# Air

**KEY PERFORMANCE MEASURES**

- *Levels of Particulate Matter Pollution*
- *Castle Creek Bridge Traffic Counts*
- *Radon Levels and Mitigation*
- *Ozone Levels*

***The Aspen community enjoys clean healthy air.*** *Aspen's air quality is one of the factors that distinguish it from other places. Residents and visitors alike expect and value clear skies and unpolluted indoor and outdoor air. Because Aspen has clean healthy air, residents can fully enjoy indoor and outdoor activities with reduced concern for their health, including reduced incidence of respiratory and cardiovascular illness and irritation.*

Clean air is a privilege that the City of Aspen has fought to attain and improve in past decades. While many visitors and residents now consider clear mountain vistas as essential to the Aspen experience, haze and smog were common not long ago. Industry, construction, traffic, natural geography, fireplaces, and restaurant grills all contribute to decreased air quality, visibility, and amplified health concerns.

Due to poor air quality in the 1970s and 1980s, Aspen reached "non-attainment" status with the EPA for PM 10 (coarse particulate) pollution. This means that PM 10 levels exceeded those deemed acceptable by the Clean Air Act. Aspen was then mandated to create an implementation plan to reach and maintain appropriate levels. Consequently, Aspen established a number of ordinances and programs to promote clean air. Drawing on the collaboration of a wide swath of sectors, these efforts include:

- Sweeping streets regularly
- Conditioning icy roads (washed rock vs sand)
- Prohibiting wood burning fireplaces
- Promoting public transit and paid parking
- Limiting restaurant char grill emissions
- Regulating fugitive construction dust

As a result, Aspen's air quality has greatly improved. In 2003, the community reestablished attainment status for PM 10. The Aspen community's response to PM 10 nonattainment is a great example of how the community can and should take action to combat air pollution. While important to celebrate these gains, continued focus on and dedication to Aspen's clean air, both indoor and out, remains paramount to the community's health. This is especially important given a growing population, burgeoning tourism industry, and petroleum-based transportation system. Moving forward, this will mean a stronger focus on the issues of PM 2.5, ozone, and radon.

In creating this report, a group of local stakeholder and experts convened to determine which key performance measures should be tracked to gauge the environmental sustainability of Aspen's air. The following four topics, introduced in greater detail on the following one-page dashboards, reflect their advice.

- *Levels of Particulate Matter Pollution*
- *Castle Creek Bridge Traffic Counts*
- *Radon Levels and Mitigation*
- *Ozone Levels*

Figure 1. Jannette Whitcomb, City of Aspen Air Quality Specialist, in front of the GRIMM air quality monitor.[3]

## Levels of Particulate Matter Pollution

The Clean Air Act's National Ambient Air Quality Standards (NAAQS) identify particulate matter (PM) as a criteria pollutant with public health and welfare impacts, meaning that it is dangerous to sensitive populations and can lead to decreased visibility and damage to animals, crops, vegetation, and buildings.[4]

The City of Aspen measures particulate matter pollution using a GRIMM air quality monitor, located at the Yellow Brick Building, at the intersection of Bleeker and Garmisch Streets. This location is representative of the general exposure to particulate matter pollution for the Aspen community.

There are varying sizes of PM, which have different health implications. Generally, the smaller the particle, the more detrimental to human health. Accordingly, Aspen conducts PM measurements in two size categories, "inhalable course particles" (PM 10), and "fine particles" (PM 2.5). See the perspective box below for more information.

A concise analysis of Aspen's historical and present PM levels can be seen in the following dashboard:

- *Levels of Particulate Matter Pollution*

In PM data, it is common to see hourly spikes in PM data, which are often attributed to hyper-local air quality events, such as an idling vehicle or the emissions of a fireplace. However, these local events dissipate quickly and are not good indicator of the community's air quality as a whole. For that reason, data is reported as a daily, 24-hour averages, which are telling of the more persistent presence of particulate matter in Aspen's air.

**PERSPECTIVE**

*The EPA groups particle pollution into two categories:*

*"'**Inhalable coarse particles,**' such as those found near roadways and dusty industries, are larger than 2.5 micrometers and smaller than 10 micrometers in diameter. '**Fine particles**,' such as those found in smoke and haze, are 2.5 micrometers in diameter and smaller. These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from power plants, industries and automobiles react in the air."*

## Castle Creek Bridge Traffic Counts

Vehicle traffic is a significant driver of air pollution. As one of the principle entry points into Aspen, the Castle Creek Bridge on Highway 82 proves a good site to track how the volume of vehicles has changed over time. In turn, they inform the City of the impact that the transportation sector has on air pollution. While this bridge is not the only entrance to town, and thereby cannot be used as a measurement of total traffic, data from this site can be tracked on a regular basis, and used as a proxy to gauge fluctuations in total vehicle trips.

