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One Tribe, One Earth
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Wildfire Smoke: An Indoor-Air Issue

In August of 2015, two massive wild fires struck the Reservation of the Colville Confederated Tribes in NE Washington state, decimating more than 250,000 acres of tribal land, burning a dozen homes and destroying a quarter of Colville's timber resources.

The combined blazes sent resident asthmatics and others to the emergency room, jammed up travel, and disrupted the lives of residents throughout the area. Because visibility approached zero on stretches of the main tribal thoroughfare, roadblocks were erected to prevent vehicles from entering. Those within tribal boundaries who hadn't already fled were preparing to evacuate or knew someone who was evacuating.

Colville AQ Program Manager, Kris Ray.

The impact of the Tunk Block and North Star fires on Colville's ambient air quality was chokingly obvious. Inside many tribal buildings, the pollution threat was also evident. As the flames swept through Colville's forested acres, Kris Ray, Colville's Air Quality Program Manager, noted the thickening haze in his office. He decided to conduct a quick check on particulate matter levels.

A fire in 2012 that impacted the nearby town of Chelan had spurred an air quality pro there to perform similar indoor-air measurements. "That got me to thinking," Kris says, "which is why I purchased an Aeroset 831 portable monitor, so I could do that kind of work." He had just purchased the monitor a week earlier and hadn't yet operated it. But seasoned air pro that he is, he quickly reviewed the user's guide for the monitor and fired it up.

The outside air registered 980 µg/m3— 150 µg/m3 of Particulate Matter is considered a threat to human health, and it's finer cousin, PM2.5, is hazardous at far-lower levels. Kris knew PM levels in his office would be elevated, as bluish haze from the fire was visible around him. But he was taken aback by how much PM had penetrated tribal buildings. The initial reading was 405 µg/m3 (micrograms per cubic meter) of PM2.5. He would soon detect levels up to 800 µg/m3—far above the concentration considered hazardous to human health.

Kris decided to check the air in a number of tribal buildings. "The readings were one-minute averages," he says. "So I went to different spots in the buildings, usually starting from where office staff sit and moving back through, doing a few readings per room. About 3–5 readings per building were enough to get reliable averages." He was concerned by the levels he found in every building he monitored. PM2.5 concentrations ranged from 166 to 800 µg/m3—all falling within the unhealthy to hazard ranges. That included the tribes' Head Start office, childcare facility, IHS clinic, and administration and legal offices. On the second day of the fire, the PM level spiked in at least one indoor space to a dizzying 1403µg/m3. Elevated indoor PM levels would persist at Colville for the next three weeks.

Clearly, maximizing the value of indoor shelters was crucial for responding to this and future fire events. On his rounds, Kris began identifying simple practices that could increase the level of protection for those staying indoors during a fire.

He realized, for example, that few people really understood the dangers of smoke-saturated air. Although many of the structures are built with double-door entries to help keep cold air out during frigid months—and could provide a similar check on polluted air—some workers were opening those and other doors excessively. Some were propping nearby self-closing doors open so they could step outside for breaks. Masks were not widely available, and some office dwellers continued to run air conditioning units that drew smoke in from the outside.

"I hadn't given much thought about what to tell people," he says. "but they were dying for information." He handed out copies of U.S. EPA's Air Quality Index, a color-coded chart that delineates

health risks tied to increasing levels of air pollution, and he circled the levels he found in each space. "The AQI is really designed for ambient air," he says, "but I think the levels correspond to indoor air pretty well." He also roughed-out and distributed pamphlets on using masks and managing buildings for clean air, and distributed them to workers.

As volunteer nurses arrived and helped Colville's own health staff check on elders with asthma and heart-lung issues, Kris partnered with the tribes' Emergency Services and health workers to distribute masks and offer advice on protecting indoor air spaces, such as keeping doors and windows closed and turning off AC during heavy smoke events.

The main highway through the Colville Reservation was closed during the fire; during some periods visibility approached zero.

The event made clear to Colville air and health staff the value of guidance (still in development by tribal health workers) to address future wildfire smoke—which will almost certainly remain a problem in the foreseeable future due to drought and climate change; climate scientists predict an increase in wildfires throughout the Western U.S.


A portable AC unit recirculates room air, providing heat relief without drawing smoke from outside.

"Droughts will likely increase during the summers," Kris says. "There's a decrease in the snowpack, with more rain- than snow-dominated precipitation, which means the water doesn't stick around as long. So forests dry out and fires become more likely. We're also getting heavier wind events that last longer."

To address smoke-related threats to residents from his techie vantage apoint, Kris has developed Standard Operating Procedures (SOPs) to follow when conducting smoke monitoring. He says in the heat of the event, "I could have been a little more organized. I took a steno pad, and I barely knew how to operate the monitor."

Following up on Kris's initial efforts, Colville's health staff are preparing comprehensive guidance for those unable to leave the reservation during a smoke event (the protective principles can also apply in the case of silvicultural and fuel-reduction burns). Their "Smoke Ready Communities" approach will spell out a number of steps that Colville's residents—and any community—can take to address smoke pollution. The still-developing guidance is based on a three-tiered approach: What to do before, during and after a fire.

Before a Fire

Air program staff planning to monitor for indoor smoke should purchase portable monitors; Colville's Aeroset monitor is one of several that can perform PM and other readings. It's also important, Kris says, to develop SOPs for monitoring during a blaze, and to work up some data management principles to help you manage the monitoring information efficiently.

Evaluate your home and/or office for its potential to allow smoke intrusion. A few simple actions, such as installing or replacing weather-stripping around doors and windows, can make a difference during heavy smoke events.

Have a "clean room" within the home or building where you can stay during smoke events.

Purchase items to use in the event of a fire, such as N95 masks, in-room air conditioners, fans and air filters.


The Aeroset 831 portable monitor.

During a Fire

Smoke-related health symptoms include shortness of breath, watery eyes, coughing, and possibly disorientation caused by oxygen deprivation. Kris notes that disorientation can be a significant issue during a crisis. "You're probably already under stress, and because of a lack of oxygen you may not be making decisions very well, so it's harder to protect yourself." Smoke and CO/CO2 produce similar symptoms. The Aeroset monitor used at Colville measures PM2.5 and even finer particulates, and two other sensors track CO and CO2.

Some protective measures during a fire:

–Leave the area (safely) if possible.

–Wear an N95 mask to reduce exposure to smoke.

The guidance strongly suggests that those with respiratory problems should obtain doctor approval

before using a mask, which can constrict breathing to some degree.

–Keep doors and windows closed as much as possible.

–Use a fan to increase positive indoor-air pressure and help keep smoke out.

–Use air filters. Some include ozone generators, which their manufacturers claim can help draw particles from the air. U.S. EPA does not endorse the use of ozone-generating devices but does provide information on them (www.epa.gov/indoor-air-quality-iaq/ozone-generators-are-sold-air-cleaners).

A mask can help keep lungs clear of particluates.

–Turn off air conditioning units that draw air from outside. If AC use is necessary, use portable AC units (available at some home-improvement stores) that recirculate indoor air rather than drawing air from outside.

After a Fire

Thoroughly clean indoor surfaces. "After the fires," Kris says, "the tribal health insurance company spent a huge amount of money on cleaning buildings. The cleaners were here for over a month, cleaning about 20 buildings. Smoke tends to stick to everything, and then you rub up against it and the particles are re-released into the air. And smoke can be really greasy."

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