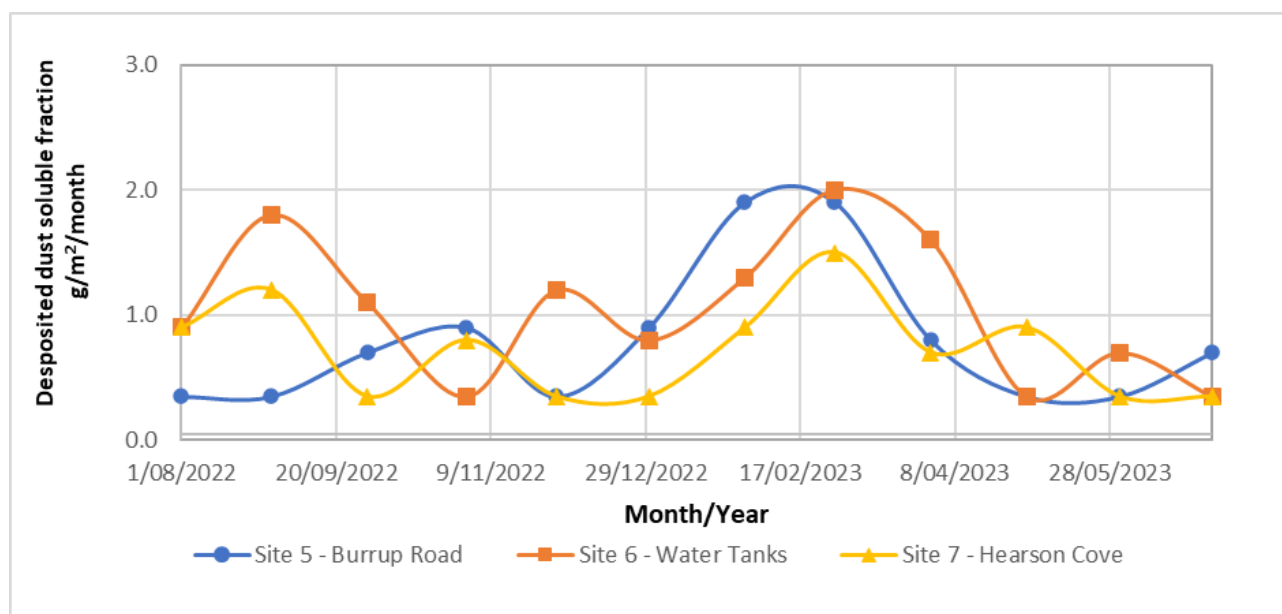


Figure 15: Deposited dust soluble fraction 2022-2023

Most of the soluble dust deposited on the Burrup is expected to be from marine sources, i.e., sea salt, which suggests similar soluble deposition rates should be observed at the three monitoring sites. The more variable nature of soluble deposition rates from August 2022 to December 2022 than January 2023 to July 2023 are similar to results from previous reporting periods and may reflect the wind being predominantly from the west.

During westerly winds, the landform that air coming from the ocean must pass over could influence the amount of entrained sea salt, and thus deposition varies at the three sites, which have varying degrees of shielding to the west.

Salt particles from cooling tower aerosols may also potentially report to the soluble deposition fraction at the monitoring sites for relevant wind directions, confounding the analysis.

Overall, the levels of dust deposited at the monitoring sites remain largely consistent with those observed from the baseline study and previous monitoring carried out since 2017.

5. Dry Deposition Rate Investigation and Actions

As described in Section 4.1.3, the monitoring carried out in 2022-2023 showed that the annual dry deposition rate for the monitoring period did not exceed the investigation levels established from the baseline study; therefore, investigation is not required. The deposition rates are presented in Figure 16 to Figure 19 for completeness.

The Burrup Road rolling annual deposition had a falling trend across the period, with the monthly rolling annual deposition falling below the investigation level by the end of the 2022-2023 monitoring period (Figure 16). Peak concentrations were below the previous year (Figure 17) when the investigation level was exceeded for the duration of the monitoring. The monthly rolling annual deposition at Water Tanks and Hearson Cove remained below the investigation level throughout the monitoring period (Figure 18 and Figure 19).

