SKYSIDE

In association with SKYSIDE SOUTH AFRICA

Ambient Air Quality Monitoring Report for Saldanha Bay and Vredenburg Sites

December 2025

Prepared for

Saldanha Bay Municipality

EXECUTIVE SUMMARY

This report covers data from the Saldanha Bay and Vredenburg Air Quality Monitoring stations which have been commissioned and operated throughout the Saldanha Bay Municipality Area by Argos Scientific Africa (Pty) Ltd since 2015 and by Skyside South Africa (Pty) Ltd since October 2024.

This report covers activities during December 2025.

Data capture was >98% for all measured pollutants at the Saldanha AQM site for December 2025.

Data capture was >99% for O_3 at the Vredenburg AQM site for December 2025. The NO_X and SO_2 analysers are awaiting an upgrade to the air conditioner at this site.

There were no DFFE Air Quality Standard exceedances during December 2025.

Meteorological conditions at the Saldanha AQM site were characterised by moderate to strong winds from the south (S) and south-west (SW). There was a 1.1% occurrence of calm conditions.

Meteorological conditions at the Vredenburg site were characterised by moderate to strong winds from the south (S) and south-west (SW). There was a 0.7% occurrence of calm conditions.

REPORT DETAILS

Reference	AS1138\sbm\202512
Report Title	Ambient Air Quality Monitoring Report for Saldanha Bay and Vredenburg Sites : December 2025
Date Submitted	21 January 2026
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Signed	
Technical signatory	Grant Ravenscroft Signed:
Status	Final
Notice	

TABLE OF CONTENTS

1 INTRODUCTION AND BACKGROUND

1.1 Scope of Work

This project covers the communications, data processing and reporting for two Air Quality Monitoring (AQM) Stations in the Saldanha Bay Municipality Area. Argos Scientific's understanding of the scope of work is as follows:

- Establish 3G communications from ambient air quality monitoring station loggers (PC with Linux Operating System) via 2G/3G modem to a centralised server.
- Provide SIM cards for 2G/3G modems.
- Ensure communication support stations and server.
- Provide real-time access to raw data and validated data from SBM offices.
- Provide real-time downloading of raw data and validated data from SBM offices.
- Submission of monthly reports for each monitoring station, including data graphs, exceedance graphs, meteorology, analysis and station status.

1.2 Project Description

This report evaluates data collected from the Saldanha Bay and Vredenburg Air Quality Monitoring Station. The Saldanha Bay station is located at 32°58'56.16"S, 17°59'21.57"E, at Freeport Saldanha to the north east of the town and the Vredenburg station is located at 32°54'6.20"S, 17°59'31.94"E, to the east of the town. These sites meet all the requirements as outlined in the US EPA's "Quality Assurance Handbook for Air Pollution Measurement Systems" and "SANS 1929" report.

Figure 1.2-1 Location of the Air Quality Monitoring Stations at Saldanha Bay & Vredenburg

2 GUIDELINES AND AIR QUALITY STANDARDS

The National Department of Environmental Affairs (DEA) standards for common pollutants as listed in the Government Gazette No.32816, published 24 October 2009, are listed in Table 2-1 below.

Table 2-1 National Ambient Air Quality Standards for SO_2, NO_2, O_3, PM-10 and PM2.5

Pollutant	SO_2	SO_2	NO_2	O_3	PM-10	PM-2.5
Period	10 minute	1 hour	1 hour	8 hour	1 day	1 day
RSA AQ Standard	191ppb	48ppb	106ppb	61ppb	75 μg/m^3	40 μg/m^3

3 METHODOLOGY

3.1 Ambient Air Quality

Ambient concentrations of sulphur dioxide, oxides of nitrogen (NO, NO_2 and NO_X), ozone, and particulates less than 10 μm in diameter (PM-10) are measured at the Saldanha Bay monitoring site and Vredenburg monitoring site in accordance with the latest National Ambient Air Quality Standards (as above) and SANS standard methods. Levels of these pollutants are presented graphically and in table form in section 4 below.

3.2 Data Capture

Data is analysed for completeness against a required standard of 90% and presented in Table 3.2-1 below.

Table 3.2-1 Percentage Data Capture for Ambient Air Quality Pollutants during December 2025 at the Saldanha & Vredenburg AQM Site

Pollutant\Station	Saldanha Bay	Vredenburg
Nitrogen Dioxide	98.7%	0%
Ozone	98.7%	99.8%
PM-10	0%	0%
PM-2.5	0%	0%
Sulphur Dioxide	98.6%	0%

4 RESULTS

4.1 Ambient Air Quality Trends – Saldanha Bay AQM Station

A graphical summary of pollutants for December 2025 is provided in Figure 4.1-1– Figure 4.1-7 below. A tabulated summary of results is attached as Appendix 1.

