Community smoke, air quality and health standard

Air quality assessment, forecasting and health protection messaging for particulate matter

Version 1.0
December 2015
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Background

Context

The Community smoke, air quality and health standard (‘community SAQH standard’) is one of several standards that sit under the State smoke framework, which guides the Victorian Government’s response to significant or prolonged events that generate smoke or other emissions that may affect public health.

The community SAQH standard provides direction for protecting community health in response to smoke events that result in significant levels of fine particles in the outdoor air environment.

This standard’s focus applies to protection from the health effects of fine particles as PM$_{2.5}$ (particulate matter of an aerodynamic diameter of less than 2.5 µg/m$^3$), which is the component of smoke recognised as typically being the most useful air quality monitoring measure to inform recommended precautionary actions to protect public health.

The community SAQH standard can be applied to large-area smoke impacts from bushfires or planned burns where fine particles are the primary health hazard and for single location events that produce significant levels of fine particles such as fires in coal mines, tyre stockpiles or other industrial events (large-scale, extended or complex incidents where smoke or emissions generated may impact on the community). For such events, there may be other unique air quality hazards of equal or greater health concern, which may also require management through the use of additional specialised standards.

Purpose

This standard has been developed to detail the framework which will be used to manage potential risks to public health during smoke events that have the capacity to produce significantly elevated levels of fine particles in the outdoor environment. In particular, it details the basis for air quality categories which will trigger advice to the community during such events.

The community SAQH standard concerns the areas around the fire impacted by the smoke plume and the protection of community health and safety.

The community SAQH standard’s focus applies to protecting community health and therefore does not apply to occupational health and safety, for example, to firefighters and other emergency service workers.

It is important to note that the standard is not an operational protocol and therefore does not provide a step-by-step guide to responding to incidents that generate significant levels of fine particles in the outdoor environment. Rather, this standard should be used to inform agency-specific protocols, standard operating procedures, training procedures and decision support tools.
Strategic intent

Consistent with the *Emergency management manual Victoria*, the incident controller’s priorities are protecting and preserving life, which is paramount. This includes the:

- safety of emergency services personnel
- safety of other responding agency personnel
- safety of community members, including vulnerable community members and visitors/tourists located within the incident area
- issuing of community information and community warnings.

Governance

The community SAQH standard is authorised in accordance with the statutory responsibilities of the Chief Health Officer (Department of Health and Human Services) with respect to protecting public health in accordance with the *Public Health and Wellbeing Act 2008*, the Environment Protection Authority’s chief executive officer in accordance with the *Environment Protection Act 1970* and the Emergency Management Commissioner (Emergency Management Victoria) in accordance with the *Emergency Management Act 2013*.

The community SAQH standard was produced by a working group consisting of representatives from the following agencies:

- Department of Health and Human Services (the department)
- Environment Protection Authority Victoria (EPA)
- Emergency Management Victoria (EMV).

Authorising framework

The community SAQH standard is supported by the following legislation and documents:

- *Emergency Management Act 1986*
- *Emergency Management Act 2013*
- *Public Health and Wellbeing Act 2008*
- *Environment Protection Act 1970* and associated air-related state environment protection policies
- *Emergency management manual Victoria.*

The community SAQH standard refers to the following documents:

- *Wildfire smoke: a guide for public health officials* (the California wildfire smoke guide)
- *Rapid deployment of air quality monitoring for community health guideline* (EPA, the department and EMV 2015).
Review of the standard

Latest review

This standard is an updated version of the Community smoke, air quality and health protocol (community SAQH protocol), which was approved in July 2015 by Victoria’s Chief Health Officer and EPA’s chief executive officer and endorsed by the Emergency Management Commissioner (EMV).

The community SAQH standard provides guidance for protecting communities during smoke events that have the potential to generate significant levels of fine particles in the air, and is supported by cross-government standard operating procedures that define agency-level actions for protecting community health. It applies to all fire settings where levels of fine particles in smoke are significant and a health concern. This includes extremely hazardous events where the incident controller and other agencies have a need to understand the process in place for community health protection advice and precautionary actions.

This standard and the associated standard operating procedures retain amendments to the superseded community SAQH protocol that were based on recommendations from an independent expert panel review of the Hazelwood coal mine fire PM$_{2.5}$ health protection protocol (Department of Health 2014) and the Bushfire smoke, air quality and health protocol (Department of Health and EPA 2014).