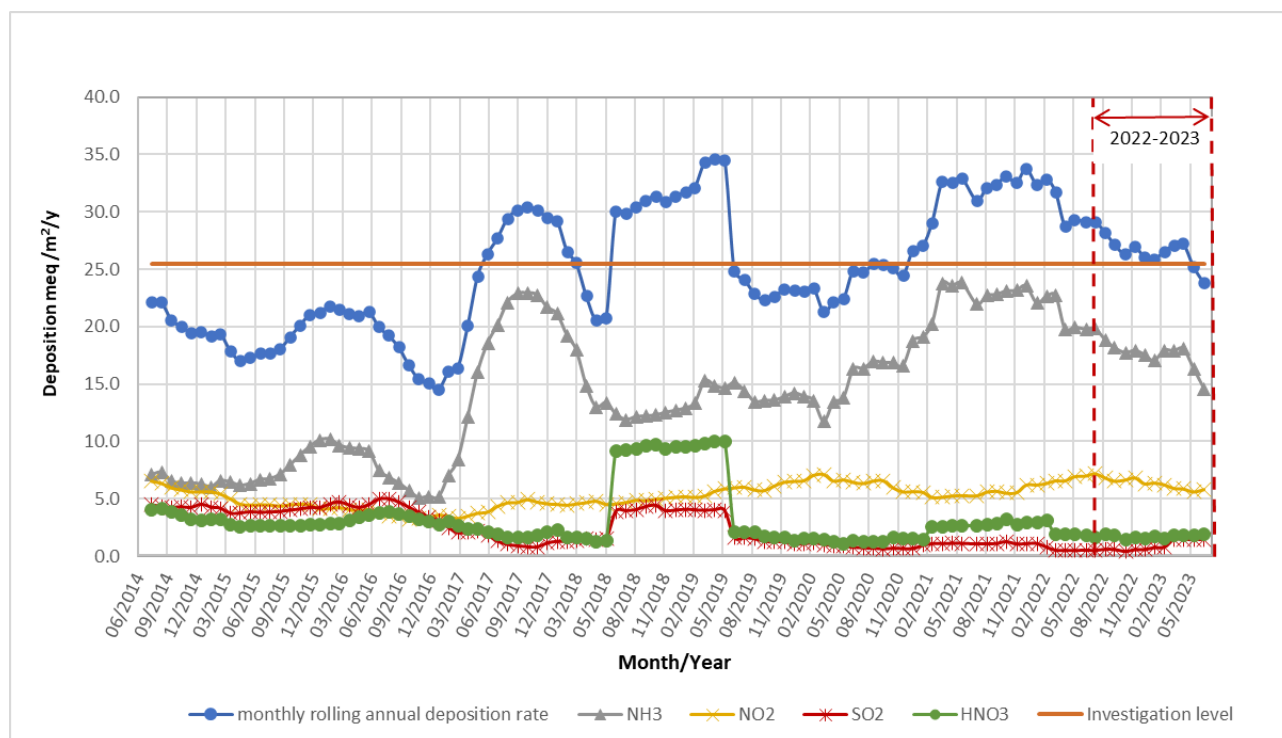


Figure 16: Monthly rolling annual total and individual gas dry deposition rates – Burrup Road

