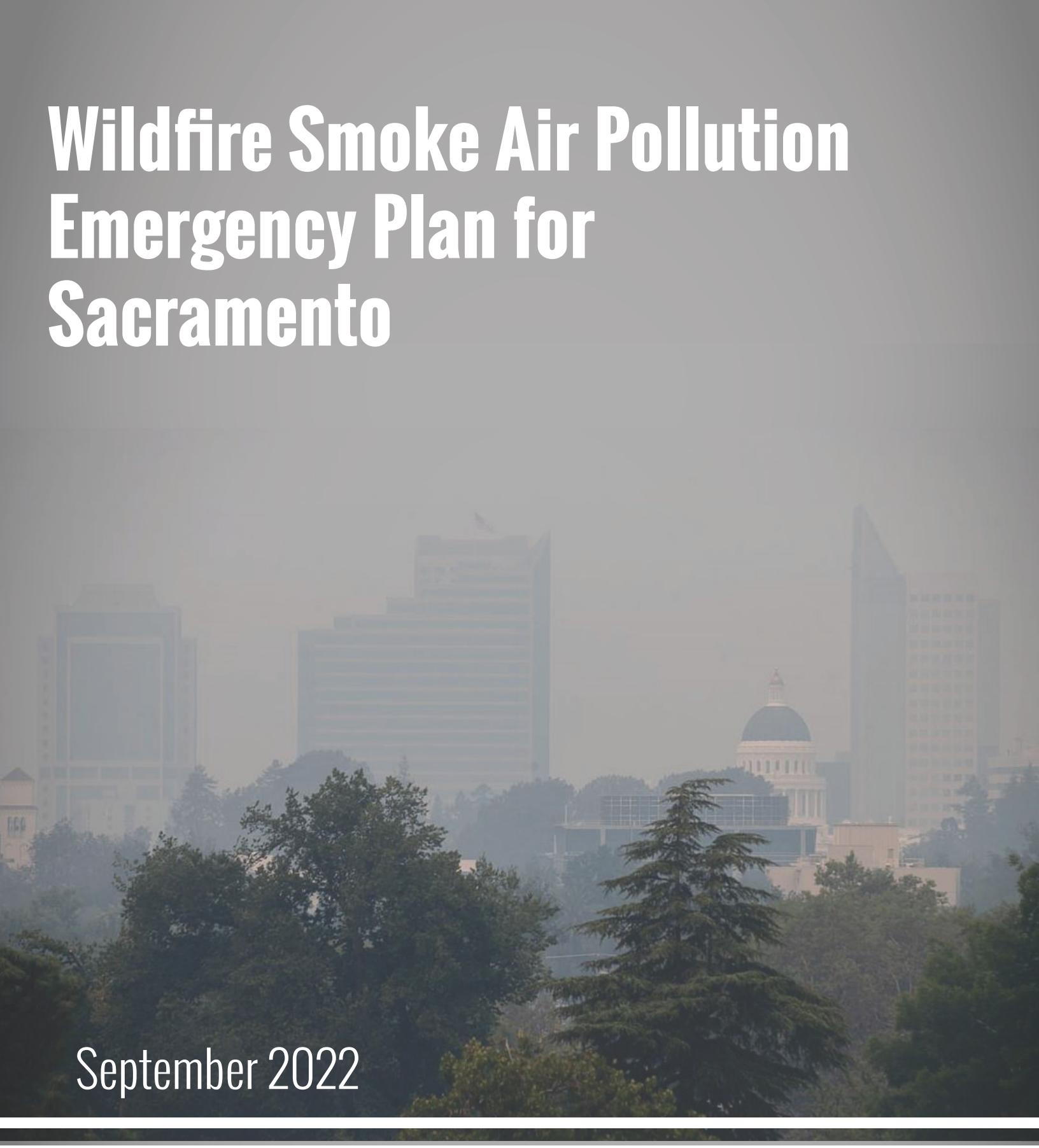
Wildfire Smoke Air Pollution Emergency Plan for Sacramento



September 2022

BREATHE CALIFORNIA Sacramento Region

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

SACRAMENTO COUNTY PUBLIC HEALTH
Promote • Prevent • Protect

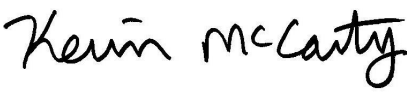
Foreword

As the State Representative for the Seventh Assembly District, I am pleased to see the completion of the *Wildfire Smoke Air Pollution Emergency Plan*, its new resources and coordination, and the new level of organization among jurisdictions and agencies.

The destructive wildfire season of 2018 revealed the need for our local region to become better prepared to protect its residents. During those few days, Sacramento residents suffered through some of the worst air pollution in the world. The public was seeking direction and resources to protect against the overwhelming amount of smoke pollution that settled in the capital. Now nearly four years later, we continue to see megafires growing in intensity and a year-round fire season that can bring smoke and pollution to millions around the state. Within Sacramento and around the entire valley, there have been too many days when wildfire smoke threatens the health of our residents, but especially those most vulnerable to unhealthy and hazardous breathing conditions.

My goal in authoring AB 661 (October 2019), and the *Wildfire Smoke Air Pollution Emergency Plan* that was required by that legislation, was multi-fold and written to help protect our communities and mitigate the negative effects of what I was seeing and hearing about first-hand during the 2018 Camp Fire. It was clear that residents needed a plan for a coordinated and integrated response from the various responsible agencies and jurisdictions in Sacramento and generate new informational resources to help everyone impacted by smoke know what to do and how to make the best possible choices to reduce their exposure. The plan's main audiences are our local businesses, school districts, and the public and private sectors at large. This effort seeks to provide these audiences with the necessary tools in hand to react promptly and accordingly to best protect employees, the public, and the most vulnerable among us – our school children, elderly and unhoused populations.

With the completion of the *Wildlife Smoke Air Pollution Emergency Plan*, the community is now better prepared and can benefit from the tools and approaches that were created to fulfill the statute's original objective. Finally, I would like to commend the Sacramento Metropolitan Air Quality Management District, who working in close coordination with the Sacramento County Department of Public Health and many emergency response partners and others in this effort, has completed a plan that is ready to be delivered to the California state legislature. The plan will serve as a solid foundation for better public health protection, ongoing coordination, and targeted local action necessary to adapt and respond to the consequences of climate change-induced wildfires and a rapidly shifting environment.

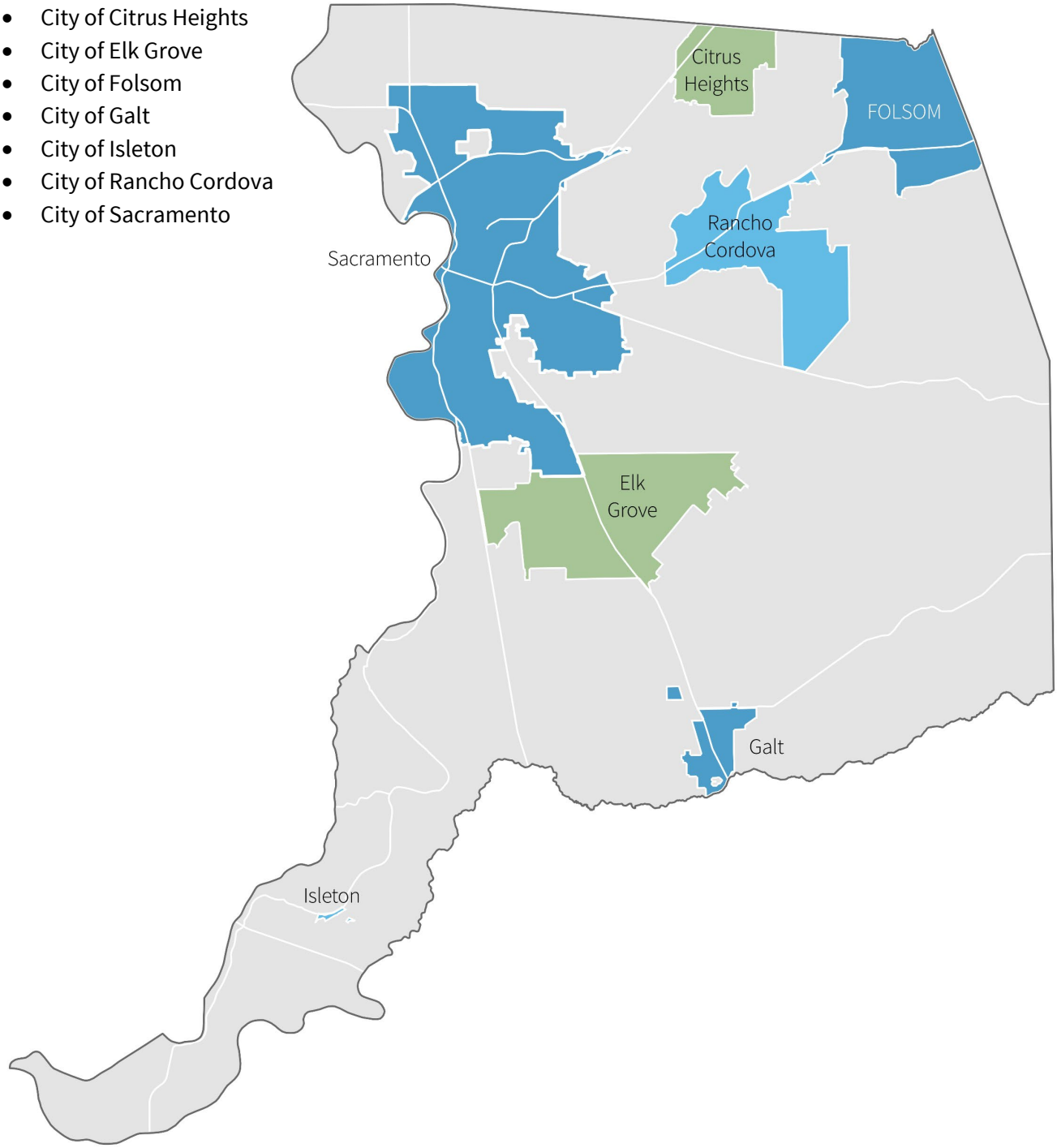


The Honorable Kevin McCarty
California State Assemblymember, District 7

Sacramento County Jurisdictions

The ***Wildfire Smoke Air Pollution Emergency Plan for Sacramento*** was created to serve local public agencies, businesses and communities within Sacramento County. It was developed in coordination with the Sacramento Public Health Officer and in consultation with the Sacramento County Office of Emergency Services, Sacramento County Office of Education, local school districts, local businesses and the following jurisdictions and respective emergency services personnel within Sacramento County:

- City of Citrus Heights
- City of Elk Grove
- City of Folsom
- City of Galt
- City of Isleton
- City of Rancho Cordova
- City of Sacramento



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Definitions/Key Terms

Air Quality Index (AQI): An index used to report air pollution levels with values ranging from 0-301+ that is divided into six categories: Good (0-50), Moderate (51-100), Unhealthy for Sensitive Groups (101-150), Unhealthy (151-200), Very Unhealthy (201-300) and Hazardous (301+). The higher the AQI value, the greater the level of air pollution and the greater the health concern.

California Air Resources Board: The state agency responsible for protecting the public from the harmful effects of air pollution and developing programs and actions to fight climate change.

Ozone: Ozone at ground level is a harmful air pollutant and is the main ingredient in “smog." Ozone is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC). This happens when pollutants emitted by cars, power plants, industrial boilers, refineries, chemical plants and other sources chemically react in the presence of sunlight.

Particulate Matter: A mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot or smoke, are large or dark enough to be seen with the naked eye. Others are so small they can be inhaled and cause serious health problems. Particle pollution includes inhalable particles with diameters that are generally 10 micrometers and smaller (PM_{10}) and fine inhalable particles with diameters that are generally 2.5 micrometers and smaller ($PM_{2.5}$).

Regulatory Monitor: Regulatory monitors are part of a nationwide network of approximately 4,000 air monitoring stations called State/Local Air Monitoring Stations (SLAMS). They measure pollutants such as ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), lead (Pb) and particulate matter (PM_{10} and $PM_{2.5}$). These stations also measure meteorological parameters such as wind direction, wind speed, relative humidity, temperature, rainfall and solar radiation.

Portable Sensor: An air sensor widely available on the market for anyone to purchase that can directly read air pollutant(s) and supplement air quality data provided by regulatory monitoring stations. They are smaller in size, more affordable, relatively easy to install and allow for a greater number of monitoring locations to be established. They are sometimes referred to as “low-cost air sensors,” “air sensor devices,” and “air quality sensors.” Portable sensors are designed for multiple uses and can be used at a stationary location or on a vehicle or person for mobile air quality assessment. Portable sensors are beneficial in providing a general sense of air quality levels, but these sensors do have accuracy limitations and can sometimes over- or under-estimate air pollution data.

Sacramento Metropolitan Air Quality Management District (Sac Metro Air District): The local air quality district that is responsible for monitoring air quality, issuing air quality permits to businesses and enforcing air federal, state and local air quality regulations in Sacramento County. Under Assembly Bill (AB) 661 (McCarty, 2019) the Sac Metro Air District is tasked with developing the *Wildfire Smoke Air Pollution Emergency Plan* (Emergency Plan) for Sacramento County in coordination with the Sacramento Public Health Office and collaboration with other local agencies.

Vulnerable Populations: Under AB 661 (McCarty, 2019), vulnerable populations include school-age children, the elderly, people experiencing homelessness, outdoor employees and people with health issues exacerbated by wildfire smoke.

Wildfire Smoke: Particulate matter emissions from fires in “wildlands,” as defined in Section 3402 of Title 8 of the California Code of Regulations, or in adjacent developed areas.

Wildfire Smoke Event: A period of time when Sacramento County is impacted by smoke from fires in wildlands or in adjacent developed areas.

Acknowledgements

The development of the AB 661 *Wildfire Smoke Air Pollution Emergency Plan* involved numerous partners and stakeholders that contributed their expertise and knowledge to its content. First, the Sacramento County Public Health Officer participated in immeasurable ways to make sure the recommendations herein are consistent with health protective standards. Various emergency service agencies, including the Sacramento County Office of Emergency Services, and the cities of Citrus Heights, Elk Grove, Folsom, Galt, Isleton, Rancho Cordova and Sacramento and Emergency Services departments from all jurisdictions provided their immense experience to guide the process and add relevant material to the plan. Sacramento school districts were also involved early on and throughout the course of the Emergency Plan creation and their feedback and elucidation of the challenges they face during a wildfire smoke event helped in the crafting of usable outreach tools. Lastly, members of our business and non-profit community contributed to the Emergency Plan, especially where it related to employee safety and planning.

Worth noting, the Emergency Plan was developed during the greatest health emergency of the past century – the COVID pandemic. The AB 661 partners had just begun the process of meeting and crafting the Emergency Plan when, in March of 2020, life and the focus of our key stakeholders were dramatically shifted. Our Public Health Officer, our emergency services departments and our school districts were thrust into unprecedented territory that required their full attention to navigate, problem-solve and deal with a protracted health crisis. Nonetheless, the AB 661 partners remained engaged and active to provide the necessary feedback and keep the Emergency Plan development going, albeit at a revised timeframe.

We would also like to thank our state partners at the California Air Resources Board and the Office of Environmental Health and Hazard Assessment for their input over the past two years as we investigated various elements of the Emergency Plan related to the use of a shorter timeframe air quality metric.