The community SAQH standard and associated standard operating procedures supersede the following documents:

- Community smoke, air quality and health protocol (Department of Health and Human Services, EPA Victoria and Emergency Management Victoria 2015)
- Bushfire smoke, air quality and health protocol (Department of Health and EPA Victoria 2014)
- Hazelwood coal mine fire PM$_{2.5}$ health protection protocol (Department of Health and EPA Victoria 2014).

Future reviews

The community SAQH standard will be reviewed following the 2015–2016 summer season to address recommendations from the Hazelwood Mine Fire Inquiry1. It will be further reviewed annually or as necessary, for example, following any updates to international frameworks such as the California wildfire smoke guide, which forms a basis for the Victorian framework, or following major smoke events.

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Roles and responsibilities to protect the community

The following roles and responsibilities are in place to protect the community during fire events:

- The first responders to a fire event (for example, the Country Fire Authority (CFA) or Metropolitan Fire Brigade (MFB)) may have the capacity to deploy mobile air-monitoring equipment across the state.
- The incident controller will provide information to EPA and the department on first responder assessment of any smoke and related air quality impacts from the incident. The criteria for initiating air quality monitoring are detailed in the Rapid deployment of air quality monitoring for community health guideline (EPA Victoria, Department of Health and Human Services and Emergency Management Victoria 2015).
- The incident controller will continue to provide qualitative assessment and any available data from equipment deployed by first responders to EPA for their assessment and advice. EPA will provide assessments to the department.
- EPA will request that the Bureau of Meteorology (BoM) and other organisations (for example, the Department of Environment, Land, Water and Planning (DELWP)) provide advice on predicted weather conditions for affected communities for the use of EPA and other agencies.
- EPA has fixed and mobile air monitoring stations in Melbourne, Geelong, the Latrobe Valley, and other regional locations, as well as capacity to deploy mobile air monitoring equipment in other parts of Victoria.
- In the event of actual or predicted adverse smoke conditions, EPA may undertake or be requested by the incident controller (or the department via the incident controller) to initiate continuous monitoring to determine appropriate air quality parameters (for example, PM$_{2.5}$) in potentially affected communities. EPA will provide the department with interpreted data for public health assessment. EPA will draw on information from a variety of sources including from the BoM to advise the department of the potential future behaviour of smoke.
- CFA, MFB and DELWP may support the incident controller by undertaking predictive modelling of the smoke plume.
- The incident controller will provide information regarding the predicted fire duration and suppression strategies through the Incident Emergency Management Team.
- Emergency Management Victoria, in conjunction with the department and local government, will coordinate relief and recovery arrangements for relocated communities.

The respective roles of EPA, EMV and the department in the context of events that generate smoke or other emissions are further detailed below.
EPA

EPA operates monitoring stations in Melbourne, Geelong, the Latrobe Valley, and elsewhere, and has additional capacity to deploy mobile air-monitoring equipment in other parts of Victoria. EPA may work with other organisations, such as first-response agencies, to ensure the appropriate and timely collection of air quality data and forecasting. During major smoke events, EPA makes use of satellite images and local reports of visual range to assess conditions in other populated areas of Victoria. EPA also forecasts air quality on a daily basis and communicates this via its webpage.

During a bushfire or other significant fire or smoke event, EPA may initiate, or may be requested by the incident controller, to rapidly deploy monitoring equipment to the incident. The process for deployment of monitoring equipment is described in the Rapid deployment of air quality monitoring for community health guideline (EPA Victoria, Department of Health and Human Services and Emergency Management Victoria 2005).

Department of Health and Human Services

The department is responsible for determining health protection messages for the community during significant or prolonged events that generate smoke or other emissions based on air quality monitoring and forecast advice from EPA. The department may issue advice to the incident controller to issue specific health protection messages to the community.

Emergency Management Victoria

EMV leads emergency management in Victoria by working with communities, government, agencies and business to strengthen their capacity to withstand, plan for, respond to and recover from emergencies. EMV is also responsible for VicEmergency, Victoria’s primary website for incident information and warnings.
Smoke hazard

Smoke from fires is a mixture of different-sized particles, water vapour and gases, including carbon monoxide, carbon dioxide and nitrogen oxides. The larger particles (which are visible to the eye) contribute to the visible haze when a fire is burning. They are generally too large to be breathed deeply into the lungs but can irritate the nose and throat. Finer microscopic particles and gases are small enough to be breathed deep into the lungs and can cause health effects.

