

**UNIVERSITY OF CALIFORNIA**

# Wildfire Smoke and Air Quality

A Report to University of California President Janet Napolitano

September 2019

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## Executive Summary

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The largest and most destructive wildfires in the state's history have occurred over the last three years. In 2018, multiple Northern California campuses (Berkeley, Davis, and San Francisco) and numerous off-campus locations were impacted by heavy drift smoke conditions originating from distant wildfires. While air quality conditions quickly deteriorated to very unhealthy levels (as defined by the Air Quality Index or AQI), conflicting guidance issued by public health and environmental agencies created confusion and complicated the UC location's decision-making processes with regard to curtailing operations and cancelling classes. Some locations received criticism over their decisions and perceived inconsistencies compared to other locations.

In May 2019, UCOP formed the Systemwide Air Quality Protocol Working Group with technical and operational representation from across the UC system to explore operational and health related issues and develop recommendations for how UC locations should respond to situations that require varying levels of operational curtailment due to unhealthy air quality conditions caused by wildfire smoke (see Appendix A for the Working Group's charge letter). This report represents the completed efforts of the Working Group and the report's recommendations are intended to help all UC locations prepare for and respond to wildfire smoke events that negatively impact air quality.

The Working Group identified 21 report recommendations that address the following:

- **Wildfire Smoke Regulatory Context** – To better protect outdoor workers from the impacts of wildfire smoke exposure, the report recommends locations be fully prepared to comply with new wildfire smoke regulations (Cal/OSHA Section 5141.1) including but not limited to exposure and harm reduction, N95 respirator distribution to outdoor workers (as defined) for voluntary use (AQI 151-500) and mandatory N95 respirator use, fit testing, training and documentation when the AQI is above 500. Locations should also be prepared to provide timely two-way communication to outdoor workers regarding current and anticipated worsening air quality conditions.
- **Air Quality Monitoring** – Accurate and reliable outdoor and indoor air quality monitoring and data sources are critical to decision-making related to regulatory compliance, and operational actions. The report identifies an official AQI data source as well as qualitative and site-specific indoor and outdoor monitoring options, including a recommendation for the installation of low cost outdoor sensors to better assess real-time air quality conditions and trends. Given that the most common advisory and effective protective measure to wildfire smoke conditions is to stay indoors, locations should conduct an inventory of filtered mechanical systems in all owned and leased occupied buildings, develop protocols and procedures for pre-event HVAC system inspection and maintenance, and identify alternative options for creating “cleaner air spaces”.

- **Public Health and Science-Based Decision Making** – To ensure a consistent systemwide approach to responding to wildfire smoke conditions, the Working Group developed a AQI-Based Decision Making Matrix that should be provisionally adopted as the systemwide standard for wildfire smoke events and ultimately formalized as a systemwide or location-based policy. This matrix supports decision-making through a public health and science-based approach and contains both required and recommended actions for each AQI category (including identifying AQI thresholds for curtailing operations and cancelling classes). To ensure local actions and decisions align with regional higher education partners, the report recommends that UCOP coordinate with the California State University and California Community College systems to encourage the adoption of a similar decision matrix. For wildfire smoke events that last for more than a few days, or that occur repeatedly over the course of the fire season, locations should be prepared to take additional prolonged exposure reduction measures, especially for sensitive groups. “Cleaner air spaces/centers” should be identified and used as a smoke exposure reduction strategy if needed.
- **Operational Curtailment** – To better ensure the continuity of essential services during an operational curtailment, the report recommends that locations develop a policy that addresses a temporary change in operating status due to emergency conditions. The report emphasizes the importance of business and mission continuity planning in preparing for all levels of curtailment. Locations should continue to support and leverage location-wide continuity planning efforts to better prepare for operational interruptions. Locations should also be prepared to address potential impacts from academic class cancellation by developing or updating policies that address academic accommodations when instruction is interrupted. The report concludes that existing systemwide and local Human Resources (HR) and Academic Personnel (AP) policies sufficiently address the potential HR and AP impacts related to curtailment decisions. The report also concludes that any level of curtailment at UC Health System locations and related health science instruction that supports clinical operations may not be feasible given their unique operational and business needs.
- **Location Response Operations** – Effective coordination is critical in responding to unhealthy air quality events caused by wildfire drift smoke. The report identifies the essential response roles and responsibilities of key functional areas/units and recommends these responsibilities be incorporated into local response plans and procedures. As part of local response efforts, locations should maintain a sufficient supply of N95 respirators to comply with Cal/OSHA Section 5141.1. Additional availability or distribution of respirators is at the discretion of each location. Given the general disagreement in the public health community over the benefit of N95 use by the general public, the report recommends that if a location chooses to make N95s available beyond the requirements of Cal/OSHA that they also issue guidance and information regarding the limitations and possible negative health impacts of respirator use.

- **Crisis Communications** – During a wildfire smoke event, the report recommends locations align all messaging regarding health impacts and health-related actions with local public health department advisories. The report provides suggested basic messaging content for key AQI thresholds and recommends locations develop pre-scripted messages to help ensure timely communication during a wildfire smoke event. Finally, the report underscores the importance of outreach campaigns to educate the University community *before* an event occurs regarding the risks posed by wildfires and drift smoke, exposure reduction measures, and preparedness actions.

The recommendations contained in this report have been shared and vetted in draft form by Working Group members at each location. Revisions have been made to better reflect and align the report content with operational needs, current planning initiatives, and evolving regulatory context. With additional regulatory changes on the horizon, the report recommends UCOP reconvene the Working Group a year following the acceptance of this report by the President to review the recommendations and update the AQI-Based Decision Making Matrix with any new information, regulatory standards, and best practices. This will help better ensure the University is working in the highest capacity to protect the health and safety of all members of the University community when wildfire smoke conditions occur.

## I. Regulatory Context

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As a direct result of the 2018 catastrophic wildfires in California, the California Occupational Safety & Health (Cal/OSHA) Standards Board adopted a new emergency rule to address the potential harm posed to outdoor workers exposed to wildfire smoke (Section 5141.1).

While there are many chemical compounds present in wildfire smoke, the principal harmful pollutant of concern for persons not in close proximity to the wildfire is fine particulate matter with a diameter of 2.5 micrometers or smaller, known as “PM2.5”. Airborne particle size is directly linked to the potential for causing health risks and microscopic PM2.5 pose the greatest risk because they penetrate deep into the lungs and can enter the bloodstream. Health effects include increased lung and systemic inflammation as well as acute and chronic cardiovascular and respiratory effects. Epidemiological studies have shown wildfire smoke exacerbates asthma and chronic obstructive pulmonary disease in persons with pre-existing medical conditions.

In July 2019, Cal/OSHA issued new regulatory *Section 5141.1 – Protection from Wildfire Smoke* (Attachment 1). This section applies when the Air Quality Index (AQI) for PM2.5 is ‘151’ (“Unhealthy” level) or greater and there is a “reasonable anticipation” that employees may be exposed to wildfire smoke.

(University) workplace and operations exemptions to the new Cal/OSHA rule include:

- Enclosed buildings with indoor air filtered by a mechanical ventilation system
- Enclosed vehicles with interior air filters and windows/doors that are kept closed (note that campus shuttle buses do *not* meet this standard due to constantly opening doors)
- (Campus) demonstrates that AQI is <151 by measuring PM2.5 levels on site
- Staff is exposed to AQI >151 or greater for a total of one hour or less during a shift
- Staff conducting emergency operations including rescue and evacuation or other operations directly aiding firefighting or emergency response

The new Section requires the following measures be taken to reduce employee exposure to AQI for PM2.5 to an acceptable level (<151) including:

- **Engineering Controls** – provide enclosed buildings, structures, or vehicles with filtered air whenever feasible; if insufficient, reduce employee exposures as much as feasible.
- **Administrative Controls** – whenever engineering controls are insufficient, employer [UC location] shall implement administrative measures, if practicable, such as relocating work to location with acceptable AQI level; changing work schedules; reducing work intensity; or providing additional rest periods.
- **Respiratory Protective Equipment (PPE)** – for AQI levels (151-500), employer [UC location] shall provide (N95 filtering facepiece respirators) to employees designated as outdoor workers for voluntary use. Employer [UC location] shall use ‘Appendix B’ to this

section for training regarding voluntary use of respirators. If AQI>500, respirator use is required in accordance with Section 5144 (that requires fit testing and medical evaluations of each employee).

*Section 5141.1 Appendix B* outlines information that must be provided by employer [UC location] to employees designated as outdoor workers when respirators are provided for voluntary use (AQI 151-500). In addition to standard information on the health effects of wildfire smoke and the proper use and limitations of using a respirator, the employer [UC location] must inform employees of how they will be notified when air quality reaches harmful levels; what protective measures are available; and a method for employees to notify the employer [UC location] if they notice deteriorating air quality conditions, or if they are suffering from any symptoms due to poor air quality. This two-way staff communication system must be identified and can be face-to-face verbal, email, text messages, etc. In addition, the employer [UC location] must identify what protective measures (engineering or administrative controls) will be used to protect employees from wildfire smoke exposure.

### Non-University Employees

Contractors working at UC locations should follow the advice of their own employers. However, for any work where the non-University employer may not be aware of conditions to which the employee could be exposed that could present a greater hazard than anticipated (*e.g.*, a plumbing contractor expects its employee to work exclusively inside buildings, but the University's needs require that the employee work on the roof of a building for multiple hours during a wildfire smoke event), the University should consider as a best practice providing notice to the relevant entity in a contractual relationship with UC (*e.g.*, to the general contractor rather than to a subcontractor) of the actual work to be performed and the air quality to which that employee might be exposed, particularly if the employee appears not to be taking precautions that UC staff would take under similar circumstances.

### Recommendations

**Recommendation 1:** Fully implement and comply with the Cal/OSHA emergency rule including N95 respirator distribution to outdoor workers, reduction of exposure, and fit testing and distribution of required information when the AQI exceeds 500.

**Recommendation 2:** Identify and regularly test two-way communication method and notification procedures to ensure timely communication to and from employees designated as outdoor workers (as defined by Cal/OSHA Section 5141.1) during a wildfire smoke event where the AQI measures 151 or greater.



## II. Air Quality Monitoring

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### Official AQI Data Source

There are a number of online sources that report AQI, including US EPA, local Air Quality Management Districts, and the unofficial but widely used PurpleAir public sensor network. US EPA AQI monitoring sites were primarily established to measure and predict ozone or “smog,” not the rapidly changing impacts of smoke from wildfires. These different sources also use varying time periods over which the AQI measurement is calculated, resulting in conflicting reported AQI levels for the same geographic region. For instance, Air Quality Management Districts report the AQI averaged over a 24-hour period while PurpleAir shows readings at a single point in time. Neither approach is appropriate when trying to measure dynamically changing local smoke conditions during a wildfire event.

Cal/OSHA and US EPA both recommend using the current Air Quality Index (or ‘Current Conditions AQI’) posted on the US EPA [AirNow website](#) as the official source of AQI information.

The Current Conditions AQI is also referred to as the “NowCast” and represents data collected over time periods of varying length in order to reflect present air quality conditions as accurately as possible. By definition, the AQI for PM<sub>2.5</sub> is calculated by averaging a full 24 hours of data, so hourly reporting requires using the [NowCast algorithm](#) to estimate the 24-hour AQI for each individual hour, reported as Current Conditions.

The NowCast methodology for reporting hourly AQI Current Conditions is designed to be responsive to rapidly changing air quality conditions, such as during a wildfire. The NowCast uses a weighted average of the previous 12 hours but weights the most recent hours more heavily when air quality is changing rapidly. So, when air quality is stable, a longer averaging time approaching 12 hours is used but when conditions are highly variable, a shorter averaging time approaching three hours is used for greater accuracy. The NowCast allows *AirNow’s* AQI Current Conditions to align more closely with what individuals are actually experiencing outdoors. The *AirNow* website also provides forecasts for AQI levels later in the day as well as the next day.

Whenever possible, the US EPA *AirNow* website should be the official source of reported AQI levels for UC locations. However, if NowCast and *AirNow* AQI estimates are not based on monitors located near a UC location, other available air quality monitoring information such as local air district resources, monitors installed at the UC location, and unofficial public sensors, may be used to assess local wildfire smoke conditions. The limitations and accuracy of these disparate sources should be taken into consideration when used as a basis for decision-making.

### Monitoring Qualitative Real-Time Trends

Locations can monitor *qualitative real-time trends* using low cost PM<sub>2.5</sub> sensors. These sensors use laser sensors to count particles in real time. It is important to note that PM<sub>2.5</sub> from wildfire

smoke has a different density than PM2.5 from other particulates such as dust. This means the concentrations reported by these sensors can vary depending on the specific composition of particulate matter in a given location, causing the sensors to appear to "read high". Therefore, it is necessary to apply a correction factor to low cost sensors to equate it to officially reported AQI levels.