Figure 4.1-1 Daily Mean SO_2 Concentrations at Saldanha Bay in December 2025

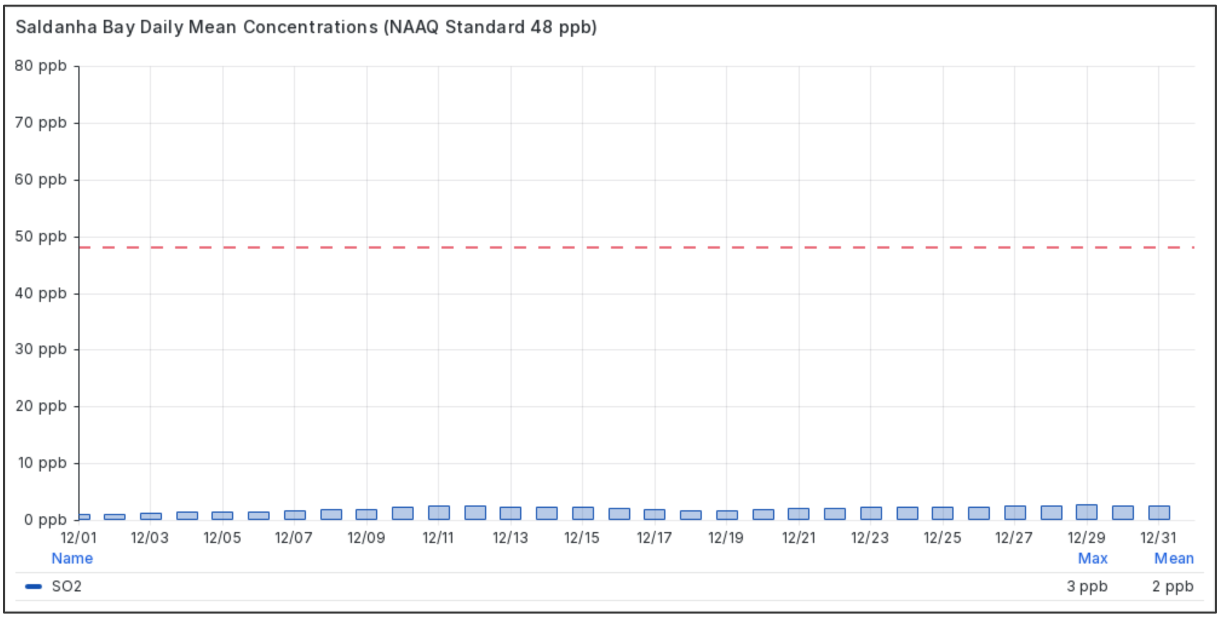


Figure 4.1-2 Mean 10-minute SO_2 Concentrations at Saldanha Bay in December 2025

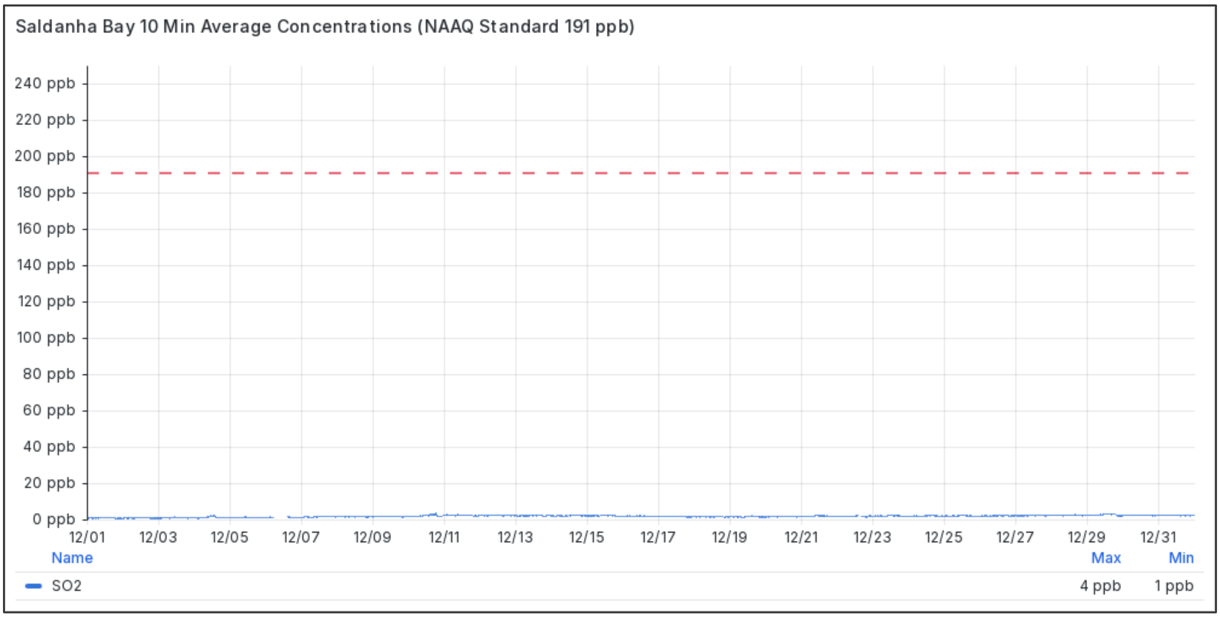


Figure 4.1-3 1 Hourly Mean NO_2 Concentrations at Saldanha Bay in December 2025

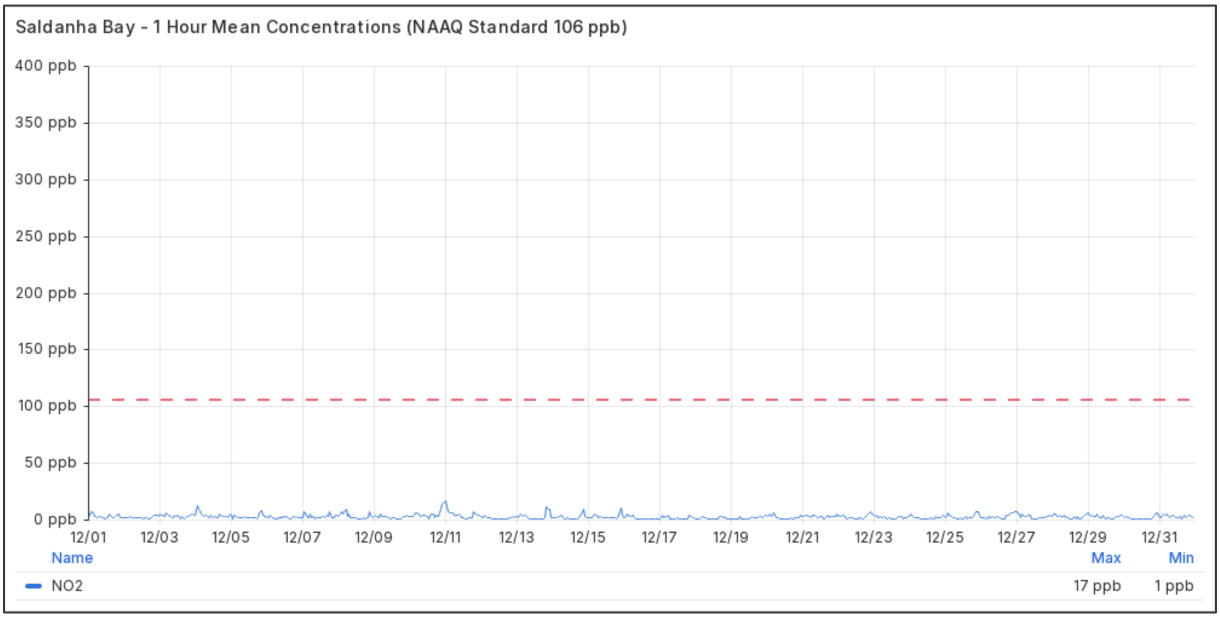


Figure 4.1-4 Daily Mean NO_X Concentrations at Saldanha Bay in December 2025

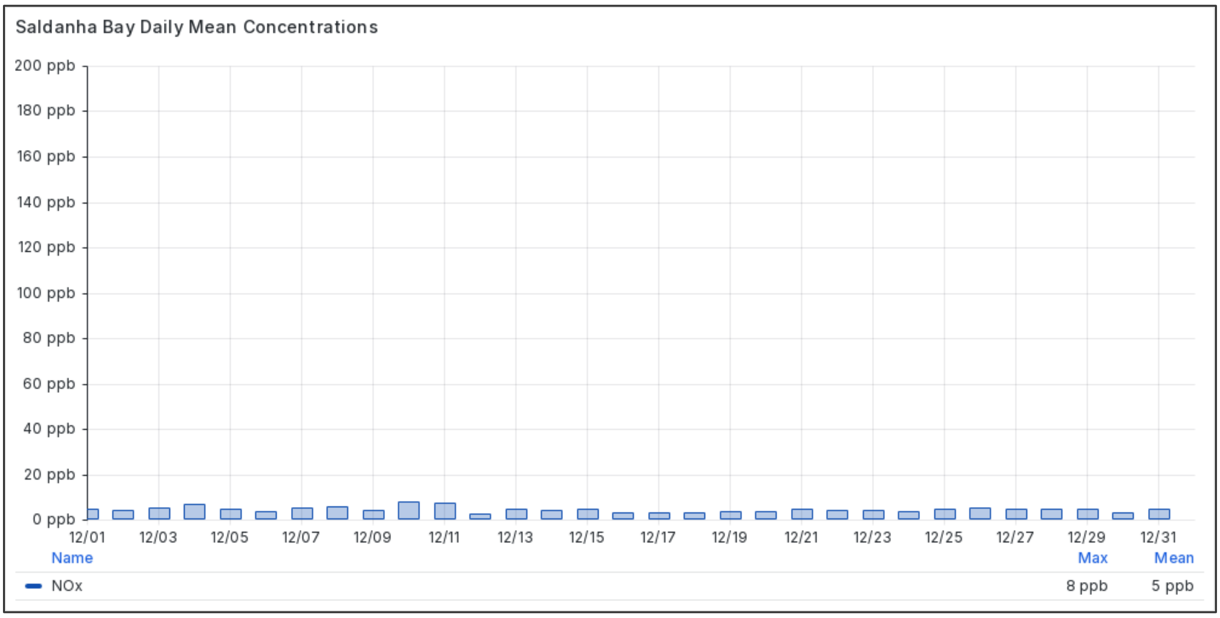


Figure 4.1-5 Eight-hourly Rolling Mean O_3 Concentrations at Saldanha Bay in December 2025

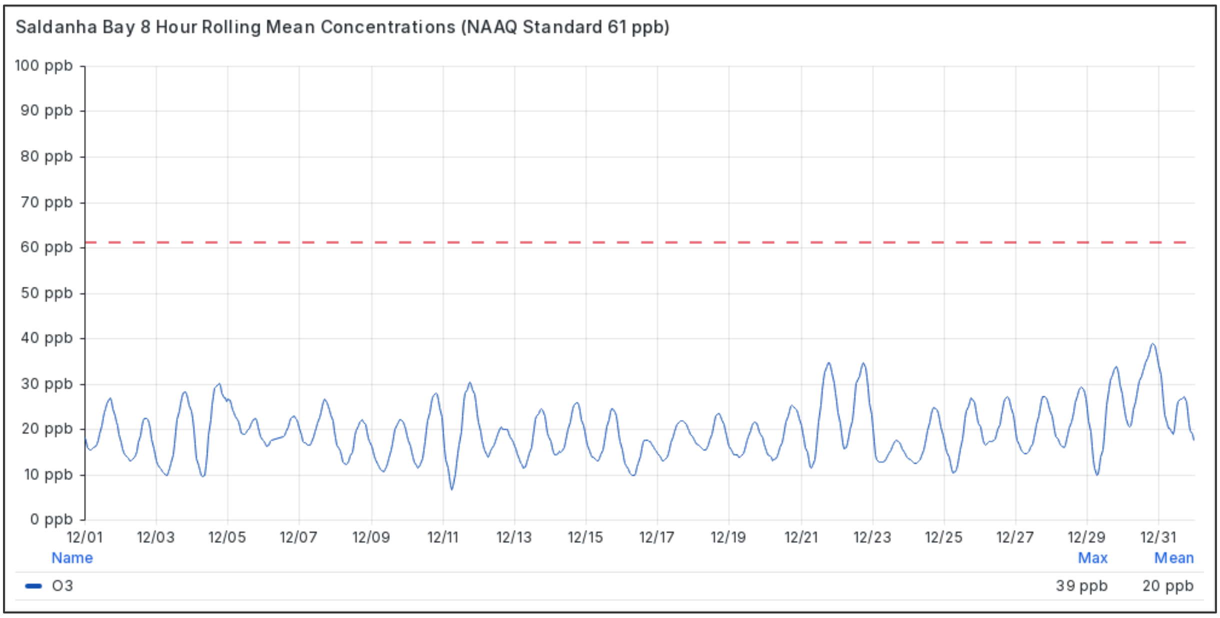


Figure 4.1-6 Daily Mean PM-10 Concentrations at Saldanha Bay in December 2025.

(Analyser away for assessment and repairs)

Figure 4.1-7 Daily Mean PM-2.5 Concentrations at Saldanha Bay in December 2025.

(Analyser away for assessment and repairs)

4.2 Ambient Air Quality Trends – Vredenburg AQM Station

A graphical summary of pollutants for December 2025 is provided in Figure 4.2-1 to Figure 4.2-5 below. A tabulated summary of results is attached as Appendix 2.

Figure 4.2-1 Daily Mean Hourly SO_2 Concentrations at Vredenburg in December 2025

(Analyser installation pending air conditioner upgrade.)

Figure 4.2-2 Daily Maximum 10-minute SO_2 Concentrations at Vredenburg in December 2025

(Analyser installation pending air conditioner upgrade.)

