Wildfires and Water Quality

By Kelly A. Reynolds, MSPH, PhD

Wildfires in 2020 have reached record proportions in North America. These events are not only damaging to people, structures and land, but also dramatically impact source-water quality. Future predictions indicate worsening conditions and the need for proactive water treatment management.

A record year

California has recently experienced five of the top 20 largest wildfires in the history of the state. In the current year, over 8,400 wildfires have burned over four million acres in the Golden State, doubling the previous record and destroying over 9,200 structures and killing 31 people.[1] The California August Complex Fire, which started on August 10, has burned over a million acres and was still only 75-percent contained at the time of this writing. Further, over 16,000 firefighters continue to work on containing another 23 major blazes. With fire season typically spanning from August to November, experts fear these numbers could continue to increase. Dry, windy conditions, above-normal temperatures and no rainfall in the forecast continue to drive the risk of additional wildfires throughout the state.

Other western areas of the United States and Canada are also at risk. According to the National Interagency Fire Center's Coordination Center, "above normal significant fire potential is expected across much of California, Arizona, eastern Nevada, Utah, Colorado Rockies and southern Wyoming in October" with elevated fire-activity risks expected in November and into the winter for Oklahoma and Texas. The majority of fires in 11 US states are on US Forest Service or national park lands, including protected regions of Washington, Idaho, Wyoming, Colorado, Arizona and Montana. Likewise, approximately 80 percent of US freshwater resources also originate on forest lands. High-quality water from forested-source watersheds benefits from natural rainfall, storage and filtration, a process valued at $4.1 trillion US (2013 dollars) per year.[2]

Devastating effects

Many of the western wildfires were started by lightning. Others were accidental or suspected arson. All were further exacerbated by drought conditions. In much of the western US, an earlier than usual snowmelt and disappointing monsoon season intensified already dry regions. Climate change and wildfire mismanagement are also blamed for contributing to the crisis. Structures ever-encroaching on remote forest regions and fire-suppression strategies are additional controversial issues that likely contribute.[3]

Wildfires have a devastating impact on surrounding ecosystems, affecting soil, water and air-quality measures. After the flames are extinguished and the air clears, source waters continue to be polluted from land runoff and erosion contaminants choking lakes and streams and taxing municipal treatment works. According to the US Geological Survey, municipal water providers spent over $26 million on water quality treatments to remove wildfire-associated debris following two Colorado fires.[4]

The use of fire retardants can lead to an increase in chemicals (such as phosphates, nitrates and nitrites) and promote algal blooms in reservoirs. Changes in water chemistry can disrupt established biofilms in plumbing, leading to leaching of lead, copper and microbes or the formation of cancer-causing DBPs. Heavy metals and residuals from burned structures and melted plastics are additional sources of hazardous chemicals that can reach the water supply. Following the 2002 Hayman Fire in the Colorado Rocky Mountains, concentrations of arsenic, aluminum, cadmium, iron, lead and mercury were two to 2,500 times higher than normal.[2]

Treatment difficulties

In 2018, the Water Research Foundation (WRF) released *Wildfire Impacts on Drinking Water Treatment Process Performance: Development of Evaluation Protocols and Management Practices*[5] Researchers evaluated the effects and treatability of source waters impacted by wildfires in consideration of treatment plant operations and costs, while providing recommendations and a framework for water quality and treatment assessment. Changes in source water quality require corresponding responses in treatment works that can be difficult to synchronize. While eroding soil, ash, sediment and other fire debris from land runoff can be physically filtered from water supplies, other contaminants require advanced treatments.

Weeks following the 2017 Tubbs Fire in Santa Rosa, CA, residents continued to smell chemicals in their tap water. The smell turned out to be benzene in the water, a known carcinogen that is regulated by US EPA. The federal limit is five ppb but California set a more stringent standard at one ppb. Initial testing in Santa Rosa found concentrations of eight ppb, well above California's standard and even the higher federal standard. Additional testing reportedly resulted in some sites testing positive at levels of 40,000 ppb of benzene in the water (US EPA's hazardous waste threshold is 500 ppb).[6] The source of the benzene was not definitively identified; contaminated air, melted plastics and burning structures have all been suggested factors. The contaminants appeared to be stuck in the plumbing and distribution system, which required continuous flushing and even replacement of service lines to fix the problem. A similar scenario was documented in Paradise, CA following the 2018 Camp Fire. This time homeowners reported symptoms of nausea, light-headedness and other symptoms after showering in potentially contaminated water.

Other impacts of fire on water quality include changes in water flow and pressure due to fire-hydrant releases or power outages. During pressure losses, contaminants may be drawn into distribution pipes or water may sit stagnant at certain points in the line. Changes in water taste, odor and color may indicate a problem but many harmful contaminants cannot be detected by human senses, even at unsafe levels.

Prepare at the point of use

Wildfires are unpredictable and subsequent contamination potentials are difficult to foresee. Post-fire residuals in the environment threaten safe water supplies, the ecosystem and public health. History supports that adjusting water treatment works to handle the massive influx of contaminants may be problematic, resulting in delayed action and delivery of water that exceeds

regulatory health standards. At-risk regions should consider how tap-water supplies are affected and prepare for treatment at the point of use while supporting natural resource management groups.

How you can help

For information on how you can donate to help those affected by wildfire disasters or who are working on strategies to prevent and control wildfires, contact the Center for Disaster Philanthropy at www.disasterphilanthropy.org

References

1. *Welcome to Daily Wildfire Report*. https://www.fire.ca.gov/daily-wildfire-report/. Accessed October 12, 2020.
2. Bladon KD, Emelko MB, Silins U, Stone M. Wildfire and the future of water supply. *Environ Sci Technol.* 2014;48(16):8936-8943. doi:10.1021/es500130g
3. 'Wake-up call': wildfires tear through drought-plagued US southwest. *The Guardian*. https://www.theguardian.com/us-news/2020/aug/26/wildfires-us-south-west-colorado-arizona-new-mexico-utah. Accessed October 12, 2020.
4. USGS. *Water Quality After Wildfire*. https://www.usgs.gov/mission-areas/water-resources/science/water-quality-after-wildfire?qt-science_center_objects=0#qt-science_center_objects. Accessed October 12, 2020.
5. *Wildfire Impacts on Drinking Water Treatment Process Performance: Development of Evaluation Protocols and Management Practices*. The Water Research Foundation. https://www.waterrf.org/research/projects/wildfire-impacts-drinking-water-treatment-process-performance-development. Accessed October 12, 2020.
6. How Wildfires Are Contaminating The Water Supply With Benzene, Other Hazardous Chemicals. *Here & Now*. https://www.wbur.org/hereandnow/2020/10/02/wildfires-water-contamination. Accessed October 12, 2020.

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