Unlike the official EPA air monitors, low cost sensors can be purchased and installed by the general public and may provide inaccurate readings if not properly installed and maintained. For those reasons, the use of this data should be limited to real-time trends analysis and should *not* be used as a stand-alone measurement or data source.

To enhance local real-time PM2.5 monitoring, the University's systemwide EH&S Industrial Hygiene (IH) workgroup recommends each location install three to five low cost outdoor sensors. After examining several options, including PurpleAir sensors, the workgroup recommends the use of Clarity Node PM2.5 sensors. While Clarity sensors use lasers to count particles like other low-cost sensors, these sensors are unique in that they adjust their measurement algorithms as regulatory data in the area is made available. This "smart calibration" process allows the sensors to correct their estimation methods based on more precise readings in the area, minimizing any bias that may be formed over time (Appendix B contains the full IH workgroup report). IT resources at each location should be made available to help connect the sensors to the local network in a secure manner compliant with current information security policies.

Low cost sensor data should be considered a supplement to a larger package of information when compared to nearby EPA reference air monitors, EPA and other agency AQI and smoke forecasts and model projections, as well as weather forecasts and satellite imagery data. This 'multiple lines of evidence' provides for a comprehensive and holistic approach to assessing both current and future smoke conditions in order to make better informed decisions.

### Site-Specific Monitoring

In addition to monitoring the EPA Current Conditions AQI level posted on the *AirNow* website, Cal/OSHA also allows University locations to measure site-specific PM2.5 concentrations in accordance with the requirements set forth in Section 5141.1 Appendix A regarding monitoring devices, calibration, and technician (EH&S) training/experience.

University locations should begin monitoring local weather conditions and wildfire activity during forecasted high fire danger conditions, particularly during "red flag" warnings issued by the National Weather Service. The latest information on new or rapidly emerging wildfires can be obtained by monitoring local public safety agency radio broadcasts and social media posts from public safety agencies.

Online tools are available for monitoring and predicting smoke conditions from distant wildfires. The US Forest Service Wildland Fire Air Quality Response Program website includes a

[PM2.5 monitoring tool](#). This tool allows users to select monitors from a map and view time-series data showing daily averages, hourly NowCast values, and diurnal smoke impact patterns. Multiple air monitors of interest can be selected, tracked, and shared with others via the site's URL. In addition, the website also includes the *BlueSky* smoke [modeling tool](#) that predicts air quality impacts from active wildfires. Multiple versions of *BlueSky* run automatically every day based on daily updates of fire and weather information to estimate local smoke effects including plume rise and dispersion. Smoke model runs are viewable on a map with options for 1-hour, 3-hour, and daily (24-hour) smoke estimates and typical forecasts extend for 2-3 days into the future.

As soon as local or distant wildfires have the potential or predicted potential to affect University locations, an integrated comprehensive approach to monitoring local smoke conditions should begin. This should include monitoring the official *AirNow* AQI to ascertain short-term changes local smoke conditions, monitoring UC location site-specific air monitors (if available) to determine localized air quality conditions that may differ from and more accurately reflect smoke conditions compared to reported *AirNow* AQI levels in the area, and the use of local sensors to analyze real-time trends to determine how rapidly and severely local air quality conditions are deteriorating or improving.

## Recommendations

**Recommendation 3:** Utilize the EPA *AirNow* "Current Conditions AQI" as the official AQI data source for decision-making and operational actions.

**Recommendation 4:** Install and maintain three to five Clarity Node PM2.5 outdoor sensors per location for a two year pilot project to improve local real-time PM2.5 data to better assess if local air quality conditions are deteriorating or improving.

### III. Indoor Air Quality

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The most common advisory and effective protective measure for a location experiencing wildfire smoke conditions is to stay indoors. However, the usefulness of this strategy depends on how well a building limits smoke coming in from the outside. Buildings with filtered central air conditioning with re-circulated indoor air should significantly reduce exposure to ambient wildfire smoke. Generally, newer buildings are “tighter” and have better and more easily controlled and modified heating, ventilation, and air conditioning (HVAC) systems than older buildings. As previously noted, staff located in buildings without a filtered HVAC system are subject to the provisions of Cal/OSHA Section 5141.1. Therefore, locations must inventory the HVAC systems of all occupied buildings to determine which buildings are exempt from the Cal/OSHA requirements.

#### Building Engineering Controls

During wildfire events, building HVAC systems should be operated continuously while occupied in order to provide the minimum quantity of outdoor air for ventilation as required by the standards or building codes to which the building was designed. Eliminating or substantially reducing the outdoor air supply in campus buildings as a first step to reduce exposure to smoke is generally *not* recommended. HVAC systems typically bring in outside air into the building through filters, blend it with building return air, and thermally condition the air before distributing it throughout the building. Buildings also have exhaust air systems for restrooms and kitchens, as well as for laboratory fume hoods, parking garages, and other building operations. These exhaust systems require makeup (outdoor) air in order to function properly. In addition, without an adequate supply of outdoor air, HVAC systems may create negative pressure in the building that will increase the movement of unfiltered air into the building through any openings such as windows and doors, and could create a vacuum lock effect making it difficult to open exterior doors.

As a first step to protect building occupants from outdoor air pollution including wildfire smoke, facilities staff should ensure that HVAC system filters are not dirty, damaged, dislodged, or leaking around the edges. Before the peak wildfire season (late summer and early fall), and during smoke events if necessary, facilities staff should inspect HVAC systems, make necessary repairs, and conduct appropriate maintenance. Filters should fit snugly into their frames and should have gaskets or sealants on all perimeter edges to ensure that air does not leak around the filters.

Locations should consider installation of the highest efficiency filters that do not exceed the static pressure limits of the HVAC systems as specified by the manufacturer or system designer. Locations should consider replacing and upgrading standard filters (typically MERV-8) with more protective high efficiency filters (MERV-13) before peak wildfire season. Pressure gauges

can be installed across the filter to indicate when the filter needs replacing, especially during very smoky conditions.

In some circumstances, it may be helpful to reduce the amount of outdoor air in order to reduce smoke pollution inside the building, while still maintaining positive pressure. Temporary restrictions in outdoor air flow rates should be considered when all of the following conditions are met:

1. Local AQI >151 (reaches “Unhealthy” level for PM2.5 due to wildfire smoke)
2. Location HVAC technician has inspected the HVAC system and ensured that the filters are functioning properly; the filter bank is in good repair; and that the highest feasible level of filtration has been provided
3. Location HVAC technician or engineer has assessed the building mechanical systems and determined the minimum amount of outside air necessary to prevent negative pressurization of the building, and to sufficiently ventilate any hazardous processes inside the building (such as laboratory fume hoods or enclosed parking garages)
4. HVAC systems are operated continuously while the building is occupied to provide at least the minimum quantity of outdoor air needed, as determined by the HVAC technician or engineer
5. Location ensures that the HVAC systems are restored to maintain the minimum quantity of outdoor air for ventilation as required by the standards or building codes to which the building was designed no later than 48 hours after PM2.5 levels fall below AQI 151 (“Unhealthy” level)

The EH&S IH workgroup was tasked with developing systemwide guidance on indoor air quality monitoring procedures and protocol to respond to indoor air quality complaints. The IH workgroup recommends each location maintain at least one portable PM monitor to be used for general indoor air quality (IAQ) investigations. This type of instrument is especially useful when comparing conditions indoors versus outdoors and investigating specific tasks, workspaces, or sources of pollution. If a building’s outdoor air intake has been reduced, locations should also be prepared to monitor carbon dioxide during IAQ surveys. Building occupation without adequate fresh air intake can lead to elevated (exhaled) carbon dioxide levels and complaints of drowsiness, headaches, and dizziness among occupants. During a wildfire smoke event, priority for indoor air sampling should be given to buildings that lack HVAC systems with filters, designated cleaner air spaces, and in response to complaints, requests, and time-sensitive events. (Appendix B contains the full IH workgroup report)

## Recommendations

**Recommendation 5:** Conduct inventory of filtered mechanical ventilation systems in all owned and leased occupied buildings to determine which buildings are exempt from Cal/OSHA Section 5141.1 requirements.

**Recommendation 6:** Each location EH&S should maintain at least one portable PM monitor to be used for general indoor air quality (IAQ) investigations and follow EH&S IH guidance for indoor air quality monitoring during wildfire smoke events.

**Recommendation 7:** For campus residential locations without filtered mechanical ventilation systems, consider alternative options for providing “cleaner air” to occupants, including stricter administrative building controls and/or portable air filters (either purchased by students for personal use in campus housing facilities or supplied by the campus in central locations).

**Recommendation 8:** Develop University location specific facilities protocols and procedures for pre-event building HVAC system inspection and maintenance.

**Recommendation 9:** Consider replacing or upgrading HVAC system filters with more protective high efficiency filters before peak wildfire season (late summer and early fall).

## IV. Public Health and Science-Based Decision-Making

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When poor air quality from wildfires threatens the health and well-being of students, faculty, staff or visitors to UC locations, it is important that leadership respond quickly, and that key decisions align with proven AQI-based health risks and impacts. In order to best protect the University community, decisions should be public health and science-based and align with local public health guidance and advisories. The Working Group has based its guidance and recommendations primarily on the authoritative US EPA *Wildfire Smoke - A Guide for Public Health Officials* (August 2019). This expert guidance is the product of an inter-agency collaboration between US EPA, California Air Resources Board, California Office of Environmental Health Hazard Assessment, US Centers for Disease Control and Prevention (CDC), and the US Forest Service and represents the state of the science in this area.

### Decision-Making Guidance

An AQI-Based Decision-Making Matrix (Table 1 and Appendix C) was developed by the Working Group to ensure a consistent systemwide approach to responding to local wildfire smoke conditions and to support alignment with current public health guidance. The matrix includes actions *required* by each UC location once certain AQI thresholds are met. It is not meant to be overly prescriptive, rather, it was designed to align key decisions across the system, especially when wildfire smoke conditions impact multiple locations simultaneously. The matrix also lists recommended actions or actions locations should consider implementing for each AQI category. This balance of required and recommended actions aligns key decisions but also allows for flexibility, autonomy, and the integration of location-specific factors, local mitigation measures, and regional impacts into the decision-making process.

To better support alignment with other local colleges and universities, the matrix should be shared with the California State University (CSU) and California Community College (CCC) systems and efforts should be made to encourage them to adopt a similar AQI public health and science-based decision-making matrix.

In order to ensure continued alignment with current guidelines and regulations, as well as to incorporate lessons learned from actual events, the decision matrix should be reviewed periodically and updated as necessary. This will allow the University to maintain a dynamic and current framework that effectively coordinates systemwide decision-making.

Key characteristics of the AQI-Based Decision-Making Matrix:

- The matrix is designed for use when wildfire smoke conditions result in worsening and unhealthy air quality. It does *not* apply if there is a direct threat of wildfire and/or other significant hazard to the location, or for smog-related air quality conditions.
- *Required actions* are in **bolded red text**. These are definitive actions that must take place when - but not before - the corresponding AQI threshold is met.