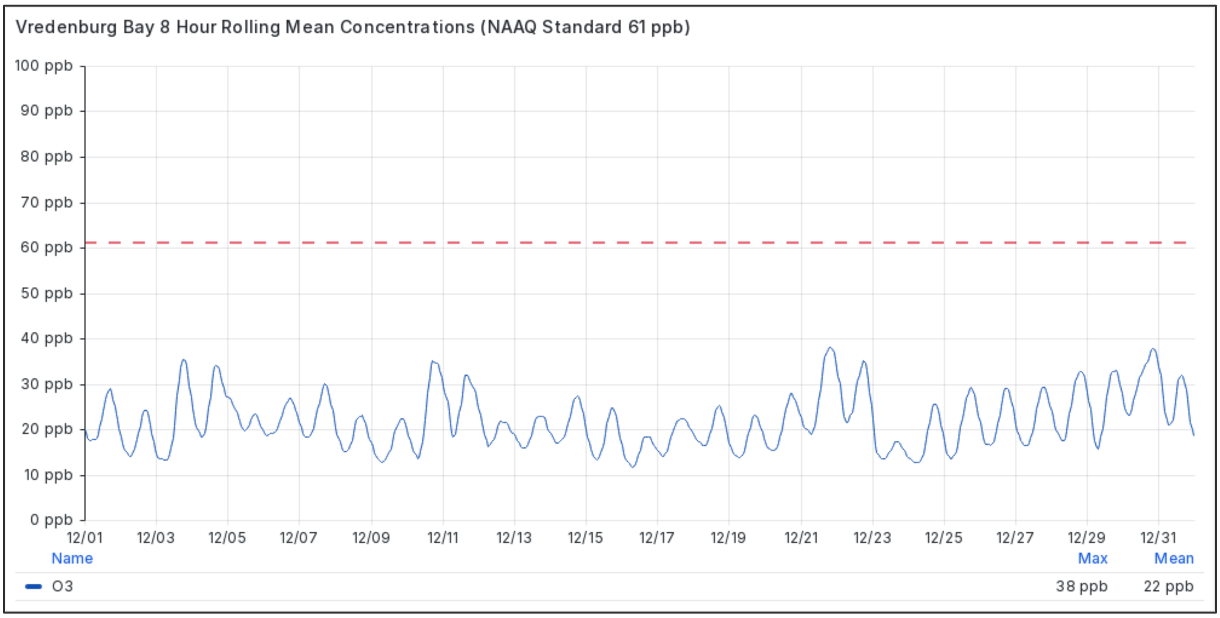
Figure 4.2-3 Daily Maximum NO_2 Concentrations at Vredenburg in December 2025

(Analyser installation pending air conditioner upgrade.)

Figure 4.2-4 Daily Mean Hourly NO_X Concentrations at Vredenburg in December 2025

(Analyser installation pending air conditioner upgrade.)

Figure 4.2-5 Eight-hourly Rolling Mean O_3 Concentrations at Vredenburg in December 2025



4.3 COMPLIANCE

Compliance with National Ambient AQM Standards can be found in Table 4.3-1 below.

Table 4.3-1 Compliance with National Ambient Air Quality Standards at the Saldanha & Vredenburg Site – Number of Exceedances for December 2025

Pollutant	Saldanha	Vredenburg	Averaging Period	NAAQ Standard
Sulphur Dioxide	0	0	10 minutes	191
Sulphur Dioxide	0	0	1 hour	134
Sulphur Dioxide	0	0	24 hour	48
Nitrogen Dioxide	0	0	1 hour	106
Ozone	0	0	8 hour	61
PM-10	0	0	24 hour	75
PM-2.5	0	0	24 hour	40

4.4 MEAN AND MAXIMUM CONCENTRATIONS

Statistical Analysis of ambient pollutants can be found in Table 4.4-1 below.

Table 4.4-1 Mean and Maximum Pollutant Concentrations during December 2025 at Saldanha & Vredenburg sites (80% data capture required)

Pollutant	Saldanha	Vredenburg	Averaging Period
Sulphur Dioxide	2	-	Monthly Mean (ppb)
Sulphur Dioxide	3	-	24 Hour Avg Maximum (ppb)
Sulphur Dioxide	3	-	1 Hour Avg Maximum (ppb)
Nitrogen Dioxide	3	-	Monthly Mean (ppb)
Nitrogen Dioxide	5	-	24 Hour Avg Maximum (ppb)
Nitrogen Dioxide	17	-	1 Hour Avg Maximum (ppb)
Ozone	20	22	Monthly Mean (ppb)
Ozone	32	32	24 Hour Avg Maximum (ppb)
Ozone	43	42	1 Hour Avg Maximum (ppb)
PM-10	-	-	Monthly Mean (µg/m³)
PM-10	-	-	24 Hour Avg Maximum (µg/m³)
PM-10	-	-	1 Hour Avg Maximum (µg/m³)
PM-2.5	-	-	Monthly Mean (µg/m³)
PM-2.5	-	-	24 Hour Avg Maximum (µg/m³)
PM-2.5	-	-	1 Hour Avg Maximum (µg/m³)

*- * Vredenburg NOx & SO2 analysers awaiting aircon upgrade.*

*- * PM monitor sent away for repairs.*

4.5 Diurnal Trends

Diurnal trends of the ambient pollutants are only shown for those pollutants where overall data capture was above 50%, which is considered representative enough for providing an indication of diurnal trends. These trends can be found in Table 4.5-1 and Table 4.5-2 below.

Figure 4.5-1 Diurnal Trend for Ambient Air Pollutants at Saldanha Bay in December 2025

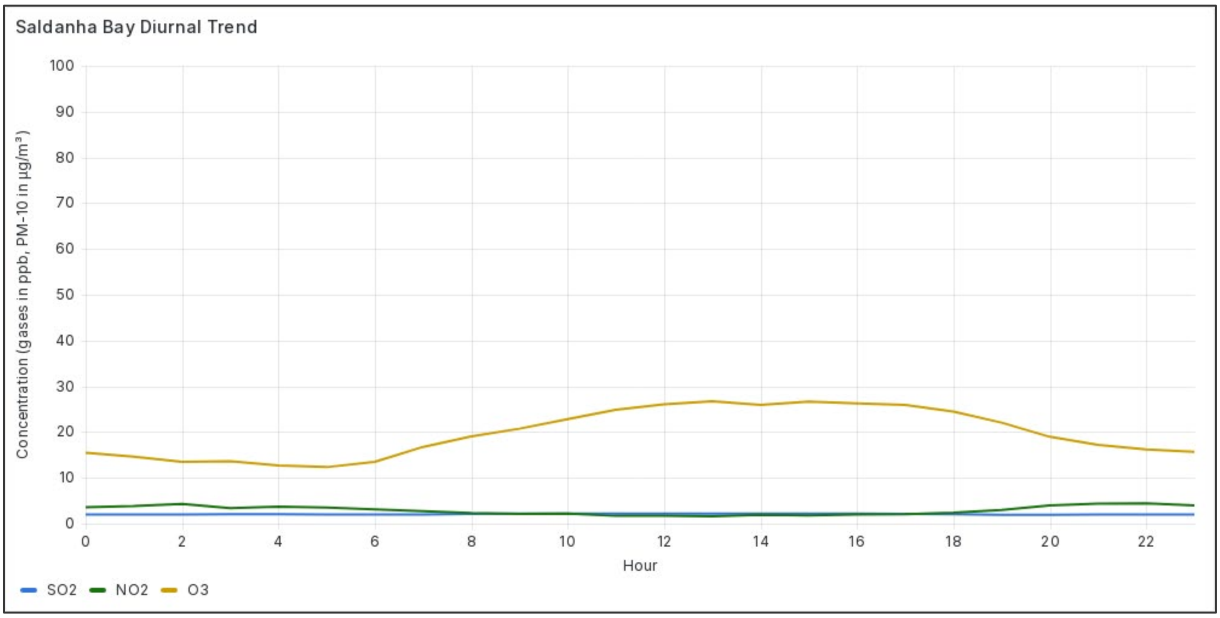
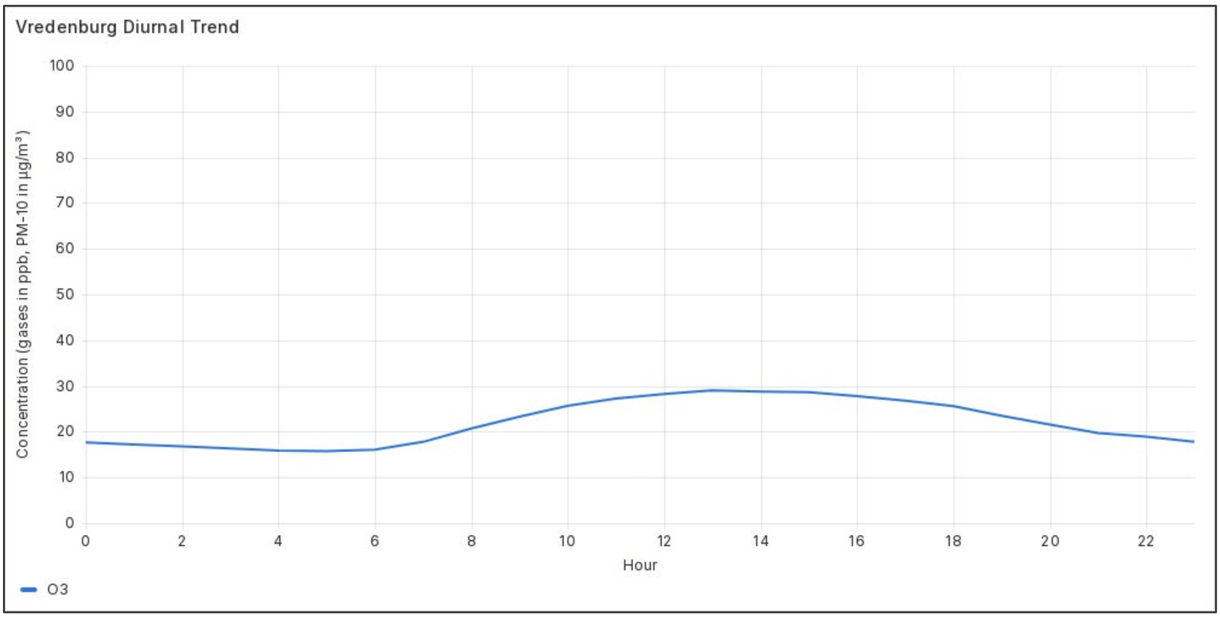