These fine particles are typically recognised as the best air quality indicator for protecting community health from exposure to smoke. Fine particles are classified according to size. Those particles that are smaller than 10 micrometres in diameter are known as PM\textsubscript{10}, and those that are less than 2.5 micrometres in diameter are known as PM\textsubscript{2.5}. While both PM\textsubscript{10} and PM\textsubscript{2.5} are small enough to be breathed deeply into the lungs, PM\textsubscript{2.5} is considered the better indicator for potential health impacts associated with exposure to smoke – PM\textsubscript{2.5} is the dominant form of fine particles present in smoke and has the greater potential for significant health impacts.

Health effects from exposure to fine particles will depend on the nature of the exposure, the person’s age, pre-existing medical conditions (particularly cardiorespiratory disease), predispositions and other individual susceptibilities.

Fine particles are a respiratory irritant. Exposure to fine particles during smoke events may aggravate existing heart or lung conditions, including asthma.

Longer term exposure to fine particles, such as that which occurs in urban areas with poor air quality (exposures lasting a year or more), may be associated with the development of disease in otherwise healthy individuals.

The following community groups are most sensitive to fine particle exposure associated with smoke events:

- a developing baby prior to birth (a foetus)
- people with heart or lung conditions
- people over the age of 65
- children 14 years and younger
- smokers.
Fine particles monitoring capability

The concentration of smoke and fine particles in the air fluctuates continuously, and spikes in elevated concentrations may occur periodically throughout a smoke event. As concentrations of fine particles in the air vary from moment to moment, threshold exposure values are based on averaged values of fine particle concentrations in the air.

Fine particle atmospheric monitoring results will need to be interpreted and scientific advice obtained to determine current and forecast air quality. The trends in atmospheric concentration of fine particles are the most important for decision making.

Based on currently available equipment the following options are available for fine particle monitoring:

- **Australian standard air quality monitoring equipment:**
  - Beta attenuation monitor (BAM) – measures and records airborne particles (PM$_{2.5}$). This instrument works by collecting particles on a filter tape and measuring the reduction in beta rays travelling through the particles. From this, the concentration of airborne particles is calculated.
  - Tapered element oscillating microbalance (TEOM) – measures the concentration of airborne particles (PM$_{10}$). This instrument works by collecting and weighing the particles using a very sensitive balance.

- **Portable air quality monitoring instruments:**
  - Examples of these instruments include the ADR 1500 and the DustTrak/SmokeTrak. These instruments produce data for levels of PM$_{2.5}$ and are not as accurate as BAMs.

Data from Australian Standard air quality monitoring equipment will be used to inform decisions regarding public health advice to the community. Where PM$_{2.5}$ data is unavailable from Australian Standard air quality monitoring equipment, PM$_{10}$ data from Australian Standard air quality monitoring equipment will be provided by EPA to the department. In such circumstances, PM$_{10}$ concentrations will be conservatively assumed to be equivalent to PM$_{2.5}$ concentrations. If PM$_{2.5}$ or PM$_{10}$ data is unavailable from Australian Standard air quality monitoring equipment then EPA will use data from portable air quality monitoring instruments and will adjust the data to ensure a conservative and comparative value is available to inform decision making.

Table 1 sets out the equipment and agencies involved in atmospheric monitoring and forecasting for fine particles in the air for public health and safety.

**Table 1: Resources for monitoring atmospheric fine particles during a smoke event**

<table>
<thead>
<tr>
<th>Resources</th>
<th>Community safety</th>
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<td>Monitoring equipment options</td>
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<td></td>
<td>TEOM – for monitoring PM$_{10}$ concentrations</td>
</tr>
<tr>
<td></td>
<td>ADR monitors – for monitoring PM$_{2.5}$ concentrations</td>
</tr>
<tr>
<td></td>
<td>DustTrak/SmokeTrak – for monitoring PM$_{10}$ concentrations</td>
</tr>
<tr>
<td>Lead agency for atmospheric monitoring</td>
<td>EPA</td>
</tr>
<tr>
<td>Support agencies</td>
<td>Fire services</td>
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<tr>
<td></td>
<td>BoM</td>
</tr>
</tbody>
</table>
Air exposure levels for fine particles

**Ambient air quality values for fine particles**

Ambient (outdoor) air quality values exist for the air we breathe, including for fine particles, under normal day-to-day conditions.

It is widely accepted that fine particles are a non-threshold pollutant, which means that any level of exposure may be associated with an increase in health effects, especially the exacerbation of pre-existing conditions. The higher the exposure level the greater the potential for adverse health effects.