- Non-bolded actions are recommended for consideration and should be implemented at the location's discretion.
- The Chancellor/Chief Executive or Executive Policy Group at the impacted location is responsible for decision-making and implementing measures based on the matrix.
- The matrix is not a stand-alone document. It should be used in conjunction with existing local response plans, protocols, and procedures including the *Emergency Operations Plan*, *Crisis Management Plan*, and *Continuity of Operations Plans*.
- If building indoor air quality is measured at a level consistent with the AQI thresholds, applicable mitigation measures should be implemented if feasible, and required actions listed in the matrix should be taken.
- Contractors working at UC locations should follow the advice of their own employers.
- The Pre-K-12 actions apply to UC-managed facilities only.
- The matrix incorporates actions required by Cal/OSHA Section 5141.1 including voluntary use of N95 respirators for outdoor workers at an AQI of 151-500 and mandatory N95 respiratory use, fit testing, respirator training and documentation when the AQI is above 500. At an AQI > 151, employees in buildings without filtered ventilation systems should be relocated to buildings with filtered air. If they cannot be relocated, they are subject to the actions required by Cal/OSHA Section 5141.1 where feasible.
- University sponsored outdoor events held at off-campus locations are subject to actions associated with that location's AQI levels.
- Actions for athletic practice and competition were based on current National Collegiate Athletic Association (NCAA) guidance. Decisions regarding the cancellation and/or rescheduling of athletic competitions should be made in accordance with the NCAA. Rescheduling of athletic and recreation competitions may take place when the AQI lowers to an acceptable level.
- Locations should ensure timely communication of AQI-based decisions and expected actions via multiple and redundant communication methods.
- Higher AQI thresholds automatically incorporate all guidance and actions associated with lower AQI levels



Table 1: AQI-Based Decision-Making Matrix

Levels of Health Concern	PM2.5 (24hr avg; $\mu\text{g}/\text{m}^3$ )	Current AQI Value	Who is Affected?	Actions	
Good	0-12	0-50	None Expected	No Action Anticipated	
Moderate	12.1-35.4	51-100	Unusually Sensitive Individuals (people with lung and heart disease) may be affected.	Outdoor Workers/ Volunteers	<ul style="list-style-type: none"> <li>Unusually sensitive people may require work accommodations.</li> </ul>
				Academic Classes	No Action Anticipated
				Campus Operations	No Action Anticipated
				Health System Operations	<ul style="list-style-type: none"> <li>In patient care areas, consider modifying filtered mechanical ventilation systems and/or implementing other controls to reduce outdoor air intake.</li> </ul>
				Athletics & Outdoor Recreation	No Action Anticipated
				Outdoor Camps/Events	No Action Anticipated
				Pre-K-12	No Action Anticipated
Unhealthy for Sensitive Groups	35.5-55.4	101-150	Sensitive groups including people with heart or lung disease, older adults, pregnant women, and children.	Outdoor Workers/ Volunteers	<ul style="list-style-type: none"> <li>Workers in sensitive groups may require work accommodations.</li> </ul>
				Academic Classes	No Action Anticipated
				Campus Operations	<ul style="list-style-type: none"> <li>Consider closing building doors and windows to reduce outdoor air intake.</li> </ul>
				Health System Operations	<ul style="list-style-type: none"> <li>As feasible, modify filtered mechanical ventilation systems to reduce outdoor air intake in patient care areas.</li> </ul>
				Athletics & Outdoor Recreation	<ul style="list-style-type: none"> <li><b>Medical/athletic staff/outdoor recreation staff should consult with individuals who fall into the sensitive groups about participation in practice, competition, and/or outdoor events.</b></li> </ul>
				Outdoor Camps/Events	<ul style="list-style-type: none"> <li>At higher end of range, consider moving activities indoors.</li> </ul>
				Pre-K-12	<ul style="list-style-type: none"> <li>For longer activities such as athletic practice, take more breaks and do less intense activities</li> </ul>

Levels of Health Concern	PM2.5 (24hr avg; µg/m3)	Current AQI Value	Who is Affected?	Actions	
Unhealthy	55.5-150.4	151-200	Everyone	Outdoor Workers/Volunteers	<ul style="list-style-type: none"> <li>• <b>Limit outdoor work and prolonged or heavy exertion where practicable.</b></li> <li>• <b>Reassign employees who work outdoors for more than one hour or provide N95 respirators for voluntary use.</b></li> </ul>
				Academic Classes	<ul style="list-style-type: none"> <li>• Consider academic accommodations for students and faculty with pre-existing health conditions.</li> <li>• Consider cancelling or moving outdoor classes indoors.</li> </ul>
				Campus Operations	<ul style="list-style-type: none"> <li>• Consider making N95 respirators and use/care guidance available for voluntary use.</li> <li>• Consider increasing campus-managed shuttle/bus service.</li> <li>• As feasible, modify filtered mechanical ventilation systems to reduce outdoor air intake.</li> </ul>
				Health System Operations	<ul style="list-style-type: none"> <li>• Consider making N95 respirators and use/care guidance available for voluntary use.</li> <li>• In patient care areas, consider monitoring indoor air quality and implement mitigation actions if indoor AQI is within this range.</li> </ul>
				Athletics & Outdoor Recreation	<ul style="list-style-type: none"> <li>• Medical/athletic training staff should closely monitor the health of all athletes in practice and competition. Modifications to athletic activities should be considered and implemented as necessary.</li> <li>• <b>Shorten/modify outdoor recreational activity to limit prolonged or heavy exertion.</b></li> </ul>
				Outdoor Camps/Events	<ul style="list-style-type: none"> <li>• Consider cancellation of more intense outdoor events or move events indoors.</li> </ul>
				Pre-K-12	<ul style="list-style-type: none"> <li>• <b>For all outdoor activities, take more breaks and do less intense activities.</b></li> <li>• Consider moving longer or more intense activities indoors or rescheduling them to another day or time.</li> </ul>

Levels of Health Concern	PM2.5 (24hr avg; µg/m3)	Current AQI Value	Who is Affected?	Actions	
Very Unhealthy	150.5-250.4	201-300	Everyone	Outdoor Workers/Volunteers	<ul style="list-style-type: none"> <li>• <b>Suspend outdoor work. If work is absolutely necessary, provide N95 respirators for voluntary use.</b></li> </ul>
				Academic Classes	<ul style="list-style-type: none"> <li>• <b>Per local procedures and in consultation with the divisional Academic Senate Chair or designee, cancel or restructure classes if current AQI levels have maintained in this range and are expected to continue (academic activities that support clinical operations or research may be excluded from cancellation).</b></li> </ul>
				Campus Operations	<ul style="list-style-type: none"> <li>• To the extent feasible, curtail campus operations.</li> <li>• Consider monitoring indoor air quality and implement mitigation actions if indoor AQI is within this range.</li> </ul>
				Health System Operations	<ul style="list-style-type: none"> <li>• To the extent feasible, curtail health system operations.</li> <li>• Consider monitoring indoor air quality and implement mitigation actions if indoor AQI is within this range.</li> </ul>
				Athletics/Outdoor Recreation	<ul style="list-style-type: none"> <li>• Outdoor athletic activities should be moved indoors or delayed, postponed, or relocated.</li> <li>• <b>Cancel or move indoors outdoor recreational activities.</b></li> </ul>
				Outdoor Camps/Events	<ul style="list-style-type: none"> <li>• <b>Cancel outdoor events involving activity (e.g., sports).</b></li> <li>• Consider cancellation of outdoor events that do not involve activity (e.g., concerts).</li> </ul>
				Pre-K-12	<ul style="list-style-type: none"> <li>• <b>Close school if current AQI levels have maintained in this range and are expected to continue.</b></li> </ul>

Levels of Health Concern	PM2.5 (24hr avg; µg/m3)	Current AQI Value	Who is Affected?	Actions	
Hazardous	250.5-500.4	301-500	Everyone	Outdoor Workers/Volunteers	<ul style="list-style-type: none"> <li>• <b>Follow recommendations for the Very Unhealthy category.</b></li> </ul>
				Academic Classes	<ul style="list-style-type: none"> <li>• <b>Follow recommendations for the Very Unhealthy category.</b></li> </ul>
				Campus Operations	<ul style="list-style-type: none"> <li>• Follow recommendations for the Very Unhealthy category.</li> </ul>
				Health System Operations	<ul style="list-style-type: none"> <li>• Follow recommendations for the Very Unhealthy category.</li> </ul>
				Athletics/Outdoor Recreation	<ul style="list-style-type: none"> <li>• <b>Cancel or move indoors all outdoor athletic and recreation events/activities.</b></li> <li>• Consider cancellation of indoor events/activities based on indoor air quality measurements.</li> </ul>
				Outdoor Camps/Events	<ul style="list-style-type: none"> <li>• <b>Cancel all outdoor events and camp activities.</b></li> <li>• Consider cancellation of indoor camps that require participants or families to travel to and from campus.</li> </ul>
Beyond the AQI	> 500.4	> 500	Everyone	All groups	<ul style="list-style-type: none"> <li>• Follow recommendations for the Hazardous Category.</li> <li>• <b>Suspend outdoor work and activities. If outdoor work is absolutely necessary, N95 respirators are mandatory and require training and fit testing.</b></li> </ul>

#### IV. Public Health and Science-Based Approach cont.

##### Recommendations

**Recommendation 10:** Provisionally adopt the AQI-Based Decision-Making Matrix as the interim systemwide standard for a wildfire smoke event and formalize as a systemwide or location-based policy.

**Recommendation 11:** Coordinate with the CSU and CCC systems to encourage adoption of a similar AQI-Based Decision-Making Matrix to ensure local actions and decisions align with regional higher education partners. (Office of the President)

**Recommendation 12:** Reconvene Systemwide Air Quality Protocol Working Group one year following the President's acceptance of this report's recommendations to review and update the matrix with lessons learned, new regulatory requirements, updated public health guidance, and/or newly established best practices. (Office of the President)

## V. Curtailment of Operations

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### Decision-Making

When wildfire smoke causes unhealthy air quality conditions, it may be necessary to temporarily curtail location operations to better protect the health and safety of the University community. Curtailment decisions should be tied to specific AQI thresholds in Table 1 where the air quality data indicates AQI levels are expected to continue or worsen.

The authority to curtail campus operations rests with the Chancellor or designee, which may include a campus Executive Policy Group/Crisis Management Team or others as defined by location-specific crisis management plans and procedures. Campuses should have policies and procedures in place to account for and address an interruption to the academic calendar. Depending on the time of year, length of curtailment, and other factors, academic class cancellation can have far-reaching impacts and implications. Therefore, it is important that the campus Provost/Executive Vice Chancellor and divisional Academic Senate Chair or their designees be consulted to better understand and address the academic impacts of this decision. The UC Provost and systemwide Academic Senate Chair or their designees should be informed of curtailment decisions that impact academic activities.

Communicating the decisions and decision criteria to students should be an integral part of the campus plan for responding to wildfire events. Prior to and during a wildfire smoke event, campus leadership should engage student government leaders regarding decisions and the potential impacts on students.

The authority to curtail operations at UC Health facilities, Agriculture and National Resources (ANR), National Laboratories, and other UC facilities rests with the Chief Executive Officer of those locations. The Chief Executive may include and consult with others on curtailment decision-making as appropriate or as defined by location-specific crisis management plans and procedures. It is important to note that for UC Health System locations curtailing operations in any manner may not be feasible or align with operational and business needs. University healthcare locations as well as related health science instruction that supports clinical or research operations may be exempt from curtailment decisions made by the location; any decisions on such instruction should include the location's Provost/Executive Vice Chancellor.

### Business and Mission Continuity Planning

During any curtailment of campus and other University location operations, it is important to ensure the continuity of essential services to students, patients, and the public. These essential services are not subject to curtailment because they help ensure the health and safety of the University community or the operation of critical facilities, infrastructure, and programs (e.g., healthcare and patient care, student housing and dining, public safety functions, maintenance of buildings, care and feeding of laboratory animals, delicate research, etc.).

The business and mission continuity planning efforts at each location should be used to support curtailment preparation. Continuity plans contain key information related to essential campus and University location functions, including staffing and resource requirements, information technology systems, vital records, communication methods, and continuity strategies that will be used to continue or maintain essential functions. The continuity planning process also identifies non-interruptible activities (activities that must continue regardless of a curtailment decision), documents potential impacts of a disruption, and establishes priorities for the allocation of resources. This information is critical to curtailment planning and locations should continue to support these efforts to better understand and leverage continuity information to prepare for all levels of curtailment.

### Human Resources and Academic Personnel Impacts

Curtailment decisions have Human Resources (HR) and Academic Personnel implications related to employee compensation, alternative work schedules, and other work modifications for represented staff, non-represented staff, and academic employees. Existing systemwide and local HR and Academic Personnel policies and procedures specifically designed for use during emergencies and disruptions sufficiently address the potential HR impacts related to a wildfire smoke event. For staff employees, these policies include [HR Policy PPSM-2.210 - Absence from Work](#) that covers administrative leave for emergencies as well as curtailment leave. Academic appointees are covered under the Academic Personnel Manual. Employment-related decisions should be location-specific but UCOP should be consulted on decisions related to University employee compensation since such actions could establish systemwide precedents, especially regarding represented employees.

### Recommendations

**Recommendation 13:** Develop a location policy or protocol that describes the authority, procedures, and responsibilities for implementing a temporary change in location's operating status due to an emergency event or hazardous condition threatening the safety, health, or welfare of the community while ensuring continuity of services to students, patients, and the public.

**Recommendation 14:** Develop or update location policies and/or procedures related to academic accommodations if the delivery of instruction is interrupted due to academic class cancellations.

**Recommendation 15:** Develop or update an *Enterprise Continuity Plan* (or equivalent plan) that describes the organizational framework, guidance, and authority to continuing to perform essential functions in the event of a location-wide disruption of normal business operations.

## VI. Prolonged Wildfire Smoke Event

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For wildfire smoke events that last for more than a few days, or that occur repeatedly over the course of the fire season, locations should communicate the importance of reducing smoke exposure to the University community. Messages should include actions individuals can take to reduce wildfire smoke exposure as the longer a smoke event continues, the more individuals will start to experience adverse health effects. Therefore, exposure reduction measures that are recommended for short-term exposures to wildfire smoke become even more important during prolonged smoke exposure, especially for sensitive groups. Locations should give more consideration to the recommended actions listed in the AQI-Based Decision-Making Matrix and consider additional measures to protect the University community, especially individuals in at-risk or sensitive groups. To the extent possible, locations should consult with UCOP on any additional response measures or actions.