Figure 4.5-2 Diurnal Trend for Ambient Air Pollutants at Vredenburg in December 2025



4.6 Wind and Pollution Roses

Wind roses for December 2025 are shown in Figures 4.6-1 and 4.6-2 below.

Figure 4.6-1 Wind Rose for Saldanha Bay for December 2025

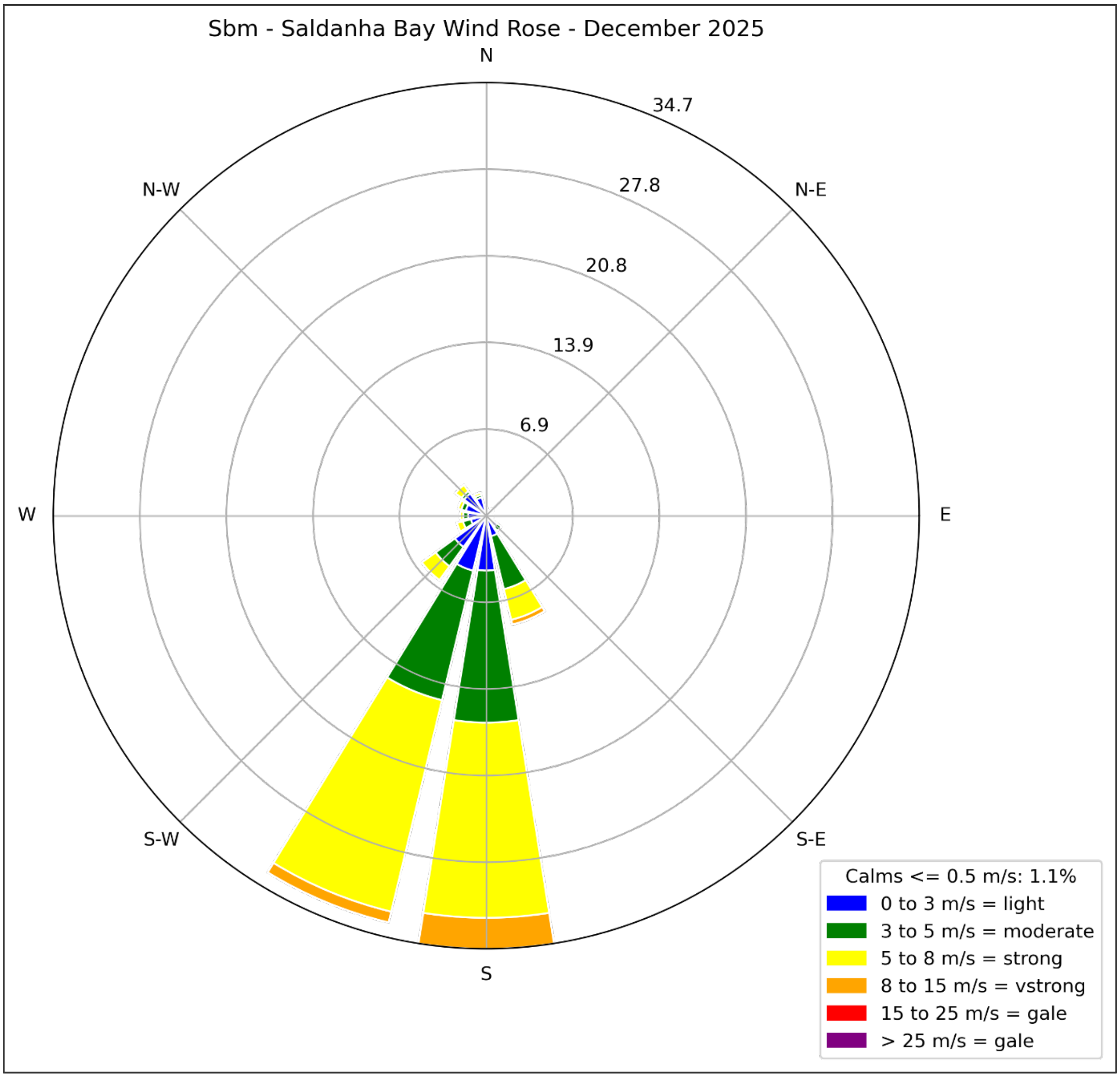
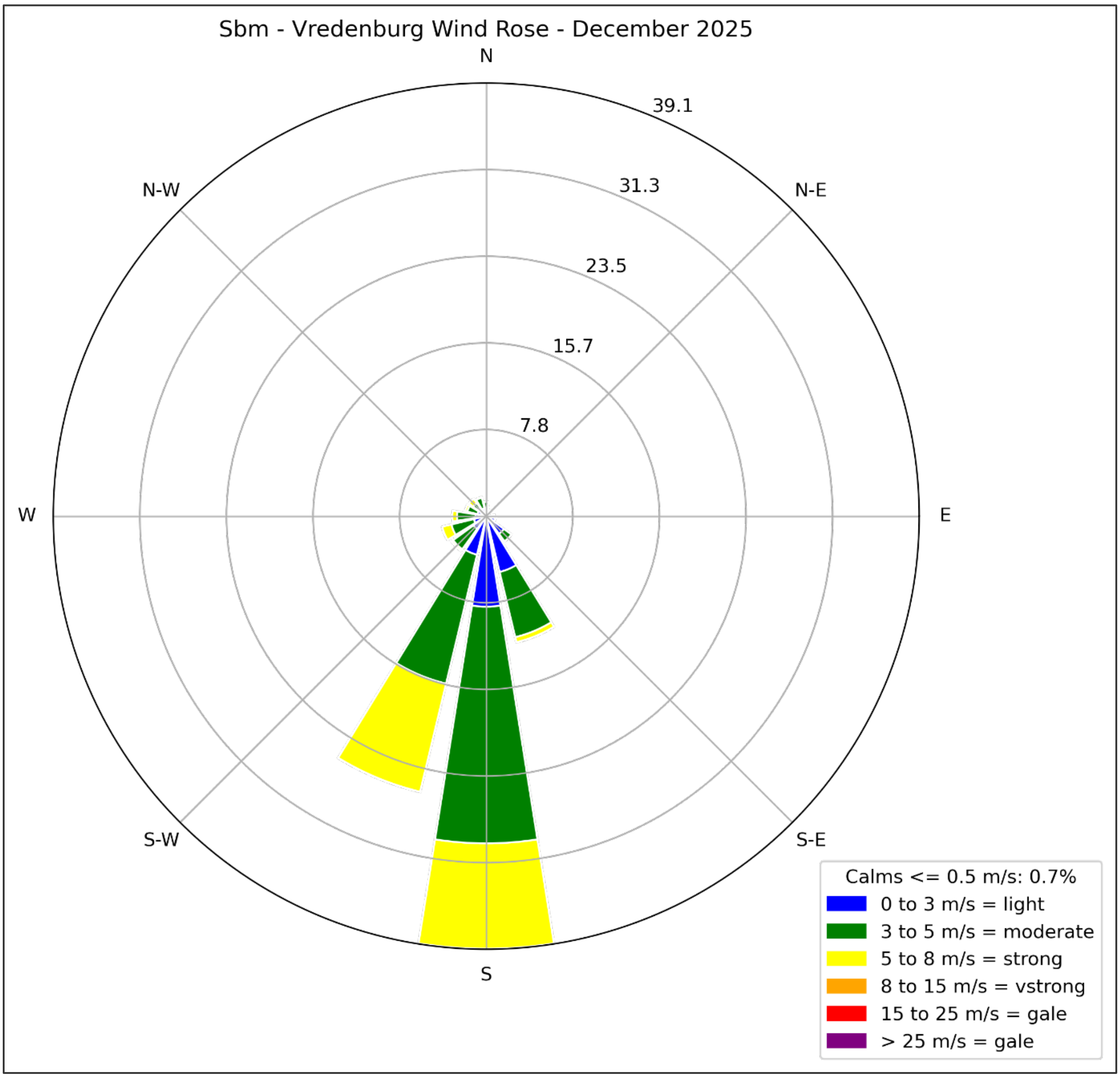


Figure 4.6-2 Wind Rose for Vredenburg for December 2025



5 CONCLUSIONS AND RECOMMENDATIONS

Information on data collection and compliance with standards are presented below and covers activities during December 2025.