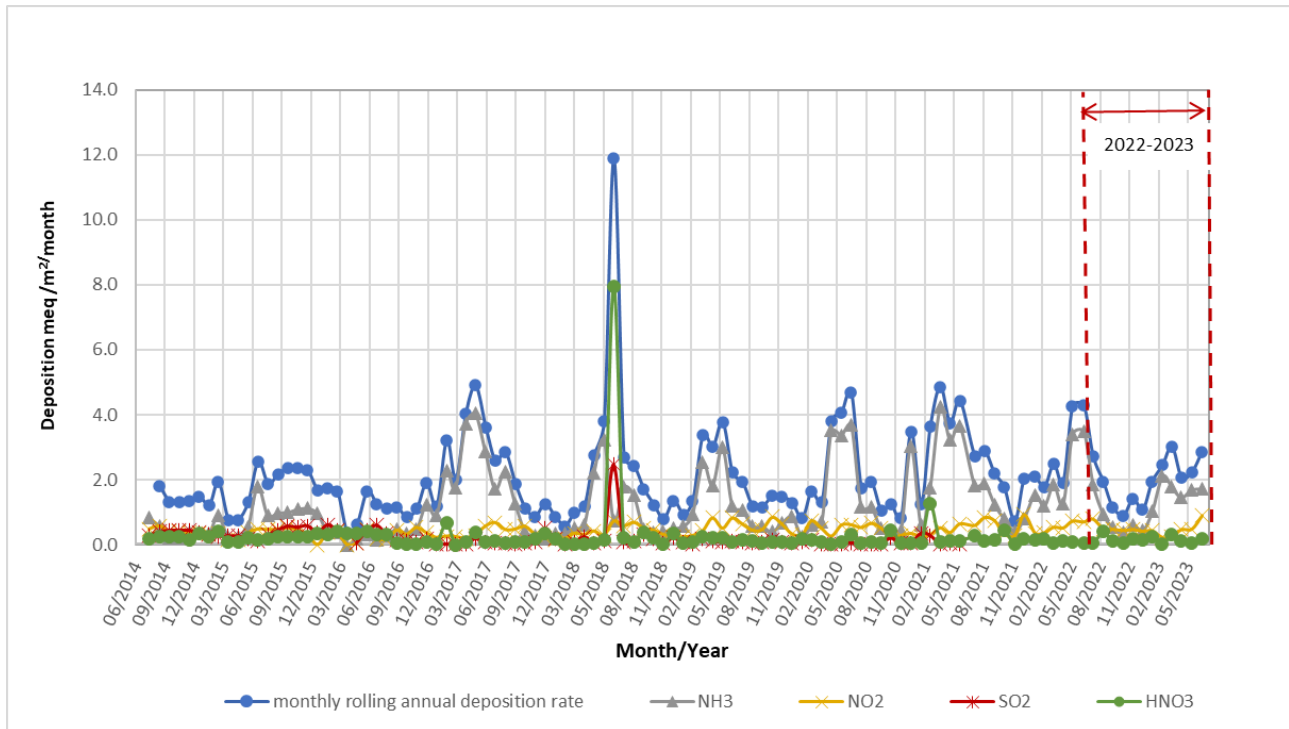


Figure 17: Monthly total and individual gas dry deposition rates – Burrup Road

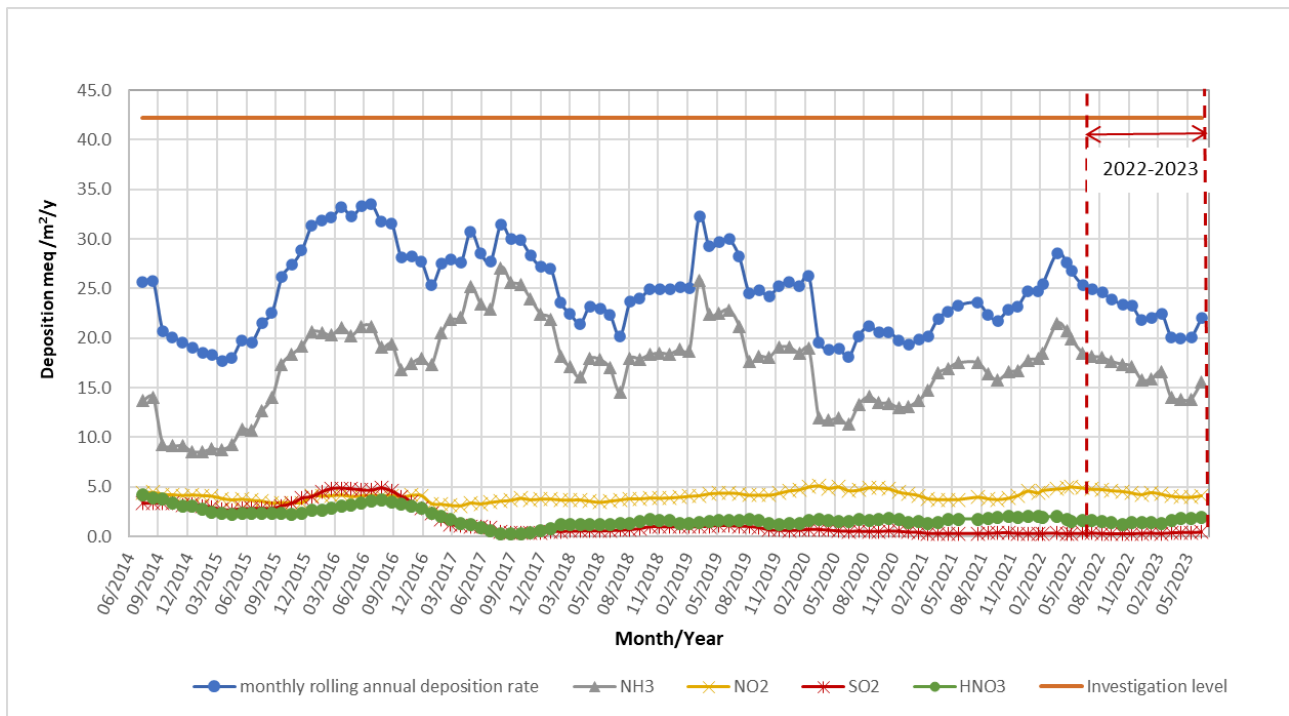


Figure 18: Monthly rolling annual