Environment Protection Authority

Ambient air monitoring guidance note

Draft for consultation

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The updated *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW*, which is currently being consulted on, does not include methods for monitoring ambient air. This document provides guidance on methods for undertaking ambient air monitoring. When finalised it will sit as stand-alone guidance document on EPA's website.

1. Introduction

1.1. Purpose of the Guide

This guidance note (Guide) provides general information for NSW Environment Protection Licence holders to reference when undertaking ambient air monitoring.

This Guide identifies key aspects of an ambient air monitoring program that must be considered to ensure data produced is sufficiently accurate, representative, comparable and suitable for the intended use ('fit for purpose').

1.2. What this Guide covers

This Guide includes general guidance on ambient air monitoring and sets the EPA's expectations in regard to fit-for-purpose monitoring and appropriate method selection. The Guide covers meteorological monitoring and data-management fundamentals, including the collection, quality assurance and storage of data. It also provides a reference list of Australian Standards monitoring methods.

1.3. What this Guide does not cover

This Guide does not include equipment-specific guidance. Readers should consult the equipment manual or contact the equipment vendor for such information.

1.4. Overview

Ambient air monitoring is an important aspect of an air quality management system and should form an integral part of a licensee's environmental management strategy. Monitoring networks should be fit for purpose and suitably time-resolved to ensure the data collected can be used in an effective and timely manner.

Monitoring systems vary in the type, quantity and quality of data they generate. When planning for monitoring, carefully consider how the data will be used, taking into account:

- quantification of absolute concentration versus change in concentration or relative instrument response
- long term (trend) versus campaign or verification monitoring
- monitoring for management versus assessment or compliance purposes.

For example:

- Where air quality monitoring data is used to characterise background air quality for an air quality assessment, the parameters measured should be consistent with the parameter being assessed (TSP, PM_{10}, $PM_{2.5}$, etc.). The data must be sufficiently accurate and representative of prevailing conditions for the location under assessment.
- Where air quality monitoring data is used to inform reactive and proactive management, the data should have a suitable temporal resolution to facilitate the timely implementation of management measures and controls. For example, monthly average data would not be suitable for reactive management over a timeframe of minutes or hours.

2. Monitoring methods

Many types of methods are available for the determination of pollutants in ambient air. They are published by organisations such as Standards Australia (SA), United States Environmental Protection Agency (USEPA), British Standards (BS) and the International Organisation for Standardisation (ISO).

Methods should be selected according to individual site considerations and must be appropriate for the intended purpose of the monitoring. Where compliance monitoring (monitoring where results are compared against compliance limits or standards) is specified in an environment protection licence, the licence typically specifies the monitoring method that must be used.

If modifications to a prescribed method are required for site-specific reasons, guidance should be sought from section 4 of the *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW*. The EPA should be contacted where any uncertainty exists regarding use of modified test methods.

Where a monitoring method is not prescribed, the EPA recommends monitoring be undertaken in accordance with a published method or standard. Standard monitoring methods set out the basic principles of operation, instrument performance requirements, apparatus set-up, calibration procedures, and the calculation and expression of results. They should be used unless it is not reasonable or feasible to do so.

The EPA gives precedence to ambient air monitoring methods published by Standards Australia as an Australian Standard (AS) or joint Australian/New Zealand Standard (AS/NZS). A non-exhaustive list of published Australian Standards for ambient air monitoring is included as Attachment A. Where an Australian Standard is not available for an analyte, or it is not practicable to use an AS method, appropriate alternative method(s) may be used. The EPA recommends monitoring methods be selected in accordance with the following hierarchy:

1. method published by Standards Australia designated as an Australian standard or joint Australian/ New Zealand standard
2. method that has been demonstrated via AS/NZS 3580.9.17 to have equivalence to an AS or AS/NZS
3. method published by the International Organisation for Standardisation
4. method designated as a reference method in a comparable jurisdiction, such as the United States of America, United Kingdom or Germany
5. method designated as an equivalent reference method in a comparable jurisdiction
6. method published in a comparable jurisdiction
7. non-reference/non-accredited method.