We would be remiss if we did not thank Assemblymember Kevin McCarty and former City of Sacramento councilmember and Sac Metro Air District Board member Steve Hansen for propelling the AB 661 legislation forward into adoption. It was the impetus for the Emergency Plan development, without which it may not have been realized. Lastly, the Sac Metro Air District Board of Directors has been supportive of the financial and resource intensive efforts required for the Emergency Plan to be completed. Their recognition of the impacts wildfire smoke events have on all Sacramento County residents, and the role that the Sac Metro Air District plays, has allowed this important work to occur.

Executive Summary

The growing impact from wildfires in California is undeniable. Climate change and the resultant effects, along with historic forest management practices, have coalesced into the observed mega-fires and year-round fire seasons now impacting communities statewide. The fire damage to communities within the fire zone has been swift and severe, but the impacts from these fires are felt far beyond the fire perimeter. Wildfire smoke impacts populations living hundreds of miles away and often for days and weeks at a time.

Because of this new climatic and fire paradigm, we are tasked with adapting to the new reality. This *Wildfire Smoke Air Pollution Emergency Plan* has been developed as an adaptation tool to help Sacramento County residents, businesses, schools and public agencies prepare and protect themselves from regular and ongoing exposure to wildfire smoke. The Emergency Plan includes general information on air quality, forecasting and monitoring and provides a basic understanding of health impacts from smoke. Most importantly, the Emergency Plan outlines best practices for different sectors to better prepare and respond during a wildfire smoke event. Quick-reference tools like the sector-specific Air Quality Action Charts will help residents, businesses, schools and other agencies respond promptly to reduce smoke exposure when smoke descends. The Emergency Plan also contains standardized messaging tools for public agencies to use and other useful resources for those that want additional information on public health and wildfire response.

The Emergency Plan development process generated many positive outcomes and unique and innovative strategies to deal with wildfire smoke events:

Formation of countywide coalition & improved coordination and response

One of the first actions taken in the region was the establishment of a broad coalition of decision makers and key partners within Sacramento County including the public health department, city and county agencies with emergency response functions and county school superintendents. The coalition was activated in last year's fire events leading to more effective and coordinated wildfire response and decision making. This new effort fully utilizes relevant expertise of all members and optimizes the use of existing emergency response resources.

The Sac Metro Air District also made concerted efforts during the Emergency Plan development to learn about existing emergency response protocols, understand how the region responds to assist vulnerable populations during wildfire smoke events, hear about specific challenges and determine best practices from city and county leadership. The listening session process was crucial to identify key plan elements and enhance the Emergency Plan content.

Action charts and other communication aids for key stakeholder groups

One of the most popular requests we heard from our partners was the need for simple and clear recommendations during wildfire smoke events depending on the severity of the pollution impacting local communities. In response, our agency developed four distinct Air Quality Action Charts building on previous efforts by other California air districts. The charts include a list of succinct recommended response actions based on the Air Quality Index (AQI) observed. The charts are now readily available to assist regional decisionmakers when wildfire smoke impacts are experienced.

Regional survey for informing an evidence-based AB 661 Plan

In one unique feature of our approach, we conducted a survey of three key cohorts – businesses, public agencies, and non-profit organizations – to determine the characteristics of typical responses being taken when the region was affected by wildfire pollution. The survey established a baseline to understand how these sectors are impacted by wildfire smoke, what decisions and actions had been made during previous events, and what best practices could be implemented during future wildfire smoke events that could help reduce overall air pollution and reduce employee smoke exposure.

The survey was a key element of the AB 661 work and the survey responses ultimately helped inform the Emergency Plan. In brief, the survey showed most employers from both public and private sectors were either highly or moderately impacted during previous smoke events. Loss of revenue and productivity were the most often mentioned impact. The survey also revealed that employers are interested in taking additional steps during future smoke events to decrease smoke exposure for their employees – increasing access to personal protective equipment, implementing telework for employees, reducing or cancelling outdoor work and monitoring indoor air quality. Lastly, the survey confirmed that tools created for the Emergency Plan, like the Air Quality Action Charts, will be helpful resources for our businesses and public agencies during wildfire smoke events.

New AQI science and resources

Determining the appropriate response to impacts from wildfire pollution has been based on the AQI. The AQI is a metric that captures ambient air pollution levels averaged over the previous 24 hours. Since the worst wildfire pollution impacts tend to occur over a shorter time interval, for our AB 661 work we sought to explore the potential for a more appropriate and shorter AQI timeframe, presuming an adjusted AQI would be more health protective. Through efforts spear-headed by our partners, in particular the state Office of Environmental Health Hazard Assessment (OEHHA) and the California Air Pollution Control Officers Association (CAPCOA), we now have evidence to support the continued use of the existing AQI since use of an AQI with a shorter timeframe shows no significant difference.

Increased numbers of wildfires and the smoke impacts they create are felt nationwide. In recognition of the importance of having adequate tools to help people take action, the U.S. Environmental Protection Agency (EPA) and the U.S. Forest Service developed a new AQI resource during the last two years, the AirNow Fire and Smoke Map (fire.airnow.gov) that provides a more localized look at air quality. This mapping tool shows reliable government and public air quality sensor data that helps everyone respond based on the latest and nearest air quality information.

In summary, while the official process of developing the *Wildfire Smoke Air Pollution Emergency Plan* has reached a conclusion with the production of this plan, it marks only the beginning of continued coordination, communication and collaboration amongst Sacramento public and private sectors, now equipped with a refined approach. The Emergency Plan represents local, state and federal information collected and synthesized during the 2020 through 2022 timeframe and serves as an anchor point for improved local organization during wildfire smoke air quality emergencies. However, the ongoing research and resultant policy and health guidance will continue to foster new and better ways to confront the challenges of wildfire smoke response. Our region will continue efforts to follow the latest available information to improve our local coordination. Wildfire smoke events will be a part of the natural disaster landscape for the foreseeable future and our joint-response efforts to reduce exposure to poor air quality for Sacramento communities, employees and those most vulnerable are vital.

Wildfire Smoke Air Pollution Emergency Plan: Introduction

Background

During the past five years, California has experienced severe wildfire seasons, devastating communities and bringing unprecedented loss of life and damage to both wildland and urban environments. In Sacramento County, the smoke-filled weeks during the Camp Fire in November 2018 and again during other major wildfires in 2020 and 2021 forced residents, businesses and public agencies to grapple with difficult decisions of how best to protect the public, employees and importantly, school-aged children and other vulnerable communities. From these experiences, and acknowledging the unfortunate reality that wildfire smoke events will continue, improved communication and readily available resources to help guide decision-making are needed.

In October 2019, Assembly Bill 661 [1] (K. McCarty) was signed into State law. This legislation mandates the Sacramento Metropolitan Air Quality Management District (Sac Metro Air District) develop a *Wildfire Smoke Air Pollution Emergency Plan* (Emergency Plan) in full collaboration with the Sacramento County Health Officer and in consultation with other agencies – local emergency services offices, school districts, the Sacramento County planning agency and the California Air Resources Board (CARB). The plan is intended to serve as an information resource for Sacramento's school districts, local agencies, businesses and the public during wildfire smoke air pollution emergencies.

The plan must specifically include these main elements:

1. Health protective recommendations and guidelines at different tiers of air quality
2. Clear designation of responsible agencies and their respective roles and actions
3. Recommendations and best practices for businesses and public agencies
4. Strategies for vulnerable populations

Wildfire Plan Development

In December 2019, the Sac Metro Air District formed a Wildfire Smoke Air Pollution Emergency Working Group (Working Group). The Working Group consisted of the County Health Officer, local emergency services departments, school districts, the regional planning agency, CARB and other key partners. Beginning in January 2020, meetings were held to gather feedback, vet ideas and formulate the plan contents. An online survey was also performed to specifically address Element 3 – best practices for businesses and public agencies. The survey collected information from businesses, public agencies and non-profit organizations on operational practices these entities implemented during wildfire smoke events and gathered feedback on draft tools created to assist with wildfire smoke event response. The plan was reviewed with the Sac Metro Air District Board of Directors

[1] AB 661 *Wildfire Smoke Air Pollution Emergency Plan*: Sacramento Metropolitan Air Quality Management District, Cal. Assemb. B. 661 (2019-2020), Chapter 392 (Cal. Stat. 2019)

during Board meetings to keep them updated on plan development progress. The Sac Metro Air District also provided annual updates to the author of AB 661, Assemblymember McCarty, in October 2020 and December 2021.

Wildfire Plan Layout

The plan provides information to address all required elements and includes other useful information that can be used during a wildfire smoke event.

The plan is organized into these main sections:

1. Overview of health impacts from wildfire smoke and air quality basics
2. Specific plan elements *(elements 1-4)*
3. Resources and tools available for various sectors to help prepare and respond during wildfire smoke events *(appendixes A-F)*

The plan focuses its guidance toward four main sectors:


Schools


Government Agencies


General Public


Sacramento County Business

Air Pollution and Wildfire Smoke Health Impacts

Poor air quality poses a health risk to all individuals. However, children, adolescents, pregnant women, the elderly, the immunocompromised and those with pre-existing chronic diseases and lung conditions are especially vulnerable to the compounding detrimental health impacts of poor air quality events. Wildfire smoke creates and often exacerbates poor air quality situations. Of the many harmful components that exist in wildfire smoke, one of the most dangerous is particulate matter (PM), specifically fine PM ($PM_{2.5}$). The microscopic particles of $PM_{2.5}$ are so fine that they are inhaled deep into the lungs and cross the blood-air barrier to enter the bloodstream. Short-term exposure over hours or days can lead to increased asthma attacks, acute bronchitis, increased susceptibility to respiratory infections and can lead to an increased risk of heart attack for individuals with lung disease.

Ground-level ozone is another air pollutant of concern because it is a strong irritant that can cause constriction of the airways, forcing the respiratory system to work harder to provide oxygen. It can also cause other health problems including aggravated respiratory disease such as emphysema, bronchitis and asthma, lung damage, wheezing, chest pain, dry throat, headache, nausea, reduced

resistance to infection, increased fatigue and weakened athletic performance. While ozone is typically seen at its highest levels during the summer, wildfire plumes can increase ozone formation. [2]

With an increased number of prolonged wildfire smoke events impacting populations near and far from fire epicenters, it has become imperative to understand the health impact from acute and extended exposure to wildfire smoke.

Three important factors affect the likeliness and severity of health impacts from breathing smoke:

1. What air pollutants are in the wildfire smoke?
2. How concentrated is the smoke exposure?
3. How long is the wildfire smoke exposure?

Particulate matter from any source can be detrimental to health, but there is growing evidence to indicate that wildfire smoke may be even more unhealthy to breathe and result in more adverse health outcomes compared to other sources of particles. [3] Additional research is still needed to fully understand what chemical compounds are in wildfire smoke, but recent findings by CARB showed increased levels of lead and other metals in wildfire smoke produced from the 2018 Camp Fire compared to other fires where mostly trees and vegetation were burned. [4] When fires burn buildings, homes, cars and other non-vegetative materials, it is expected that additional toxic substances from plastics, paints and metals will be released and entrained in the smoke.

The concentration and duration of smoke exposure can also increase the possibility of detrimental health effects. When smoke concentrations are at or above unhealthy levels, short-term health impacts like irritated eyes, scratchy throat, cough, shortness of breath, cardiac arrythmias, respiratory infections and asthma attacks are more likely to develop. Multiple days of exposure to unhealthy air quality due to wildfire smoke increases the likeliness of more severe health effects and can exacerbate existing heart and respiratory conditions leading to increased numbers of heart attacks, exacerbated COPD (chronic obstructive pulmonary disease) and result in higher numbers of emergency room visits. Long-term health impacts from wildfire smoke are a bigger challenge to decipher, but ongoing research continues to try to answer this important question. Some early analysis points to a link between extended wildfire smoke exposure and a reduction in respiratory health in subsequent years. [5]

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[2] Oceanic and Atmosphere Research (OAR). (2022, January 10). Smoke from wildfires influences ozone pollution on a global scale. *NOAA Research News.* https://research.noaa.gov/article/ArtMID/587/ArticleID/2822/Smoke-from-fires-influences-ozone-pollution-on-a-global-scale

[3] Aguilera, R., Corringham, T., Gershunov A., & Benmarhnia, T. (2021). Wildfire smoke impacts respiratory health more than fine particles from other sources: observational evidence from Southern California. *Nature Communications 12*(1493). https://doi.org/10.1038/s41467-021-21708-0

[4] California Air Resources Board. (July 2021). *Camp fire air quality data analysis.* https://ww2.arb.ca.gov/sites/default/files/2021-07/Camp_Fire_report_July2021.pdf

[5] Orr, A., Migliaccio, C. A. L., Buford, M., Ballou, S., & Migliaccio, C. (2020) Sustained effects on lung function in community members following exposure to hazardous $PM_{2.5}$ levels from wildfire smoke. *Toxics, 8*(3), 53 https://doi.org/10.3390/toxics8030053

Air Quality Basics

Air Quality Monitoring

Air quality is monitored in Sacramento County by the Sac Metro Air District and CARB. There are seven regulatory air monitoring stations used for air quality planning located throughout Sacramento County. The Sac Metro Air District operates six of these monitoring stations and CARB operates one (Figure 1). These air monitoring stations provide various real-time air pollutant concentrations and data to the public. The data is collected on an hourly basis. These monitors are part of a state, local and nationwide monitoring network of approximately 4,000 air monitors that measure regional air pollution. Included in the air monitoring network are air quality monitors that specifically detect particulate matter. The air pollution data from these monitoring stations are available online (see Appendix D – General Resource Links).

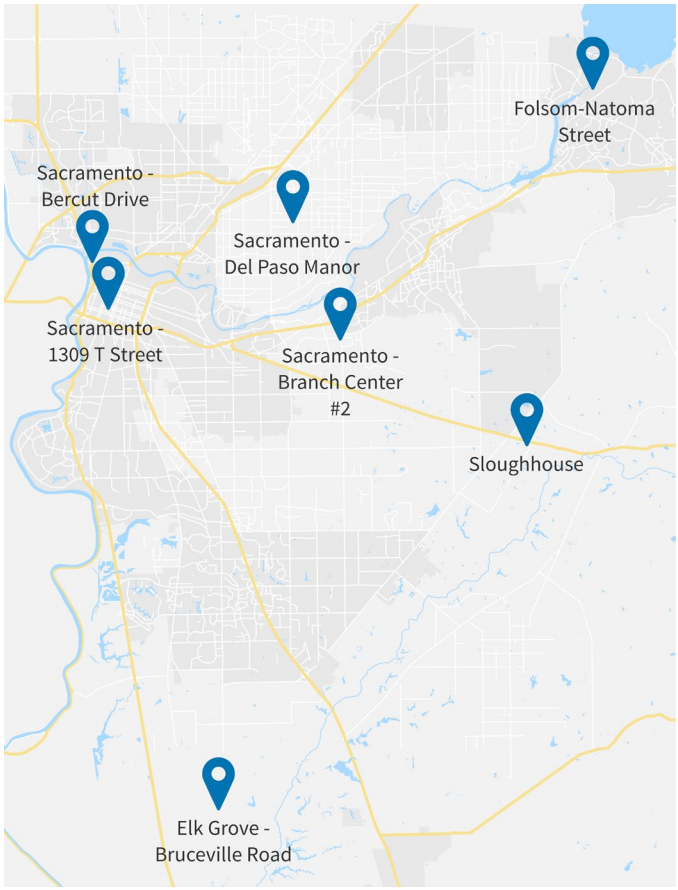

Figure 1 Regulatory Air Quality Monitors located in Sacramento County

Regulatory Monitors

Regulatory monitors are quality-controlled measuring devices that use standardized siting and operating procedures and undergo rigorous quality assurance calibration steps to make sure the air quality data is accurate. Regulatory monitors are used for air quality planning, forecasting, and to provide local air quality information to the public.