total and individual gas dry deposition rates – Water Tanks

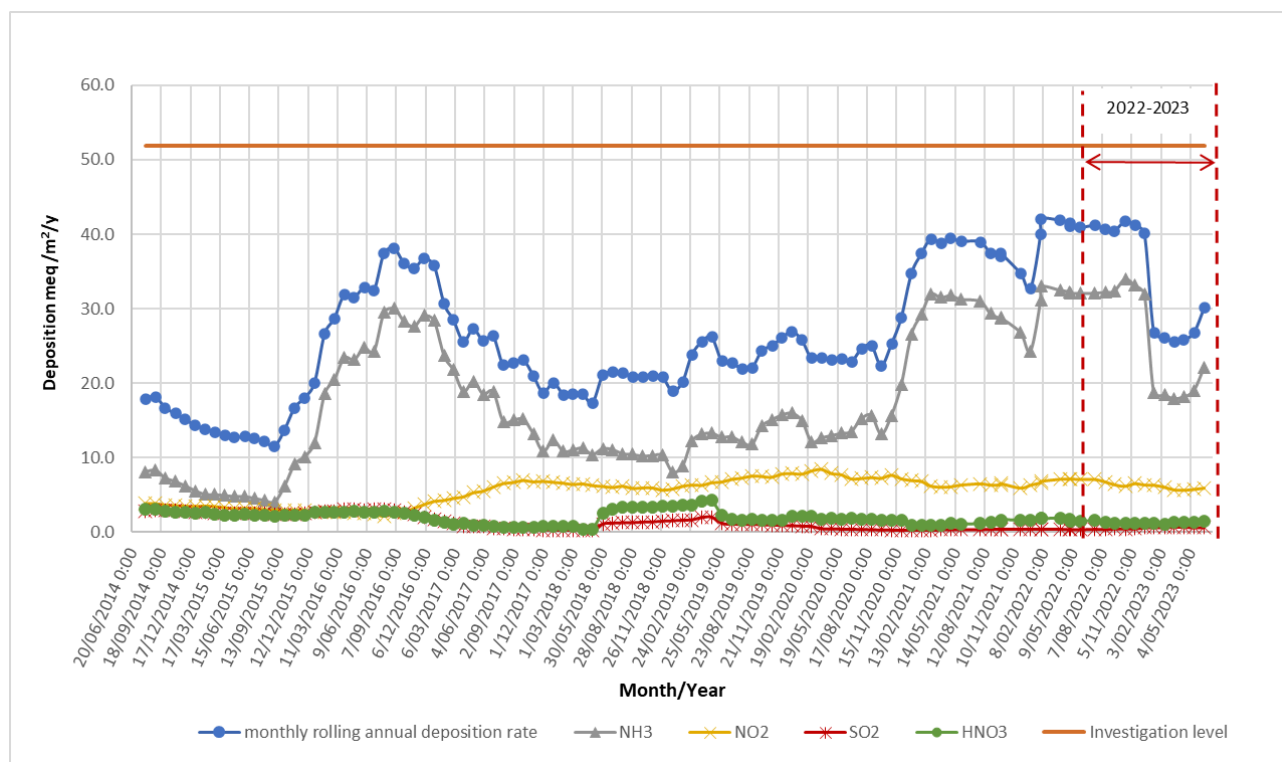


Figure 19: Monthly rolling annual total and individual gas dry deposition rates – Hearson Cove