As such, air quality standards are established, acknowledging that they do not provide absolute protection of public health, and for fine particles there is some residual risk. The aim is to minimise the risk to the population including the most vulnerable groups.

For the purposes of managing the general quality of a local air shed the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM) reporting standards for fine particles as PM$_{10}$ and PM$_{2.5}$ apply.  

- The AAQ NEPM advisory reporting standard for PM$_{2.5}$ is set nationally at 25 µg/m$^3$ averaged over a period of 24 hours and 8 µg/m$^3$ averaged over a year.
- The AAQ NEPM compliance reporting standard for PM$_{10}$ is set nationally at 50 µg/m$^3$ averaged over a period of 24 hours, with five exceedances allowed per year.

These standards apply for the purpose of monitoring the general quality of a local air shed, and are applied on a continuous basis at fixed location air monitoring stations operated by EPA.

Although useful to inform normal pollution levels generally, they should not be applied to significant local emergency events where short-term poor air quality may exceed this measure.

**Community exposure guideline values for emergencies**

The response to smoke events resulting in significant levels of fine particles in the outdoor air environment is managed internationally by use of graduated smoke advisory systems that link air quality monitoring of fine particles to health protection messages and advice for the community.

These systems derive air quality thresholds to inform actions for public health officials and associated public health messaging based on fine particle concentrations in air expressed as air quality indexes (AQI).  

The AQI is a nationally uniform index that can be used to communicate how polluted the air is by converting sometimes difficult to interpret particulate mass per volume numbers to an AQI number and corresponding AQI category (standard descriptors such as good, moderate or unhealthy).

The AQI categories reflect the level of deviation of fine particle concentrations in air from nationally set ambient air quality guideline values. At each increasing AQI category, the actions required by public health officials and health protection messages change to reflect changes in public health risk.

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2 The AAQ NEPM ambient air quality 24-hour standard is consistent with the current World Health Organization guideline, and the annual average is more stringent than any international standards.

3 Fine particles are only one component of smoke but are the sole analyte used to determine AQI.
As described in these graduating systems, possible risk management options to protect the community from short to medium term exposure to high levels of fine particles in smoke include:

- Provision of different levels of advice with increasing levels of fine particles for both susceptible groups (people with pre-existing respiratory or heart conditions, the young and older people, and pregnant women) and the rest of the general population. This includes reference to taking medication as prescribed; asthmatics following their asthma plan; minimising physical activity and taking regular breaks (respite) out of smoky conditions to reduce overall exposure.
- Advice for children, older adults, pregnant women and those with pre-existing respiratory or heart conditions to temporarily relocate in rare circumstances.

**California wildfire smoke guide**

The leading internationally recognised system considered most applicable to the Victorian context is described in *Wildfire smoke: a guide for public health officials* (2013). The development of the California wildfire smoke guide is a collaborative effort of the California Department of Public Health, the US Environment Protection Agency, the Missoula County Health Department and the California Office of Environmental Health Hazard Assessment & California Air Resources Board.

The California wildfire smoke guide applies an AQI normalised scale from 0 to 500, where an AQI of 100 equates to the US EPA national 24-hour fine particle standard of 35 µg/m³ for PM_{2.5}. When the AQI exceeds 100 (the US EPA standard) air quality is considered to be unhealthy, at first for members of sensitive groups, then for everyone as the AQI values increase.

California AQI categories include: good (AQI 0–50), moderate (AQI 51–100), unhealthy sensitive (AQI 101–150), unhealthy all (AQI 151–200), very unhealthy all (AQI 201–300) and hazardous (AQI > 300). At each of these AQI categories the guide provides equivalent fine particle concentration levels (action levels) that trigger recommended public health official actions and community health messaging.

The action levels for PM_{10} reflect those of PM_{2.5} based on the conservative assumption that during bushfire smoke events PM_{10} is primarily comprised of PM_{2.5}.

The current California wildfire smoke guide recommended actions for public health officials and their corresponding AQI and action levels are included in Appendix 1.
Community exposure guideline values for fine particles

The graduated system described in the Californian wildfire smoke guide is the preferred system for managing smoke, air quality and public health regarding smoke events that result in significant levels of fine particles in the outdoor air environment.

This system can be applied to the Victorian context through application of Australian equivalent action levels derived based on the AAQ NEPM advisory reporting standard for PM$_{2.5}$.

Table 2 reflects the derivation process for the Australian equivalent action levels. Specifically, action levels reported in the Californian wildfire smoke guide are calculated as a percentage of the US EPA national ambient air quality standard for PM$_{2.5}$. These percentages are then applied to the AAQ NEPM advisory reporting standard for PM$_{2.5}$ to derive Australian equivalent actions levels for PM$_{2.5}$.