Portable Sensors

In addition to these regulatory air quality monitoring sites, portable air quality sensors are used by government agencies, private businesses and the general public. While regulatory monitors provide data that is most accurate, portable sensors are affordable and help provide real-time and very localized air quality conditions over a larger geographical area. Portable sensors are best used to get a general idea of the air quality at a local level, but they may tend to read lower or higher than regulatory monitoring sites. The EPA AirNow Fire and Smoke Map includes portable sensor data, which enables the map to have broader geographical coverage at that more local level. Data from the portable sensors are adjusted to account for their generally high air quality readings when compared to regulatory monitors. More information on portable sensors can be found in research done by the

EPA and South Coast Air Quality Management District [6] and a general overview of portable air sensors is available from the EPA. [7] Both the Cities of Rancho Cordova and Sacramento, and various non-profit organizations have established programs to place portable sensors in their jurisdictions to help gauge air quality conditions within certain city boundaries or overburdened communities. Air Quality data collected from these sensors are available online at various sources (see Appendix D – General Resource Links).

Air Quality Index

The Air Quality Index (AQI) is a widely used number-based system created by the EPA to communicate air quality conditions to the general public. The AQI uses a scale of 0-301+ to let users know if air quality is Good, Moderate, Unhealthy for Sensitive Groups, Unhealthy, Very Unhealthy, or Hazardous (see Figure 2). The AQI is used throughout this plan and in the provided tools and resources. It is a key metric that will help guide planning and decision-making when looking at forecasted and current air quality levels.

Levels of Concern	Values of Index	Description of Air Quality
Good	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Moderate	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution
Unhealthy for Sensitive Groups	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Unhealthy	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy	201 to 300	Health alert; The risk of health effects is increased for everyone.
Hazardous	301 and higher	Health warning of emergency conditions; everyone is more likely to be affected.

Figure 2. The Air Quality Index. Find more information on the AQI at https://www.airnow.gov/aqi/aqi-basics

Air Quality Forecasting vs. Current Air Quality Conditions

Forecasted air quality is the most useful tool to provide schools, the public, public agencies and businesses with an idea of what air quality will likely look like in the near future and help them make important decisions about school closures, the possible need to prepare cleaner air centers and make sure they have necessary worker protection measures in place. For example, if an AQI of 300 is

[6] Polidori A., Papapostolou V., Collier-Oxandale A., Hafner H., and Blakey T. (April 2021) Community in action: A comprehensive guidebook on air quality sensors. Available on the South Coast AQMD's AQ-SPEC website: http://www.aqmd.gov/aq-spec/special-projects/star-grant

[7] U.S. Environmental Protection Agency. (n.d.), *Frequent questions about air sensors*. Retrieved February 1, 2022, from https://www.epa.gov/air-sensor-toolbox/frequent-questions-about-air-sensors

forecasted to occur in the next 24 hours, school districts may want to consider closing schools, implementing their communication plan, and determining how to distribute meals to students during the closure period.

An air quality forecast is available by noon every day and can be found online (see Appendix C – General Resource Links). The forecast provides an outlook of what air quality conditions are likely to be for the coming ***two*** days. The forecast is based on powerful modeling tools that take the average $PM_{2.5}$ levels observed during the previous 24 hours, and meteorological factors, like temperatures and winds, that could impact conditions.

The original intent of AB 661 was to determine and include in the Emergency Plan a short-term air quality metric (an advisory index similar to the current AQI, but one based on a shorter time scale than 24 hours) to guide decisions during rapidly changing conditions in wildfire smoke scenarios. In collaboration with CAPCOA, OEHHA reviewed the recent literature reporting on the health effects of sub-daily exposure to $PM_{2.5}$ pollution and concluded that while some outcomes are reported, the effects observed from sub-daily exposures to pollution are similar to those derived from daily average exposures. In essence, the review suggested that the continued use of the current AQI based on daily averages of pollution levels even during smoke events is justified (X. Wu, personal communication, February 1, 2022). For additional information on short-term air quality metrics see Appendix F.

Current air quality conditions are updated approximately every hour and can be found online (see Appendix D – General Resource Links). These near-real-time AQI values can help schools, residents, public agencies and businesses make decisions for more immediate actions by referencing the Air Quality Action Charts found in this Emergency Plan for different sectors. For example, if a current AQI of 170 is observed, a school district may choose to keep students indoors instead of allowing them to go outside for outdoor activities.

Where to Get Air Quality Information

There are various online resources available to get air quality information. This section provides a summary of the recommended online resources to use specifically during a wildfire smoke event.

The most comprehensive and recommended online resource to use during wildfire smoke events is the EPA AirNow Fire and Smoke Map (see Appendix C – General Resource Links). Other websites, like the Sac Metro Air District's website and SpareTheAir.com, are useful to access air quality forecasts and current air quality conditions (see Appendix C – General Resource Links). However, the air quality data is more sparsely distributed compared to the EPA AirNow Fire and Smoke Map that includes a wide distribution of portable air quality sensors. The EPA AirNow Fire and Smoke Map also includes several valuable layers of data that are important to see during a wildfire smoke event – current, forecasted and historical air quality data, smoke visualization and basic fire information. There is also a mobile app (EPA AirNow) that can be downloaded to access air quality information at user-designated locations that includes a quick access link to the EPA AirNow Fire and Smoke Map.

The map includes air quality data from both local and state air monitoring stations and portable sensors (Purple Air sensors). One of the most important features of the EPA AirNow Fire and Smoke Map is the use of *corrected* portable sensor data. As previously mentioned, portable sensors are typically less accurate than regulatory monitoring stations using more sophisticated monitoring equipment. By displaying corrected values, air quality data is available throughout the county, which is especially important during a smoke event when conditions can be highly localized.

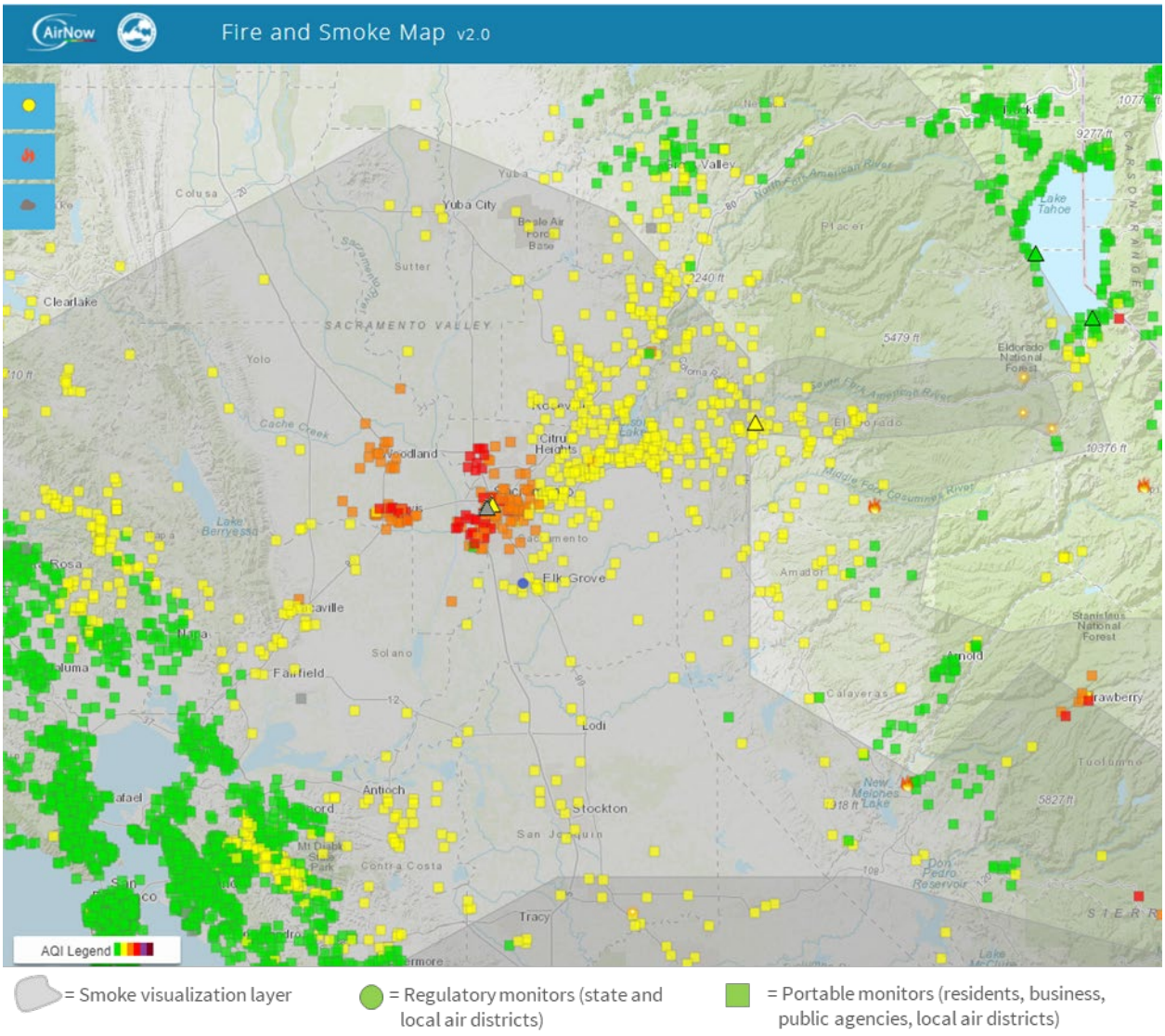

Figure 3. Example of the EPA AirNow Fire and Smoke Map showing regulatory and portable sensor air quality data, the gray smoke layer visualization, and the wildfire locations. The EPA AirNow Fire and Smoke Map is the recommended resource to be used during wildfire smoke events because it contains the most useful set of data to evaluate conditions and make decisions.

Indoor Air Quality

Indoor air quality is an important factor for everyone to understand. Poor indoor air quality can have short- and long-term health impacts and can be a source of asthma and exacerbate other heart and lung conditions. Indoor air quality is not regulated by the EPA, but they do provide information on indoor air quality (see Appendix C – General Resource Links). Several other federal and state agencies focus on regulating consumer products, like air fresheners, deodorants and spray paint, and can set emission thresholds. Local air district authority to regulate air quality comes from the federal Clean Air Act (CAA), which regulates six main air pollutants that cause outdoor air pollution. The traditional role for local air districts is therefore to monitor ambient (outdoor) air quality, permit businesses that emit air pollutants and enforce air quality rules and regulations.

Information about poor indoor air quality is a growing body of science. And while the science, regulations and recommendations around indoor air quality are still developing, it is widely accepted that understanding and trying to reduce sources of indoor air pollution in the homes and buildings we live and work in is important. During a wildfire smoke event, staying indoors is the best way to reduce exposure to harmful particulate matter. Because smoke from wildfires can seep into indoor spaces, it's necessary to understand how to limit and reduce smoke levels and other sources of indoor air pollution. Recommendations for improving air quality indoors during a smoke event are found in Element 1, Health Protective Recommendations and Guidelines.

Element 1: Health Protective Recommendations and Guidelines

This section provides recommendations and guidelines for school districts, public agencies, businesses, and the general public to use during wildfire smoke events. These recommendations are separated into these main areas: (1) preparing for a wildfire smoke event, (2) what to do during a wildfire smoke event and (3) using a mask during wildfire smoke events.

Preparing for a Wildfire Smoke Event

Prior to a wildfire event occurring, there are important steps that can be taken by school districts, public agencies, businesses and the general public to prepare for when wildfire smoke impacts air quality conditions. Pre-planning for how individuals, family members, students and employees could be impacted will make it easier to take action when the time comes.

Figure 4. Preparation prior to wildfire smoke events is important for everyone to be ready to reduce smoke exposure when an event actually occurs. These steps are some general best practices for everyone, including public and private entities.

Understand the Health Risks From Breathing Wildfire Smoke

Before taking action to reduce smoke exposure, it helps to understand why those actions are important. Anyone can benefit from having a general knowledge about how wildfire smoke can be harmful to their health, especially over prolonged periods of time. A summary of wildfire health impacts and air quality information basics is provided in previous sections of this plan. There is also ample information provided by the EPA, [8] the Centers for Disease Control and Prevention, [9] and CARB. [10]

Know Where to Get Air Quality Info & Available Resources

During a wildfire smoke event, it is important to know the most current air quality conditions for informed decision-making. Saving links to online air quality information, downloading the AirNow or the Sacramento Region Air Quality mobile applications and saving general phone numbers for the Sac Metro Air District are good steps to take before a smoke event. The Sac Metro Air District also has a dedicated website with information related to Wildfire Smoke, which can be used to find tools and other information.

Understand HVAC System & Impacts to Indoor Air Quality

During a wildfire smoke event, staying indoors is the main and most effective way to reduce exposure to smoke. Whether at home, at school or at the workplace, knowing how the HVAC system works and making improvements to the filtration is important to be able to reduce smoke levels indoors. Recommendations include:

- Set HVAC systems to recirculate mode to stop smoke-filled air from being brought inside.
- Filters should be replaced to the highest filtration rating possible (MERV 13 [11] rating or higher, if appropriate for your system).
- Extra filters should be kept on hand to replace dirty filters. Wildfire smoke events that last for multiple days may require filter changes more frequently.
- Understanding costs can be prohibitive, where possible, upgrade HVAC systems to provide the cleanest indoor air possible.

To avoid damaging your system, please follow the manufacturer's recommended settings for proper operation. Some HVAC systems may have default settings that bring in air from the outside and it may not be possible to reset an HVAC system to recirculate mode. Additional information on indoor air quality can be found in the EPA Indoor Air Quality Guidance. [12]

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[8] Environmental Protection Agency. (n.d.). *How smoke from fires can affect your heath.* Retrieved January 31, 2022, from https://www.epa.gov/pm-pollution/how-smoke-fires-can-affect-your-health

[9] Centers for Disease Control and Prevention. (n.d.). *Protect yourself from wildfire smoke.* Retrieved January 31, 2022, from https://www.cdc.gov/air/wildfire-smoke/default.htm

[10] California Air Resources Board (n.d.). *Protect yourself from wildfire smoke.* Retrieved January 31, 2022, from https://ww2.arb.ca.gov/protecting-yourself-wildfire-smoke

[11] Additional information on Minimum Efficiency Reporting Values (MERVs) can be found on the EPA's website: https://www.epa.gov/indoor-air-quality-iaq/what-merv-rating

[12] Environmental Protection Agency. (n.d.). *Wildfire smoke factsheet: Indoor air filtration.* Retrieved January 31, 2022, from https://www.airnow.gov/sites/default/files/2020-10/indoor-air-filtration-factsheet_1.pdf

Know How to Create Indoor Cleaner Air Spaces

When someone sees or smells smoke, the best strategy is to stay indoors. But sometimes, smoke can still find its way inside and reduce air quality indoors as well, especially when smoke concentrations are high and during a prolonged smoke event. It's therefore a good plan to think about a room or space inside the home, office or school where air can be made as clean as possible. Part of a good strategy includes the section above on HVAC systems and installing high-rated MERV air filters on HVAC systems, but this isn't always possible for everyone. Here are several other recommended steps to keep indoor air as smoke-free as possible.