### Cleaner Air Spaces/Centers

Locations should also consider identifying “cleaner air spaces/centers” to utilize as a smoke exposure reduction strategy if needed, especially as a means to temporarily reduce smoke exposure to outdoor workers to the extent feasible pursuant to the Cal/OSHA requirements. “Cleaner air spaces/centers” provide a temporary location site for individuals seeking relief from wildfire smoke conditions or for individuals with limited access to facilities with adequate air filtration systems. These spaces could include general occupancy ‘public’ campus buildings such as libraries or recreation/sports centers. Considerations should also be made for students who are under-housed, which could include expanding emergency housing resources.

### Mental Health Impacts

As wildfire smoke events continue, stress associated with increasing health concerns and reduction in physical activity can cause mental health issues to arise, especially when the smoke event lasts multiple days. Locations should be aware of mental health issues in the University community and consider creating messages about mental health and available resources/services. Regularly updated location-wide messaging becomes even more important during a prolonged smoke event.

### Recommendation

**Recommendation 16:** Identify facilities that could serve as temporary “cleaner air spaces/centers” during a wildfire smoke event.



## VII. Location Response Coordination

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Each location should determine the best mechanism to coordinate and manage a wildfire smoke event – either as an emergency through the activation of the location Emergency Operations Center (EOC) and related emergency plans/procedures; or as a crisis through the activation of the Crisis Management Team and related crisis management plans. In either case, the location should also communicate and coordinate with UCOP and other affected UC locations.

In addition to internal location-wide and systemwide coordination, an affected location should also coordinate closely with local public health agencies/authorities to ascertain what guidance and directives are being disseminated locally in response to wildfire smoke conditions. Each public health agency in the state is independent and autonomous so it is possible for different and even conflicting information and guidance to be issued by various local public health agencies. This poses a challenge for the University to be able to respond consistently on a systemwide basis to any public health emergency including a wildfire smoke event. Other external entities including nearby CSU/Community College campuses and local school districts may also be consulted to determine their plans and intended actions for benchmarking purposes to assist in local decision-making.

### Roles and Responsibilities

Locations specify the roles and responsibilities of all units, departments, and entities involved in response to ensure a coordinated and cooperative location-wide approach to wildfire smoke events. Appendix D lists suggested “Roles and Responsibilities” for key location functional units/entities involved in wildfire smoke event response. These include:

- Academic Personnel and Human Resources
- Athletics and Recreation
- Crisis Management Team/Executive Policy Group
- Crisis Communication
- Environment, Health & Safety (EH&S)
- Emergency Management (EM)
- Facilities Management/Physical Plant
- Housing and Dining
- Pre K-12 programs on campuses
- Occupational Health
- Student Health Services

## N95 Respirator Use

Each location must make available a sufficient number of N95 filtering facepiece respirators to cover outdoor workers (as defined by Cal/OSHA Section 5141.1). When AQI exceeds 500, N95 use is mandatory and requires both fit testing and medical evaluations for affected staff.

N95 respirator use and availability beyond the requirements of Cal/OSHA Section 5141.1 (including for students, faculty, and staff not captured by the regulation) is at the discretion of the individual location but should be consistent with local public health agency guidance which may vary considerably by location.

It's important to note that there is general disagreement in the public health community over the scientific evidence that N95 respirator use by members of the general public is actually beneficial, and indeed there are many known limitations and potential adverse effects of N95 use particularly for persons in sensitive groups. Health officials have indicated that wearing a N95 during brief periods of smoke exposure such as walking to the bus stop or to class is likely to provide more of an emotional benefit than health benefit. If respirators are not fit properly, they do not work.

Supplies of N95 respirators should be prioritized towards outdoor workers (as defined by Cal/OSHA Section 5141.1) and only made available to other members of the University community if a sufficient stock is available. Information regarding the use and limitations of N95 respirators should be provided at the time N95s are made available. At a minimum, this information should include how to properly wear, use, and maintain the respirator as well as when to discontinue its use, particularly if experiencing symptoms such as difficulty breathing, dizziness, or nausea. Cal/OSHA Section 5141.1 Appendix B contains applicable information on proper N95 use and limitations.

## Recommendations

**Recommendation 17:** Incorporate the wildfire smoke event roles and responsibilities identified in Appendix D into existing local response plans, protocols, and training efforts.

**Recommendation 18:** Assess current stock of N95 respirators and ensure sufficient quantities to meet Cal/OSHA Section 5141.1 and any additional planned location-based response actions.

## VIII. Crisis Communication

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Locations should consider initiating location-wide messaging when the AQI level reaches 101 (“Unhealthy for Sensitive Groups”) and use multiple and redundant methods and platforms to communicate, including mass email messaging, social media, campus websites, digital messaging boards, etc. Locations should ensure timely communication of decisions made regarding classes, a change in operating status, cancellation of athletic events or other outdoor activities, etc. Location-wide messaging should include information on available mental health resources (especially during prolonged smoke events) and address all stakeholder groups, including parents, patients, and/or visitors. Campus/Medical Center locations should consider coordinated or joint communications to better align message content.

### Basic Message Content and Strategies for Key AQI Thresholds

- When the AQI level reaches 101 (“Unhealthy for Sensitive Groups”) messaging should include:
  - Personal preparedness advisory information consistent with local public health messages and directed at sensitive groups including persons with pre-existing heart or lung disease, older adults, children, and pregnant women.
  - Information regarding potential operational impacts if wildfire smoke conditions continue to worsen, as well as the location’s official source of AQI data.
- When the AQI level reaches 151 (“Unhealthy”) regularly updated messaging should begin and include:
  - Personal preparedness, exposure reduction measures plus any associated risks, and health advisory information consistent with local public health messages.
  - Details of current operational impacts and potential future impacts if conditions continue to worsen.
  - Input from key location stakeholders (as needed), including HR/Labor Relations, Academic Personnel, Occupational Health, Environment, Health & Safety, Health Services, etc.
  - Information on how “outdoor” employees will be notified when air quality reaches harmful levels; what protective measures are available; and a method for employees to notify the location if they notice deteriorating air quality conditions, or if they are suffering from any symptoms due to poor air quality. This two-way staff communication system must be identified and can be face-to-face verbal, email, text messages, etc. (per Cal/OSHA Section 5141.1).
  - At this level and above, locations should consider the use of their emergency mass notification system to communicate time-sensitive information regarding curtailment of operations and associated protective measures.
  - Additional content as needed.

- When the AQI level reaches 201 (“Very Unhealthy”) and above, locations should continue to implement messaging content initiated at the AQI >151 threshold and also include:
  - Current and future academic impacts and any associated expected actions.
  - Anticipated duration of cancelled classes and other operational curtailments.
  - Current operational impacts, including any change in operating status, and potential future impacts if conditions continue to worsen.
  - If available, buildings with filtered air that are open to members of the University community temporarily seeking cleaner air spaces/centers.
  - Additional content as needed.

## Recommendations

**Recommendation 19:** During a wildfire smoke event, follow the guidance and align all location messaging regarding health impacts and health-related actions with local public health department advisories and other external entities as appropriate.

**Recommendation 20:** Consider developing pre-scripted messages to location communities that summarize expected actions, AQI-based decision thresholds, exposure reductions measures, limitations, and associated risks, resource links, etc.

**Recommendation 21:** Implement an annual notification or outreach campaign that conveys wildfire and wildfire smoke risk/hazard, expected actions, preparedness and protective actions, links to additional resources, and any relevant location-specific information.

## IX. Recommendations

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**Recommendation 1:** Fully implement and comply with the Cal/OSHA emergency rule including N95 respirator distribution to outdoor workers, reduction of exposure, and fit testing and distribution of required information when the AQI exceeds 500.

**Recommendation 2:** Identify and regularly test two-way communication method and notification procedures to ensure timely communication to and from employees designated as outdoor workers (as defined by Cal/OSHA Section 5141.1) during a wildfire smoke event where the AQI measures 151 or greater.

**Recommendation 3:** Utilize the EPA *AirNow* “Current Conditions AQI” as the official AQI data source for decision-making and operational actions.

**Recommendation 4:** Install and maintain three to five Clarity Node PM2.5 outdoor sensors per location for a two year pilot project to improve local real-time PM2.5 data to better assess if local air quality conditions are deteriorating or improving.

**Recommendation 5:** Conduct inventory of filtered mechanical ventilation systems in all owned and leased occupied buildings to determine which buildings are exempt from Cal/OSHA Section 5141.1 requirements.

**Recommendation 6:** Each location EH&S should maintain at least one portable PM monitor to be used for general indoor air quality (IAQ) investigations and follow EH&S IH guidance for indoor air quality monitoring during wildfire smoke events.

**Recommendation 7:** For campus residential locations without filtered mechanical ventilation systems, consider alternative options for providing “cleaner air” to occupants, including stricter administrative building controls and/or portable air filters (either purchased by students for personal use in campus housing facilities or supplied by the campus in central locations).

**Recommendation 8:** Develop University location specific facilities protocols and procedures for pre-event building HVAC system inspection and maintenance.

**Recommendation 9:** Consider replacing or upgrading HVAC system filters with more protective high efficiency filters before peak wildfire season (late summer and early fall).

**Recommendation 10:** Provisionally adopt the AQI-Based Decision-Making Matrix as the interim systemwide standard for a wildfire smoke event and formalize as a systemwide or location-based policy.

**Recommendation 11:** Coordinate with the CSU and CCC systems to encourage adoption of a similar AQI-Based Decision-Making Matrix to ensure local actions and decisions align with regional higher education partners. (Office of the President)

**Recommendation 12:** Reconvene Systemwide Air Quality Protocol Working Group one year following the President’s acceptance of this report’s recommendations to review and update the matrix with lessons learned, new regulatory requirements, updated public health guidance, and/or newly established best practices. (Office of the President)

**Recommendation 13:** Develop a location policy or protocol that describes the authority, procedures, and responsibilities for implementing a temporary change in location’s operating status due to an emergency event or hazardous condition threatening the safety, health, or welfare of the community while ensuring continuity of services to students, patients, and the public.

**Recommendation 14:** Develop or update location policies and/or procedures related to academic accommodations if the delivery of instruction is interrupted due to academic class cancellations.

**Recommendation 15:** Develop or update an *Enterprise Continuity Plan* (or equivalent plan) that describes the organizational framework, guidance, and authority to continuing to perform essential functions in the event of a location-wide disruption of normal business operations.

**Recommendation 16:** Identify facilities that could serve as temporary “cleaner air spaces/centers” during a wildfire smoke event.

**Recommendation 17:** Incorporate the wildfire smoke event roles and responsibilities identified in Appendix D into existing local response plans, protocols, and training efforts.

**Recommendation 18:** Assess current stock of N95 respirators and ensure sufficient quantities to meet Cal/OSHA Section 5141.1 and any additional planned location-based response actions (only make N95s available with proper use instructions).

**Recommendation 19:** During a wildfire smoke event, follow the guidance and align all location messaging regarding health impacts and health-related actions with local public health department advisories and other external entities as appropriate.

**Recommendation 20:** Consider developing pre-scripted messages to location communities that summarize expected actions, AQI-based decision thresholds, exposure reductions measures, limitations, and associated risks, resource links, etc.

**Recommendation 21:** Implement an annual notification or outreach campaign that conveys wildfire and wildfire smoke risk/hazard, expected actions, preparedness and protective actions, links to additional resources, and any relevant location-specific information.

## References

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Wildfire Smoke – A Guide for Public Health Officials (US EPA et al, August 2019):

<https://www3.epa.gov/airnow/wildfire-smoke/wildfire-smoke-guide-revised-2019.pdf>

California Department of Industrial Relations (Cal/OSHA) – Protection of Workers from Wildfire Smoke:

<https://www.dir.ca.gov/dosh/doshreg/Protection-from-Wildfire-Smoke/>

US EPA AirNow website “Fires and Your Health”:

[https://www.airnow.gov/index.cfm?action=topics.smoke\\_events](https://www.airnow.gov/index.cfm?action=topics.smoke_events)

US EPA – Air Quality and Outdoor Activity Guidance for Schools (EPA-456/F-14-003, Aug 2014):

<https://www3.epa.gov/airnow/flag/school-chart-2014.pdf>

PurpleAir Frequently Asked Questions (FAQ):

<https://www2.purpleair.com/community/faq>

NCAA Sport Science Institute – Poor Air Quality Guidance (September 2018):

<http://www.ncaa.org/sport-science-institute/air-quality>

Lawrence Berkeley National Lab website “Indoor Air Quality”:

<https://iaqscience.lbl.gov/>

University of California HR Policy PPSM-2.210 - Absence from Work:

<https://policy.ucop.edu/doc/4010406/PPSM-2.210>

Broadcastify Public Safety Scanner Radio Feeds (California statewide):

<https://www.broadcastify.com/listen/std/6>

US Forest Service Wildland Fire Air Quality Response Program (WFAQRP) online tools:

<https://sites.google.com/firenet.gov/wfaqrp-airfire-tools/>

# Appendix A: Systemwide Working Group Charge Letter

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UNIVERSITY OF CALIFORNIA

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May 2, 2019

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**Kum-Kum Bhavnani, Vice Chair - Academic Council, UCOP**  
**Joe Brothman, Director - Safety, Security, & Emergency Management, UCI** **Jim**  
**Cesear, Campus Emergency Manager, UCSB**  
**Pat Goff, Executive Director - Environment, Health & Safety, UCB**  
**Mark Freiberg, Executive Director - Environment, Health & Safety, UCSF** **Chuck**  
**Haines, Assistant Chancellor - Budget and Planning, UCSB**  
**Barton Lounsbury, Senior Counsel, UCOP**  
**Lisa Martin, Campus Emergency Manager, UCR** **Charles**  
**Nies, Vice Chancellor - Student Affairs, UCM**  
**Kelly Ratliff, Vice Chancellor - Finance, Operations and Administration, UCD** **Alysson**  
**Satterlund, Vice Chancellor - Student Affairs, UCSD**  
**Steve Sutton, Vice Chancellor - Student Affairs, UCB** **Hayley**  
**Weddle, Student Regent, UCSD**

Dear Colleagues:

We are pleased to appoint you formally and welcome you as members of the Systemwide Air Quality Protocol Working Group.