[3] *City of Aspen Department of Environmental Health.*
[4] *"Criteria Air Pollutants." EPA. Environmental Protection Agency, Web. 31 Mar. 2016. <https://www.epa.gov/criteria-air-pollutants>.*

Consistent annual traffic counting commenced in 1999, using permanent counters located at intersection of Cemetery Lane and Highway 82. These calculations are used as key metric in the Transportation Chapter of the 2012 Aspen Area Community Plan, which asserts as one of its Primary Transportation Policies is to: "continue to limit Average Annual Daily Trips (AADT) to 1993 levels at the Castle Creek Bridge, and strive to reduce peak-hour vehicle-trips to below 1993 levels."[5]

The following dashboard provides a concise view of the historical and current Castle Creek Bridge Traffic Counts in Aspen.

- *Castle Creek Bridge Traffic Counts*

## Radon Levels and Mitigation

Just as outdoor indicators such as particulate matter, ozone, and traffic levels are important elements of air health, radon levels are a vital indicator of the indoor air quality. Radon is a naturally occurring gas that escapes from the ground and, where not properly mitigated, can be trapped inside the built environment. The presence of radon in the soil or rock below a building and the manner in which individual buildings are constructed to disperse or trap gases are the key factors contributing to indoor radon levels. The entire state of Colorado is considered at high risk for radon.[6]

### PERSPECTIVE

The Aspen community adopted an Ecological Bill of Rights in 1989. The first right listed claims:

*"The right to breathe clean air and enjoy clear vistas."*

The Vision Statement of the *2012 Aspen Community Plan's* Transportation Chapter affirms,

*"We are committed to providing an efficient, multi-modal and integrated transportation system that reduces congestion and air pollution.*

In 2003, the City of Aspen reached the EPA's "attainment" status for PM 10. This resulted from 15 years of creative and rigorous actions to improve air quality.

As the leading cause of lung cancer in non-smokers, high radon levels pose a severe risk to humans over periods of long exposure (years not months). This accounts for approximately 21,000 deaths per year.[7] Accordingly, the EPA has set the national action level for radon at 4.0 picocuries per liter of air (pCi/L).

There is no comprehensive radon database for all of Aspen's buildings. In efforts to encourage radon testing, and mitigation where needed, the City of Aspen and Pitkin County maintain a program that gives away free radon test kits. Over half of these tests have returned radon results above that action level. The corresponding one-page dashboard provides a concise view of the City of Aspen radon program and results:

- *Radon Levels and Mitigation*

If high levels are discovered, mitigation is relatively affordable and accessible for homeowners and individuals to lower long-term health risks. The City of Aspen offers resources on how residents can seek out professional, certified radon mitigation services in the Roaring Fork Valley.

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[5] *Aspen Area Community Plan. 2012. City of Aspen and Pitkin County. Web. <http://www.apcha.org/FINAL_AACP_2272012_reduced.pdf>.*
[6] *Whitcomb, Jannette. City of Aspen Department of Environmental Health. 2016.*
[7] *"Health Risk of Radon." EPA. Environmental Protection Agency, Web. <https://www.epa.gov/radon/health-risk-radon>.*

## Ozone Levels

Like particulate matter, ozone is classified by the EPA as one of the six principle pollutants categorized by the National Ambient Air Quality Standards (NAAQS). This means that at high levels, ozone is harmful to public health and the environment. Given Aspen is at higher elevation, the ambient ground ozone levels are higher than they would be at sea level, increasing the community's need to consider the pollutant's potential impacts.

Figure 2. Jannette Whitcomb conducts weekly checks on the Ozone Monitor located at the head of Cemetery Lane.[8]

In order to understand how to mitigate high ozone levels, it is important to know how ground ozone is made. Unlike many air pollutants which result from direct emission and can then be targeted at the source (such as tailpipe emissions), ground level ozone is created through a chemical reaction of nitrogen, volatile organic compounds (VOCs), and light. The precursors to ground level ozone are naturally occurring and man-made and originate from regional and local activities. The typical urban precursors to ground level ozone, such as traffic, regional oil and gas activity, power plants, industrial boilers, wildfires, and extreme winds, all impact Aspen.[9] Weather patterns play an important role in producing ozone; wind can transport precursor pollutants to Aspen from hundreds of miles where they originate. Interestingly, one of Aspen's largest source of VOCs is the natural process of trees budding in springtime, which releases high amounts of terpenes (a VOC) into the air.