- Choose a space with as few doors and windows as possible to limit smoke intrusion.
- Choose a space that will be comfortable and possible to spend a lot of time in during the day.
- Weatherize windows and doors to make the room less susceptible to smoke intrusion.
- Add a certified portable air cleaner sized to efficiently clean the chosen space [13] or make a DIY air cleaner. [14] DIY air filters can be inexpensive to build, relatively simple to make and replacement filters are often less expensive than filters used in many portable air cleaners while still providing cleaner indoor air.
- For larger, public spaces, industrial-grade portable air cleaners will likely need to be used.

Additional information on creating a cleaner air space indoors can be found from the Center for Disease Control [15] and the EPA. [16]

Keep Supplies on Hand

During a prolonged smoke event, limit the time spent outdoors. For those with certain medical conditions that can be aggravated by smoke exposure, make sure to plan ahead to keep some basic supplies on hand:

- Food and water for several days
- Important medications
- Asthma management plan
- N95, KN95 or KF94 masks
- Other basic supplies needed to avoid going outdoors
- Spare air filters

Make a Communication & Action Plan

One of the best preparatory steps anyone can take is to create a plan prior to an event happening. It is especially important for individuals that are unable to reduce smoke exposure indoors by weatherizing their home, using a portable air clean or creating a clean room to have a plan to find a publicly available cleaner air space. When wildfire smoke occurs during hotter times of year, it may

[13] California Air Resources Board. (n.d.). *List of CARB-certified air cleaning devices*. Retrieved January 31, 2022, from https://ww2.arb.ca.gov/list-carb-certified-air-cleaning-devices
[14] Puget Sound Clean Air Agency. (n.d.). *DIY Air Filter.* Retrieved January 31, 2022, from https://pscleanair.gov/525/DIY-Air-Filter
[15] Centers for Disease Control and Prevention. (n.d.). *Protect yourself from wildfire smoke.* Retrieved January 31, 2022, from https://www.cdc.gov/air/wildfire-smoke/default.htm
[16] Environmental Protection Agency. (n.d.). *Wildfires and Indoor Air Quality (IAQ).* Retrieved January 31, 2022, from https://www.epa.gov/indoor-air-quality-iaq/wildfires-and-indoor-air-quality-iaq

not be possible to create a clean indoor space and stay cool. Public spaces that typically can provide cooler and cleaner air include malls, libraries and designated cleaner air centers.

Developing a Communication & Action Plan to address wildfire smoke impacts is especially important for school districts, public agencies and businesses that make decisions for students, the public and employees that impact their exposure potential. Here are some key elements to any Communication & Action Plan: [17]

- Determine the goal for the communication plan
- Identify your main audience
- Develop standard and agreed-upon messages and actions
- Clearly list contacts and information websites
- Create templates and communication materials to quickly distribute messages
- Determine communication pathways to disseminate messages and actions
- Develop partnerships with other organizations and agencies that can assist during events
- Activate plan during event and adjust as necessary
- Review plan during and after event and revise plan from any lessons learned

Other resources are available to help guide communication planning and emergency response at the federal emergency preparedness website. [18] There are specific recommendations and planning tools for both the public [19] and businesses. [20]

[17] Macfarlan, A. (2018, May 3). Three templates for effective communications planning. *Better Evaluation.* https://www.betterevaluation.org/en/blog/three_communication_planning_templates
[18] Plan Ahead for Disasters, Ready.gov. (n.d.). Retrieved February 1, 2022, from https://www.ready.gov/
[19] Make A Plan, Ready.gov. (n.d.). Retrieved February 1, 2022, from https://www.ready.gov/plan
[20] Business, Ready.gov. (n.d.). Retrieved February 1, 2022, from https://www.ready.gov/business

What to do During a Wildfire Smoke Event

Wildfire smoke can impact an area quickly. With the right wind conditions, even a wildfire that is occurring hundreds of miles away can produce smoke that is brought into Sacramento County within a matter of hours. When that happens, there are several general recommended steps to be taken by school districts, public agencies, businesses and the general public to respond and take action to reduce exposure to smoke.

Check Air Quality Information Regularly

Use Air Quality Action Charts to Guide Decisions

Reduce Smoke Exposure and Stay Indoors

Reduce Activities that Increase Air Pollution

Monitor Health Conditions and Follow Medical Plans

Activate Communication & Action Plans (for schools, public agencies and businesses)

Figure 5. Recommended actions to follow during a wildfire smoke event.

Check Air Quality Info Regularly

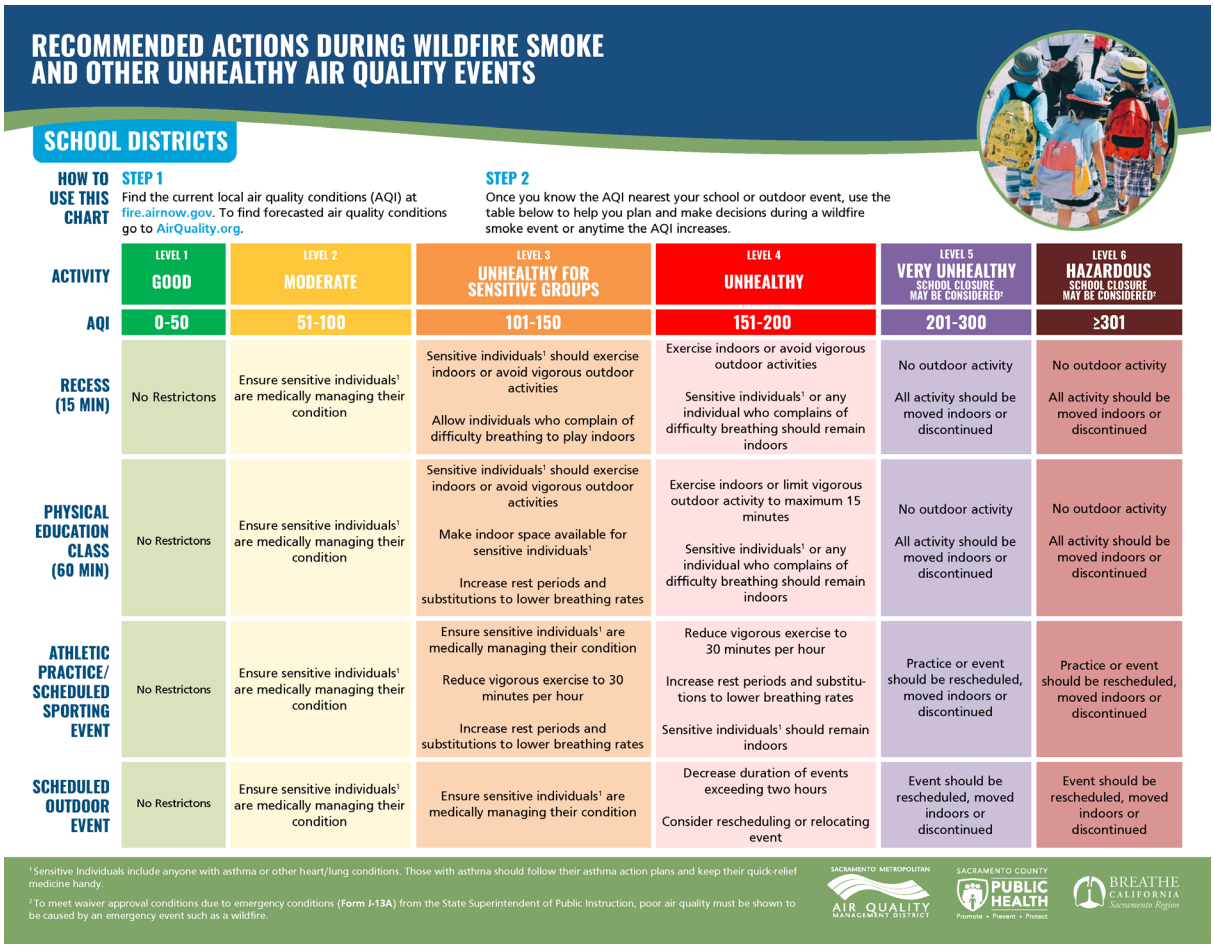
One of the most important things to do during a smoke event is to know the air quality conditions nearest your location. The EPA AirNow Fire and Smoke Map (www.fire.airnow.gov) is the recommended website to use during a smoke event because it contains current, forecasted and historical air quality information using both regulatory monitors and corrected portable sensor data. It also has good information about where wildfires are occurring and provides a simulated smoke layer to help visualize potential smoke impacts.

Use Air Quality Action Charts to Guide Decisions

During a wildfire smoke event, government agencies, schools and businesses need to be able to promptly make informed decisions and take health-protective actions. This plan provides users with specific recommendations and guidelines based on different tiers of air quality. These guidelines are

referred to as Air Quality Action Charts. This plan includes Air Quality Action Charts for four different sectors: (1) schools, (2) the general public, (3) public agencies and (4) businesses. All charts were created with input and review from public health and other local partners and stakeholders.

The charts recommend actions to be taken when air quality conditions reach certain AQI levels. For example, in the action chart for school districts shown below (Figure 6), individual schools may consider closing when air quality reaches the very unhealthy range (AQI = >200). Full charts are available in Appendix A and online at www.AirQuality.org. The charts will be updated as needed.



RECOMMENDED ACTIONS DURING WILDFIRE SMOKE AND OTHER UNHEALTHY AIR QUALITY EVENTS

SCHOOL DISTRICTS

HOW TO USE THIS CHART

STEP 1 Find the current local air quality conditions (AQI) at fire.airnow.gov. To find forecasted air quality conditions go to AirQuality.org.

STEP 2 Once you know the AQI nearest your school or outdoor event, use the table below to help you plan and make decisions during a wildfire smoke event or anytime the AQI increases.

ACTIVITY	LEVEL 1 GOOD	LEVEL 2 MODERATE	LEVEL 3 UNHEALTHY FOR SENSITIVE GROUPS	LEVEL 4 UNHEALTHY	LEVEL 5 VERY UNHEALTHY SCHOOL CLOSURE MAY BE CONSIDERED[2]	LEVEL 6 HAZARDOUS SCHOOL CLOSURE MAY BE CONSIDERED[2]
AQI	0-50	51-100	101-150	151-200	201-300	≥301
RECESS (15 MIN)	No Restrictons	Ensure sensitive individuals[1] are medically managing their condition	Sensitive individuals[1] should exercise indoors or avoid vigorous outdoor activities Allow individuals who complain of difficulty breathing to play indoors	Exercise indoors or avoid vigorous outdoor activities Sensitive individuals[1] or any individual who complains of difficulty breathing should remain indoors	No outdoor activity All activity should be moved indoors or discontinued	No outdoor activity All activity should be moved indoors or discontinued
PHYSICAL EDUCATION CLASS (60 MIN)	No Restrictons	Ensure sensitive individuals[1] are medically managing their condition	Sensitive individuals[1] should exercise indoors or avoid vigorous outdoor activities Make indoor space available for sensitive individuals[1] Increase rest periods and substitutions to lower breathing rates	Exercise indoors or limit vigorous outdoor activity to maximum 15 minutes Sensitive individuals[1] or any individual who complains of difficulty breathing should remain indoors	No outdoor activity All activity should be moved indoors or discontinued	No outdoor activity All activity should be moved indoors or discontinued
ATHLETIC PRACTICE/ SCHEDULED SPORTING EVENT	No Restrictons	Ensure sensitive individuals[1] are medically managing their condition	Ensure sensitive individuals[1] are medically managing their condition Reduce vigorous exercise to 30 minutes per hour Increase rest periods and substitutions to lower breathing rates	Reduce vigorous exercise to 30 minutes per hour Increase rest periods and substitutions to lower breathing rates Sensitive individuals[1] should remain indoors	Practice or event should be rescheduled, moved indoors or discontinued	Practice or event should be rescheduled, moved indoors or discontinued
SCHEDULED OUTDOOR EVENT	No Restrictons	Ensure sensitive individuals[1] are medically managing their condition	Ensure sensitive individuals[1] are medically managing their condition	Decrease duration of events exceeding two hours Consider rescheduling or relocating event	Event should be rescheduled, moved indoors or discontinued	Event should be rescheduled, moved indoors or discontinued

[1] Sensitive Individuals include anyone with asthma or other heart/lung conditions. Those with asthma should follow their asthma action plans and keep their quick-relief medicine handy.

[2] To meet waiver approval conditions due to emergency conditions (Form J-13A) from the State Superintendent of Public Instruction, poor air quality must be shown to be caused by an emergency event such as a wildfire.

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT · SACRAMENTO COUNTY PUBLIC HEALTH Promote • Prevent • Protect · BREATHE CALIFORNIA Sacramento Region

Figure 6. Example of an Air Quality Action Chart (see Appendix A for full-size charts available for all sectors)

Reduce Smoke Exposure and Stay Indoors

The best strategy during a wildfire smoke event is to reduce exposure to smoke. Here are recommended strategies to take: (1) stay indoors in a space that has cleaner air, (2) as needed, move to an area less impacted by smoke and (3) limit outdoor activities and exercise.

Leaving a smoke-impacted area, even for a respite period, may be especially beneficial for those that could suffer severe health outcomes from breathing smoke-filled air for extended periods. However, this option will not be possible for many individuals. Therefore, it is best to focus on reducing smoke exposure by staying indoors and working to improve indoor air quality by taking these recommended actions:

- Turn the HVAC system to recirculate mode so air is not brought inside.
- Weatherize leaky windows and doors using caulking or other sealing mechanism.
- Make a dedicated clean air room.
- Use certified portable air cleaners or make a DIY air filter.[21]
- Reduce activities inside that create additional indoor pollution – frying foods, vacuuming, using aerosol cleaners, burning candles, burning wood in a fireplace.

It is recommended for all individuals to try to limit their outdoor activity levels during a wildfire smoke event. For those with certain health conditions, limiting outdoor activities and exercise levels should be done when the AQI reaches 100 and above, or even lower than that level for particularly sensitive individuals. Everyone should limit outdoor activities and exercise levels when the AQI reaches unhealthy levels at 150 and above. These AQI levels are general guidance, but individuals may experience health issues at lower AQI levels. Therefore, everyone is advised to monitor their overall sense of wellbeing and signs of breathing or heart issues and adjust their actions accordingly to reduce health impacts. If someone must go outside during a wildfire smoke event, it is recommended that a well-fitted N95 mask be used. See below section Using a Mask During a Wildfire Smoke Event for more information.

Reduce Activities that Increase Air Pollution

Everyone can play a role in reducing other sources of air pollution during a smoke event. Here's a list of best practices when wildfire smoke is negatively impacting air quality:

- Do not use lawn equipment like leaf blowers and lawn mowers that add more dust and exhaust into already smoke-filled air.
- Reduce driving when possible. Not only do you expose yourself to outdoor smoke levels but driving contributes to poor air quality. If you must drive, set your car ventilation system to recirculate mode to lower smoke coming into the cabin of your vehicle.
- Avoid dust-making activities like construction or demolition activities.
- Avoid any outdoor burning, including for cooking or recreational purposes. Don't use barbeques, outdoor chimineas or other burning devices.