As you know, the 2018 wildfire season, which was the deadliest and most destructive wildfire season on record in California, greatly impacted a number of our campuses. In order to prepare for future disasters, we are forming the Systemwide Air Quality Protocol Working Group (“Working Group”) to explore issues and develop recommendations for how campuses respond to situations that require full or partial campus curtailment due to air quality issues.

As presented in the attached overview document, the Working Group will address what should be systemwide standards and what should be campus-specific guidelines. The Working Group will also evaluate the implications of the recommendations on UC stakeholders including students, faculty, staff and visitors to campus.

The Working Group will be chaired by UCLA’s Administrative Vice Chancellor Michael Beck and sponsored by Chief Operating Officer and Chief of Staff to the President Rachael Nava, Chief Financial Officer Nathan Brostrom, Provost Michael Brown, and Chief Risk Officer Cheryl Lloyd. It is empowered to work with all relevant offices and personnel at the UC Office of the President and throughout the UC system to develop recommendations that will be delivered to the President and the Council of Chancellors.



Your support will be invaluable to the Working Group as it works to address a number of issues including:

- Air-quality standards – What policies / guidelines do campuses already have in place for situations such as serious air quality issues? When it is appropriate to close/curtail the campus and what does that mean?
- Administrative considerations – Who has the authority to issue a curtailment of campus operations and for what duration? What should be the systemwide standard protocol and what should be left to the discretion of campuses?
- Academic considerations – What are the impacts of campus curtailments on the academic activities of the campus?
- Financial and Employment considerations – What are the financial implications of curtailing specific campus operations?

Your Chancellor was consulted in advance of this letter being sent and is supportive of your service on this working group. Your work will bolster UC's mission to serve our students, faculty, and staff during very challenging times that require full or partial campus curtailment due to air quality issues. We appreciate your willingness to serve on this critical body.

Sincerely,



Rachael Nava  
Chief Operating Officer and  
Officer Chief of Staff to the President



Nathan Brostrom  
Chief Financial

#### Attachments

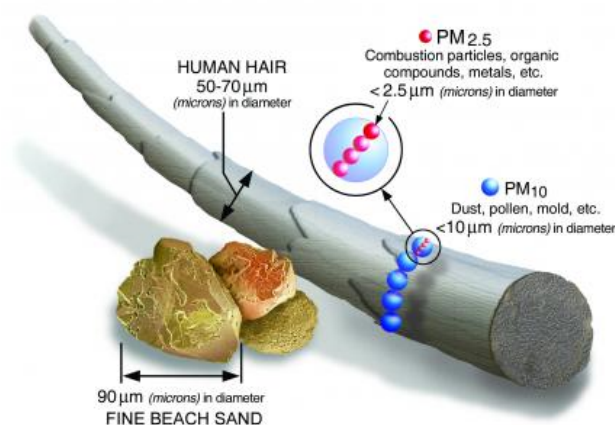
cc: Chancellors  
Administrative Vice Chancellor Michael Beck  
Provost Michael Brown  
Chief Risk Officer Cheryl Lloyd  
Chief of Staff Cathy O'Sullivan  
Director Robert Charbonneau  
UC Systemwide Readiness Lead Amina Assefa

# Appendix B: UC Industrial Hygiene Workgroup Wildfire Smoke Air Monitoring Recommendations

September 19, 2019

## Background

Wildfire smoke is a complex mixture of carbon dioxide, water vapor, carbon monoxide, particles, hydrocarbons, other organic chemicals, nitrogen oxides, and trace minerals. Particles in smoke tend to be very small and can be inhaled into the deepest parts of the lung. PM<sub>2.5</sub> refers to particulate matter with a diameter of 2.5 microns or smaller; these fine particles are the principal pollutant of health concern from wildfire smoke for short-term exposures (hours to weeks) [[AirNOW FAQs](#)].



Source: [EPA Particulate Matter Basics](#)

## Air Quality Index (AQI)

The US Environmental Protection Agency (EPA) has assigned a specific color to each AQI category to make it easier for people to understand quickly whether air pollution is reaching unhealthy levels in their communities. The AQI reported on the EPA’s AirNOW website reflects measurements collected via Federal Reference or Federal Equivalent Method (FR/FEM) monitors, typically calibrated and maintained by the regional air district. PM<sub>2.5</sub> concentrations corresponding to the six AQI categories are provided here; or the [AQI Calculator](#) on the AirNOW website may be utilized to convert measured PM<sub>2.5</sub> concentrations to the AQI.

<i>PM<sub>2.5</sub> in micrograms per cubic meter</i>	<i>Air Quality Index Categories for PM<sub>2.5</sub></i>
0 to 12.0	0 to 50 Good
12.1 to 35.4	51 to 100 Moderate
35.5 to 55.4	101 to 150 Unhealthy for Sensitive Groups
55.5 to 150.4	151-200 Unhealthy
150.5 to 250.4	201 to 300 Very Unhealthy
250.5 to 500.4	301-500 Hazardous

### Cal/OSHA's Emergency Standard 5141.1

The Cal/OSHA Protection from Wildfire Smoke emergency standard ([Title 8 § 5141.1](#)), adopted July 18, 2019, does not mandate that employers perform PM<sub>2.5</sub> monitoring in the workplace. It allows California employers to:

- (1) Check AQI forecasts and the current AQI for PM<sub>2.5</sub> from any of the following: U.S. EPA AirNow website, U.S. Forest Service Wildland Air Quality Response Program website, California Air Resources Board website, local air pollution control district website, or local air quality management district website; or
- (2) Obtain AQI forecasts and the current AQI for PM<sub>2.5</sub> directly from the EPA, California Air Resources Board, local air pollution control district, or local air quality management district by telephone, email, text, or other effective method; or
- (3) Measure PM<sub>2.5</sub> levels at the worksite and convert the PM<sub>2.5</sub> levels to the corresponding AQI in accordance with § 5141.1 Appendix A.

Although not required by § 5141.1, PM<sub>2.5</sub> monitoring on campus could be valuable for operational decision-making regarding both indoor and outdoor activities. It is possible that regional AirNOW measurements may not accurately reflect air quality at all campus locations due to variable weather patterns, geography, elevation, and contribution from other particulate sources. Government-maintained monitors by Basin/County/District are searchable via the California Air Resources Board website <https://ww3.arb.ca.gov/qaweb/siteinfo.php>. Only UC Davis currently has a continuous PM<sub>2.5</sub> monitor installed on campus that is maintained by the regional air district with data accessible via AirNOW.

### PM<sub>2.5</sub> Instrumentation

Traditional reference methods to quantify PM<sub>2.5</sub> mass concentrations in air are based on gravimetric analysis, i.e. particles are collected on a filter and manually weighed. The flow rate and volume of air sampled must be measured and a size-selector like a cyclone or impactor is used to exclude particles with diameter greater than 2.5 microns. This type of method is labor-intensive and can not provide real-time data, but is still used for reference and for projects when high-accuracy is required.

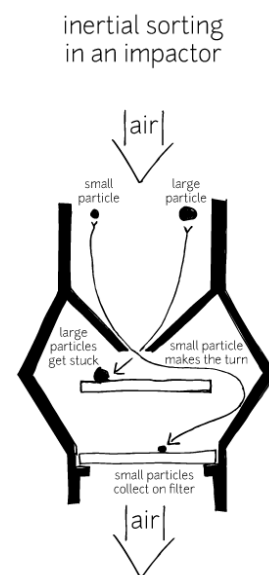
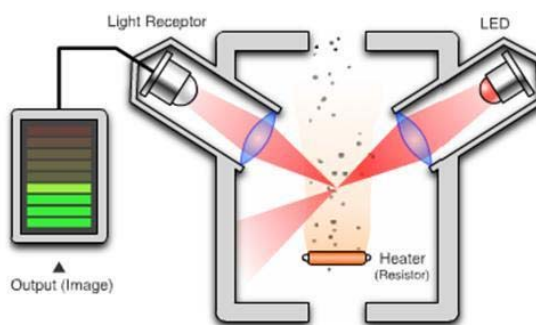


Image Source: [Publiclab.org](https://www.publiclab.org/)

The EPA has validated a number of PM<sub>2.5</sub> continuous monitors as Federal Equivalent Methods (FEM) for ambient air pollution monitoring. Many of these monitors use optical sensors (e.g. Grimm Model EDM 180) or beta attenuation (e.g. Met One BAM-1020 Monitor, Teledyne Model 602). These methods are accurate and reliable, but are expensive and the instrumentation requires routine maintenance and calibration. FEM monitors reporting via AirNOW provide a 24 hour average, as well as current conditions updated hourly ([more information about the AirNOW current conditions NowCast algorithm is available here](#)).

Low-cost sensors do not meet the EPA's Federal Reference/Federal Equivalent Method (FR/FEM) standards, but due to affordability, simple installation procedures, and minimal maintenance, they are being utilized wide-spread in our communities to provide local air quality data to supplement regional FR/FEM monitors maintained by government agencies. Low-cost sensors use lasers to count particles in real time. Because particles in air reflect light, the reflection can be measured as a pulse and used to determine the size of the particle and particle count. Evaluation data on low-cost sensor performance is available from many sources; for example the South Coast Air Management District Air Quality – Sensor Performance Evaluation Center provides a valuable summary on their website <http://www.aqmd.gov/aq-spec/evaluations>.

Some low-cost sensors display results on the device; others upload data via wifi or cellular networks to publicly-accessible web portals or maps. Lawrence Berkeley Lab (LBL) has had Purple Air II low-cost sensors installed for over a year (one outdoors on a weather station tower and others indoors) and noted that variability is high during wildfire smoke events, but access to real-time local data for relative comparison to other locations was “indispensable” during the Camp Fire of 2018.



PM Sensor Operation Diagram. Source: [SCAQMD AQ-SPEC](#)

### *Limitations*

Widespread use of low-cost sensors is relatively new; durability and longevity of the sensors is uncertain and there may be potential for bias or drift over time because the sensors are not directly calibrated against a reference once deployed and installed. Concerns about potential bias exist for all real-time optical sensors, specifically the tendency to report high during wildfire smoke events unless regional correction factors are developed and utilized. Per air monitoring guidance from the National Wildfire Coordination Group, optical instruments should be calibrated against a co-located Federal Reference in the same area, and pollutant mix, that they will operate.

## Fixed Outdoor PM<sub>2.5</sub> Sensor Recommendation



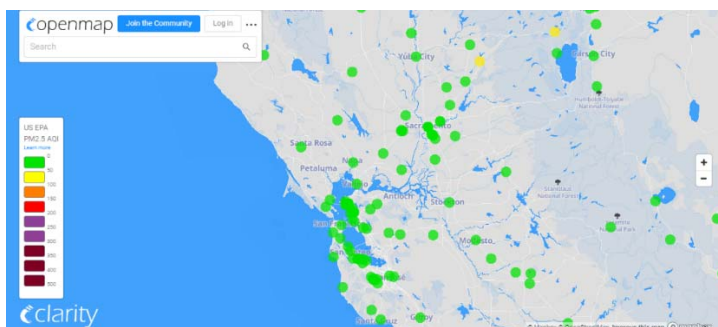
### Clarity Node C (\$200 each)

**Recommendation:** Install three to five low-cost outdoor sensors per campus for a two year pilot project to improve local real-time PM<sub>2.5</sub> data.

**Installation strategy:** On accessible rooftops representing quadrants of campus, various elevations for hilly campuses, and/or satellite campuses when appropriate.