Monitoring methods other than an Australian Standard should only be used if:

- the method can be demonstrated to be fit for purpose

  and
- calibration and validation studies show that the measurement range, accuracy and precision of the method are appropriate for the intended purpose and reporting requirements.

All monitoring conducted for regulatory reporting purposes should be carried out by a laboratory or company accredited under ISO/IEC17025 to perform the method. The accreditation must be current and issued by an independent accreditation body acceptable to the EPA, such as the National Association of Testing Authorities (NATA).

3. Monitoring locations: selecting monitoring sites

The EPA recommends monitoring locations and methods be chosen based on the specific monitoring objectives. A detailed monitoring plan assists with decisions about the design of an ambient monitoring network. The EPA recommends that a monitoring plan be prepared for the design and implementation of all ambient air quality monitoring. The monitoring plan should include robust justification to support the number, type and location of monitors.

It is particularly important to select sites that are representative, both spatially and temporally, of the location being investigated. Monitoring is typically conducted at either:

- the source – to determine the peak concentrations that are expected to occur
- the boundary of a premises – to determine analytes that are moving beyond or entering onto a premises
- a sensitive receptor – to determine potential impacts at an identified sensitive receptor
- a neighbourhood location – to determine representative exposure or impacts on a general population or community
- a background location – to determine the quality of air that is not influenced by the emission source(s)

Monitoring locations should be informed by site-specific details and information such as existing air quality monitoring data, meteorological data, emission-source configuration, emissions inventories and atmospheric-dispersion modelling.

Factors to consider when selecting a monitoring location include:

- terrain and site-specific meteorology
- location of emission sources
- possible chemical or physical interferences
- area and size of the project or premises
- proximity to sensitive receptors
- availability of services (e.g. 240 V power) and site security
- whether emissions are likely to be constant or variable
- how the data collected from the monitoring is to be interpreted and used.

The EPA recommends monitoring locations be selected in accordance AS/NZS 3580.1.1, *Methods for sampling and analysis of ambient air – Guide to siting air monitoring equipment*[1]. In general, this standard requires sites be selected where:

- air flows are not restricted and are free from potential interferences such as buildings, trees and tall fences
- sampling inlets have a minimum clear sky angle of 120° from nearby structures
- there is a low potential for interference and contamination from localised sources such as roads and construction activities
- adverse effects from local topographical factors are minimised

[1] Additional guidance is also available in New Zealand Ministry for the Environment *Good Practice Guide for Air Quality Monitoring and Data Management 2009*.

- it is safe and secure and has a low potential for vandalism
- reasonable access is available for people and equipment
- reliable electricity supply is available
- it is unlikely to be impacted by environmental factors such as extreme heat, flooding and strong winds

Licensees are encouraged to engage a suitably qualified and experienced air-monitoring professional to advise on the appropriate locations of monitors for the given application before establishing an air quality monitoring network.

4. Meteorological monitoring

Meteorological conditions influence the transport and dispersion of contaminants in ambient air. Good-quality, site-representative meteorological data is important when assessing potential impacts, evaluating mitigation measures or confirming the validity of complaints. Meteorological data are also critical in the use of atmospheric dispersion modelling. Parameters typically monitored include:

- wind speed (metres per second) and direction (degrees) at 10 metres
- temperature (degrees Celsius) at 2 and 10 metres
- sigma theta at 10 metres (degrees)
- solar radiation (watts per square metre)
- rainfall (millimetres).

AS 3580.14, *Methods for sampling and analysis of ambient air Meteorological monitoring for ambient air quality monitoring applications,* sets out methods for the collection of meteorological data for use in ambient air quality monitoring and modelling applications. The EPA recommends that, as far as is reasonably practicable, meteorology monitoring that is used for air quality assessment and management comply with the requirements of AS 3580.14.

Meteorological monitoring should be performed at a location considered representative of the meteorological conditions for the site(s) of interest. For large sites or premises with complex terrain, multiple stations should be considered. Additionally, meteorological and ambient air monitoring equipment should be co-located wherever possible.

In circumstances where characterisation of low wind speeds is important, such as assessment and management of odorous compounds, the EPA recommends the use of a sonic anemometer capable of measuring windspeeds less than 0.2 metres per second and logging data at 1-minute intervals.