Monitor Health Conditions and Follow Medical Plans

As discussed earlier, particle pollution, including wildfire smoke, can cause acute and chronic health conditions. It is advised that individuals monitor their wellbeing and overall health during a wildfire smoke event. It's extremely important for individuals with pre-existing health conditions, like asthma, lung and heart conditions, to actively monitor their health during a smoke event and be ready to enact their medical plan when needed. Individuals experiencing labored breathing, shortness of breath or pain in the chest that may indicate a severe medical condition, should immediately consult with medical professionals and seek medical attention as needed.

[21] California Air Resources Board. (n.d.). *List of CARB-certified air cleaning devices*. Retrieved January 31, 2022, from https://ww2.arb.ca.gov/list-carb-certified-air-cleaning-devices

Activate Communication & Action Plans

Schools, public agencies and businesses that have Communication & Action Plans should review and activate these plans when wildfire smoke is predicted to occur. The following five-step response guide was developed as a quick reference for schools, public agencies and businesses on how to respond during a smoke event. Paired with the respective Air Quality Action Chart for a particular sector, having a Communication & Action Plan can alleviate the stress of not knowing what to do during a wildfire smoke event.

Figure 7. A quick reference guide of steps to take during a wildfire event.

Using a Mask During a Wildfire Smoke Event

To protect against wildfire smoke, the best step is to stay inside. For those who must be outside when the air quality is unhealthy, a respirator, like an N95 mask or others with similar protection levels (KN95 or KF94), can be used to reduce smoke exposure. There are important considerations when using a N95 mask and they should be used only as a last option.

- N95, KN95 and KF94 masks may make breathing difficult. People with lung conditions should contact a healthcare provider before using these masks.
- Children under 2 years old should not wear masks.
- During smoke events, N95, KN95 and KF94 masks will likely be in short supply. Add these masks to your home and vehicle emergency kits now, so if you have no other options, they will be available during extreme wildfire smoke events.
- Masks should be changed if they get moist or dirty.
- When N95, KN95 and KF94 respirators are in short supply due to certain health emergencies like the COVID-19 pandemic, the CDC recommends they be reserved for health care workers.
- Cloth masks that are used to slow the spread of COVID-19 ***do not*** protect you against wildfire smoke because they might not catch small, harmful particles in smoke that can harm your health.
- Dust or surgical masks, towels and bandanas are not effective against smoke.
- California Occupational Safety and Health Administration (Cal/OSHA) requires employers to provide N95 masks to employees working outdoors when the AQI exceeds 150. Employees are required to wear N95 masks when the AQI exceeds 500. [22]

[22] California Department of Industrial Relations. (n.d.). *Wildfire Protection from Wildfire Smoke*. Retrieved February 1, 2022, from https://www.dir.ca.gov/dosh/doshreg/Protection-from-Wildfire-Smoke/Wildfire-smoke-emergency-standard.html

Element 2: Responsible Agencies & Respective Action

During a wildfire smoke event, it is important for everyone to know how to respond and quickly take action to reduce their exposure to smoke. This section serves as a guide to identify local agencies involved during wildfire response and outlines the responsibilities of each agency. It also identifies who provides important information during wildfire smoke events. In general, air quality and public health data is used to inform next steps and actions are taken by Offices of Emergency Services, Sacramento County and cities agencies, school districts, businesses, and residents.

	Entity	Duties
Air Quality Information	Sac Metro Air District	• Monitor Air Quality & Provide Forecasting & Current Air Quality Info • Provide Wildfire Smoke Information, Tools & Resources Online • Coordinate Public Health Messaging [23] • Advise Public Agencies During Wildfire Smoke Events
Public Health Information	Public Health	• Coordinate Wildfire Smoke Plan Implementation with Sacramento County OES • Provide Wildfire Smoke & Public Health Info Online • Coordinate Public Health Messaging [24]
Public Safety Measures	Sacramento County Office of Emergency Services (SacOES)	• Develop Communication & Action Plans • Activate Wildfire Smoke Plan • Resource Request Coordination • Coordinate Messaging
	City Governments	• Develop Communication & Action Plans • Provide Resources (if available) • Determine need to open Cleaner Air Centers • Communicate Information to the public
Decision-making	School Districts	• Monitor Air Quality & Public Health Messages • Assess Information & Action Plans • Make Decisions & Implement Action Plans • Communicate Information to Parents, Students, etc.
	Businesses	• Monitor Air Quality & Public Health Messages • Assess Information & Action Plans • Make Decisions & Implement Action Plans • Communicate Information to Employees, etc.

Figure 8. Chart shows the high-level responsibilities of different public agencies, school districts and private businesses during a wildfire smoke event. The Sac Metro Air District and Public Health provide information and public messaging that informs the coordination, planning and actions then taken by Sacramento County Office of Emergency Services and local city governments. School Districts and private entities use the information and the advised actions to make their respective decisions.

[23] Sac Metro Air District and Sacramento County Public Health. (2021, August 5). *Wildfire smoke expected to impact Sacramento County starting Friday residents urged to avoid exposure to fine particle air pollution* [Press release]. http://www.airquality.org/Communications/Documents/FINAL%20Smoke%20Statement%208-5-2021.pdf

[24] Ibid.

Sac Metro Air District

The Sac Metro Air District monitors air quality throughout Sacramento County and provides forecasted and real-time air quality information to help school districts, public agencies, businesses, and residents make health-protective choices. The air quality information is provided online at AirQuality.org, on SpareTheAir.com and can also be found using the Sacramento Region Air Quality mobile application. The Sac Metro Air District also maintains a dedicated Wildfire Smoke information webpage – Wildfire Smoke Information – for quick access to resources and information that can be helpful during a wildfire smoke event.

During wildfire smoke events, there are specific actions the Sac Metro Air District takes:

- Closely monitors air quality and reports actual or forecasted air quality information following the criteria established in the *Activation of Wildfire Smoke Plan and Release of Public Messaging Due to Wildfire Smoke Event.*
- Participates in daily conference calls to provide air quality information to participating Sacramento County agencies.
- Develops public health statements in coordination with the Sacramento County Public Health Department.
- Disseminates air quality information to the public using various platforms.
- Provides support to local public agencies and school districts by providing air quality information and guidance on an as needed basis. District staff are available to attend ad hoc meetings and respond to inquiries and requests for assistance.

The Sac Metro Air District will also provide training to school districts, other public entities, and businesses prior to expected wildfire seasons as requested. The training and overview of air quality and wildfire smoke information can help agencies and school districts prepare for upcoming wildfire smoke events, requirements, and best practices.

Sacramento County Public Health

The Sacramento County Department of Public Health (Public Health) promotes and protects the health and public safety for residents and communities of Sacramento County. During wildfire smoke events, there are specific actions that Public Health takes:

- Follows criteria established in the *Activation of Wildfire Smoke Plan and Release of Public Messaging Due to Wildfire Smoke Event.*
- Participates in daily conference calls to provide public health guidance based on air quality information to participating Sacramento County agencies.
- Develops public health statements in coordination with the Sac Metro Air District.
- Disseminates public health information to the public using various platforms.
- Provides support to local public agencies and school districts by providing public health information and guidance on an as-needed basis. Public Health staff are available to attend ad hoc meetings and respond to inquiries and requests for assistance.
- May provide health orders, closures or proclaim a public health emergency, as needed.

Sacramento County Office of Emergency Services

The Sacramento County Office of Emergency Services (SacOES) coordinates the overall Sacramento Countywide response to large scale incidents and disasters. SacOES is responsible for alerting and

notifying appropriate agencies when disaster strikes; coordinating all agencies that respond; ensuring resources are available and mobilized in times of disaster; developing plans and procedures in response to and recovery from disasters; and developing and providing preparedness materials for the public. During wildfire smoke events, there are specific actions the SacOES takes:

- In coordination with the Sac Metro Air District and Public Health, activates the *Wildfire Smoke Plan* when alerted that certain air quality or action thresholds are met.
- Coordinates a call for public agencies and affiliated volunteer entities involved in a smoke event.
- Contributes to the development of coordinated messages distributed by Public Health.
- Coordinates opening of cleaner air centers upon a recommendation by the Public Health Officer.
- Coordinates logistical requests among activated stakeholders through the Emergency Operations Center or Duty Officer.
- If necessary, proclaims a local emergency.

Cities Within Sacramento County

The effects of wildfire smoke can vary greatly between different geographic regions within Sacramento County. Cities within county boundaries will have varying levels of response to wildfire smoke during an event based on their jurisdiction's specific impacts. In general, local city governments are responsible for communicating important messages to city residents and coordinating actions based on need and budgetary constraints. Some of those actions could be the opening of cleaner air centers, providing expanded staffing for centers or coordinating with volunteer organizations with center openings. See Appendix C – Individual City Responsibilities & Actions for specific actions and roles for cities within Sacramento County.

School Districts

During wildfire smoke events, school districts within Sacramento County are responsible for making decisions about school activities including outdoor activities and events, school closures and meal distribution programs. Schools are also responsible for communicating information to parents and students related to wildfire smoke events, school closures or other changes to school activities. As employers, schools are responsible for determining policies and working practices for outdoor and indoor employees.

School districts also make decisions related to the indoor air quality of school buildings. Wildfire smoke events can impact indoor air quality. School districts should assess heating and cooling systems, filtration levels and the use of portable air cleaners to determine if air environments can be improved. Creating cleaner indoor air spaces to prevent smoke exposure during a wildfire smoke event can be costly, especially when considering upgrades to HVAC systems. Advances in HVAC systems and HEPA air filtration as a response to COVID-19 should be evaluated for their ability to improve indoor air quality during smoke events.

Contact Information for Relevant Agencies

Here is a summary table of phone numbers, websites, and other useful links for reference during wildfire smoke events:

Entity	Main Phone Line	Website
Sac Metro Air District	(279) 207-1122	https://AirQuality.org
Sac County Public Health	(916) 875-5881	https://dhs.saccounty.gov
Sacramento County Office of Emergency Services	(916) 874-4670	https://sacramentoready.saccounty.gov/Pages/default.aspx
Sacramento County Office of Education	(916) 228-2500	https://www.scoe.net
City of Sacramento Office of Emergency Management	(916) 808-5011 (916) 264-5011 (for out of city callers/inquiries)	https://www.cityofsacramento.org/emergency-management
City of Citrus Heights	(916) 725-2448	https://www.citrusheights.net
City of Elk Grove	(916) 691-2489	https://www.elkgrovecity.org
City of Folsom	(916) 461-6000	https://www.folsom.ca.us
City of Galt	(209) 366-7130	https://www.ci.galt.ca.us
City of Isleton	(916) 777-7770	https://cityofisleton.com
City of Rancho Cordova	(916) 851-8700	https://www.cityofranchocordova.org

Element 3: Recommendations & Best Practices for Businesses & Public Agencies

This section provides recommendations and best practices for private businesses and public agencies to reduce or modify certain activities that contribute to the worsening of air pollution during a wildfire smoke event. It also provides considerations and best practices that can be implemented to protect outdoor and indoor employees during smoke events.

Reduce Landscaping Activities

Reduce Dust Making Activities

Comply With Local and State Regulations

Develop Strategies to Reduce Employee Exposure

Keep Supplies on Hand (air filters, N95 masks)

Make a Communication & Action Plan

Figure 9. Best practices and recommendations public and private entities that can help reduce pollution during wildfire smoke events and help protect their outdoor and indoor employees.

Reduce Landscaping & Dust Making Activities

Both public agencies and private businesses can impact air quality. During wildfire smoke events when air quality reaches unhealthy and above air quality levels, these entities can play a role in trying to reduce any additional air pollution going into the air.

Public agencies are typically responsible for maintaining public outdoor spaces, often requiring the use of gasoline-powered lawn equipment that can emit exhaust emissions when operated and can

also add significant levels of dust into the air when used. Public agencies are involved in public works projects that may generate dust and additional particulate matter. Private construction and landscaping companies may also generate air pollution in the normal course of business. During past smoke events, many residents complained about the use of leaf blowers and construction activities that create additional dust and impact already poor air quality conditions. Public agencies and private businesses whose activities create excess pollution can consider these actions on days when wildfire smoke is impacting air quality:

- Reduce landscaping activities and the use of leaf blowers when the AQI is greater than 100.
- Postpone landscaping activities and the use of leaf blowers when the AQI is greater than 150.
- Reduce or postpone other activities that will increase dust pollution, e.g., construction or dirt-moving activities. If those activities must proceed, make sure to use all efforts to control dust.

Comply With Local and State Regulations

Everyone should be aware of local regulations and comply with these requirements at all times. Here is a summary of local regulations related to public nuisance, excess dust, and use of leaf blowers:

- City of Sacramento restriction on portable blower use on days with poor air quality [25]
- Sacramento Metropolitan Air Quality Management District Rule 403 Fugitive Dust
- Sacramento Metropolitan Air Quality Management District Rule 402 Nuisance

Employers are responsible for following Cal/OSHA Protection from Wildfire Smoke Regulation. [26] This regulation has specific requirements for certain employers to: (1) identify the potential for exposure to particulate matter during wildfire smoke events by checking air quality forecasts or measuring onsite, (2) communicate air quality information and protective measures to employees, (3) provide training to employees on the regulation and exposure reduction options, and (4) reduce exposure using engineering and administrative controls and by providing personal protective equipment (i.e., N95 respirators).

Develop Strategies to Reduce Employee Exposure

Considerations for Outdoor Employees

Public agencies and businesses with employees that perform work outdoors should consider how they will reduce employee smoke exposure during wildfire smoke events. Agricultural workers are considered essential workers [27] and can be particularly vulnerable during wildfire smoke events when no alternative workplaces or indoor work options are available. These are some of the recommended practices for employers to implement for outdoor employees during smoke events:

[25] Portable Blowers, Sacramento City Code, Chapter 8.70, 2020-0042 § 1 (2020). http://www.qcode.us/codes/sacramento/view.php?topic=8-8_70&frames=on

[26] California Department of Industrial Relations. (n.d.). *Worker Protection from Wildfire Smoke*. Retrieved May 2, 2022, from https://www.dir.ca.gov/dosh/doshreg/Protection-from-Wildfire-Smoke/Wildfire-smoke-emergency-standard.html

[27] AB-73 Health emergencies: employment safety: agricultural workers: wildfire smoke, Cal. Assemb. B. 73 (2021-2022), Chapter 332 (Cal. Stat. 2021)

- Make sure supervisors and employees know how to access the AQI.
- Determine whether onsite AQI measurements will be needed and, if so, establish onsite measurement protocols
    - Reduce outdoor work time to the greatest extent possible (AQI > 150).
    - Where possible, cancel outdoor work when hazardous air quality (AQI > 300) is forecasted to persist for more than one (1) hour in a day.
- Establish clear guidance and authority for onsite supervisors to reduce smoke exposure for outdoor employees including halting work.
- Provide alternate indoor work locations or, when possible, move employees to other outdoor locations where smoke exposure will be reduced.
- Reduce work intensity and provide additional respite breaks in a building or vehicle with filtered air for employees that must continue to work outdoors.
- Assure access to N95 respirators and encourage employees to use them when needed.
- Establish lower thresholds (when AQI exceeds 150) for when N95 respirators are required to be used during outdoor work.
- Establish a training program for N95 respirator use to ensure proper fit.
- Establish clear guidance for employees to report worsening air quality conditions and any health impacts they are experiencing from smoke.
- Establish a clear training and communication program to inform employees of smoke exposure reduction protocols.