**Table 2: Australian equivalent action levels for fine particles in outdoor air based on the AAQ NEPM advisory reporting standard for PM$_{2.5}$**

<table>
<thead>
<tr>
<th>AQI category</th>
<th>Californian action level – 24 hour PM$_{2.5}$ (µg/m$^3$)</th>
<th>% PM$_{2.5}$ US EPA national ambient air quality standard</th>
<th>Victorian air quality categories – 24-hour PM$_{2.5}$ (µg/m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>0–12</td>
<td>0–34</td>
<td>0–8</td>
</tr>
<tr>
<td>Moderate</td>
<td>12–35</td>
<td>34–100</td>
<td>9–25</td>
</tr>
<tr>
<td>Unhealthy – sensitive</td>
<td>35–55</td>
<td>100–156</td>
<td>26–39</td>
</tr>
<tr>
<td>Unhealthy – all</td>
<td>55–150</td>
<td>156–424</td>
<td>40–106</td>
</tr>
<tr>
<td>Very unhealthy – all</td>
<td>150–250</td>
<td>424–705</td>
<td>107–177</td>
</tr>
<tr>
<td>Hazardous</td>
<td>250–500</td>
<td>706–1,408</td>
<td>177–353$^a$</td>
</tr>
</tbody>
</table>

$^a$ Calculated as a percentage of the AAQ NEPM advisory standard of 25 µg/m$^3$ for PM$_{2.5}$. This standard is more conservative than the US EPA national ambient air quality standard of 35 µg/m$^3$ for PM$_{2.5}$.

$^b$ The Victorian system includes two hazardous categories (hazardous high and hazardous extreme). Victoria’s hazardous–extreme category has been conservatively set at an upper limit greater than 250 µg/m$^3$.

The Victorian air quality categories are more conservative than those of the Californian system due to the increased level of conservatism in the Australian AAQ NEPM when compared with the US EPA ambient air guideline values for fine particles.
Objective of community exposure guideline values for fine particles

The Victorian graduated system should prevent the known impacts from exposure and particularly prevent sensitive groups in the community being exposed to particles in air where the rolling 24-hour average of PM$_{2.5}$ is above 250 µg/m$^3$ for three or more consecutive days.

To achieve this objective management of fine particles in smoke in Victoria will differ from the Californian system in the following ways:

- The Victorian system separates the air quality category ‘hazardous’ into two categories ‘hazardous–high’ and ‘hazardous–extreme’ to allow for a staged approach to issuing advice at these levels. This is consistent with the US EPA (2012) *Revised air quality standards for particle pollution and updates to the air quality index (AQI)*, which forms the basis for the California wildfire smoke guide.
- Differences in national fine particle air quality standards between Australia and the US result in different action levels between the two systems, with the Victorian system being the more conservative system.
- The Victorian system derives action levels relevant to 24-hour averages only. The California wildfire smoke guide devised one- to three-hour, eight-hour and 24-hour average action levels.

The Victorian graduated system and associated fine particle action levels are described in detail in ‘The Victorian fine particle response framework’ section below.
Application of community exposure guideline values

Using standards to protect the community

In order to protect the community from health effects due to fine particles in smoke, air quality is monitored in communities likely to be affected by smoke from fires with the greatest fine particle producing potential.

Results of this monitoring are assessed continually to ensure that early preparation occurs for appropriate community messaging. Fine particle monitoring continues until fires are sufficiently controlled to ensure that community health is protected.

The concentration of fine particles in the air fluctuates continuously, with frequent spikes in concentration. As concentrations of fine particles in the air will vary from moment to moment, averaged values are calculated.

The averaged values are considered in relation to the Victorian air quality categories described in Table 3, along with information about the likely duration of the fire, the fire suppression strategy, and predictions about future wind and weather conditions. If the duration of exposure to elevated levels of fine particles is a risk to community health, a number of options to protect the community are available.

Options to protect the community

EPA provides air quality information and general health protection advice on its website, which links to the department’s website for further/detailed health protection advice.

The department’s website has various community information factsheets that provide detailed health protection advice. Members of the community can refer to these for detailed information on the steps that can be taken to protect health during incidents involving reduced air quality due to smoke and fine particles.

In instances where air quality monitoring data is unavailable, members of the community may conduct a self-assessment of air quality based on visibility. Information on this process is available from EPA’s website at <www.epa.vic.gov.au> (see Appendix 2 for an air quality self-assessment guide that can be used by community members to inform protective action).