6. Concluding Remarks

Monitoring data are reported for all parameters specified in EPBC Approval 2008/4546 (as varied 24 March 2020).

Analysis of data for gases shows the following:

- The average NH₃ concentrations at Burrup Road were found to be statistically significantly different (higher) to the baseline;
- The average NH₃ concentrations at Water Tanks and Hearson Cove were lower and higher than baseline, respectively, but the difference was not statistically significant;
- The average NO₂ concentrations at all sites were not found to be statistically significant; and
- The average SO₂ concentrations at all three monitoring sites were lower than the baseline concentrations, with differences in the averages being statistically significant.

The TAN Plant was operating at steady state for 66% of the reported period. Six plant start-ups occurred throughout the year, when potentially higher NH₃ emissions may occur; however, these did not correlate with elevated ambient concentrations.

Overall, there is no evidence to show that operation of the TAN Plant has resulted in significant increases in NO₂ levels over the monitoring period.

Analysis of annual dry deposition rates of gas species shows the following:

- Dry deposition rates were within the range determined for previous years;
- The annual dry deposition rate for the 2022-2023 monitoring period was below the investigation level derived from baseline measurements for all sites; and

- NH₃ is the dominant contributor to dry deposition at all monitoring sites.

Analysis of the TSP data shows the following:

- Concentrations of TSP measured in 2022-2023 continue to be comparable across the three monitoring sites suggesting reflection of air shed background concentrations as seen in previous reporting periods; and
- Average TSP concentrations at all three monitoring sites were below the results from the previous monitoring carried out since 2017.

Overall, there is no evidence to show that the operation of the TAN Plant has resulted in a significant increase in ambient TSP concentrations in 2022-2023.

Analysis of dust deposition data shows the following:

- Average insoluble deposition rates within previous levels were observed at Water Tanks and Hearson Cove;
- Average insoluble deposition rates at Burrup Road were elevated compared to historical monitoring results;
- Average insoluble deposition at Burrup Road was statistically significantly different to those concentrations measured in the baseline study for all sites; and
- The soluble fraction of the deposited dust from 2022-2023 was within the range of previous years.

Overall, there is no evidence to suggest that the operation of the TAN Plant has resulted in materially significant increases in insoluble dust deposition rates.

7. References

Strategen (2018). *Yara Pilbara Nitrates, EPBC Approval 2008/4546*. Ambient air quality report 2017-2018. Document 650-200-rep-sec-0004, issued October 2018.

Strategen (2019). *Yara Pilbara Nitrates, EPBC Approval 2008/4546*. Ambient air quality report 2018-2019. Document 650-200-rep-sec-0006, issued October 2019.

Strategen (2020). *Yara Pilbara Nitrates, EPBC Approval 2008/4546*. Ambient air quality report 2019-2020. 650-200-rep-sec-0007, issued October 2020.

Strategen JBS&G (2021). *Yara Pilbara Nitrates, EPBC Approval 2008/4546*. Ambient air quality report 2020-2021. 650-200-rep-sec-0007, issued October 2021.

Strategen JBS&G (2022). *Yara Pilbara Nitrates, EPBC Approval 2008/4546*. Ambient air quality report 2020-2021. 650-200-rep-sec-0007, issued October 2022.

YPN (2017). *Yara Pilbara Nitrates, EPBC Approval 2008/4546. Baseline Air Quality Monitoring Report*. Document 250-200-rep-ypf-0002, issued 16 June 2017, updated 24 March 2020.