**Meanwhile, in consultation with the Campus Environmental Program Managers, UCIH and/or the EHSLC, UC representatives should meet with CARB and evaluate the feasibility of installing and maintaining one Federal Equivalent Method PM<sub>2.5</sub> continuous monitor such as a Teledyne or Met One station at each campus to serve as a reliable reference monitor.**

Clarity sensors use lasers to count particles like other low-cost sensors; but these sensors are unique because they adjust their measurement algorithms as regulatory data in the area is made available. This “smart calibration” process allows the sensors to correct their estimation methods based on more precise readings in the area, minimizing any bias that may be formed over time (per San Joaquin [Valleyair](#) report). Clarity is also a California company with existing affiliations to UC. A partial list of UC faculty references is provided as an appendix to this document. Due to these partnerships, Clarity has offered UC an educational discount and is able to provide three to five sensors for each campus immediately at \$200 each (up to 50 sensors total). Installation is simple and could be completed by EH&S and/or Facilities staff once target locations/rooftops are identified at each campus. Clarity Nodes require a standard electrical outlet and transmit data via wi-fi. PM<sub>2.5</sub> measurements can be made publicly available via [OpenMap](#). The optical sensors do not require any calibration by the end user; maintenance is limited to troubleshooting connectivity issues. **Longevity is unknown; thus a two-year pilot project with subsequent re-evaluation is recommended.**



## Alternatives Considered

Low-cost PM<sub>2.5</sub> sensors: PurpleAir PA-II sensors are widespread and low-cost (around \$200); and the [PurpleAir Map](#) platform is well designed. Correlation data during field evaluations looks good, but currently only two conversions are available via PurpleAir based on conditions in Utah and Oregon; it's unclear if the conversions provide an accurate estimate for wildfire smoke events in California. Also of note, for a number of UC campuses, adding a few more outdoor PurpleAir data points would not provide much additional information as many publicly-available data points already exist.

FEM continuous PM<sub>2.5</sub> monitors: The California Air Resources Board (CARB) should be consulted regarding feasibility of installation of Federal Equivalent Method (FEM) monitors at all UC campuses. In parallel, an inventory and evaluation of existing fixed particulate monitors should be made UC systemwide, along with estimates of ongoing maintenance costs and/or actions needed to bring data back online if not currently in use (e.g. UC Berkeley has a Met One station installed on the roof of the Banway building that requires repairs and attention; and UCSB has an air district-maintained monitor site on campus [ARB# 42401](#), but it doesn't measure PM<sub>2.5</sub>). **Long term, having one FEM continuous PM<sub>2.5</sub> monitor at each campus would provide a valuable reference point, for operational decisions and researchers. Currently, only UC Davis has an air district-maintained FEM monitor installed on campus ([ARB# 57577](#)).**

## Portable PM<sub>2.5</sub> Indoor/Outdoor Survey Monitor Recommendation



### TSI DustTrak II or DRX Aerosol Monitors

Available in handheld and desktop models; purchase price \$6000-9500

**Recommendation:** Each campus EH&S should maintain a portable PM monitor to be used for general indoor air quality (IAQ) investigations. This type of instrument is a useful survey tool to compare conditions indoors versus outdoors and investigate specific tasks, workspaces, or sources of pollution.

#### Sampling strategy priorities during a wildfire smoke event:

- Buildings that lack HVAC systems with filters
- To verify that “cleaner air shelters” are operating as expected
- In response to complaints, requests, or time-sensitive special events

**Note:** During wildfire smoke events a direct reading carbon dioxide meter such as a TSI Q-Trak should also be carried during IAQ surveys if a building's outside air intake has been reduced. Building occupation without adequate fresh air intake can lead to elevated (exhaled) carbon dioxide levels and complaints of drowsiness, headaches, and dizziness among occupants.

The TSI DustTrak is a real-time laser photometer that serves as a valuable tool for a wide range of indoor air quality (IAQ) evaluations. Some models allow simultaneous measurement and data logging of mass fraction concentrations for Total PM, PM<sub>10</sub>, Respirable PM, PM<sub>2.5</sub> and PM<sub>1.0</sub>; others require an accessory PM<sub>2.5</sub> impactor for particle size selection. Most campuses have a TSI DustTrak currently available for routine IAQ evaluations (see attached campus inventory spreadsheet updated via UCIH September 6, 2019).

### *Limitations*

As a handheld survey tool, interpretation of fluctuating readings can be challenging for the operator. A sample duration of one hour in each location of concern will provide more representative data for comparison with the AQI than shorter samples, but in practice sample duration is limited if an operator is tasked with surveying an entire campus building or multiple buildings. The device is most useful as a comparison between indoor and outdoor environments and to evaluate specific operations that generate dust or aerosols. In wildfire smoke events, if the instrument is not custom calibrated, high readings on the order of 1.5 to 2 times actual PM<sub>2.5</sub> concentrations have been reported. McNamara, Noonan and Ward have published a recommended correction factor of 1.65 for measuring wood smoke that should be used as a default unless a custom calibration to wildfire smoke is performed. TSI uses Arizona road dust for standard calibration of the DustTrak; but provides [guidance on custom calibration](#) using a reference gravimetric 37 mm cassette sample. The instrument cost is approximately \$9000 along with annual calibration costs of approximately \$800 per year; but TSI DustTraks are already maintained by EH&S on most campuses for a wide variety of IAQ surveys.

## **Qualifications and Training Requirements**

As with all monitoring, results collected likely will indicate variation in PM<sub>2.5</sub> concentration between various indoor work environments due to mechanical ventilation system configuration, filter variation, passive airflow through open windows and doors, and indoor activities. EH&S Professionals should be available to review results with occupants; and if necessary, evaluate concerns further and coordinate any work orders in partnership with supervisors, the Building Manager, and/or Facilities Services.

All personnel conducting PM<sub>2.5</sub> surveys (portable instrumentation) or interpreting data from fixed sensors in response to wildfire smoke events should have:

- 1) Experience collecting environmental samples and/or performing exposure assessments; and
- 2) A basic understanding of the air quality index, smoke composition, building HVAC systems, and the limitations of the monitoring equipment.

At a minimum, the **operations manual** for monitoring equipment should be reviewed before use as well as “Section III: Specific Strategies to Reduce Exposure to Wildfire Smoke” and “Appendix D: Guidance on Protecting Workers in Offices and Similar Indoor Workplaces from Wildfire Smoke” of the document **Wildfire Smoke: A Guide for Public Health Officials** (a joint product of the U.S. Environmental Protection Agency, U.S. Forest Service, U.S. Centers for Disease Control and Prevention, and California Air Resources Board, latest 2019 version). Other useful references are listed below.

## References

### *Background*

AirNOW <https://airnow.gov/>

AirNOW NowCast Algorithm: <https://airnow.zendesk.com/hc/en-us/articles/211625478-How-is-the-NowCast-algorithm-used-to-report-current-air-quality->

AQI Calculator <https://airnow.gov/index.cfm?action=airnow.calculator>

California Air Resources Board (CARB) monitors by Basin/County/District: <https://ww3.arb.ca.gov/qaweb/siteinfo.php>

Cal/OSHA Protection from Wildfire Smoke emergency standard ([Title 8 § 5141.1](#)), adopted July 18, 2019 <https://www.dir.ca.gov/oshsb/Protection-from-Wildfire-Smoke-Emergency.html>

EPA Air Sensor Toolbox: <https://www.epa.gov/air-sensor-toolbox/how-use-air-sensors-air-sensor-guidebook>

EPA Particulate Matter Basics: <https://www.epa.gov/pm-pollution/particulate-matter-pm-basics#PM>

EPA report: New Paradigm on Air Pollution Monitoring [https://www.epa.gov/sites/production/files/2018-03/documents/final\\_em-3\\_master\\_slide\\_set.pdf](https://www.epa.gov/sites/production/files/2018-03/documents/final_em-3_master_slide_set.pdf)

EPA Smoke Ready Toolbox: <https://www.epa.gov/smoke-ready-toolbox-wildfires>

Wildfire Smoke: A Guide for Public Health Officials, latest version <https://www3.epa.gov/airnow/wildfire-smoke/wildfire-smoke-guide-revised-2019.pdf> (2019)

### *Instrumentation*

EPA List of Federal Reference and Equivalent Methods for PM<sub>2.5</sub>: <https://www.epa.gov/air-research/epa-scientists-develop-and-evaluate-federal-reference-equivalent-methods-measuring-key>

National Wildfire Coordinating Group Smoke Management Guide, Chapter 10 Air Quality Monitoring for Smoke: [https://www.nifc.gov/smoke/smoke\\_monitoring.html](https://www.nifc.gov/smoke/smoke_monitoring.html)

SCAQMD, Air Quality Sensor Performance Evaluation Center: <http://www.aqmd.gov/aq-spec/evaluations>



## Appendix

### Clarity Supporting Documentation

Clarity Movement: <https://clarity.io/solution>

San Joaquin Air District Evaluation between PurpleAir (PA-II) and Clarity sensors ([link](#))

Faculty References from Clarity:

- **Dr. Brett Singer (LBNL)** <[BCSinger@lbl.gov](mailto:BCSinger@lbl.gov)>
  - *Actively using Clarity Nodes for Research*
- **Dr. Jovan Pantelic (UC Berkeley)** <[pantelic@berkeley.edu](mailto:pantelic@berkeley.edu)>
  - *2018 CITRIS Seed Fund Collaborator (Project PI)*
- **Dr. Rengie Chan (LBNL)** <[wrchan@lbl.gov](mailto:wrchan@lbl.gov)>
  - *Actively using Clarity Nodes for Research (with Brett Singer)*
- **Prof. Cesunica Ivey (UC Riverside)** <[cesunica@ucr.edu](mailto:cesunica@ucr.edu)>
  - *Actively using Clarity Nodes for Research*
- **Prof. Wolfgang Rogge (UC Merced)** <[wrogge@ucmerced.edu](mailto:wrogge@ucmerced.edu)>
  - *2018 CITRIS Seed Fund Collaborator (Co-PI)*
- **Prof. Mark Modera (UC Davis)** <[mpmodera@ucdavis.edu](mailto:mpmodera@ucdavis.edu)>
  - *2018 CITRIS Seed Fund Collaborator (Co-PI)*
- **Prof. Thomas Kirchstetter (UC Berkeley / LBNL)** <[TWKirchstetter@lbl.gov](mailto:TWKirchstetter@lbl.gov)>
  - *Assisted with our Co-Location Deployment at Bay Area Air Quality Management District (BAAQMD) Reference Site*

Example Collaborating UC Research Institutes (Data Beneficiaries):

- **Center for Information Technology Research in the Interest of Society (CITRIS)** <<https://citris-uc.org/>>
  - Contact(s): Prof. Costas Spanos (Executive Director) <[spanos@berkeley.edu](mailto:spanos@berkeley.edu)>; Dr. Camille Crittenden (Deputy Director <[ccrittenden@berkeley.edu](mailto:ccrittenden@berkeley.edu)>
- **Center for Environmental Research and Technology (CE-CERT) @ UC Riverside** <<https://www.cert.ucr.edu>>
  - Contact(s): Prof. Nicole Cleary (Deputy Director) <[nicole.cleary@ucr.edu](mailto:nicole.cleary@ucr.edu)>; Prof. Cesunica Ivey <[cesunica@ucr.edu](mailto:cesunica@ucr.edu)>

Node C Spec Sheet ([link](#))

### *TSI DustTrak Supporting Documentation*

Campus inventory of existing TSI dust monitors (spreadsheet attached)

TSI DustTrak™ II and DRX Aerosol Monitors Product Specifications: <https://tsi.com/dust-monitors/>

TSI DustTrak Custom Calibration Procedures: [https://www.tsi.com/getmedia/2fa507b0-111d-449f-8ebc-83e18ff413a1/EXPMN-005\\_DRX-Calibration?ext=.pdf](https://www.tsi.com/getmedia/2fa507b0-111d-449f-8ebc-83e18ff413a1/EXPMN-005_DRX-Calibration?ext=.pdf)

Published reference for using a correction factor of 1.65 for DustTrak surveys during wildfire smoke events: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4214921/>

Additionally, UC Davis has developed a training presentation for operation of their DustTrak aerosol monitor that will be shared systemwide via UCIH

Ventilation for Acceptable Indoor Air Quality: [ASHRAE 62.1-2016](#)

### **EHSLC Assignment to UCIH (for reference)**

- 1) Indoor/Outdoor Air Monitoring Program Recommendations by 9/15/2019
  - a. Identify instruments and develop written protocols for use systemwide in conformance with adopted Cal/OSHA Protection from Wildfire Smoke order 5141.1
    - i. Evaluate available PM<sub>2.5</sub> measurement products and make two instrument recommendations:
      1. One recommendation for fixed outdoor installations
      2. One recommendation for portable indoor/outdoor instrument
    - ii. Develop a set of qualifications and training requirements for individuals who operate the above recommended instruments.
    - iii. Develop an instrument calibration procedure for the above recommended instruments.
    - iv. Develop a sampling protocol for use systemwide using the above recommended instruments.
    - v. Develop a maintenance schedule for the above recommended instruments.