During significant or prolonged events EMV’s VicEmergency website will also be used to convey specific health protection messages to the community, following advice from the Chief Health Officer to the incident controller.

Under these circumstances, options to protect the community from prolonged exposure to high levels of fine particles include:

- advice for sensitive groups to reduce prolonged or physical activity, with reference to taking medication as prescribed, and asthmatics to follow their asthma plans and to take regular breaks (respite) out of smoky conditions
- advice for sensitive groups to avoid prolonged physical activity and for everyone else to reduce prolonged or heavy physical activity, with reference to medication as prescribed, and asthmatics to follow their asthma plans and to take regular breaks (respite) out of smoky conditions
- advice (as described above) coupled with steps to protect all sensitive groups (for example, consideration of closing some or all schools and early childhood centres and rescheduling outdoor events such as converts and competitive sports events, until air quality improves)
• advice for **sensitive groups to temporarily relocate** outside the smoke-affected area, or if relocation is not possible, to remain indoors and keep activity levels as low as possible; and advice for **everyone else to avoid all physical activity**; steps to protect all sensitive groups (as described above) should be taken

• **strongly recommend advice that sensitive groups temporarily relocate** until there is a sustained improvement in air quality; and advice for **everyone else to avoid all physical activity**. Steps to protect all sensitive groups (as described above) should be taken.

This graduated advice is correlated with relevant air quality categories as detailed in Table 4.

Information issued to the community is based on both measured air quality data and forecast weather and fire data, which includes:

• measured results, some adjusted to 24-hourly averages from monitoring
• BoM forecast data
• fire behaviour – both actual and forecast
• the predicted duration of prevailing conditions and elevated levels
• the size of the affected community.

In circumstances where the rolling 24-hour average PM$_{2.5}$ concentration is at or above the hazardous–extreme threshold (250 µg/m$^3$) for a period of two days and is predicted to continue at this level or increase, the Chief Health Officer may issue advice strongly recommending that sensitive groups temporarily relocate. In other words, such advice could be issued 24 hours prior to the community being exposed to particles in air where the rolling 24-hour average of PM$_{2.5}$ is above 250 µg/m$^3$ for three or more consecutive days.

**Community actions**

Members of the community must remain vigilant during the emergency so they can receive and act on emergency warnings and information in a timely way. The community should use multiple sources to obtain emergency information.

Anyone with a heart or lung condition should follow the treatment plan advised by their doctor and keep at least five days’ supply of medication on hand.

Anyone with asthma should ensure their personal asthma plan is up to date, and follow it.

Everyone should prepare to avoid smoky conditions as necessary. Avoiding smoky conditions may involve:

• staying indoors
• closing all doors and windows
• switching air-conditioning to ‘recycle’ or ‘recirculate’
• sealing any gaps under doors or around windows and wall vents with towels, blankets or plastic
• avoiding other sources of indoor air pollution (such as smoking, burning candles, using unflued gas appliances or woodstoves or stirring up fine dust from sweeping or vacuuming)
• taking the opportunity during breaks in smoky conditions to air out homes and improve air quality
• taking air-conditioned breaks at a local community library, shopping centre or respite centre under circumstances where homes becomes too smoky or hot to be comfortable.
Tactical or operational considerations

For the community, tactical decisions require sufficient time to communicate and implement on a whole-of-population basis. The tactical options to protect the health of the community include:

- time to assess the potential risks to public health well below outdoor air concentrations at which health effects could occur
- informing the community of the potential risk of fine particle exposure with advice to reduce activity and minimise exposure
- steps to protect all sensitive groups such as closing some or all schools and early childhood centres and rescheduling outdoor events
- planned support for temporary relocation of sensitive groups (if required).
The Victorian fine particle response framework

A staged approach to protecting the community from adverse effects from exposure to fine particles during smoke events that result in significant levels of fine particles in the outdoor air environment is described in Table 3.

Table 3 outlines seven air quality categories from ‘low’ through to ‘hazardous–extreme’. Each air quality category is defined by a fine particle concentration range (expressed as PM$_{2.5}$ 24 or one-hour averages).

For each air quality category, the health effects that may occur are provided along with appropriate health protection advice and actions. These are based on strong epidemiological evidence associating exposure to fine particles with respiratory and cardiovascular effects.