8. Limitations

Scope of services

This report (“the report”) has been prepared by JBS&G in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and JBS&G. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

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Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

The advice herein relates only to this project and all results conclusions and recommendations made should be reviewed by a competent person with experience in environmental investigations, before being used for any other purpose.

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Appendix A Results from Monitoring of Gases

Site	Date on	Date off	NH ₃ µg/m ³	NO ₂ µg/m ³	SO ₂ µg/m ³	HNO ₃ µg/m ³
Site 5 - Burrup Road	1/07/2022	15/07/2022	1.97	6.38	0.03	0.11
Site 5 - Burrup Road	15/07/2022	1/08/2022	0.64	6.55	0.07	0.20
Site 5 - Burrup Road	1/08/2022	16/08/2022	0.54	5.17	0.10	0.23
Site 5 - Burrup Road	16/08/2022	30/08/2022	0.81	3.26	0.96	2.07
Site 5 - Burrup Road	30/08/2022	13/09/2022	0.35	3.37	0.16	0.52
Site 5 - Burrup Road	13/09/2022	30/09/2022	0.39	4.34	0.06	0.05
Site 5 - Burrup Road	30/09/2022	17/10/2022	0.33	3.68	0.02	0.05
Site 5 - Burrup Road	17/10/2022	1/11/2022	0.16	3.24	0.10	0.28
Site 5 - Burrup Road	1/11/2022	15/11/2022	0.12	4.24	0.99	0.61
Site 5 - Burrup Road	15/11/2022	30/11/2022	0.74	3.99	0.43	0.37
Site 5 - Burrup Road	30/11/2022	15/12/2022	0.28	5.11	0.31	0.42
Site 5 - Burrup Road	15/12/2022	30/12/2022	0.32	1.91	0.39	0.33
Site 5 - Burrup Road	30/12/2022	13/01/2023	0.37	2.61	0.06	0.05
Site 5 - Burrup Road	13/01/2023	31/01/2023	0.89	4.05	1.60	1.14
Site 5 - Burrup Road	31/01/2023	14/02/2023	1.38	2.44	0.03	0.00
Site 5 - Burrup Road	14/02/2023	28/02/2023	1.76	1.41	0.78	0.19
Site 5 - Burrup Road	28/02/2023	15/03/2023	0.93	2.36	4.62	0.34
Site 5 - Burrup Road	15/03/2023	30/03/2023	1.51	1.54	1.49	1.37
Site 5 - Burrup Road	30/03/2023	13/04/2023	0.64	3.62	0.08	0.26
Site 5 - Burrup Road	13/04/2023	1/05/2023	1.16	3.71	0.11	0.36
Site 5 - Burrup Road	1/05/2023	15/05/2023	0.60	4.00	0.03	0.14
Site 5 - Burrup Road	15/05/2023	31/05/2023	1.68	4.12	0.05	0.07
Site 5 - Burrup Road	31/05/2023	16/06/2023	1.03	5.73	0.02	0.18
Site 5 - Burrup Road	16/06/2023	30/06/2023	1.38	9.85	0.28	0.92
Site 6 - Water Tanks	1/07/2022	15/07/2022	0.30	1.80	0.04	0.24
Site 6 - Water Tanks	15/07/2022	1/08/2022	0.48	3.56	0.17	0.73
Site 6 - Water Tanks	1/08/2022	16/08/2022	1.13	3.40	0.16	0.52
Site 6 - Water Tanks	16/08/2022	30/08/2022	0.64	1.84	0.08	0.10
Site 6 - Water Tanks	30/08/2022	13/09/2022	0.26	2.68	0.02	0.10
Site 6 - Water Tanks	13/09/2022	30/09/2022	0.56	3.80	0.10	0.18
Site 6 - Water Tanks	30/09/2022	17/10/2022	1.01	3.72	0.29	0.30
Site 6 - Water Tanks	17/10/2022	1/11/2022	0.38	3.93	0.03	0.13
Site 6 - Water Tanks	1/11/2022	15/11/2022	0.33	4.16	0.08	0.17
Site 6 - Water Tanks	15/11/2022	30/11/2022	0.66	3.17	0.25	1.20
Site 6 - Water Tanks	30/11/2022	15/12/2022	0.33	4.44	0.37	0.29
Site 6 - Water Tanks	15/12/2022	30/12/2022	0.44	3.73	0.13	0.25
Site 6 - Water Tanks	30/12/2022	13/01/2023	0.62	2.95	0.21	0.05
Site 6 - Water Tanks	13/01/2023	31/01/2023	0.64	2.22	0.04	0.06