# Appendix C: AQI-Based Decision Making Matrix

Levels of Health Concern	PM2.5 (24hr avg; µg/m³)	Current AQI Value	Who is Affected?	Actions						
				Outdoor Workers/Volunteers	Classes	Campus Operations	Health System Operations	Athletics & Outdoor Rec	Outdoor Camps/Events	Pre-K -12
Good	0-12	0-50	None expected	No Action Anticipated	No Action Anticipated	No Action Anticipated	No Action Anticipated	No Action Anticipated	No Action Anticipated	No Action Anticipated
Moderate	12.1-35.4	51-100	Unusually Sensitive Individuals (people with lung and heart disease) may be affected.	• Unusually sensitive people may require work accommodations.	No Action Anticipated	No Action Anticipated	• In patient care areas, consider modifying filtered mechanical ventilation systems and/or implementing other controls to reduce outdoor air intake.	No Action Anticipated	No Action Anticipated	No Action Anticipated
Unhealthy for Sensitive Groups	35.5-55.4	101-150	Sensitive groups including people with heart or lung disease, older adults, pregnant women, and children.	• Workers in sensitive groups may require work accommodations.	No Action Anticipated	• Consider closing building doors and windows to reduce outdoor air intake.	• As feasible, modify filtered mechanical ventilation systems to reduce outdoor air intake in patient care areas.	• Medical/athletic staff/outdoor recreation staff should consult with individuals who fall into the sensitive groups about participation in practice, competition, and/or outdoor events.	• At higher end of range, consider moving activities indoors.	• For longer activities such as athletic practice, take more breaks and do less intense activities.
Unhealthy	55.5-150.4	151-200	Everyone	• Limit outdoor work and prolonged or heavy exertion if practicable. • Reassign employees who work outdoors for more than one hour or provide N95 respirators for voluntary use.	• Consider academic accommodations for students and faculty with pre-existing health conditions. • Consider cancelling or moving outdoor classes indoors.	• Consider making N95 respirators and use/care guidance available for voluntary use. • Consider increasing campus-managed shuttle/bus service. • As feasible, modify filtered mechanical ventilation systems to reduce outdoor air intake.	• Consider making N95 respirators and use/care guidance available for voluntary use. • In patient care areas, consider monitoring indoor air quality and implement mitigation actions if indoor AQI is within this range.	• Medical/athletic training staff should closely monitor the health of all athletes in practice and competition. Modifications to athletic activities should be considered and implemented as necessary. • Shorten/modify outdoor recreational activity to limit prolonged or heavy exertion.	• Consider cancellation of more intense outdoor events or move events indoors.	• For all outdoor activities, take more breaks and do less intense activities. • Consider moving longer or more intense activities indoors or rescheduling them to another day or time.
Very Unhealthy	150.5-250.4	201-300	Everyone	• Suspend outdoor work. If work is absolutely necessary, provide N-95 respirators for voluntary use.	• Per local procedures and in consultation with the divisional Academic Senate Chair or designee, cancel or restructure classes if current AQI levels have maintained in this range and are expected to continue (academic activities that support clinical operations or research may be excluded from cancellation).	• To the extent feasible, curtail campus operations. • Consider monitoring indoor air quality and implement mitigation actions if indoor AQI is within this range.	• To the extent feasible, curtail health system operations. • Consider monitoring indoor air quality and implement mitigation actions if indoor AQI is within this range.	• Outdoor athletic activities should be moved indoors or delayed, postponed, or relocated. • Cancel or move indoors outdoor recreational activities.	• Cancel outdoor events involving activity (e.g., sports). • Consider cancellation of outdoor events that do not involve activity (e.g., concerts).	• Close school if current AQI levels have maintained in this range and are expected to continue.
Hazardous	250.5-500.4	301-500	Everyone	• Follow recommendations for the Very Unhealthy category.	• Follow recommendations for the Very Unhealthy category.	• Follow recommendations for the Very Unhealthy category.	• Follow recommendations for the Very Unhealthy category.	• To the extent feasible, move indoors or delay, postpone, or relocate outdoor athletic activities. • Consider cancellation of indoor events/activities based on indoor air quality measurements.	• Cancel all outdoor events and camp activities. • Consider cancellation of indoor camps that require participants or families to travel to and from campus.	• Follow recommendations for the Very Unhealthy category.
Beyond the AQI	> 500.4	> 500	Everyone	All groups	• Follow recommendations for the Hazardous Category. • Suspend outdoor work and activities. If outdoor work is absolutely necessary, N95 respirators are mandatory and require training and fit testing.					

## Appendix D: Wildfire Smoke Response Roles and Responsibilities

These are the essential roles and responsibilities associated with wildfire smoke response. UC locations should add roles and responsibilities as appropriate and should reassign responsibilities as necessary to align with the location’s existing response plans and procedures.

Functional Area	Roles and Responsibilities
Academic Personnel and Staff Human Resources	<ul style="list-style-type: none"> <li>• Support implementation of telework agreements and develop return to work provisions</li> <li>• Provide input into messaging as necessary</li> <li>• Assist departments and employees to address personnel related matters (schedule modifications, alternate work locations, reasonable accommodations, modified duties) during AQI forecast of 151 or higher (“Unhealthy”) due to wildfire smoke</li> </ul>
Athletics and Recreation	<ul style="list-style-type: none"> <li>• Adjust outdoor activities as necessary to comply with public health guidance</li> <li>• Coordinate with NCAA on cancellation of any athletic competition</li> <li>• Consult with individuals who fall into the sensitive groups about participation in outdoor practice, competition, and events.</li> </ul>
Crisis Communication	<ul style="list-style-type: none"> <li>• Coordinate with Crisis Management Team (CMT) and assist as needed with development of messaging</li> <li>• Keep website(s) and social media updated with current information and links to available resources</li> <li>• Monitor social media for emerging issues and coordinate with EOC and/or CMT for response</li> <li>• Coordinate location-wide to gather information and distribute key public messaging</li> </ul>
Crisis Management Team	<ul style="list-style-type: none"> <li>• Determine need to cancel classes or curtail operations based on AQI forecast</li> <li>• Determine public messaging and communication strategies for key stakeholders, both external and internal</li> <li>• Consult with academic and student leaders on key decisions as needed</li> <li>• Approve location-wide messaging</li> </ul>
Emergency Management	<ul style="list-style-type: none"> <li>• Monitor regional air quality and notify the Crisis Management Team when AQI is forecasted for or reaches 101 (“Unhealthy for Sensitive Groups”) or higher due to wildfire smoke</li> <li>• Regularly monitor the AQI forecast and weather conditions</li> </ul>

Functional Area	Roles and Responsibilities
	<ul style="list-style-type: none"> <li>• Ensure emergency and continuity plans and procedures are current and accessible</li> <li>• Determine EOC activation level and facilitate activation</li> <li>• Provide situation summary reports to CMT</li> <li>• Issue emergency alert notifications when AQI is forecasted for or reaches 151 or higher (“Unhealthy”) due to wildfire smoke</li> </ul>
Environment, Health & Safety	<ul style="list-style-type: none"> <li>• Monitor local air quality sensors</li> <li>• Make safety recommendations</li> <li>• Provide input to public messaging as requested</li> <li>• Provide respirator fit testing and fit instructions to support use of N95 respirators</li> <li>• Monitor indoor air quality in buildings as needed</li> </ul>
Facilities Management/Physical Plant	<ul style="list-style-type: none"> <li>• Modify air handling units to reduce outside air intake, as appropriate</li> <li>• Regularly inspect local air quality sensors and perform routine maintenance</li> <li>• Coordinate with EH&amp;S regarding indoor air sampling</li> <li>• Conduct inventory of filtered mechanical ventilation systems</li> </ul>
Housing and Dining	<ul style="list-style-type: none"> <li>• Modify dining operations if necessary and feasible</li> <li>• If applicable, coordinate with Facilities Management/Physical Plant to ensure air handling units in residential housing buildings are working properly</li> <li>• If feasible, provide for cleaner air spaces in common residential areas</li> </ul>
Pre-K-12 Programs	<ul style="list-style-type: none"> <li>• Adjust outdoor activities to comply with public health guidance</li> <li>• If applicable, coordinate with Facilities Management/Physical Plant to ensure air handling units in classroom buildings are working properly</li> </ul>
Occupational Health	<ul style="list-style-type: none"> <li>• Provide input into health guidance developed for staff</li> </ul>
Student Health Services	<ul style="list-style-type: none"> <li>• Provide health subject matter expertise to CMT to assist in decision-making</li> <li>• Provide health input to all location-wide messaging</li> <li>• Post health information and resources on departmental website</li> <li>• Make available N95 respirators to students with medical needs (for AQI forecast of 101 or higher due to wildfire smoke)</li> <li>• Ensure adequate staffing for prolonged operations</li> <li>• Coordinate with Facilities Management to ensure air handling units in Student Health building(s) are working properly</li> </ul>

# Attachment 1: Cal/OSHA Section 5141.1 Protection from Wildfire Smoke.

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## (a) Scope.

### (1) This section applies to workplaces where:

- (A) The current Air Quality Index (current AQI) for PM2.5 is 151 or greater, regardless of the AQI for other pollutants; and
- (B) The employer should reasonably anticipate that employees may be exposed to wildfire smoke.

### (2) The following workplaces and operations are exempt from this section:

- (A) Enclosed buildings or structures in which the air is filtered by a mechanical ventilation system and the employer ensures that windows, doors, bays, and other openings are kept closed to minimize contamination by outdoor or unfiltered air.
- (B) Enclosed vehicles in which the air is filtered by a cabin air filter and the employer ensures that windows, doors, and other openings are kept closed to minimize contamination by outdoor or unfiltered air.
- (C) The employer demonstrates that the concentration of PM2.5 in the air does not exceed a concentration that corresponds to a current AQI of 151 or greater by measuring PM2.5 levels at the worksite in accordance with Appendix A.
- (D) Employees exposed to a current AQI for PM2.5 of 151 or greater for a total of one hour or less during a shift.
- (E) Firefighters engaged in wildland firefighting.

(3) For workplaces covered by this section, an employer that complies with this section will be considered compliant with sections 5141 and 5155 for the limited purpose of exposures to a current AQI for PM2.5 of 151 or greater from wildfire smoke.

## (b) Definitions.

Current Air Quality Index (Current AQI). The method used by the U.S. Environmental Protection Agency (U.S. EPA) to report air quality on a real-time basis. Current AQI is also referred to as the “NowCast,” and represents data collected over time periods of varying length in order to reflect present conditions as accurately as possible.

The current AQI is divided into six categories as shown in the table below, adapted from Table 2 of Title 40 Code of Federal Regulations, Part 58, Appendix G.

*Air Quality Index (AQI)*

*Categories for PM2.5 Levels of Health Concern*

0 to 50	Good
51 to 100	Moderate
101 to 150	Unhealthy for Sensitive Groups
151 to 200	Unhealthy
201 to 300	Very Unhealthy
301 to 500	Hazardous

NIOSH. The National Institute for Occupational Safety and Health of the U.S. Centers for Disease Control and Prevention. NIOSH tests and approves respirators for use in the workplace.

PM2.5. Solid particles and liquid droplets suspended in air, known as particulate matter, with an aerodynamic diameter of 2.5 micrometers or smaller.

Wildfire Smoke. Emissions from fires in “wildlands,” as defined in Title 8, section 3402, or in adjacent developed areas.

(c) Identification of harmful exposures. The employer shall determine employee exposure to PM2.5 for worksites covered by this section before each shift and periodically thereafter, as needed to protect the health of the employee, by any of the following methods:

(1) Check AQI forecasts and the current AQI for PM2.5 from any of the following: U.S. EPA AirNow website, U.S. Forest Service Wildland Air Quality Response Program website, California Air Resources Board website, local air pollution control district website, or local air quality management district website; or

(2) Obtain AQI forecasts and the current AQI for PM2.5 directly from the EPA, California Air Resources Board, local air pollution control district, or local air quality management district by telephone, email, text, or other effective method; or

(3) Measure PM2.5 levels at the worksite and convert the PM2.5 levels to the corresponding AQI in accordance with Appendix A.

EXCEPTION: Subsection (c) does not apply where an employer assumes the current AQI for PM2.5 is greater than 500 and uses that assumption to comply with subsection (f)(4)(B).

(d) Communication. As required by section 3203, the employer shall establish and implement a system for communicating wildfire smoke hazards in a form readily understandable by all affected employees, including provisions designed to encourage employees to inform the

employer of wildfire smoke hazards at the worksite without fear of reprisal. The system shall include effective procedures for:

(1) Informing employees of:

(A) The current AQI for PM2.5 as identified in subsection (c); and

(B) Protective measures available to employees to reduce their wildfire smoke exposures.