The corresponding dashboard provides a concise view of ground level ozone pollution in Aspen and the community's performance in improving it:

- *Ozone Levels*

[8] *Armstrong, Laura. 2016.*
[9] *"Ozone Basics." EPA. Environmental Protection Agency, Web. 31 Mar. 2016. <https://www.epa.gov/ozone-pollution/ozone-basics>.*

**Current & Proposed Actions**

- Maintaining and improving Aspen's outdoor air quality (PM & Ozone) will require continued monitoring of long-term trends, as well as quick reactions to real-time spikes. Long-term strategies include: traffic and idling reduction, low or no-emissions vehicles, and increased participation in alternative transit.
- Current climate change modeling indicates ozone and PM 2.5 levels have the potential to rise in our region. Accordingly, focusing on climate change (including wildfire) mitigation and adaption is crucial for long term public health planning and resiliency.
- Frequent street sweeping in the winter and active construction dust suppression in the summer are also vital in limiting day-to-day jumps in PM.
- Traffic reduction measures include improvements in bike-ability and walkability, as well as the introduction of paid parking and dynamic pricing during peak seasons.
- Public transit: funds generated from parking fees are used to subsidize public transit. The City of Aspen, in collaboration with the Roaring Fork Transit Authority, has widely expanded mass transit options in Aspen and the surrounding communities to create the nation's first rural bus rapid transit system. Bus rides on City of Aspen routes are free.
- Aspen's local bike share organization, WeCycle, is expanding its reach within the City and to the neighboring town of Basalt.
- The City of Aspen offers free radon test kits to City residents and partners with Pitkin County and the Community Office for Resource Efficiency to make these tests available regionally. In future, special attention and dedicated outreach to those people who have tested for especially high radon levels is encouraged. Radon Mitigation can include sealing cracks and crawl spaces, as well as depressurization systems, such as vent pipes and fans.
- In the future, radon resistant new construction (RRNC) could be added into multi-family and commercial building codes. Ozone's source components must be reduced at the regional level by limiting vehicle emissions and other creators of NOx and VOC.

# Levels of Particulate Matter Pollution

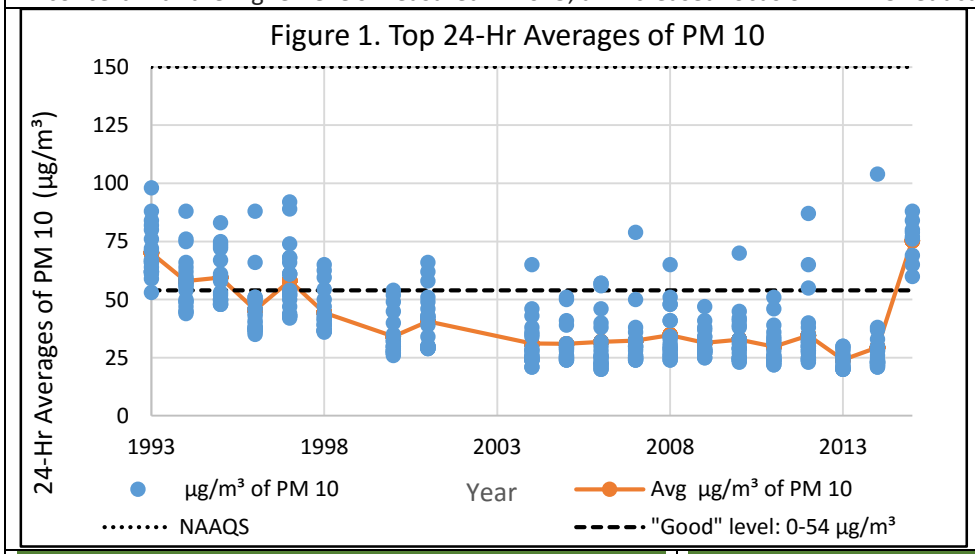
## What is it? Why is it important?

This measure indicates the level of particulate matter pollution in Aspen. Airborne particulate matter (PM) pollution is made up of a number of components, including acids, organic chemicals, metals, and dust particles, which impact human health and visibility. PM is quantified as coarse particles (PM 10) and fine particles (PM 2.5). Both pose a respiratory and cardiovascular threats to humans, but smaller particles cause greater harm as they more easily enter the nose, throat, and lungs. If a city exceeds the EPA's National Ambient Air Quality Standard (NAAQS) for PM more than once per year on average over 3 years, then it is designated with non-attainment status.[1] Aspen was designated with non-attainment in 1988 for PM 10, and through rigorous air quality improvement efforts regained attainment in 2003.