- Data capture was >98% for all measured pollutants at the Saldanha AQM site for December 2025
- Data capture was >99% for O_3 at the Vredenburg AQM site for December 2025. The NO_X and SO_2 analysers are awaiting an upgrade to the air conditioner at this site.
- There were no DFFE Air Quality Standard exceedances during December 2025.
- Meteorological conditions at the Saldanha AQM site were characterised by moderate to strong winds from the south (S) and south-west (SW). There was a 1.1% occurrence of calm conditions.
- Meteorological conditions at the Vredenburg AQM site were characterised by moderate to strong winds from the south (S) and south-west (SW). There was a 0.7% occurrence of calm conditions.

APPENDIX 1: MONITORING METHODOLOGIES

1. CONTINUOUS REAL TIME MONITORS

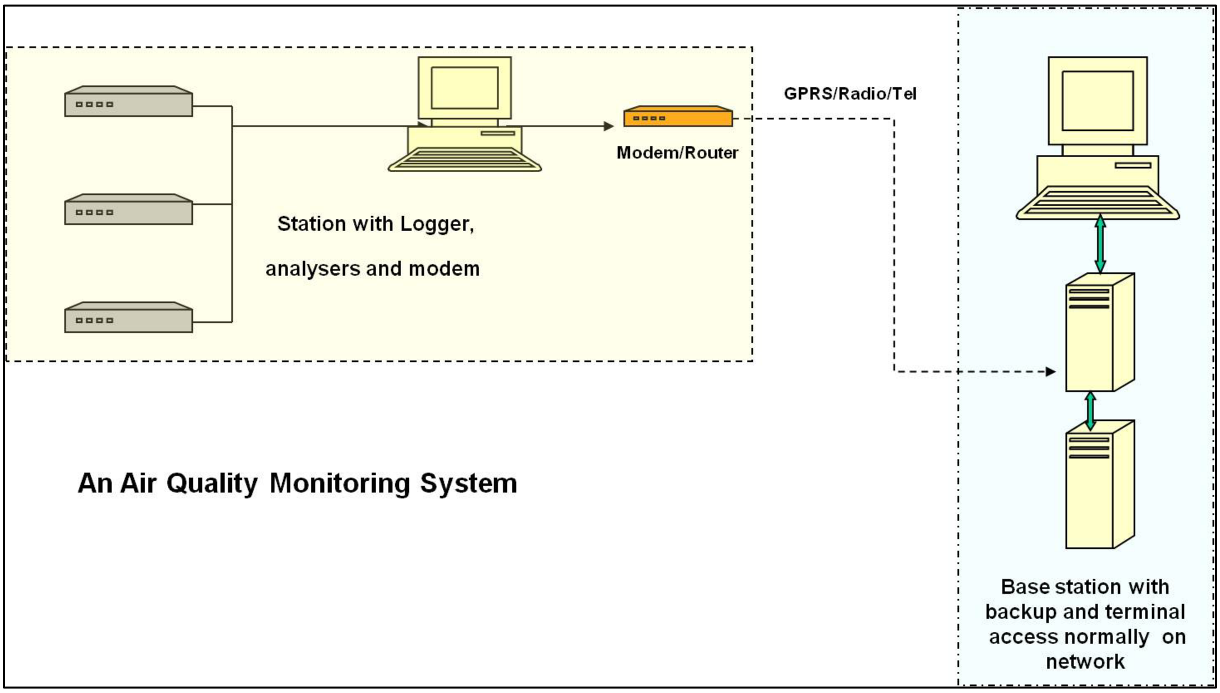
Continuous real-time monitors are used to measure real-time concentrations of gases. These are usually one part of an AQMS and often are remote in location and need to be connected in a network as per Figure A below. Such a system would have the following as a minimum requirement:

- Environmental enclosure
- Inlet manifold
- Analysers
- Calibration
- Meteorological instrumentation
- Data acquisition
- Data reporting
- Communication
- Housekeeping (log book, shelter check sheet, instruments data sheets)

In particular the monitoring station would have the following basic components:

- Monitoring station design
  - Housing
  - Air inlet system
  - Monitoring instrumentation
  - Calibration of monitors
  - Logging devices

Figure A. A Typical Air Quality Monitoring System Design



- Monitoring Methods

This section gives an overview of the methods employed in the continuous monitoring of ambient compounds.

1.1 CO/CO_2

CO and CO_2 are monitored continuously by non-dispersive infrared photometry.

The non-dispersive infrared photometry process is based upon the absorption of infrared light by CO or CO_2.

1.2 NO_X

Oxides of nitrogen are measured continuously by the principle of chemiluminescence.

The air sample is split into two pathways: one to measure NO and the other to measure total NO_X. The intensity of light is measured with a photomultiplier to obtain the concentration of NO. To obtain NO_2 the sample gas is passed through a moly converter.

Measurement is the sum of NO_2 and NO, expressed as NO_X.

1.3 SO_2/H_2S

SO_2 and H_2S are monitored continuously by pulsed fluorescence.

In this method, air is drawn through a chamber where it is irradiated with pulses of ultra-violet (UV) light. Any SO_2 in the sample is excited to a higher energy level and upon returning to its original state, light or fluorescence is released. The amount of fluorescence measured is proportional to the SO_2 concentration.

1.4 O_3

O_3 is monitored continuously using ultra-violet (UV) light absorption.

The sampled air is exposed to UV light which is absorbed by the O_3. The amount of UV light absorbed is proportional to the amount of O_3 in the sample; that is, the more UV light is absorbed, the greater the amount of O3 in the sample.

1.5 PM-10 and PM-2.5

Particulate matter is monitored continuously and intermittently. The Tapered Element Oscillating Microbalance (TEOM) is the most widely used and continuous PM-10 (or PM-2.5) monitor.

The TEOM draws an air sample through an inlet system that aerodynamically separates particles of a specified diameter. The air sample then passes through a filter that is attached to a tapered element in the mass transducer. This tapered element vibrates at its natural frequency. As particles are deposited onto the filter, the oscillating frequency changes in proportion to the amount of mass deposited.

1.6 Meteorological Parameters

Meteorological parameters such as wind direction, wind speed, temperature, relative humidity, solar radiation and atmospheric pressure are monitored in order to assist in identifying the sources of elevated concentration events or episodes.

2. Quality Control Requirements

Quality control of the monitored data is important to verify that the data reported is accurate and of a low uncertainty. Each monitoring station or passive monitoring site should be treated as if it were a laboratory. A laboratory is defined as “A place equipped for testing and analysis” or “A place providing the opportunity for observation in a field of study”.

It must be noted that it has been stated by DEA that only air quality data that is accredited will be accepted by DEA. The definition for accreditation is “the procedure by which an authoritative body gives formal recognition that a body is competent to carry out specific tasks”. In order to be accredited a sampling method must have:

- A recognised methodology that competence can be measured against
- A quality system
- Have been audited by a certification body

A relevant quality system for air quality measurements according to SANAS is ISO 17025. This system provides guidance to laboratories on essential elements for both:

- Quality management
- Technical requirements for the proper operation of a testing laboratory

3. Instrument Calibration and Frequency

This section covers the calibration of continuous air quality monitors. The basic requirements based on the US EPA Red Book are:

- Each analyser must have a dynamic calibration every three months
- This type of calibration must also be carried out on installation, after any repair, if tolerances of zero/ span are not met and if the analyser is relocated
- Zero and span calibration every two weeks
- Zero check every other week

4. Data Acquisition Requirements

This section also refers to an AQMS based on continuous monitoring from a monitoring station and to the data logging system:

The data logger must:

- Be verified annually
- Output from the analyser must be recorded
- Generate hourly mean concentrations
- Be able to scan at 30 second intervals with a minimum scan period of 1 hour and store this data
- Collect at least 40 minutes of uninterrupted data per hour for a valid average
- Use calculations verified by a statistician

5. Site Selection

The following quote is noteworthy when considering the location of sites: *"Irrespective of how well a monitoring station is run, if it is not sited correctly data collected will have little value"*

As was mentioned earlier sites are selected for one of the following reasons:

- To judge compliance with air quality standards
- To activate emergency control procedures for episodes
- To observe pollution trends throughout a region
- To provide a database for research.

When selecting monitoring sites the following must be considered:

- **Economic**: Resources must be available for the expensive instrumentation, data retrieval and evaluation, maintenance and quality assurance and reporting of data
- **Security**: Problems can arise in this regard that make a site unsuitable when standard measures are taken into account
- **Logistics:** Planning, staffing, procurement procedures, training, communications, safety, task scheduling
- **Atmospheric conditions:**
    - Variability of air pollutants and their transport (effects of buildings, terrain and heat sources)
    - Dispersion factors – wind speed, wind direction, atmospheric stability
- **Topography**: Transport and diffusion of air pollutants are complicated by topographical features such as valleys or hills
- **Pollutant consideration:** A sampling site for one pollutant may or may not be suitable for other pollutants
    - For example, monitoring ozone close to primary NO emissions would not provide accurate pollutant information
- The final placement once a monitoring site has been selected depends on the presence of physical obstructions, accessibility and availability of utilities.
- **Obstructions** such as trees and buildings significantly affect the air flow over the monitoring station and the placement should expose the station to the general air flow of the area to prevent sampling bias.
- **Major roads** can produce bias, and sites should be 15-60m away unless there are specific requirements for roadway monitoring. Typically, sites would be between 3m and 15m away in this case.