For the purposes of evaluating and implementing risk management options to protect the community from exposure to PM$_{2.5}$ during smoke events, timeframes can be defined as follows:

- short term: generally one to 24 hours and up to a few days
- medium term: days to a few weeks
- long term: anything greater than a few weeks.

This standard provides a framework that is most applicable to protecting the community from short- to medium-term exposure to smoke. In relation to sensitive groups, the community SAQH standard is specifically aimed at preventing sensitive groups in the community from being exposed to hazardous levels of particles in air for three or more consecutive days.

Judgement should be applied to this framework during major smoke events where there are, for example, significant exceedances of the prescribed air quality concentrations, or where the event is of significant duration. Actions in these circumstances would include consideration of the demographics of the community, exposure predictions and health risk assessments relevant to the circumstances.
Concept of operations

In Victoria a joint standard operating procedure (JSOP) for managing significant community exposure to fine particles from smoke has been developed to support this standard.

The JSOP will be applied to any event that generates significant smoke where fine particles (in the form of PM$_{2.5}$) are the primary health hazard. It includes details of the arrangements between relevant agencies for providing air-quality monitoring information and the process for communicating health protection messages to affected communities.
### Table 3: Air quality categories for PM$_{2.5}$ (rolling 24-hour and one-hour averages) and visibility

<table>
<thead>
<tr>
<th>Air quality categories</th>
<th>PM$_{2.5}$ (24 hour) µg/m$^3$</th>
<th>PM$_{2.5}$ (1 hour) µg/m$^3$</th>
<th>Visibility (by observers)</th>
<th>Potential health effects without following advice or actions</th>
<th>Sensitive groups: People over 65, children 14 years and younger, pregnant women and those with existing heart or lung conditions, should <strong>reduce</strong> prolonged or heavy physical activity. People over 65, children 14 years and younger, pregnant women and those with existing heart or lung conditions, should <strong>avoid</strong> prolonged or heavy physical activity. People over 65, children 14 years and younger, pregnant women and those with existing heart or lung conditions, should <strong>temporarily relocate</strong> to a friend or relative living outside the smoke-affected area. If this is not possible, remain indoors and keep activity levels as low as possible. Further advice on temporary relocation may be issued for sensitive groups.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>0–8</td>
<td>0–27</td>
<td>NA – Below the relevant air quality standard</td>
<td>None</td>
<td>Cautionary health advice/actions** The keywords relating to sensitive populations are highlighted in red; keywords relating to people other than sensitive populations are highlighted in blue. The bolding gives an idea of the increased level of health protection advice proportional to the decrease in air quality for these groups.</td>
</tr>
<tr>
<td>Moderate</td>
<td>9–25</td>
<td>28–62</td>
<td>NA – Meets the relevant air quality standard</td>
<td>No tailored advice necessary. General air quality information and health advice is available from the EPA Victoria and the Department of Health and Human Services websites.</td>
<td></td>
</tr>
<tr>
<td>Unhealthy for sensitive groups</td>
<td>26–39</td>
<td>63–97</td>
<td>5–10 km</td>
<td>Everyone should <strong>reduce</strong> prolonged or heavy physical activity. People over 65, children 14 years and younger, pregnant women and those with existing heart or lung conditions, should also limit their time spent outdoors. No specific message for everyone else other than sensitive groups.</td>
<td></td>
</tr>
<tr>
<td>Unhealthy all</td>
<td>40–106</td>
<td>98–248</td>
<td>2–5 km</td>
<td>Increased likelihood of effects for sensitive groups. General population symptoms occur.</td>
<td></td>
</tr>
<tr>
<td>Very unhealthy all</td>
<td>107–177</td>
<td>249–370</td>
<td>1.5–2 km</td>
<td>Significant likelihood of effects for sensitive groups. General population symptoms common.</td>
<td></td>
</tr>
<tr>
<td>Hazardous high</td>
<td>&gt;177</td>
<td>&gt;370</td>
<td>1–1.5 km</td>
<td>Serious likelihood of effects for sensitive groups. General population symptoms very common.</td>
<td></td>
</tr>
<tr>
<td>Hazardous extreme</td>
<td>&gt;250</td>
<td>&gt;370</td>
<td>&lt;0.5 km</td>
<td>Hazardous extreme effects for sensitive groups. General population symptoms very common.</td>
<td></td>
</tr>
</tbody>
</table>

* The keywords relating to sensitive populations are highlighted in red; keywords relating to people other than sensitive populations are highlighted in blue. The bolding gives an idea of the increased level of health protection advice proportional to the decrease in air quality for these groups.