Considerations for Indoor Employees

While outdoor employees will be those most exposed to wildfire smoke, indoor conditions can also reach levels that are unhealthy. Employers should consider these recommendations to reduce smoke exposure for indoor employees:

- Test the effectiveness of the building HVAC system.
- Make sure the HVAC system does not draw in outdoor air.
- Install high-efficiency air filters (MERV rating 13 or higher).
- Keep doors and windows closed as much as possible.
- Use certified portable air cleaners (or industrial HEPA air purifiers for larger spaces) to clean indoor air.
- Use other options to keep employees home when possible – telework, reduced work schedules.
- Make sure to have a communication and action plan developed prior to a smoke event.

Keep Supplies on Hand

Air filter supplies and N95 respirators can be limited or out of stock during a wildfire smoke event. Keep extra HVAC and portable air cleaner filters on hand to be able to change them out when they become dirty. Additionally, maintain an adequate stock of N95 respirators for outdoor employees. If maintaining a stock of respirators is not feasible, be sure to make consideration for potential shortages of respirators as a part of your emergency plan.

Make a Communication & Action Plan

One of the best steps for public agencies and private businesses to take is to create a Communication & Action Plan for dealing with wildfire smoke. This plan will create the foundation for responding promptly when smoke impacts Sacramento County.

Element 4: Strategies for Vulnerable Populations

Vulnerable populations, including school-age children, the elderly, people experiencing homelessness, and people with certain health issues, are more impacted by exposure to wildfire smoke. There are steps individuals can take when they or their family members are part of a vulnerable population. Many of these strategies were discussed in Element 1 above. information specific to children's health and ways to reduce their exposure to wildfire smoke can be reviewed in the Children's Health and Wildfire Smoke Exposure Workshop Recommendations (see Appendix D – General Resource Links).[28]

Best Practices to Assist Vulnerable Populations

This section focuses on strategies and best practices that can be implemented by public agencies during a wildfire smoke event to assist vulnerable populations, as much as possible, and lessen the health impacts on these groups.

Figure 10. Considerations for public agencies when they are preparing and responding during a wildfire smoke event.

Make a Communication & Action Plan

As previously mentioned, developing a Communication & Action Plan is a key step to be ready to respond during an emergency, including wildfire smoke events. Consider including these elements in any plan to address the needs of vulnerable populations prior to a wildfire smoke event:

[28] Children's Health and Wildfire Smoke Exposure Workshop (2022, January 24). Workshop Recommendations. https://www.airnow.gov/sites/default/files/2022-01/childrens-health-wildfire-smoke-workshop-recommendations.pdf

- Participate in county briefings that occur during smoke events to share information and know what other resources are available.
- Communicate air quality and cleaner air center information using multiple channels:
    - Website
    - Mobile applications
    - Social media (Twitter, Facebook, etc.)
    - News or press releases
    - Emergency notifications systems (Nixle, Everbridge, etc.)
    - Push messages to partner groups
- Consider challenges when communicating with different populations (unsheltered, seniors, children, those with health conditions) and have strategies to address the challenges in the communication plan, e.g., lack of internet, low use of online technology, no access to immediate alert systems.
- Consider how to communicate with unsheltered populations:
    - Encampment walkthroughs (police staff, volunteer organizations, homeless navigators, social services)
    - Engagement with non-profit (NPO), community-based (CBO), faith-based (FBO) organizations that work with unsheltered persons
- Consider how to communicate with senior populations:
    - Engagement with senior centers and care facilities
    - Engagement with NPOs, CBOs, FBOs that work with senior persons
- Consider how to communicate information related to children:
    - Develop communication strategies with school administrators to keep schools informed.
    - Connect with after-school programs
    - Use training videos, in-school announcements, and send information to parents
- Consider how to communicate with individuals with health conditions:
    - Develop communication strategies with hospitals and other care facilities

Coordinate with County & Volunteer Organizations

One of the most important steps for cities to take is to connect with SacOES and develop relationships with volunteer, non-profit and faith-based organizations. Often these organizations are most connected with vulnerable population groups and can provide facilities to use for cleaner air centers, help recruit volunteers that can support centers and help communicate with and reach out to various groups. Where feasible, cities may consider developing Memorandums of Understanding (MOU) or contracts with volunteer organizations for certain services. Here is a listing of potential volunteer organizations that can assist during a wildfire smoke event:

- Hands On Sacramento
- VOAD (Voluntary Organizations Active in Disaster)
- HART (Homeless Assistance Resource Team)
- CERT (Citizen Emergency Response Team)
- Sacramento Steps Forward
- Red Cross
- Medical Reserve Corp (volunteers during disaster events)
- Local faith-based organizations
- Sacramento Food Bank

Facilitate Cleaner Air Centers

Cleaner air centers are alternative locations for vulnerable populations that do not have access to clean air in their homes or outdoor locations. Some cities may have pre-designated facilities that can be activated when there is a wildfire smoke event. However, most cities do not have dedicated spaces for cleaner air centers. In these instances, cities will use other types of facilities like libraries or other public spaces. More commonly, cleaner air center locations will be made available by volunteer and faith-based organizations. Here are some considerations for opening a cleaner air center during a wildfire smoke event:

- Pre-verify location(s) prior to smoke events
- Evaluate HVAC system, fresh-air intake (close intake during smoke events)
- Install high-efficiency filters (MERV-13 or higher)
- Weatherize building(s)
- Acquire certified portable air-cleaning unit(s) to improve indoor air quality, making sure it is the right size for the room or building space
- Monitor indoor air quality and institute guidelines that can preserve the cleanest air possible.
- Keep doors and windows closed as much as possible
- Evaluate agency staffing capacity during events
- Be ready to train volunteers on site protocols and job duties
- Coordinate with NPOs, CBOs, FBOs that can assist with location, staffing and supplies
- Have supplies on hand and know who can help support the center (water, snacks, N95 masks)
- Prepare to have health care equipment as needed: wheelchairs, first aid kits, social services
- Respite centers, where people can come indoors for intermittent periods of time, may work best for unsheltered populations that only want to use facilities sporadically
- Utilize existing sites used for other community programs: community centers, libraries and already established programs for elderly, childcare or youth programs

Facilitate Transportation Opportunities

Transportation to and from a cleaner air center can be one of the biggest challenges for vulnerable populations. It is therefore recommended that agencies review transportation options prior to a wildfire smoke event and determine how vulnerable populations may be best able to reach cleaner air centers.

- Develop transportation plan prior to event
- Work with transportation providers to develop transportation/ride-share options:
    - Sacramento Regional Transit District (SacRT)
    - Paratransit
    - In-home medical care transport
    - In-home nursing care
- Establish free public transit structures during a smoke event that do not require a physical pass to access public transit. This will help reduce barriers for unsheltered persons trying to utilize transit, but unable to find a free pass.
- Work with volunteer organizations who can provide support during events and may have transportation options (churches, etc.)

Challenges and Needs Assessment

Sacramento city and county government agencies all face challenges in being able to adequately address risks to vulnerable populations during a wildfire smoke event. Below are some of the biggest challenges and a general needs assessment to help address them.

Costs and Resource Limitations

Being able to provide services during a wildfire smoke event can be very costly, especially if part of the response deals with opening cleaner air centers and providing staffing, trained medical and mental health specialists, supplies and transportation for the use of these facilities. There are also other upfront costs associated with responding to wildfire smoke events that can be prohibitive: (1) devoting resources to develop communication and action plans, (2) selecting appropriate cleaner air centers can be time-intensive, (3) improving indoor air quality through HVAC upgrades, filter replacement and adding portable air cleaners, and (4) ensuring funds and time for training staff. Often budgetary constraints will preclude cities from taking many of the recommended steps. Cities may also be reticent to open cleaner air centers because there is often low turnout and the costs do not outweigh the benefit for a small number of persons.

Cleaner Air Centers

As highlighted by local city and county officials, there are multiple challenges to siting and opening a cleaner air center. Here are some of the main difficulties for cities when considering opening a cleaner air center.

- For some cities, selecting a location can be controversial and nearby residents may be hesitant to have a cleaner air center in their neighborhood.
- Staffing cleaner air centers can represent a significant cost, especially for centers that offer overnight hours. Depending on the populations that use these facilities, there may also be a need to staff social and mental health specialists. Having equipment to assist those with disabilities can represent another cost layer to opening cleaner air centers.
- Making sure a cleaner air center actually has cleaner indoor air often means adding portable air cleaners, upgrading HVAC filters or upgrading entire HVAC units. These are costly steps for cities and counties.
- Because of the costs associated with opening a cleaner air center and improving indoor air quality, cities want to have a clear AQI threshold for when centers should be opened.
- Variability of smoke impacts and the timing of forecast information makes it difficult to open and close centers quickly to respond to the quick onset of unhealthy conditions. Cities must assess if the event will be ongoing before they mobilize, because it often takes at least 24 hours to open a clean air center once it is approved.
- Once opened, the use of cleaner air centers by vulnerable populations is typically low and usually only used if the conditions are very unhealthy. This adds to the hesitation on the part of cities to open and staff cleaner air centers.
- Some unsheltered persons will not go to centers for various reasons. Unsheltered persons may be resistant to leaving their outdoor space or their personal effects for fear they will not be there when they return. Unsheltered persons often have pets that may not be allowed in a cleaner air center, causing them to remain outdoors. They may also be hesitant to use

government-operated facilities, or they may not have or know about adequate transportation options available to them.
- Elderly persons may be hesitant to leave their home, pets and the place that they are most comfortable even if the indoor air quality is at unhealthy levels.
- Communication can often be challenging for vulnerable populations that have less online access to information. Human touch/door-to-door efforts are more effective for these populations, but they are time and resource-intensive. With such an expensive effort, cities need state and county support to be able to reach and help these vulnerable populations.

Transportation Challenges

Transportation for vulnerable populations remains a difficult issue for getting people to cleaner air environments. Unsheltered and elderly persons are more likely to need assistance to relocate to a cleaner air center. Local jurisdictions often do not have dedicated fleets that can be used to facilitate transportation and therefore need to assess what resources are available to assist certain vulnerable populations during wildfire smoke events.

Providing free rides on public transit during events is one option that has been historically applied, but it can still be a challenge to get information out to people who need transportation assistance. Free pass systems also have limitations and an added layer of complexity to properly distribute passes to vulnerable populations.

Recommended Solutions

- Financial assistance is one of the biggest needs for local jurisdictions. Federal and state financial assistance would help provide an adequate response to reduce exposure to smoke. The state should look into expanded grant programs and funding for: (1) facility upgrades for cleaner air centers and schools, (2) portable air cleaners for onsite air quality control, (3) resources to cover staffing costs and (4) supplies (N95 masks, water, food).
- Local jurisdictions should actively establish partnerships with volunteer organizations that are willing to assist by providing facilities, staff and supplies during an event. This can decrease the overall cost of response and can be an effective means of communicating with and persuading vulnerable persons to use cleaner air facilities or accept assistance.
- More effective transportation options may involve partnerships with volunteer and non-profit organizations that can provide vanpool or ride-share possibilities.
- State agencies like the California Department of Public Health, CARB or other local agencies should develop templates to assist jurisdictions in creating communication plans and outreach toolkits to reduce upfront costs and response efforts.
- Development of clear threshold recommendations for cities to determine when outdoor events should be cancelled, clean air centers should be opened, and when employee policies to reduce smoke exposure should be enacted.
- Creation of a state or regional online resource hub for jurisdictions within that area to use during a wildfire smoke event would facilitate quick access to information, supply availability, and communication tools. The centralized hub could contain air quality and public health information, portable air cleaner information, smoke event informational videos, training and outreach materials and volunteer group contact information.

Appendix A – Air Quality Action Charts

The following four pages contain the Air Quality Action Charts for:

School Districts

Public Agencies

Businesses

General Public

RECOMMENDED ACTIONS DURING WILDFIRE SMOKE AND OTHER UNHEALTHY AIR QUALITY EVENTS

SCHOOL DISTRICTS

HOW TO USE THIS CHART

STEP 1

Find the current local air quality conditions (AQI) at fire.airnow.gov. To find forecasted air quality conditions go to AirQuality.org.

STEP 2

Once you know the AQI nearest your school or outdoor event, use the table below to help you plan and make decisions during a wildfire smoke event or anytime the AQI increases.

ACTIVITY	LEVEL 1 GOOD	LEVEL 2 MODERATE	LEVEL 3 UNHEALTHY FOR SENSITIVE GROUPS	LEVEL 4 UNHEALTHY	LEVEL 5 VERY UNHEALTHY SCHOOL CLOSURE MAY BE CONSIDERED[2]	LEVEL 6 HAZARDOUS SCHOOL CLOSURE MAY BE CONSIDERED[2]
AQI	0-50	51-100	101-150	151-200	201-300	≥301
RECESS (15 MIN)	No Restrictons	Ensure sensitive individuals[1] are medically managing their condition	Sensitive individuals[1] should exercise indoors or avoid vigorous outdoor activities Allow individuals who complain of difficulty breathing to play indoors	Exercise indoors or avoid vigorous outdoor activities Sensitive individuals[1] or any individual who complains of difficulty breathing should remain indoors	No outdoor activity All activity should be moved indoors or discontinued	No outdoor activity All activity should be moved indoors or discontinued
PHYSICAL EDUCATION CLASS (60 MIN)	No Restrictons	Ensure sensitive individuals[1] are medically managing their condition	Sensitive individuals[1] should exercise indoors or avoid vigorous outdoor activities Make indoor space available for sensitive individuals[1] Increase rest periods and substitutions to lower breathing rates	Exercise indoors or limit vigorous outdoor activity to maximum 15 minutes Sensitive individuals[1] or any individual who complains of difficulty breathing should remain indoors	No outdoor activity All activity should be moved indoors or discontinued	No outdoor activity All activity should be moved indoors or discontinued
ATHLETIC PRACTICE/ SCHEDULED SPORTING EVENT	No Restrictons	Ensure sensitive individuals[1] are medically managing their condition	Ensure sensitive individuals[1] are medically managing their condition Reduce vigorous exercise to 30 minutes per hour Increase rest periods and substitutions to lower breathing rates	Reduce vigorous exercise to 30 minutes per hour Increase rest periods and substitutions to lower breathing rates Sensitive individuals[1] should remain indoors	Practice or event should be rescheduled, moved indoors or discontinued	Practice or event should be rescheduled, moved indoors or discontinued
SCHEDULED OUTDOOR EVENT	No Restrictons	Ensure sensitive individuals[1] are medically managing their condition	Ensure sensitive individuals[1] are medically managing their condition	Decrease duration of events exceeding two hours Consider rescheduling or relocating event	Event should be rescheduled, moved indoors or discontinued	Event should be rescheduled, moved indoors or discontinued

[1] Sensitive Individuals include anyone with asthma or other heart/lung conditions. Those with asthma should follow their asthma action plans and keep their quick-relief medicine handy.

[2] To meet waiver approval conditions due to emergency conditions (**Form J-13A**) from the State Superintendent of Public Instruction, poor air quality must be shown to be caused by an emergency event such as a wildfire.

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RECOMMENDED ACTIONS AND REGULATORY REQUIREMENTS DURING WILDFIRE SMOKE AND UNHEALTHY AIR QUALITY EVENTS

PUBLIC AGENCIES

HOW TO USE THIS CHART

STEP 1

Find the current local air quality conditions (AQI) at fire.airnow.gov. To find forecasted air quality conditions go to AirQuality.org.