Site	Date on	Date off	NH ₃ µg/m ³	NO ₂ µg/m ³	SO ₂ µg/m ³	HNO ₃ µg/m ³
Site 6 - Water Tanks	31/01/2023	14/02/2023	1.52	2.75	0.06	0.11
Site 6 - Water Tanks	14/02/2023	28/02/2023	1.90	1.19	0.07	0.03
Site 6 - Water Tanks	28/02/2023	15/03/2023	1.05	1.58	0.34	0.81
Site 6 - Water Tanks	15/03/2023	30/03/2023	2.10	2.26	0.44	1.67
Site 6 - Water Tanks	30/03/2023	13/04/2023	1.61	2.91	0.30	0.98
Site 6 - Water Tanks	13/04/2023	1/05/2023	0.94	2.02	0.08	0.21
Site 6 - Water Tanks	1/05/2023	15/05/2023	0.48	2.56	0.12	0.33
Site 6 - Water Tanks	15/05/2023	31/05/2023	1.03	1.50	0.06	0.10
Site 6 - Water Tanks	31/05/2023	16/06/2023	0.99	3.79	0.04	0.13
Site 6 - Water Tanks	16/06/2023	30/06/2023	2.02	2.75	0.43	1.53
Site 7 - Hearson Cove	1/07/2022	15/07/2022	0.09	1.90	0.66	1.27
Site 7 - Hearson Cove	15/07/2022	1/08/2022	0.45	2.49	0.05	0.14
Site 7 - Hearson Cove	1/08/2022	16/08/2022	0.57	2.18	0.10	0.35
Site 7 - Hearson Cove	16/08/2022	30/08/2022	0.22	1.41	0.02	0.07
Site 7 - Hearson Cove	30/08/2022	13/09/2022	0.27	1.38	1.05	0.26
Site 7 - Hearson Cove	13/09/2022	30/09/2022	0.43	2.52	0.04	0.10
Site 7 - Hearson Cove	30/09/2022	17/10/2022	2.47	2.27	0.04	0.15
Site 7 - Hearson Cove	17/10/2022	1/11/2022	0.28	2.38	0.05	0.10
Site 7 - Hearson Cove	1/11/2022	15/11/2022	0.22	2.71	0.08	0.11
Site 7 - Hearson Cove	15/11/2022	30/11/2022	1.24	2.94	0.05	0.21
Site 7 - Hearson Cove	30/11/2022	15/12/2022	0.33	3.02	0.10	0.42
Site 7 - Hearson Cove	15/12/2022	30/12/2022	1.71	2.26	1.24	0.22
Site 7 - Hearson Cove	30/12/2022	13/01/2023	0.71	3.17	0.64	0.61
Site 7 - Hearson Cove	13/01/2023	31/01/2023	1.24	1.87	0.09	0.13
Site 7 - Hearson Cove	31/01/2023	14/02/2023	3.79	2.56	0.08	0.16
Site 7 - Hearson Cove	14/02/2023	28/02/2023	3.29	0.71	0.06	0.14
Site 7 - Hearson Cove	28/02/2023	15/03/2023	0.97	2.28	0.57	1.28
Site 7 - Hearson Cove	15/03/2023	30/03/2023	2.81	0.21	0.08	0.33
Site 7 - Hearson Cove	30/03/2023	13/04/2023	1.87	1.78	0.06	0.14
Site 7 - Hearson Cove	13/04/2023	1/05/2023	0.31	1.47	0.11	0.49
Site 7 - Hearson Cove	1/05/2023	15/05/2023	0.22	1.91	0.17	0.45
Site 7 - Hearson Cove	15/05/2023	31/05/2023	2.29	1.32	0.07	0.07
Site 7 - Hearson Cove	31/05/2023	16/06/2023	0.40	2.95	0.07	0.08
Site 7 - Hearson Cove	16/06/2023	30/06/2023	4.51	1.69	0.06	0.27