The following documents give additional guidance:

- Meteorological Monitoring Guidance for Regulatory Modelling Applications[2], EPA-454/R-99-005, prepared by the United States Environmental Protection Agency (USEPA 2000).
- Guide to Meteorological Instruments and Methods of Observation[3] (World Meteorological Organization 2018).

[2] https://www.epa.gov/scram/air-modeling-meteorological-guidance

[3] https://library.wmo.int/index.php?lvl=notice_display&id=12407#.YCBztZrV6uW

5. Data management

5.1. Data collection

The type of data collected and how it is managed will be largely determined by the intended objective of the monitoring program and reporting requirements. All data should be collected in a manner that allows for meaningful interpretation and analysis of the information to occur. Factors to consider when collecting data include:

- the nature of the pollution emission being monitored i.e. continuous, intermittent or batch
- sampling averaging times for data reporting, e.g. sub-hourly, hourly, daily, monthly, annual, rolling, etc.
- method detection limits and instrument capabilities
- reporting requirements and concentration limits
- trigger values and response/alarm set points
- data formats and storage capacities.

The measurement rate of a monitoring system will be determined by the method used, the intended purpose of the data and the expected pollutant concentrations. For most gaseous monitoring applications, continuous monitoring data should be logged at intervals not exceeding one minute. Measurement rates for ambient particulate monitoring can range from continuous (typically 1-minute averages) to monthly.

Data must be stored in a manner that maximises effective data usage and minimises data loss. Depending on the technology used, data can be logged directly to an instrument or local data logger available for download or be transmitted in real time to a central data-management hub or process control centre. Where monitoring is undertaken for management purposes, data must be available for access and review at a rate that allows for timely proactive and reactive management to occur. Additionally, the EPA recommends that data is stored and managed in a way the facilitates efficient data interrogation, including trend analysis.

Where continuous monitoring is required to be undertaken, the system must be operated and maintained in a proper and efficient manner, ensuring that the availability of the monitoring system is maximised. After allowing sufficient down time for routine maintenance and calibrations, a continuous monitoring system should be able to achieve at least a 95% availability.

5.2. Data quality

Ambient air monitoring programs should be supported by rigorous quality-assurance (QA) and quality-control (QC) procedures. Site specific QA/QC procedures should be used to review, verify and validate data to ensure the quality of data produced by the monitoring network.

AS 3580.19:2020 specifies data-validation and reporting procedures applicable to the measurement of pollutants in ambient air and to the measurement of meteorological parameters and should be considered when developing a QA/QC procedure.

As a minimum, the procedure should include documented, step-by-step instructions for all aspects of the QA/QC program including:

- sample collection and handling
- equipment calibration, maintenance and failure response
- sample analysis and reporting
- data recording, calculations and management
- data review, verification and validation

- procedural audit and review.

All monitoring equipment associated with a monitoring network must be operated, maintained and calibrated to the minimum standard required by the equipment manufacturer and relevant Australian Standard or reference method.

The NSW Department of Planning, Industry and Environment (DPIE) operates an extensive network of NATA-accredited air quality monitoring stations across NSW. The program delivers high-quality and fit-for-purpose air quality data that has been rigorously quality assured[4]. Monitoring is undertaken using a range of methods, including Standards Australia methods where available.

[4] https://www.environment.nsw.gov.au/topics/air/understanding-air-quality-data/data-validation

Attachment A: List of published Australian Standards for ambient air monitoring in NSW