STEP 2

Once you know the AQI nearest your location, use the table below to help you plan and make decisions during a wildfire smoke event. Please note, **BOLDED TEXT** denotes regulatory requirements; all other items are recommended actions. Refer to regulations for complete information.

ACTIVITY	LEVEL 1 GOOD	LEVEL 2 MODERATE	LEVEL 3 UNHEALTHY FOR SENSITIVE GROUPS	LEVEL 4 UNHEALTHY	LEVEL 5 VERY UNHEALTHY	LEVEL 6 HAZARDOUS
AQI	0-50	51-100	101-150	151-200	201-300	≥301
LANDSCAPING ACTIVITIES	No additional recommended actions	No additional recommended actions	Limit leaf blower use (**check local ordinances for use restrictions**[1]) Limit landscaping activities	Prohibit leaf blower use (**check local ordinances for use restrictions**[1]) Discontinue all landscaping activities until AQI returns to Level 3 or less	Prohibit leaf blower use (**check local ordinances for use restrictions**[1]) Discontinue all landscaping activities until AQI returns to Level 3 or less	Prohibit leaf blower use (**check local ordinances for use restrictions**[1]) Discontinue all landscaping activities until AQI returns to Level 3 or less
ACTIVITIES THAT CREATE DUST EMISSIONS	**Prevent dust per Air District Rule 403**	**Prevent dust per Air District Rule 403**	**Prevent dust per Air District Rule 403**	**Prevent dust per Air District Rule 403**	Discontinue all activities until AQI returns to Level 4 or less; at minimum **prevent dust per Air District Rule 403**	Discontinue all activities until AQI returns to Level 4 or less; at minimum **prevent dust per Air District Rule 403**
OUTDOOR WORK ACTIVITIES / EMPLOYEE SAFETY	**Establish wildfire communication plan**[2] **Train employees on Cal/OSHA Wildfire Smoke Standards**[2]	**Monitor AQI forecast to help plan work activities**[2]	**Monitor AQI forecast to plan work activities and public events**[2] **Provide air quality info to employees**[2] Sensitive groups should consider wearing N95 masks	**Reduce employee exposure to smoke**[2] **If exposure can't be reduced, provide N95 masks for voluntary use**[2] Everyone should consider wearing N95 masks	**Reduce employee exposure to smoke**[2] **If exposure can't be reduced, provide N95 masks for voluntary use**[2] Everyone should consider wearing N95 masks	**Reduce employee exposure to smoke**[2] **If exposure can't be reduced, provide N95 masks for voluntary use**[2] **Require employees wear N95 masks at AQI >500**[2]
INDOOR WORK[3] ACTIVITIES / EMPLOYEE SAFETY	No additional recommended actions	No additional recommended actions	Monitor AQI forecast to help plan work activities and public events Provide air quality information to employees	Check nearby AQI levels at fire.airnow.gov to determine work activities and public events	Create a cleaner air workspace or consider telework for employees	Create a cleaner air workspace or consider telework for employees
PUBLIC SAFETY MESSAGING/ CLEANER AIR CENTERS	No additional recommended actions	Monitor air quality	Activate Wildfire Smoke Action and Public Messaging Plan (when wildfire smoke creates two consecutive days PM 2.5 >100 AQI)	Review logistics to prepare cleaner air centers for possible opening Consider issuing public health advisory/messages Consider canceling outdoor public events	Publicize availability of cleaner air centers (if open) Discuss school closure potential, public health alert and event cancellation	Publicize availability of cleaner air centers (if open), public health alerts and any event cancellations

[1] **City of Sacramento Code section 8.70**; review ordinance for full requirements.
[2] Cal/OSHA Regulation to protect employees from smoke during wildfire events (**5141.1 Protection from Wildfire Smoke**); review regulation for full requirements. During certain health crises, N95 masks may be in short supply and/or reserved for healthcare personnel; follow state and local guidance on allowed alternatives for respiratory protective equipment.
[3] Information on indoor air quality can be found here: **https://www.epa.gov/indoor-air-quality-iaq/wildfires-and-indoor-air-quality-iaq**

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BUSINESSES

HOW TO USE THIS CHART

STEP 1

Find the current local air quality conditions (AQI) at fire.airnow.gov. To find forecasted air quality conditions go to AirQuality.org.

STEP 2

Once you know the AQI nearest your business, use the table below to help you plan and make decisions during a wildfire smoke event. Please note, **BOLDED TEXT** denotes regulatory requirements; all other items are recommended actions. Refer to regulations for complete information.

ACTIVITY	LEVEL 1 GOOD	LEVEL 2 MODERATE	LEVEL 3 UNHEALTHY FOR SENSITIVE GROUPS	LEVEL 4 UNHEALTHY	LEVEL 5 VERY UNHEALTHY	LEVEL 6 HAZARDOUS
AQI	0-50	51-100	101-150	151-200	201-300	≥301
LANDSCAPING ACTIVITIES	No additional recommended actions	No additional recommended actions	Limit leaf blower use (**check local ordinances for use restrictions**[1]) Limit landscaping activities	Prohibit leaf blower use (**check local ordinances for use restrictions**[1]) Discontinue all landscaping activities until AQI returns to Level 3 or less	Prohibit leaf blower use (**check local ordinances for use restrictions**[1]) Discontinue all landscaping activities until AQI returns to Level 3 or less	Prohibit leaf blower use (**check local ordinances for use restrictions**[1]) Discontinue all landscaping activities until AQI returns to Level 3 or less
ACTIVITIES THAT CREATE DUST EMISSIONS	**Prevent dust per Air District Rule 403**	**Prevent dust per Air District Rule 403**	**Prevent dust per Air District Rule 403**	**Prevent dust per Air District Rule 403**	Discontinue all activities until AQI returns to Level 4 or less; at minimum **prevent dust per Air District Rule 403**	Discontinue all activities until AQI returns to Level 4 or less; at minimum **prevent dust per Air District Rule 403**
OUTDOOR WORK ACTIVITIES / EMPLOYEE SAFETY	**Establish wildfire communication plan**[2] **Train employees on Cal/OSHA Wildfire Smoke Standards**[2]	**Monitor AQI forecast to help plan work activities**[2]	**Monitor AQI forecast to help plan work activities**[2] **Provide air quality info to employees**[2] Sensitive groups should consider wearing N95 masks	**Reduce employee exposure to smoke**[2] **If exposure can't be reduced, provide N95 masks for voluntary use**[2] Everyone should consider wearing N95 masks	**Reduce employee exposure to smoke**[2] **If exposure can't be reduced, provide N95 masks for voluntary use**[2] Everyone should consider wearing N95 masks	**Reduce employee exposure to smoke**[2] **If exposure can't be reduced, provide N95 masks for voluntary use**[2] **Require employees wear N95 masks at AQI >500**[2]
INDOOR WORK[3] ACTIVITIES / EMPLOYEE SAFETY	No additional recommended actions	No additional recommended actions	Monitor AQI forecast to help plan work activities Provide air quality information to employees	Check nearby AQI levels at fire.airnow.gov to determine work activities	Create a cleaner air workspace or consider telework for employees	Create a cleaner air workspace or consider telework for employees

[1] **City of Sacramento Code section 8.70**; review ordinance for full requirements.

[2] Cal/OSHA Regulation to protect employees from smoke during wildfire events (**5141.1 Protection from Wildfire Smoke**); review regulation for full requirements. During certain health crises, N95 masks may be in short supply and/or reserved for healthcare personnel; follow state and local guidance on allowed alternatives for respiratory protective equipment.

[3] Information on indoor air quality can be found here: **https://www.epa.gov/indoor-air-quality-iaq/wildfires-and-indoor-air-quality-iaq**

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RECOMMENDED ACTIONS DURING WILDFIRE SMOKE AND OTHER UNHEALTHY AIR QUALITY EVENTS

GENERAL PUBLIC

HOW TO USE THIS CHART

STEP 1

Find the current local air quality conditions (AQI) at fire.airnow.gov. To find forecasted air quality conditions go to AirQuality.org.

STEP 2

Once you know the AQI nearest your location, use the table below to help you plan and make decisions during a wildfire smoke event or anytime the AQI increases.

ACTIVITY	LEVEL 1 GOOD	LEVEL 2 MODERATE	LEVEL 3 UNHEALTHY FOR SENSITIVE GROUPS	LEVEL 4 UNHEALTHY	LEVEL 5 VERY UNHEALTHY	LEVEL 6 HAZARDOUS
AQI	0-50	51-100	101-150	151-200	201-300	≥301
GENERAL OUTDOOR ACTIVITY	No suggested action	Sensitive individuals[1] should be prepared to medically manage their condition Know where to go to get air quality information so you can plan your activities if conditions worsen	Sensitive individuals[1] should stay indoors or avoid vigorous outdoor activities	Avoid vigorous outdoor activities Sensitive individuals[1] or ***any*** individual having difficulty breathing should remain indoors	No outdoor activity All activity should be moved indoors or discontinued	No outdoor activity All activity should be moved indoors or discontinued
EXERCISE	No suggested action	Sensitive individuals[1] should be prepared to medically manage their condition Know where to go to get air quality information so you can plan your activities if conditions worsen	Sensitive individuals[1] should exercise indoors or avoid vigorous exercise activities Increase rest periods and lower breathing rates Reduce vigorous exercise to 30 minutes per hour or less	Exercise indoors or limit vigorous exercise activity to maximum 15 minutes Sensitive individuals[1] or ***any*** individual having difficulty breathing should remain indoors	No outdoor exercise All activity should be moved indoors or discontinued	No outdoor exercise All activity should be moved indoors or discontinued
INDOOR AIR QUALITY	No suggested action	Sensitive individuals[1] should be prepared to medically manage their condition Understand and maintain HVAC system to reduce smoke indoors Install and keep high-efficiency filters on hand Consider purchasing a certified portable air cleaner[2] to help improve indoor air quality when needed	Sensitive individuals[1] consider using a portable air cleaner to reduce indoor air pollution Don't use products that increase indoor air pollution (candles, cleaners, air fresheners) Reduce activities that create more dust (frying foods, vacuuming) Follow previous guidance under Level 2	Run HVAC system on recirculate mode to reduce smoke indoors Keep doors and windows closed Change dirty filters as needed Create a clean air space at home (use a certified portable air cleaner[2] or DIY air cleaner) Follow previous guidance under Levels 2-3	Follow previous guidance under Levels 2-4	Follow previous guidance under Levels 2-4
N95 MASK USE	No suggested action	Keep N95 masks on hand in case air quality worsens and you must go outside	Sensitive individuals[1] should consider using N95 masks only if you must go outside; other health conditions and breathing rates should be monitored	Use an N95 mask if you must go outside and monitor other health conditions and breathing rates	Use an N95 mask if you must go outside and monitor health conditions	Use an N95 mask if you must go outside and monitor health conditions

[1] Sensitive Individuals include anyone with asthma or other heart/lung conditions. Those with asthma should follow their asthma action plans and keep their quick-relief medicine handy.

[2] The California Air Resources Board certifies portable air cleaners. Before you purchase, check to make sure it is certified here: **https://ww2.arb.ca.gov/list-carb-certified-air-cleaning-devices**

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Appendix B – Communication Toolkit

The Sac Metro Air District has developed a comprehensive Communication and Outreach Toolkit that can be used by schools, public agencies, nonprofit organizations and businesses that would like to communicate to relevant groups about wildfire smoke events, both prior and during an event. The Toolkit is available by going to the Sac Metro Air District's website (www.AirQuality.org) and clicking on the ***Wildfire Smoke Information*** link on the homepage.

Appendix C – Individual City Responsibilities & Actions

City of Sacramento Office of Emergency Management

The Sacramento City Manager's Office of Emergency Management (SacOEM) conducts activities related to emergency preparation, mitigation, response and recovery for the City of Sacramento. SacOEM manages the Emergency Operations Center (EOC), which is activated during certain disasters to provide support to first responders and City of Sacramento residents. SacOEM also manages the activation of Crisis Action Teams (CAT) that help with citywide response activities. SacOEM is limited to their jurisdictional boundary for response and the actions below are in service to their jurisdictional residents.

During wildfire smoke events, there are specific actions the SacOEM takes:

- In coordination with the Sac Metro Air District and Public Health, activates plan when air quality or action thresholds are met
- Coordinates public agency and volunteer activities within the City of Sacramento boundaries
- Distributes messaging determined by Public Health and other city-specific messages
- Coordinates opening of clean air centers when thresholds are triggered
- Provides for their own logistical needs and properly routes requests for mutual aid through the Operational Area

Other Sacramento Cities

Contact other city jurisdictions directly to inquire about specific actions they may be taking related to wildfire smoke response.

Appendix D – General Resource Links

The resources listed here provide useful information and additional material related to air quality, wildfire and smoke and public health and emergency response. Please note, these links were collected for the development of this plan. They will not be updated or maintained after the Emergency Plan final adoption date. Some additional resources related to wildfire smoke events can be found at the Sac Metro Air District's website on the Wildfire Smoke Information page (see link below).

Air Quality Information

Entity	Website
EPA AirNow Fire and Smoke Map	https://fire.airnow.gov
San Metro Air District Website	https://www.AirQuality.org
Sacramento Region Spare The Air Website	http://www.sparetheair.com
Sacramento Region Air Quality mobile application	download on Apple or Android platforms
City of Rancho Cordova	https://www.cityofranchocordova.org/what-s-new/rancho-cordova-air-quality
City of Sacramento	https://sacramentocityexpress.com/2021/09/22/city-council-approves-air-quality-monitor-pilot-program-for-low-income-communities/#0

Wildfire & Smoke Information

Entity	Website
EPA Smoke-Ready Toolbox for Wildfires	https://www.epa.gov/smoke-ready-toolbox-wildfires
California Air Resources Board Protecting Yourself from Wildfire Smoke	https://ww2.arb.ca.gov/protecting-yourself-wildfire-smoke
Sac Metro Air District Wildfire Smoke Information	https://www.AirQuality.org/Air-Quality-Health/Climate-Change/Public-Outreach/Wildfire-Smoke-Information
Interagency Wildland Fire Air Quality Response Program	https://fires.airfire.org/outlooks
National Weather Service Experimental Smoke Forecasts	https://www.weather.gov/sto/ExperimentalSmokeForecast
National Weather Service California Fire Weather	https://www.wrh.noaa.gov/fire2/cafw/index.php
InciWeb - Incident Information System	https://inciweb.nwcg.gov

Entity	Website
CalFire Active Fires of Interest	https://www.fire.ca.gov/incidents
EPA How Smoke from Fires Can Affect Your Health	https://www.epa.gov/pm-pollution/how-smoke-fires-can-affect-your-health
CDC Wildfire Smoke Information	https://www.cdc.gov/air/wildfire-smoke/default.htm
CARB Study on Toxics in Wildfire Smoke	https://ww2.arb.ca.gov/news/new-analysis-shows-spikes-metal-contaminants-including-lead-2018-camp-fire-wildfire-smoke
Children's Health Wildfire Smoke Exposure Workshop Recommendations	https://www.airnow.gov/sites/default/files/2022-01/childrens-health-wildfire-smoke-workshop-recommendations.pdf
U.S. Department of Education Readiness and Emergency Management for Schools Technical Assistance (REMS-TA) Wildfire Fact Sheet	https://rems.ed.gov/docs/WildfireFactSheet_508C.pdf

Public Health & Emergency Services Information

Entity	Website
Sacramento County Department of Public Health	https://dhs.saccounty.gov
Sacramento Ready Website - Protective measures for other poor air quality events	http://www.sacramentoready.org/Emergencies/Pages/Air-Quality.aspx

Indoor Air Quality

Entity	Website
EPA Indoor Air Quality	https://www.epa.gov/indoor-air-quality-iaq/introduction-indoor-air-quality
EPA Wildfires and Indoor Air Quality (IAQ)	https://www.epa.gov/indoor-air-quality-iaq/wildfires-and-indoor-air-quality-iaq
EPA Indoor Air Quality Tools for Schools	https://www.epa.gov/iaq-schools/indoor-air-quality-tools-schools-action-kit
California Department of Education, School Facilities Planning Division Indoor Air Quality Guide for Educators	https://www.cde.ca.gov/ls/fa/sf/iaq.asp

Appendix E – Business and Public Agency Survey

A unique contribution of the Sac Metro Air District's Emergency Plan is a survey that was sent to businesses, public agencies and nonprofit organizations. The collected data adds useful information from employers whose business activities can affect both employees and others in Sacramento County during wildfire smoke events. The Sac Metro Air District collaborated with Breathe California Sacramento Region (Breathe) and LPC Consulting Associates, Inc. (LPC) to create a survey tool to solicit information from Sacramento public and private employers on:

1. Their experiences during previous wildfire smoke events;
2. Best practices businesses can implement on smoky days to help reduce smoke exposure for their employees and County residents; and
3. What information is needed to help businesses respond during wildfire smoke events.