Aspen's relatively poorer air quality in 1970s and 1980s compared to cleaner present day.

## What does the data/trend say?

In Aspen, PM 10 is primarily a winter pollutant that results from cars grinding rock particles on the road and dispersing them into the air. Spikes can also result from regional wildfires, which are responsible for many of the highest values. As seen in Figure 1, the average level of PM 10 experienced over the 20 highest days in each year has decreased since local air quality measures were passed in the 1990s. In 2015, there were no 24-hr averages above the **PM 10** NAAQS level of 150 µg/m³, or for any year since 1993 (figure 1). In 2015, no 24-hr averages surpassed the EPA's **PM 2.5** NAAQS level of 35 µg/m³. The highest three 24-hour averages fell in mid-August with levels of 28.2, 27.6, and 20.6 µg/m³. In sum, Aspen's PM 2.5 was closer to unhealthy levels than PM 10. 2015 was the first year in which PM 2.5 data was collected in Aspen. Accordingly, no annual trends are available Historically, PM reduction strategies in Aspen have concentrated on PM 10. Given the City's current ability to measure PM 2.5 in concert with the higher levels measured in 2015, an increased focus on PM 2.5 reduction would be beneficial.




**2. In Progress: This is a placeholder for a graph that will show seasonal variation in high values of PM 10 and PM 2.5, using data from the past 5 years for PM 10 and the past year (all available data) for PM 2.5.**

## Targets

Aspen's Target is to not exceed the EPA's NAAQS levels for PM 10 and PM 2.5. **Aspen met its target in 2015** with no 24-hr averages above 150 µg/m³ for PM 10, or above 35 µg/m³ for PM 2.5.

## Data Sourcing and Considerations

In Figure 1, the data from 2015 jumps in level because a new monitoring system was adopted, not because of a dramatic increase in PM 10 levels. Between 1999 and 2003, several years were not included because they lacked several months of data. The highest PM 10 values in figure 1 are attributable to exceptional natural events, such as wind storms, stratospheric intrusions, and fires.

*Sources: [1] EPA NAAQS Table: https://www.epa.gov/criteria-air-pollutants/naaqs-table, [Photos] City of Aspen Department of Environmental Health and Sustainability*

# Castle Creek Bridge Traffic Counts

## What is it? Why is it important?

This metric is used to determine the success of traffic reduction measures, which reduce the impact of transportation on Aspen's air quality. In the nineties, community concern over traffic and congestion prompted the City of Aspen to begin tracking vehicle counts on the Castle Creek Bridge at the Northwest entrance of town. The City of Aspen is committed to not exceeding the 1993 baseline traffic levels. Consistent traffic counts began in 1999 and have continued to present day.[1]

## What does the data/trend say?

The 1993 baseline value for **Annual Average Daily Trips** (AADT) across Castle Creek Bridge is 23,675 trips, which **has not been exceeded** since data collection began in 1999. The lowest AADT value is 21,351 trips in 2010, since which values have risen annually to a total of 23,169 in 2015. **Monthly comparisons** show that in 2015, the number of daily trips in Apr., Nov., and Dec. **did exceed** 1993 monthly levels, while all other months fell below 1993 levels. Also of note is that in all months other than May 2015, monthly totals exceeded 2014 monthly totals (data is not available for Nov. and Dec. 2014).[2]

Figure 1. Annual Average Daily Trips over Castle Creek Bridge, as a Percent of Target Maximum