(2) Encouraging employees to inform the employer of:

(A) Worsening air quality; and

(B) Any adverse symptoms that may be the result of wildfire smoke exposure such as asthma attacks, difficulty breathing, and chest pain.

(e) Training and instruction. As required by section 3203, the employer shall provide employees with effective training and instruction. At a minimum, this shall contain the information in Appendix B.

(f) Control of harmful exposures to employees.

(1) In emergencies, including rescue and evacuation, subsections (f)(2) and (f)(3) do not apply, and employers shall comply with subsection (f)(4). Emergencies include utilities, communications, and medical operations, when such operations are directly aiding firefighting or emergency response.

(2) Engineering Controls. The employer shall reduce employee exposure to PM2.5 to less than a current AQI of 151 by engineering controls whenever feasible, for instance by providing enclosed buildings, structures, or vehicles where the air is filtered. If engineering controls are not sufficient to reduce exposure to PM2.5 to less than a current AQI of 151, then the employer shall reduce employee exposures as much as feasible.

(3) Administrative Controls. Whenever engineering controls are not feasible or do not reduce employee exposures to PM2.5 to less than a current AQI of 151, the employer shall implement administrative controls, if practicable, such as relocating work to a location where the current AQI for PM2.5 is lower, changing work schedules, reducing work intensity, or providing additional rest periods.

(4) Control by Respiratory Protective Equipment.

(A) Where the current AQI for PM2.5 is equal to or greater than 151, but does not exceed 500, the employer shall provide respirators to all employees for voluntary use in accordance with section 5144 and encourage employees to use respirators. Respirators shall be NIOSH-approved devices that effectively protect the wearers from inhalation of PM2.5, such as N95 filtering facepiece respirators. Respirators shall be cleaned, stored, maintained, and replaced so that



they do not present a health hazard to users. Employers shall use Appendix B to this section in lieu of Appendix D to section 5144 for training regarding voluntary use of respirators.

NOTE: For voluntary use of filtering facepieces, such as N95 respirators, some of the requirements of section 5144 do not apply, such as fit testing and medical evaluations.

(B) Where the current AQI for PM2.5 exceeds 500, respirator use is required in accordance with section 5144. The employer shall provide respirators with an assigned protection factor, as listed in section 5144, such that the PM2.5 levels inside the respirator correspond to an AQI less than 151.

Note: Authority cited: Section 142.3, Labor Code. Reference: Sections 142.3 and 144.6, Labor Code.

**Appendix A to Section 5141.1. Protection from Wildfire Smoke Measuring PM2.5 Levels at the Worksite (Mandatory if an Employer Monitors with a Direct Reading Instrument)**

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(a) An employer may use a direct-reading particulate monitor to determine PM2.5 levels for section 5141.1, if the employer can demonstrate that it has complied with this appendix and selected a monitor that:

(1) Does not underestimate employee exposures to wildfire smoke; or

(2) May underestimate wildfire smoke exposures, but the employer has obtained information on the possible error of the monitor from the manufacturer or other published literature and has accounted for the error of the monitor when determining exposures to PM2.5 to ensure that employee exposure levels are not underestimated.

(b) The monitor shall be designed and manufactured to measure the concentration of airborne particle sizes ranging from an aerodynamic diameter of 0.1 micrometers up to and including 2.5 micrometers. The employer may use a monitor that measures a particle size range beyond these limits, if the employer treats the results as the PM2.5 levels.

(c) The employer shall ensure that the monitor it uses is calibrated, maintained, and used, including the use of necessary accessories, in accordance with the manufacturer's instructions for accurately measuring PM2.5 concentrations.

(d) The employer shall use the following table to convert the PM2.5 concentration to the AQI for PM2.5.

*PM2.5 in Micrograms per Air Quality Index (AQI)*

<i>Cubic Meter (<math>\mu\text{g}/\text{m}^3</math>)</i>	<i>Categories for PM2.5</i>
0 to 12.0	0 to 50
12.1 to 35.4	51 to 100
35.5 to 55.4	101 to 150
55.5 to 150.4	151 to 200
150.5 to 250.4	201 to 300
250.5 to 500.4	301 to 500

(e) The person supervising, directing, or evaluating workplace monitoring for PM2.5 shall have the training or experience necessary to apply this section and to ensure the correct use of the monitor and the interpretation of the results, so that exposures are not underestimated.

Note: Authority cited: Section 142.3, Labor Code. Reference: Sections 142.3 and 144.6, Labor Code.

## **Appendix B to Section 5141.1. Protection from Wildfire Smoke Information to Be Provided to Employees (Mandatory)**

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(a) The health effects of wildfire smoke.

Although there are many hazardous chemicals in wildfire smoke, the main harmful pollutant for people who are not very close to the fire is “particulate matter,” the tiny particles suspended in the air.

Particulate matter can irritate the lungs and cause persistent coughing, phlegm, wheezing, or difficulty breathing. Particulate matter can also cause more serious problems, such as reduced lung function, bronchitis, worsening of asthma, heart failure, and early death.

People over 65 and people who already have heart and lung problems are the most likely to suffer from serious health effects.

The smallest -and usually the most harmful -particulate matter is called PM2.5 because it has a diameter of 2.5 micrometers or smaller.

(b) The right to obtain medical treatment without fear of reprisal.

Employers shall allow employees who show signs of injury or illness due to wildfire smoke exposure to seek medical treatment, and may not punish affected employees for seeking such treatment. Employers shall also have effective provisions made in advance for prompt medical treatment of employees in the event of serious injury or illness caused by wildfire smoke exposure.

(c) How employees can obtain the current Air Quality Index (AQI) for PM2.5.

Various government agencies monitor the air at locations throughout California and report the current AQI for those places. The AQI is a measurement of how polluted the air is. An AQI over 100 is unhealthy for sensitive people and an AQI over 150 is unhealthy for everyone.

Although there are AQIs for several pollutants, Title 8, section 5141.1 about wildfire smoke only uses the AQI for PM2.5.

The easiest way to find the current and forecasted AQI for PM2.5 is to go to [www.AirNow.gov](http://www.AirNow.gov) and enter the zip code of the location where you will be working. The current AQI is also available from the U.S. Forest Service at <https://tools.airfire.org/> or a local air district, which can be located at [www.arb.ca.gov/capcoa/dismap.htm](http://www.arb.ca.gov/capcoa/dismap.htm). Employees who do not have access to the internet can contact their employer for the current AQI. The EPA website [www.enviroflash.info](http://www.enviroflash.info) can transmit daily and forecasted AQIs by text or email for particular cities or zip codes.

(d) The requirements in Title 8, section 5141.1 about wildfire smoke.

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If employees may be exposed to wildfire smoke, then the employer is required to find out the current AQI applicable to the worksite. If the current AQI for PM2.5 is 151 or more, the employer is required to:

- (1) Check the current AQI before and periodically during each shift.
- (2) Provide training to employees.
- (3) Lower employee exposures.
- (4) Provide respirators and encourage their use.

(e) The employer's two-way communication system.

Employers shall alert employees when the air quality is harmful and what protective measures are available to employees.

Employers shall encourage employees to inform their employers if they notice the air quality is getting worse, or if they are suffering from any symptoms due to the air quality, without fear of reprisal.

The employer's communication system is: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(f) The employer's methods to protect employees from wildfire smoke.

Employers shall take action to protect employees from PM2.5 when the current AQI for PM2.5 is 151 or greater. Examples of protective methods include:

- (1) Locating work in enclosed structures or vehicles where the air is filtered.
- (2) Changing procedures such as moving workers to a place with a lower current AQI for PM2.5.
- (3) Reducing work time in areas with unfiltered air.
- (4) Increasing rest time and frequency, and providing a rest area with filtered air.
- (5) Reducing the physical intensity of the work to help lower the breathing and heart rates.

The employer's control system at this worksite is: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(g) The importance, limitations, and benefits of using a respirator when exposed to wildfire smoke.

Respirators can be an effective way to protect employee health by reducing exposure to wildfire smoke, when they are properly selected and worn. Respirator use can be beneficial even when the AQI for PM2.5 is less than 151, to provide additional protection.

When the current AQI for PM2.5 is 151 or greater, employers shall provide their workers with proper respirators for voluntary use. If the current AQI is greater than 500, respirator use is required.

A respirator should be used properly and kept clean.

The following precautions shall be taken:

(1) Employers shall select respirators certified for protection against the specific air contaminants at the workplace. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Center for Disease Control and Prevention certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will list what the respirator is designed for (particulates, for example).

Surgical masks or items worn over the nose and mouth such as scarves, T-shirts, and bandannas will not provide protection against wildfire smoke. An N95 filtering facepiece respirator, shown in the image below, is the minimum level of protection for wildfire smoke.

(2) Read and follow the manufacturer's instructions on the respirator's use, maintenance, cleaning and care, along with any warnings regarding the respirator's limitations. The manufacturer's instructions for medical evaluations, fit testing, and shaving should also be followed, although doing so is not required by Title 8, section 5141.1 for voluntary use of filtering facepiece respirators.

(3) Do not wear respirators in areas where the air contains contaminants for which the respirator is not designed. A respirator designed to filter particles will not protect employees against gases or vapors, and it will not supply oxygen.

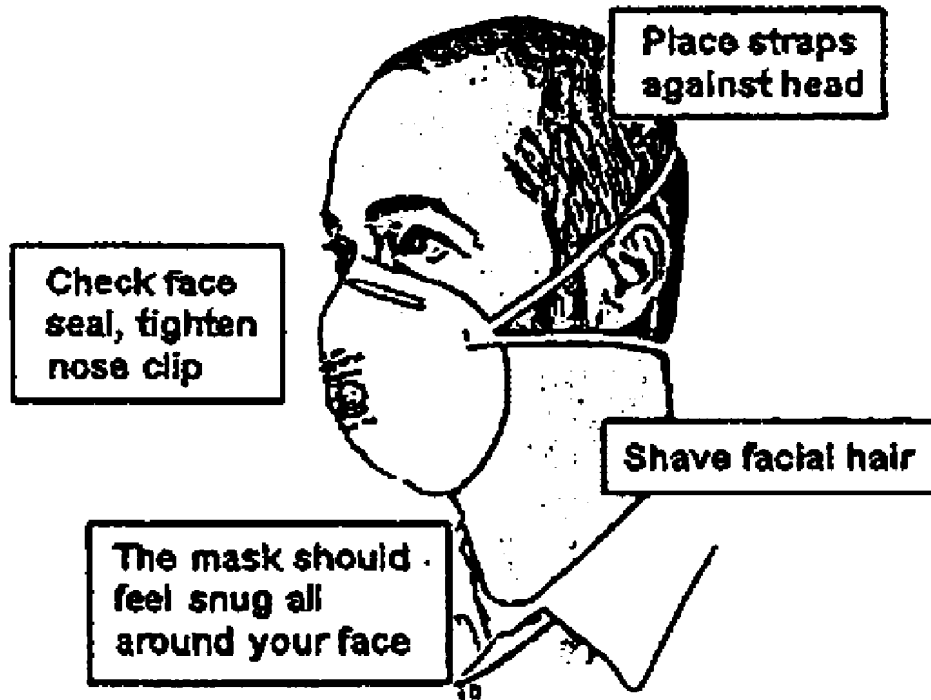
(4) Employees should keep track of their respirator so that they do not mistakenly use someone else's respirator.

(5) Employees who have a heart or lung problem should ask their doctor before using a respirator.

(h) How to properly put on, use, and maintain the respirators provided by the employer. To get the most protection from a respirator, there must be a tight seal around the face. A respirator will provide much less protection if facial hair interferes with the seal. Loose-fitting powered air purifying respirators may be worn by people with facial hair since they do not have seals that are affected by facial hair.

The proper way to put on a respirator depends on the type and model of the respirator. For those who use an N95 or other filtering facepiece respirator mask that is made of filter material:

- (1) Place the mask over the nose and under the chin, with one strap placed below the ears and one strap above.
- (2) Pinch the metal part (if there is one) of the respirator over the top of the nose so it fits securely.



***Drawing Showing Proper Fitting of a Filtering Facepiece Respirator  
(shaving is not required for voluntary respirator use)***

For a respirator that relies on a tight seal to the face, check how well it seals to the face by following the manufacturer's instructions for user seal checks. Adjust the respirator if air leaks between the seal and the face. The more air leaks under the seal, the less protection the user receives.

Respirator filters should be replaced if they get damaged, deformed, dirty, or difficult to breathe through. Filtering facepiece respirators are disposable respirators that cannot be cleaned or disinfected. A best practice is to replace filtering facepiece respirators at the beginning of each shift.

If you have symptoms such as difficulty breathing, dizziness, or nausea, go to an area with cleaner air, take off the respirator, and get medical help.

Note: Authority cited: Section 142.3, Labor Code. Reference: Sections 142.3 and 144.6, Labor Code.