Appendix B Results from Monitoring of TSP

Period start date	Site 5 -Burrup Road TSP $\mu\text{g}/\text{m}^3$	Site 6 - Water Tanks TSP $\mu\text{g}/\text{m}^3$	Site 7 – Hearson Cove TSP $\mu\text{g}/\text{m}^3$
04-Jul-22	22	28	23
10-Jul-22	15	10	10
16-Jul-22	13	11	11
22-Jul-22	13	17	15
28-Jul-22	20	19	18
03-Aug-22	13	12	13
09-Aug-22	7	9	6
15-Aug-22	12	12	15
21-Aug-22	13	14	19
27-Aug-22	17	12	14
02-Sep-22	17	20	21
08-Sep-22	15	16	18
14-Sep-22	19	20	18
20-Sep-22	17	17	12
26-Sep-22	24	24	20
02-Oct-22	20	21	17
08-Oct-22	25	23	28
14-Oct-22	17	18	16
20-Oct-22	19	24	31
26-Oct-22	26	22	20
01-Nov-22	14	19	13
07-Nov-22	21	25	24
13-Nov-22	32	29	28
19-Nov-22	30	24	24
25-Nov-22	29	26	30
01-Dec-22	37	42	40
07-Dec-22	30	33	30
13-Dec-22	50	50	33
19-Dec-22	31	41	32
25-Dec-22	26	26	23
31-Dec-22	41	46	44
06-Jan-23	47	45	50
12-Jan-23	35	31	31
18-Jan-23	44	42	36
24-Jan-23	14	16	12
30-Jan-23	32	29	28
05-Feb-23	14	15	10
11-Feb-23	31	35	15
17-Feb-23	23	25	20

Period start date	Site 5 -Burrup Road TSP $\mu\text{g}/\text{m}^3$	Site 6 - Water Tanks TSP $\mu\text{g}/\text{m}^3$	Site 7 – Hearson Cove TSP $\mu\text{g}/\text{m}^3$
23-Feb-23	15	16	20
01-Mar-23	25	22	22
06-Mar-23	26	24	23
12-Mar-23	44	32	31
18-Mar-23	42	25	23
25-Mar-23	23	17	13
31-Mar-23	12	8	8
06-Apr-23	19	17	18
12-Apr-23	24	19	16
18-Apr-23	14	15	15
24-Apr-23	18	18	19
30-Apr-23	22	19	17
06-May-23	14	17	13
12-May-23	18	29	19
18-May-23	23	35	25
24-May-23	14	15	15
30-May-23	24	22	23
05-Jun-23	22	22	16
11-Jun-23	18	14	13
17-Jun-23	22	16	12
23-Jun-23	5	6	6
29-Jun-23	13	13	10

Appendix C Results from Dust Deposition Monitoring

Date collected	Site 5 - Burrup Road		Site 6 - Water Tanks		Site 7 – Hearson Cove	
	Soluble solids	Insoluble solids	Soluble solids	Insoluble solids	Soluble solids	Insoluble solids
	g/m ² /month	g/m ² /month	g/m ² /month	g/m ² /month	g/m ² /month	g/m ² /month
1/08/2022	<0.7	<0.8	0.9	<0.8	0.9	<0.8
30/08/2022	<0.7	0.9	1.8	<0.8	1.2	<0.8
30/09/2022	0.7	1.6	1.1	1.4	<0.7	1.6
1/11/2022	0.9	2	<0.7	1	0.8	0.9
30/11/2022	<0.7	1.3	1.2	1.2	<0.7	1.4
30/12/2022	0.9	1.2	0.8	1.5	<0.7	1.5
30/01/2023	1.9	2.7	1.3	1.7	0.9	1.8
28/02/2023	1.9	3	2	1.2	1.5	2.1
31/03/2023	0.8	1.5	1.6	1.1	0.7	1.1
1/05/2023	<0.7	1.5	<0.7	<0.8	0.9	0.8
31/05/2023	<0.7	0.8	0.7	1.5	<0.7	1.1
30/06/2023	0.7	0.9	<0.7	<0.8	<0.7	<0.8



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