** Cautionary health advice/actions will be implemented based on 24-hour average PM$_{2.5}$ concentrations. Advice is unlikely to be issued in the event that one-hour average PM$_{2.5}$ concentrations are reached, as this advice is generally available from EPA Victoria’s website.
References

California Department of Public Health, California Office of Environmental Health Hazard Assessment, California Air Resources Board the United States Environmental Protection Agency, and the Missoula County Health Department, 2013. Wildfire smoke – a guide for public health officials.


Department of Health and EPA Victoria, 2014. Hazelwood coal mine fire PM$_{2.5}$ health protection protocol.


### Appendix 1: California wildfire smoke guide – recommended actions for public health officials

<table>
<thead>
<tr>
<th>AQI Category</th>
<th>Actions Levels PM$<em>{2.5}$ or PM$</em>{10}$ (µg/m$^3$)</th>
<th>Visibility – arid conditions (miles)</th>
<th>Recommended Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good (0–50)</td>
<td>0–38 0–22 0–12 ≥ 11</td>
<td>• If smoke event forecast, implement communication plan</td>
<td></td>
</tr>
</tbody>
</table>
| Moderate (51–100)             | 39–88 23–50 12.1–35.4 6–10                      | • Issue public service announcements advising public about health effects and symptoms and ways to reduce exposure  
• Distribute information about exposure avoidance |
| Unhealthy for sensitive groups (101–150) | 89–138 51–79 35.5–55.4 3–5 | • If smoke event projected to be prolonged, evaluate and notify possible sites for cleaner air shelters  
• If smoke event projected to be prolonged, prepare evacuation plans |
| Unhealthy (151–200)          | 139–351 80–200 55.5–150.4 1.5–2.75               | • Consider ‘smoke day’ for schools (no school that day), possibly based on school environment and travel considerations  
• Consider cancelling public events, based on public health and travel considerations |
| Very unhealthy (201–300)      | 352–526 201–300 150.5–250.4 1–1.25                | • Consider closing some or all schools (newer schools with a central air cleaning filter may be more protective than older, leakier homes)  
• Cancel outdoor events (such as concerts and competitive sports) |
| Hazardous (> 300)            | > 526 > 300 > 250.5–500 < 1                       | • Close schools  
• Cancel outdoor events (such as concerts and competitive sports)  
• Consider closing workplaces not essential to public health  
• If PM level is projected to remain high for a prolonged time, consider evacuation of sensitive populations |
Appendix 2: Air quality self-assessment guide

Air quality assessments should be used to decide what to do for local smoke conditions.

Follow this procedure to determine the level of visibility:

1. When there is no fire in the landscape, identify landmarks that are visible from your home. Look for particular landmarks that you know are at distances of 1.5, 2, 5, 10 and 20 kilometres.

2. Each of these distances corresponds to an air quality level in the table below.

3. Use the landmarks as a guide to estimate air quality in your area when smoke is present.

4. When you can no longer clearly see any landmark, air quality has deteriorated. Visibility is the distance of the nearest landmark that is just obscured by the smoke.

### Appendix 2: Air quality self-assessment guide

<table>
<thead>
<tr>
<th>Smoke advisory level</th>
<th>Landmark visible from home (up to that distance)</th>
<th>Cautionary health advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>&gt;20 km</td>
<td>None</td>
</tr>
<tr>
<td>Moderate</td>
<td>20 km</td>
<td>No tailored advice necessary. General air quality information and health advice is available from EPA's and the department's websites.</td>
</tr>
<tr>
<td>Unhealthy for sensitive groups</td>
<td>10 km</td>
<td>People with heart or lung conditions, children, pregnant women and older adults should reduce prolonged or heavy physical activity. No specific message for everyone else.</td>
</tr>
<tr>
<td>Unhealthy all</td>
<td>5 km</td>
<td>People with heart or lung conditions, children, pregnant women and older adults should avoid prolonged or heavy physical activity. Everyone else should reduce prolonged or heavy physical activity.</td>
</tr>
<tr>
<td>Very unhealthy all</td>
<td>2 km</td>
<td>People with heart or lung conditions, children, pregnant women and older adults should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy physical activity.</td>
</tr>
<tr>
<td>Hazardous</td>
<td>1.5 km</td>
<td>People with heart or lung conditions, children, pregnant women and older adults should remain indoors and keep activity levels as low as possible. Everyone should avoid all physical activity outdoors. If conditions persist (two or more days), some people may be advised to temporarily relocate.</td>
</tr>
</tbody>
</table>