6. Data Management

All monitoring stations produce data that may be used for various reasons as outlined above. The following should be noted when dealing with this monitoring data and systems should be designed to accommodate the following:

- A copy of the raw data must always be available
- A record must be kept of any adjustments made
- All multiplication factors/ algorithms/ manipulations on the data must be recorded and reported
- Data must be kept for a minimum of 3 years
- When data is reported the temperature and pressure at which the analyser was last calibrated must be indicated on the test report

The following points must be considered when preparing a monitoring plan:

- Local authority responsible for monitoring
- Check to see if Province has information about your area
- Check to see whether DEA has information about your area (SAAQIS)
- Do screening study to see which pollutants, if any are of concern
- SANS 1929 lets you make management decisions on whether costly continuous monitoring is needed
- If so, focus on quality control, reporting 80% or more of available data
- Use data to manage improvements in air quality

APPENDIX 2: QUALITY ASSURANCE STATEMENT

The Q4 Dynamic Calibrations were done on 25 and 27 November 2025, all analysers meeting EPA requirements and giving a linear response. Site visits were conducted on or around the 9/12/2025 and 31/12/2025.

NO_X, SO_2 and O_3 were operational at Saldanha and O_3 at Vredenburg.

The portable air-conditioner at Vredenburg is being monitored closely.

Analyser	Expected	Actual	Error (%)
SO_2 (Saldanha - 27/11/2025)	400ppb**	401ppb	<1%
NO (Saldanha - 27/11/2025)	400ppb**	405ppb	+1,3%
O3 (Saldanha - 27/11/2025)	400ppb**	428ppb	+7.0%
SO_2 (Saldanha -31/12/2025)	254ppb*	250ppb	-1.6%
NO (Saldanha -31/12/2025)	1008ppb*	940ppb	-6.8%
O3 (Saldanha - 31/12/2025)	350ppb*	350ppb	0.0%
Ozone (Vredenburg - 25/11/2025)	400ppb**	417ppb	+4.3%

**Dynamic Calibration 80% set-point

*IZS

APPENDIX 3: SUMMARY TABLE OF HOURLY MEANS (SALDANHA)

POLLUTANT: Sulphur Dioxide **HOURLY MEAN CONCENTRATIONS µg/m³**

Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Mean	Max
2025-12-01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2025-12-02	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2025-12-03	1	1	1	1	1	1	1	1	1	1	2	1	2	1	1	2	1	1	1	1	1	1	1	1	1	2
2025-12-04	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	2	1	1	1	1	1	1	1	1	2
2025-12-05	1	1	1	1	1	1	1	1	1	2	2	2	1	1	1	2	1	2	1	1	1	1	2	1	1	2
2025-12-06	1	1	1	2	2										2	2	1	2	2	2	2	2	2	2	2	2
2025-12-07	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2025-12-08	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2025-12-09	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
2025-12-10	2	2	2	2	2	2	2	2	2	2	3	3	3	2	3	3	3	3	3	2	2	2	2	3	2	3
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2025-12-12	2	3	2	2	2	2	2	2	3	3	2	3	3	3	2	2	2	2	2	2	2	2	2	2	2	3
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2025-12-28	3	2	3	3	3	2	3	2	3	3	3	3	3	3	3	3	3	3	3	2	2	3	3	3	3	3
2025-12-29	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	3	3
2025-12-30	3	2	2	3	3	2	2	2	2	3	3	3	3	3	3	3	3	2	3	2	2	2	3	3	3	3
2025-12-31	3	3	3	3	3	3	3	3	3		3	3	3	3	2	2	3	2	2	2	2	2	2	2	3	3
Mean	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	
Max	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**

POLLUTANT: no_ **HOURLY MEAN CONCENTRATIONS**

Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Mean	Max
2025-12-01	1	1	1	1	1	1	1	3	3	2	2	1	2	3	6	4	2	2	2	1	1	1	1	1	2	6
2025-12-02	1	1	1	1	1	1	2	2	3	3	3	3	2	1	2	2	2	1	2	2	1	1	2	1	2	3
2025-12-03	1	1	1	1	2	2	4	3	3	3	5	3	3	1	1	2	1	2	2	1	1	1	1	1	2	5
2025-12-04	1	3	2	4	2	1	2	4	4	3	3	3	1	2	3	2	6	3	2	1	1	1	1	1	2	6
2025-12-05	1	1	1	1	1	1	1	2	4	5	3	2	2	2	2	2	2	2	2	2	3	1	2	1	2	5
2025-12-06	1	1	1	1	1										3	2	1	2	2	1	1	1	1	1	1	3
2025-12-07	1	2	2	1	1	1	1	3	2	2	3	2	2	3	4	2	2	2	3	2	1	1	1	1	2	4
2025-12-08	1	2	2	2	1	3	2	7	4	3	3	3	3	2	2	2	2	2	1	1	1	2	1	1	2	7
2025-12-09	1	1	1	1	1	1	2	3	5	4	3	2	4	3	2	1	1	1	1	1	1	1	1	1	2	5
2025-12-10	1	1	1	1	2	1	3	4	4	6	4	3	4	2	5	4	4	2	2	1	1	1	2	1	2	6
2025-12-11	2	12	2	1	2	4	4	4	3	5	4	2	2	1	1	1	2	2	1	1	1	1	1	1	2	12
2025-12-12	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2025-12-13	1	1	1	2	2	1	3	3	2	2	2	1	2	1	1	1	2	1	1	1	2	2	2	1	2	3
2025-12-14	1	1	1	1	1	1	2	2	2	1	2	2	2	1	2	2	2	2	2	2	1	2	1	1	2	2
2025-12-15	1	1	1	1	2	1	3	3	4	3	3	3	2	2	2	2	2	2	1	1	1	1	2	1	2	4
2025-12-16	1	1	4	1	1	1	4	3	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4
2025-12-17	1	1	2	1	1	1	2	2	1	1	2	2	3	1	1	1	2	2	1	1	1	1	1	1	1	3
2025-12-18	1	1	1	1	1	1	2	2	2	2	2	1	1	2	2	2	4	3	2	2	1	1	1	1	2	4
2025-12-19	1	1	1	1	1	1	3	2	2	2	2	2	2	3	4	3	3	2	2	2	1	1	1	1	2	4
2025-12-20	1	1	2	1	1	2	2	2	3	2	2	1	1	1	2	1	2	1	1	1	1	1	1	1	1	3
2025-12-21	1	1	1	2	1	2	2	3	4	3	2	2	2	2	2	1	2	2	1	1	1	1	1	1	2	4
2025-12-22	1	1	1	1	1	1	1	2	2	2	1	1	1	1			1	1	1	1	1	1	1	1	1	2
2025-12-23	1	1	1	1	1	1	1	2	2	2	3	2	2	2	2	2	3	3	3	2	1	1	1	1	2	3
2025-12-24	1	2	1	1	1	1	2	1	2	2	2	1	2	1	1	2	2	1	3	1	1	1	1	1	1	3
2025-12-25	1	1	2	1	1	1	2	3	2	2	2	1	1	3	3	2	2	2	1	1	1	2	2	1	2	3
2025-12-26	1	1	1	1	1	1	2	3	5	3	3	3	3	2	1	2	2	3	2	1	1	1	1	1	2	5
2025-12-27	2	1	1	1	1	1	2	3	7	6	2	1	2	1	2	2	2	2	2	1	1	1	1	1	2	7
2025-12-28	1	1	1	1	1	1	2	3	5	3	3	2	2	2	1	3	2	2	1	1	1	1	1	1	2	5
2025-12-29	1	1	1	4	2	2	9	3	2	2	3	1	1	1	1	1	1	1	1	1	1	1	1	1	2	9
2025-12-30	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2025-12-31	1	1	1	1	1	1	1	1	2		2	1	1	2	3	1	2	3	2	1	1	1	1	1	1	3
Mean	**1**	**2**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	
Max	**2**	**12**	**4**	**4**	**2**	**4**	**9**	**7**	**7**	**6**	**5**	**3**	**4**	**3**	**6**	**4**	**6**	**3**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**12**