In May 2021, Breathe sent the online survey to 103 business organizations, receiving 50 total responses representing a 49 percent response rate. Below is a summary of key findings from the survey.

- More than eight out of 10 responding employers in Sacramento County stated past wildfire smoke events impacted them to a moderate or high degree.
- Wildfire impacts to private and public organizations centered around: cancelling or limiting certain activities or events, monitoring air quality both outdoors and indoors, dealing with employee-related matters like distributing personal protective equipment and communicating with employees during the event. Sixty-five percent of respondents cancelled certain activities, while 58 percent reported they reduced outdoor work hours. Six out of 10 respondents monitored air quality during events, and more than half of employers distributed N95 masks to employees.
- Most respondents had some knowledge of regulations surrounding employee safety during wildfire smoke events. Only 23% of respondents stated they were unsure or had no knowledge of regulations.
- When asked what practices would be incorporated in the future, three out of four respondents stated they would distribute N95 masks, or cancel certain work activities or events. Roughly two-thirds reported they would reduce work activities and monitor outdoor air quality. When asked what strategies they would implement to help reduce employee smoke exposure, the two biggest changes to future actions for employers were: (1) the use of telework, and (2) monitoring indoor air quality.
- The greatest challenges respondents reported when implementing work practice changes included lost revenue and lost productivity, especially for employers that have outdoor job responsibilities.
- Almost half (47%) of respondents have a communication and action plan developed for wildfire smoke events. Just under one third (30%) did not know if they had a plan, one fifth (20%) do not have a plan, and three percent intended to develop one.
- Three-quarters of respondents receive air quality information from television and radio news outlets, while half of respondents reported getting this information directly from the Sac Metro Air District's website.

In summary, the business survey highlighted areas of concern and showed that a majority of businesses are willing to respond and expand their practices to help decrease wildfire smoke exposure for their employees and the region. A full copy of the online business survey results can be found on the Sac Metro Air District's website under the Wildfire Smoke Information webpage.

Appendix F – Short-term Air Quality Metric – A Sub-daily AQI

Acknowledgements

The findings discussed in this appendix are largely based on the work of OEHHA, who collaborated with the CAPCOA. Their assessment is an important contribution to the Sac Metro Air District AB 661 Emergency Plan for the residents of the Sacramento region and is highly appreciated. We are especially grateful to Dr. Xiangmei (May) Wu, the OEHHA staff who conducted this assessment, and to Mr. Richard A. Stedman, Air Pollution Control Officer of the Monterey Bay Air Resources District, who worked with Dr. Wu and led the work on behalf of air agencies in California.

Summary

The original AB 661 legislation included a requirement for the development of a short-term air quality metric thought to better capture the short-lived and highly transient nature of wildfire smoke pollution impacts. Some air agencies believe an advisory index like the current Air Quality Index (AQI), including the recommended protective actions that accompany the six color categories of that AQI, but one based on a shorter time scale of less than 24 hours, would be more suitable to guide or inform the public during the rapidly changing conditions of wildfire smoke events. Thus, in collaboration with CAPCOA, OEHHA performed a review of the peer-reviewed published literature on the health effects of sub-daily exposures to $PM_{2.5}$ pollution. [29] The motivation for the work is two-fold. Duration and frequency of exposure to $PM_{2.5}$ and other pollutants are important determinants of adverse health outcomes. And as we experience more intense and frequent wildfires due to climate change and other factors, we expect to also see an increase in health impacts.

OEHHA found that the available literature is very limited. It suggests that while some adverse health outcomes are observed, the effects from sub-daily exposures to $PM_{2.5}$ pollution tend to be very similar to those derived from daily average exposures. In addition, the reports of associations to sub-daily exposures are limited to only two adverse health outcomes: respiratory and cardiovascular effects. Therefore, the review supports: (1) the continued use of the current AQI and its standard definition based on daily averages of $PM_{2.5}$ pollution levels during smoke events, or (2) when resources are available and other considerations are plausible, a sub-daily AQI based on shorter-time $PM_{2.5}$ pollution concentration averages is a more conservative approach and errs on precaution and the side of public health. Two examples of sub-daily AQI uses were found in Canada and Hong Kong.

High Short-term Exposures to Wildfire Smoke

Most exposures to high wildfire smoke particle pollution levels are short-term (i.e., on the order of minutes or hours). As an example, Figure F.1 illustrates the rapidly changing nature of pollution levels in Sacramento County when the region was impacted by smoke from the Camp Fire in 2018. Considering real-time pollution readings and averaging those readings over an hour resulted in maximum hourly $PM_{2.5}$ concentrations that nearly exceeded 500 on the AQI chart of 500. The figure also illustrates the high rate of change day-over-day for those maximum hourly concentrations. In contrast, considering the standard AQI (air pollution concentrations averaged over a 24-hour preceding period) for the same

[29] Xiangmei, W. State of California Office of Health Hazard Assessment. “Health Effects of Subdaily Exposure to PM2.5.” Presentation to the California Air Pollution Control Officers Association. Oct. 26, 2021.

smoke events yields vastly different results where the longer-term averaging tends to smear out the short-term high pollution concentrations over the day. The result is overall lower corresponding AQI levels as illustrated in Figure F.2 for the same period of time and location as shown in Figure F.1. This type of information emerging from many regions of the state that have been affected by wildfire smoke pollution suggests that consideration an alternative AQI, one based on short-time averaging may be more health protective, thus better serve the public advisory function of air agencies and health departments.

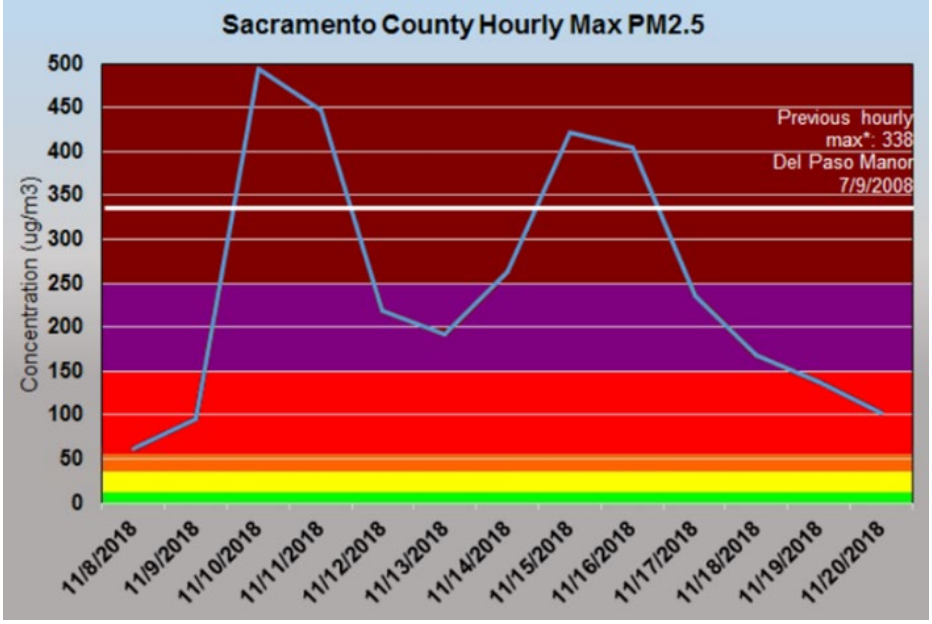

Figure F.1 Sacramento County Daily Maximum Hourly $PM_{2.5}$ Concentrations from the Camp Fire (November 2018). The background colors correspond to the six AQI categories.

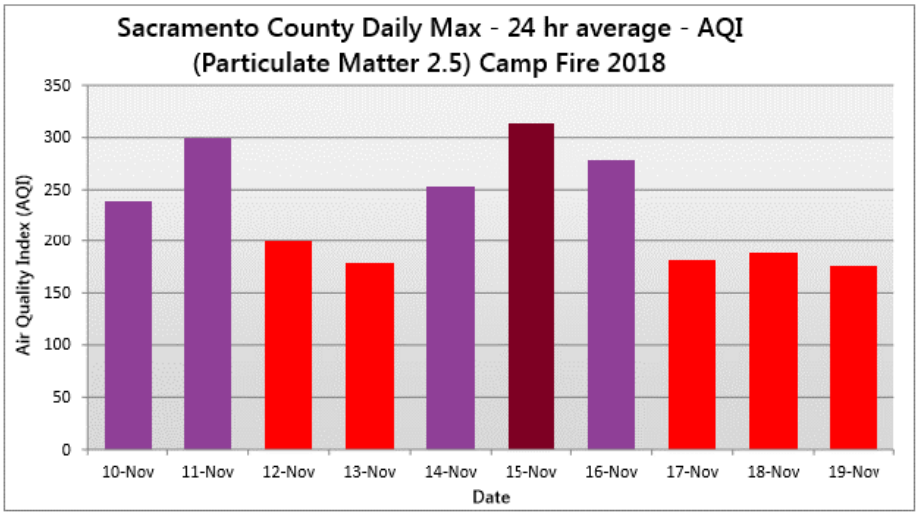

Figure F.2 Sacramento County Daily Maximum AQI for $PM_{2.5}$ from the Camp Fire (November 2018). The column color corresponds to the respective AQI category.

Quantification of Effects From Sub-daily Exposures

While understanding any adverse impacts to human health from air pollution exposure is highly desirable and the focus of ongoing research, this assessment was constrained by the paucity of the available information. Generally, the available peer-reviewed published literature is limited to two health outcomes of concern, albeit these are leading concerns - effects on the respiratory and cardiovascular systems. Four different metrics of exposure were considered: (1) hourly concentrations for different time intervals prior and after a wildfire smoke event, (2) daily maximum hourly concentrations (i.e., similar to what is shown in Figure F.1), (3) peak-hour exposures (e.g., commute hours), and (4) daily excessive concentration hours. The assessment considers whether $PM_{2.5}$ exposures within a day lead to observable adverse effects. If so, how does the magnitude of the effects compare to those based on daily average exposures (i.e., mimicking the standard AQI definition), and what is the lag of the observed effects within the first 24 hours since exposure.

Respiratory outcomes - The review yielded information that supports an association of some clinical respiratory outcomes and sub-daily exposure to $PM_{2.5}$. The outcomes included increases in emergency department visits for respiratory tract infections, hospitalization for asthma, lung infection, and lung obstructive inflammation. Subclinical effects have also been reported including decreased lung function, lung inflammation, oxidative stress, and increase in bronchodilator use. However, given the differences in metrics of exposure and outcomes as well as the similarity of the magnitude of some effects, the literature for respiratory outcomes is inconclusive.

Cardiovascular outcomes - The 2019 *Integrated Science Assessment for Particulate Matter* published by the EPA noted some studies that had reported increases in artery blockage, myocardial infarction, out-of-hospital cardiac arrest, and cerebrovascular disease emergency room visits and hospital admissions associated with sub-daily exposures. Similarly, there was some evidence of the association of some clinical outcomes and sub-daily exposures. These included increases in mortality due to cardiac events, hospitalization, emergency room visits and ambulance dispatch, urgent care and outpatient clinic visits. However, in this category, it is also difficult to compare across studies. Consideration of peak concentrations and daily excess concentration hours also did not lead to differences in the observed outcomes based on daily means. Thus, the literature for cardiovascular outcomes is also inconclusive.

The Canadian and Hong Kong Sub-daily Thresholds

Canada uses the Air Quality Health Index (AQHI), a metric presumed to be of excess mortality risk associated with exposure to ambient air pollution that is based on a 3-hour moving average of ambient concentrations of three pollutants (NO_2, ozone, and $PM_{2.5}$). The AQHI is presented on a scale of one to 10 in four risk groups: low (1-3), moderate (4-6), high (7-9), and very high (10+). The value of 10 corresponds to the highest observed pollution levels measured in 10 Canadian cities between 1998 and 2000. The Canadian advisory is based solely on pollution levels and not specific health outcomes resulting from sub-daily exposures.

Similarly, in 2012, Hong Kong adopted the WHO air quality guidelines of 2005 and determined an AQHI defined similarly as in Canada, but one that considers the excess risk for hospitalization based on four pollutants (NO_2, ozone, $PM_{2.5}$, and SO_2). A scale of one to 10 was binned into five levels of advisory: low (1-3), moderate (4-6), high (7), very high (8-10), and serious (10+). The Hong Kong advisory is also based solely on pollution levels and not specific health outcomes resulting from sub-daily exposures.

Conclusions

While a number of relevant studies were found in the literature, another limitation is few were from the U.S. The effects reported from sub-daily exposures, as expected, were mainly cardiovascular and respiratory. But varying metrics and outcomes make it difficult to interpret relationships. While subclinical effects tend to happen immediately after exposure, hospitalizations, emergency room visits, and other clinical outcomes following sub-daily exposure are not substantially different from those resulting from daily average exposures. The AQHIs are built on local health data and air pollution levels reported hourly for public notification purposes. However, the AQHIs are not based on specific association to observed adverse health effects from short-term exposure. Therefore, based on the assessment described above, the continued use of the standard definition of the AQI as a public advisory during wildfire smoke pollution events is supported. When resources and other considerations allow it, the use of a sub-daily AQI based on shorter-term average of pollution concentrations is a conservative and reasonable precaution leaning towards greater public health protection.

In the future, as new evidence emerges, this issue should be re-visited. While the information in this appendix is primarily concerning $PM_{2.5}$ pollution, it is recognized that wildfire smoke can be a source of other pollutants of high concern, especially when fires burn humanmade structures. Those can result in high pollution levels in the downwind path of the smoke plume of potent toxic compounds like lead and other metals. [30] This may be one reason some research is already suggesting that wildfire smoke impacts respiratory health more than particles from other $PM_{2.5}$ sources.

[30] *Camp Fire Air Quality Data Analysis*. A report of the California Air Resources Board. July 2021.