Standard number	Standard title
AS/NZS 3580.1.1:2016	Methods for sampling and analysis of ambient air Guide to siting air monitoring equipment
AS 3580.4.1-2008 (R2018)	Methods of sampling and analysis of ambient air Determination of sulfur dioxide – Direct reading instrumental method
AS 3580.5.1-2011	Methods for sampling and analysis of ambient air Determination of oxides of nitrogen – Direct-reading instrumental method
AS 3580.6.1:2016	Methods for sampling and analysis of ambient air Determination of ozone – Direct-reading instrumental method
AS 3580.7.1-2011	Methods for sampling and analysis of ambient air Determination of carbon monoxide – Direct-reading instrumental method
AS/NZS 3580.9.3:2015	Methods for sampling and analysis of ambient air Determination of suspended particulate matter – Total suspended particulate matter (TSP) – High volume sampler gravimetric method
AS/NZS 3580.9.6:2015	Methods for sampling and analysis of ambient air Determination of suspended particulate matter – PM_{10} high volume sampler with size selective inlet – Gravimetric method
AS/NZS 3580.9.7:2009 (R2020)	Methods for sampling and analysis of ambient air Determination of suspended particulate matter – Dichotomous sampler (PM_{10}, coarse PM and PM2.5) – Gravimetric method
AS 3580.9.8-2008 (R2018)	Methods for sampling and analysis of ambient air Determination of suspended particulate matter – PM_{10} continuous direct mass method using a tapered element oscillating microbalance analyser
AS 3580.9.9:2017	Methods for sampling and analysis of ambient air Determination of suspended particulate matter – PM_{10} low volume sampler – Gravimetric method
AS 3580.9.10:2017	Methods for sampling and analysis of ambient air Determination of suspended particulate matter – $PM_{2.5}$ low volume sampler – Gravimetric method
AS/NZS 3580.9.11:2016	Methods for sampling and analysis of ambient air Determination of suspended particulate matter – PM_{10} beta attenuation monitors
AS/NZS 3580.9.12:2013	Methods for sampling and analysis of ambient air Determination of suspended particulate matter – $PM_{2.5}$ beta attenuation monitors
AS/NZS 3580.9.13:2013	Methods for sampling and analysis of ambient air Determination of suspended particulate matter – $PM_{2.5}$ continuous direct mass method using a tapered element oscillating microbalance monitor
AS/NZS 3580.9.14:2013	Methods for sampling and analysis of ambient air Determination of suspended particulate matter – $PM_{2.5}$ high volume sampler with size selective inlet – Gravimetric method

Standard number	Standard title
AS/NZS 3580.9.15:2014	Methods for sampling and analysis of ambient air Determination of suspended particulate matter – Particulate metals high or low volume sampler gravimetric collection – Inductively coupled plasma (ICP) spectrometric method
AS/NZS 3580.9.16:2016	Methods for sampling and analysis of ambient air Determination of suspended particulate matter – PM_{10} continuous direct mass method using a tapered element oscillating microbalance monitor incorporating a filter dynamic measurement system (FDMS) unit
AS/NZS 3580.9.17:2018	Methods for sampling and analysis of ambient air Demonstration of equivalence for ambient particulate matter monitoring methods
AS/NZS 3580.10.1:2016	Methods for sampling and analysis of ambient air Determination of particulate matter – Deposited matter – Gravimetric method
AS/NZS 3580.10.2:2013	Methods for sampling and analysis of ambient air Determination of particulate matter – Impinged matter – Gravimetric method
AS/NZS 3580.11.1:2013	Methods for sampling and analysis of ambient air Determination of methane and non-methane organic compounds in ambient air – Direct-reading instrumental method
AS/NZS 3580.12.1:2015	Methods for sampling and analysis of ambient air Determination of light scattering – Integrating nephelometer method
AS/NZS 3580.13.2-2013	Methods for sampling and analysis of ambient air Determination of fluorides – Gaseous and acid-soluble particulate fluorides – Manual, double filter paper sampling
AS/NZS 3580.14:2014	Methods for sampling and analysis of ambient air Meteorological monitoring for ambient air quality monitoring applications
AS/NZS 3580.15:2014	Methods for sampling and analysis of ambient air Determination of gaseous pollutants in ambient air using differential optical absorption spectrometry (DOAS) – Direct-reading instrumental method
AS/NZS 3580.16:2014	Methods for sampling and analysis of ambient air Determination of polycyclic aromatic hydrocarbons (PAH)
AS/NZS 3580.17:2016	Methods for sampling and analysis of ambient air Determination of gaseous compounds in ambient air – Direct-reading cavity ring-down spectroscopy instrumental method
AS 3580.19:2020	Methods for sampling and analysis of ambient air – Ambient air quality data validation and reporting