POLLUTANT: no2 **HOURLY MEAN CONCENTRATIONS**

Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Mean	Max
2025-12-01	2	4	7	6	3	3	2	3	3	2	2	1	2	2	5	4	2	2	3	4	5	2	2	2	3	7
2025-12-02	3	2	2	2	3	2	2	2	2	2	2	2	2	1	2	2	1	1	2	3	4	4	4	3	2	4
2025-12-03	5	4	4	4	7	6	4	3	2	3	4	3	4	2	1	3	1	2	3	3	4	6	5	5	4	7
2025-12-04	5	13	10	9	5	4	4	5	4	3	4	3	2	4	2	2	6	5	4	3	3	3	3	5	5	13
2025-12-05	4	1	4	4	2	2	2	2	3	3	2	2	2	2	2	2	2	2	2	6	9	5	5	2	3	9
2025-12-06	3	2	4	3	2										3	1	1	2	3	2	3	2	2	2	2	4
2025-12-07	3	8	7	2	2	5	2	3	1	2	2	2	2	3	4	2	4	3	8	4	2	2	4	4	3	8
2025-12-08	4	6	7	5	7	9	4	5	3	2	2	2	3	1	1	1	2	2	1	2	2	7	4	2	4	9
2025-12-09	3	4	3	2	5	4	3	3	3	2	2	1	3	2	2	1	1	1	1	2	3	3	5	4	3	5
2025-12-10	3	3	3	4	6	6	5	3	3	4	5	4	4	2	5	5	5	3	5	4	6	10	14	15	5	15
2025-12-11	17	12	8	7	6	6	5	5	4	5	4	2	2	1	1	1	3	2	3	7	7	4	4	4	5	17
2025-12-12	3	2	4	3	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	2	3	4	2	3	2	4
2025-12-13	3	2	4	5	3	5	4	3	2	1	1	1	1	1	1	1	1	1	1	2	11	10	10	3	3	11
2025-12-14	2	2	2	2	3	3	4	2	1	1	2	1	1	1	1	1	1	2	3	5	8	9	4	2	3	9
2025-12-15	2	2	2	3	5	4	4	3	3	2	2	2	2	2	2	2	2	2	2	1	2	7	10	5	3	10
2025-12-16	2	3	5	3	4	3	4	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	5
2025-12-17	1	2	4	2	3	3	4	2	1	1	1	1	2	1	1	1	1	1	1	1	4	3	3	2	2	4
2025-12-18	1	1	1	1	2	3	3	2	1	1	2	1	1	1	1	1	4	3	3	2	3	1	1	1	2	4
2025-12-19	1	1	1	1	1	1	3	1	1	1	1	2	1	2	3	2	2	2	2	3	3	3	3	4	2	4
2025-12-20	4	3	6	4	4	6	3	2	3	1	1	1	1	1	1	1	2	1	1	2	2	2	2	4	2	6
2025-12-21	3	4	5	4	3	3	3	4	4	4	3	2	3	3	2	1	2	4	2	3	3	3	3	5	3	5
2025-12-22	4	4	3	4	5	2	2	2	2	2	2	2	2	2			1	1	2	4	5	6	7	6	3	7
2025-12-23	5	3	4	2	3	2	2	3	2	1	2	2	1	1	2	2	2	3	3	3	1	2	2	3	2	5
2025-12-24	3	5	4	2	2	2	2	1	2	1	1	1	1	1	2	2	2	1	3	2	2	2	3	5	2	5
2025-12-25	3	3	6	4	3	2	3	3	1	2	2	2	1	3	3	1	2	2	2	3	5	7	7	5	3	7
2025-12-26	3	2	2	2	2	2	3	2	3	3	2	3	3	2	1	2	2	4	5	4	6	6	6	8	3	8
2025-12-27	8	6	6	2	5	3	3	3	4	4	2	1	1	1	1	2	2	3	2	3	4	3	4	3	3	8
2025-12-28	3	5	5	4	3	4	3	3	4	2	3	1	1	1	1	3	1	3	2	2	2	4	5	5	3	5
2025-12-29	7	4	3	4	4	3	6	4	2	2	4	2	1	2	2	1	1	1	2	3	3	3	4	4	3	7
2025-12-30	4	3	3	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	4	6	6	2	6
2025-12-31	2	3	5	5	4	6	4	2	3		3	2	2	2	3	1	2	4	2	4	4	4	3	3	3	6
Mean	**4**	**4**	**4**	**3**	**4**	**4**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**4**	**4**	**4**	**4**	**3**	
Max	**17**	**13**	**10**	**9**	**7**	**9**	**6**	**5**	**4**	**5**	**5**	**4**	**4**	**4**	**5**	**5**	**6**	**5**	**8**	**7**	**11**	**10**	**14**	**15**	**5**	**17**

POLLUTANT: nox | HOURLY MEAN CONCENTRATIONS

Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Mean	Max
2025-12-01	3	5	8	8	5	4	4	6	6	4	4	3	4	5	11	8	3	4	5	5	6	3	3	3	5	11
2025-12-02	4	3	3	3	5	3	5	4	6	5	5	5	4	3	4	4	3	3	4	5	5	6	5	5	4	6
2025-12-03	6	5	5	5	8	7	8	6	5	5	9	6	7	3	3	5	3	4	5	4	5	7	7	6	6	9
2025-12-04	6	15	12	13	7	5	6	9	7	5	8	6	4	6	5	4	11	8	6	5	4	4	4	6	7	15
2025-12-05	5	2	5	5	4	3	3	4	6	8	5	4	4	4	4	5	4	3	4	8	12	6	6	3	5	12
2025-12-06	4	3	5	4	4										6	3	3	4	5	3	4	4	3	3	4	6
2025-12-07	4	9	9	3	3	6	3	6	3	4	5	4	4	5	7	4	6	5	11	5	3	3	5	5	5	11
2025-12-08	5	7	9	7	8	13	6	11	6	5	5	5	6	3	3	2	3	4	3	4	4	9	5	3	6	13
2025-12-09	4	6	4	3	6	5	5	6	7	6	5	3	6	5	4	2	2	2	2	3	4	5	6	5	4	7
2025-12-10	4	5	4	6	8	7	8	7	7	10	9	7	7	3	10	9	9	5	7	5	7	11	15	17	8	17
2025-12-11	18	24	10	8	8	10	9	8	7	10	7	5	4	2	2	2	5	3	4	8	8	5	5	5	7	24
2025-12-12	4	3	5	4	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	3	4	4	3	4	3	5
2025-12-13	5	3	5	7	5	6	7	6	4	3	3	2	3	2	2	2	2	2	2	4	13	12	12	4	5	13
2025-12-14	3	3	3	3	5	5	6	4	3	2	4	3	3	2	3	3	3	3	4	7	9	11	5	3	4	11
2025-12-15	3	3	4	4	7	5	7	6	7	5	5	5	4	3	4	5	4	4	3	2	3	9	12	6	5	12
2025-12-16	3	4	9	4	6	4	9	6	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	9
2025-12-17	2	3	6	3	4	4	6	3	3	2	2	3	5	2	2	2	3	3	2	2	5	4	4	3	3	6
2025-12-18	2	2	2	2	4	4	4	4	3	3	3	3	2	3	3	3	7	5	5	4	4	3	2	2	3	7
2025-12-19	2	2	2	2	2	2	7	3	3	3	3	4	3	6	7	5	5	4	4	5	4	4	4	5	4	7
2025-12-20	5	4	7	5	5	8	4	5	6	3	3	2	2	2	3	3	4	3	3	3	3	3	3	5	4	8
2025-12-21	5	5	6	6	4	4	4	7	8	7	5	4	5	6	3	3	4	6	3	5	4	4	4	6	5	8
2025-12-22	5	5	5	5	6	4	3	4	4	3	3	3	3	3			3	3	3	5	6	7	9	7	4	9
2025-12-23	6	4	6	3	4	3	3	5	4	3	5	4	3	3	4	3	4	6	6	4	2	3	3	4	4	6
2025-12-24	4	7	5	3	3	3	3	3	4	4	3	3	3	3	3	3	4	3	6	3	3	4	5	6	4	7
2025-12-25	4	5	8	6	4	4	4	5	3	3	4	3	2	5	6	3	5	4	3	4	6	9	9	6	5	9
2025-12-26	3	3	3	3	3	3	4	5	8	6	5	6	5	4	3	3	3	7	7	6	8	8	7	9	5	9
2025-12-27	9	7	7	3	6	4	5	6	11	10	4	3	3	2	3	4	4	5	4	4	5	4	5	4	5	11
2025-12-28	4	6	6	5	4	5	5	6	9	5	6	3	3	3	3	6	3	5	3	3	3	5	6	6	5	9
2025-12-29	8	5	4	9	6	5	15	6	3	4	7	3	3	3	3	2	3	3	3	4	4	4	5	5	5	15
2025-12-30	5	4	4	3	3	2	2	3	2	2	2	2	2	2	2	2	2	2	2	2	4	5	7	7	3	7
2025-12-31	3	4	6	6	6	7	5	3	5		5	4	3	4	6	3	3	7	4	5	5	5	4	4	5	7
Mean	**5**	**5**	**6**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**4**	**4**	**3**	**4**	**4**	**4**	**4**	**4**	**4**	**5**	**6**	**6**	**5**	**5**	
Max	**18**	**24**	**12**	**13**	**8**	**13**	**15**	**11**	**11**	**10**	**9**	**7**	**7**	**6**	**11**	**9**	**11**	**8**	**11**	**8**	**13**	**12**	**15**	**17**	**8**	**24**

Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Mean	Max
2025-12-01	18	17	13	13	16	16	18	20	21	23	26	28	27	27	24	28	30	25	19	17	15	16	16	15	20	30
2025-12-02	14	14	13	13	11	13	12	14	16	18	19	19	24	28	26	24	21	19	17	13	12	11	11	12	16	28
2025-12-03	11	11	12	11	7	8	6	14	16	18	20	25	27	29	28	28	29	28	29	27	23	19	19	18	19	29
2025-12-04	16	8	5	2	10	10	11	15	19	23	27	33	38	36	26	29	22	28	29	28	26	27	26	23	22	38
2025-12-05	25	26	22	20	21	20	19	18	17	17	18	20	23	24	24	24	21	22	20	16	12	16	15	19	20	26
2025-12-06	18	18	16	17	18										22	25	26	25	24	22	19	19	19	18	20	26
2025-12-07	17	12	14	19	18	16	18	18	21	22	24	26	27	26	26	30	29	27	17	18	20	18	15	15	21	30
2025-12-08	15	13	12	14	10	8	14	13	16	18	19	22	21	25	24	22	22	20	21	18	17	11	14	15	17	25
2025-12-09	14	12	12	12	8	7	11	11	13	15	16	18	18	22	22	24	24	24	22	21	19	17	16	16	16	24
2025-12-10	15	13	12	11	9	9	10	14	16	18	22	25	24	28	27	29	32	29	27	28	23	17	15	11	19	32
2025-12-11	3	3	7	13	6	3	7	17	24	22	25	27	30	31	32	34	30	31	29	23	22	22	17	12	20	34
2025-12-12	15	16	14	14	13	13	13	18	21	20	20	20	20	21	23	19	17	20	21	19	14	12	17	15	17	23
2025-12-13	11	15	13	9	7	12	9	17	20	21	21	22	23	26	26	24	25	27	23	20	13	11	10	18	18	27
2025-12-14	17	16	14	15	14	13	13	17	20	22	24	26	25	26	26	28	27	26	24	20	15	11	16	17	20	28
2025-12-15	15	14	14	13	10	11	12	15	16	18	20	21	23	25	27	28	27	25	20	16	16	11	10	14	18	28
2025-12-16	14	13	9	10	9	6	7	12	15	17	18	18	21	19	17	16	15	16	17	18	15	13	13	13	14	21
2025-12-17	12	12	11	15	14	16	18	20	21	22	22	23	21	21	22	22	21	21	22	19	15	16	16	17	18	23
2025-12-18	17	17	17	16	14	13	14	16	18	20	23	24	24	25	24	26	23	21	19	17	15	15	15	14	19	26
2025-12-19	14	14	14	14	14	14	11	14	16	18	21	23	22	21	21	24	20	20	18	16	16	15	15	14	17	24
2025-12-20	14	14	12	13	13	11	15	17	18	20	21	23	23	23	27	28	26	28	23	21	19	20	22	18	20	28
2025-12-21	16	15	11	7	10	6	11	16	20	25	30	32	35	36	35	34	34	36	36	31	28	25	18	16	23	36
2025-12-22	19	17	17	13	12	14	20	25	28	30	33	32	34	37			36	36	34	23	16	14	12	13	23	37
2025-12-23	13	13	12	14	12	14	13	13	15	16	16	18	20	20	18	17	15	14	14	14	15	14	13	12	15	20
2025-12-24	13	11	12	13	13	14	14	14	15	18	21	24	25	26	28	27	24	24	19	20	19	17	14	13	18	28
2025-12-25	14	13	10	11	8	7	8	14	18	21	23	25	26	25	27	27	26	30	29	24	18	13	14	16	19	30
2025-12-26	18	18	17	17	17	17	16	17	18	19	21	24	26	28	29	29	31	26	25	23	19	17	16	14	21	31
2025-12-27	13	15	15	18	14	15	15	15	14	17	21	24	25	26	28	28	29	29	28	25	22	21	20	20	21	29
2025-12-28	18	16	15	15	16	15	16	17	17	21	24	25	26	25	26	27	32	33	33	31	27	22	19	15	22	33
2025-12-29	15	12	12	6	5	6	7	18	27	29	26	29	32	35	34	32	33	34	34	36	28	25	18	14	23	36
2025-12-30	16	22	22	23	26	26	30	29	32	34	34	34	34	35	37	37	40	41	43	42	37	30	27	26	32	43
2025-12-31	27	24	20	16	16	15	18	25	23		28	35	36	26	22	25	24	21	21	18	14	14	14	14	22	36
Mean	**15**	**15**	**14**	**13**	**13**	**12**	**14**	**17**	**19**	**21**	**23**	**25**	**26**	**27**	**26**	**26**	**26**	**26**	**24**	**22**	**19**	**17**	**16**	**16**	**20**	
Max	**27**	**26**	**22**	**23**	**26**	**26**	**30**	**29**	**32**	**34**	**34**	**35**	**38**	**37**	**37**	**37**	**40**	**41**	**43**	**42**	**37**	**30**	**27**	**26**	**32**	**43**

APPENDIX 4: SUMMARY TABLE OF HOURLY MEANS(VREDENBURG)

POLLUTANT: o3_ **HOURLY MEAN CONCENTRATIONS**

Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Mean	Max
2025-12-01	20	19	16	16	17	18	18	19	23	24	28	31	31	29	28	29	31	26	21	19	17	17	16	15	22	31
2025-12-02	15	14	15	14	13	14	14	15	19	21	23	23	25	26	28	25	23	21	18	14	13	12	13	13	18	28
2025-12-03	14	15	15	13	13	11	12	14	18	22	25	30	34	38	39	41	38	31	31	30	25	22	20	20	24	41
2025-12-04	18	18	19	21	19	16	15	20	25	30	34	39	39	38	35	30	27	28	29	30	27	26	26	26	26	39
2025-12-05	26	27	25	24	22	20	19	19	18	19	19	21	24	24	25	27	23	22	22	19	18	19	18	19	22	27
2025-12-06	19	19	20	20	20	19	19	20	21	23	26	28	29	28	25	26	27	27	26	23	21	20	19	19	23	29
2025-12-07	18	17	16	19	19	19	19	21	23	26	29	30	30	30	29	30	33	30	24	20	21	18	17	16	23	33
2025-12-08	17	18	16	16	13	12	15	16	18	21	22	24	25	25	24	22	20	21	23	18	17	14	14	15	19	25
2025-12-09	14	13	13	13	11	13	12	12	15	16	17	18	16	18	23	25	25	24	23	21	20	19	18	18	17	25
2025-12-10	16	14	14	13	13	14	13	13	18	25	29	31	32	36	39	40	40	33	29	28	33	32	28	27	25	40
2025-12-11	25	23	22	18	16	12	11	19	30	35	35	31	30	31	32	32	29	30	29	27	26	26	26	16	25	35
2025-12-12	20	17	17	16	14	15	15	19	22	20	22	22	22	24	24	20	19	20	22	20	18	17	18	18	19	24
2025-12-13	18	16	16	14	11	17	17	18	20	22	22	22	23	24	25	23	23	22	22	23	21	15	15	17	19	25
2025-12-14	18	18	18	17	17	16	17	19	21	22	24	26	26	27	29	30	28	28	25	23	20	16	16	16	22	30
2025-12-15	15	15	14	13	13	11	11	14	17	18	21	23	23	26	28	28	25	24	21	16	16	14	14	15	18	28
2025-12-16	13	11	12	11	13	11	11	12	15	17	18	20	21	22	18	16	16	17	18	19	15	14	14	13	15	22
2025-12-17	13	13	14	16	16	17	19	21	22	23	23	23	22	23	22	22	22	22	22	20	17	17	18	17	19	23
2025-12-18	17	18	17	17	16	15	15	17	19	21	23	26	27	26	25	27	26	23	20	18	16	16	15	15	20	27
2025-12-19	14	14	14	14	14	14	13	14	16	18	21	24	24	24	24	26	22	22	19	18	17	16	16	15	18	26
2025-12-20	15	16	15	15	15	15	17	18	19	22	25	28	29	27	28	30	27	29	24	23	22	21	22	20	22	30
2025-12-21	19	18	19	20	20	18	19	19	23	28	32	35	37	39	41	39	37	37	38	39	37	36	34	26	30	41
2025-12-22	22	22	24	19	16	19	23	27	27	30	28	30	33	35	36	36	37	37	37	26	19	18	15	13	26	37
2025-12-23	14	13	13	14	14	13	13	13	15	16	17	18			18	18	17	15	15	15	14	13	13	13	15	18
2025-12-24	14	12	12	13	13	12	13	14	15	17	22	24	26	27	28	28	26	25	21	19	19	17	14	13	18	28
2025-12-25	13	12	11	14	16	17	16	17	19	22	27	30	30	29	29	30	27	30	31	25	21	16	16	17	21	31
2025-12-26	17	17	17	17	17	17	16	16	19	22	27	26	29	31	30	30	31	28	26	25	21	19	18	16	22	31
2025-12-27	16	17	17	17	17	16	15	16	18	21	25	27	28	29	31	31	29	30	29	26	23	21	22	21	23	31
2025-12-28	20	19	17	17	16	17	17	18	21	23	29	31	32	32	32	32	33	33	33	34	33	27	25	21	26	34
2025-12-29	19	18	17	14	13	13	12	19	28	32	33	29	32	33	34	33	34	35	32	32	27	23	22	18	25	35
2025-12-30	20	24	25	25	27	29	31	31	32	33	34	34	34	34	35	37	38	39	42	40	38	31	29	26	32	42
2025-12-31	26	24	21	19	17	16	21	24	28	32	35	36	37	35	27	26	25	23	22	19	15	16	14	14	24	37
Mean	**18**	**17**	**17**	**16**	**16**	**16**	**16**	**18**	**21**	**23**	**26**	**27**	**28**	**29**	**29**	**29**	**28**	**27**	**26**	**24**	**22**	**20**	**19**	**18**	**22**	
Max	**26**	**27**	**25**	**25**	**27**	**29**	**31**	**31**	**32**	**35**	**35**	**39**	**39**	**39**	**41**	**41**	**40**	**39**	**42**	**40**	**38**	**36**	**34**	**27**	**32**	**42**