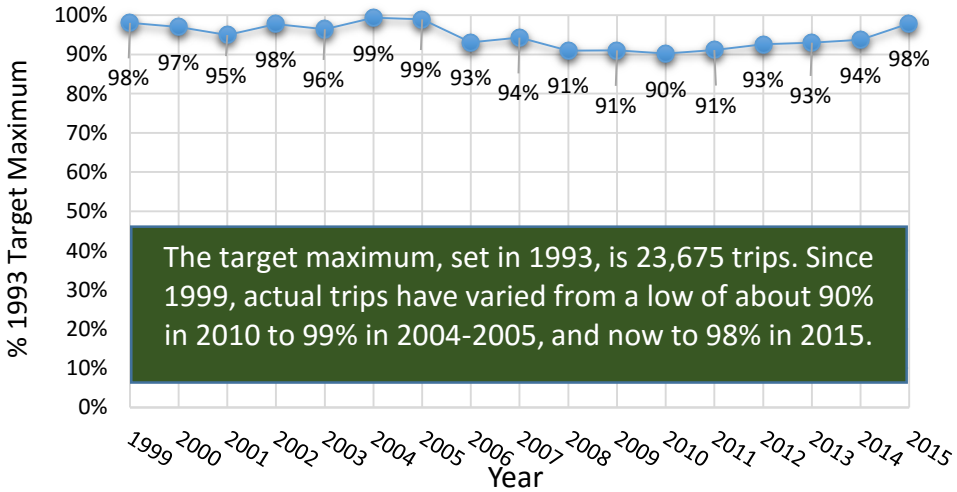
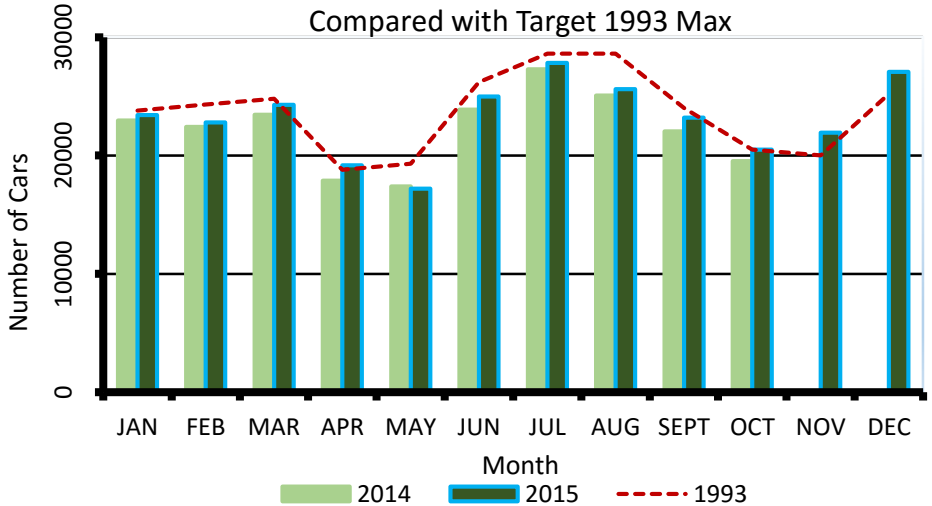



Figure 2. Castle Creek Bridge Traffic Counts Monthly Average Daily Trips: 2014, 2015 Compared with Target 1993 Max




## Targets

Castle Creek Bridge Traffic counts will remain below the 1993 baseline levels. **In AADT, Aspen has met its target in every year since 1999**. In 2015, the AADT was 506 trips lower than the 1993 baseline. However, **2015 monthly average daily trips exceeded 1993 counts in April, November, and December.** It is of note that April and November are low season months in Aspen, when traffic and resulting poor air quality are relatively low. Increased traffic in high-volume months, such as December, is more concerning for air quality concerns.

## Data Sources and Considerations

While this bridge is not the only entrance to town, and thereby cannot be used as a measurement of total traffic, data from this location can be monitored on a regular basis, and used as a proxy to gauge fluctuations in total vehicle trips.

*Sources: [1] [2] City of Aspen Department of Transportation [Photo] Armstrong, Laura. 2016.*

# Radon Levels and Mitigation

## What is it? Why is it important?

Radon is a radioactive gas found in nature, which comes from the decay of uranium atoms, and has no color, odor, or taste. There is no safe level of radon. However, the EPA has designated an action level of 4 picocuries per liter of air (pCi/L), above which building levels should be mitigated. A building with high levels of radon trapped within its walls poses a serious threat to health when humans are exposed over a 10 to 20-year period. Figure 1 demonstrates common ways that radon enters a building. Radon is the second leading cause of lung cancer and the number one cause among non-smokers. Radon is one of the identified priorities of the Pitkin County Public Health Improvement Plan. In order to encourage residents to test for and mitigate radon levels where needed, the City of Aspen began giving out grant-funded free radon test kits to residents in 2010.

## What does the data/trend say?

As seen in Figure 2, test kit results indicate that over 1/2 of tested homes have radon levels in excess of 4 pCi/L. Of the total of 496 test kits that have returned results since 2010, 226 (46%) of those showed results lower than the EPA action level. Of the 270 test kits with results above the action level, 74 have successfully mitigated to bring radon below 4 pCi/L, and 196 remain non-mitigated. This means that of those who have returned high radon results, 27.41% have successfully mitigated below the EPA action level.[1]

Home radon test kits are distributed by the City of Aspen and Pitkin County.

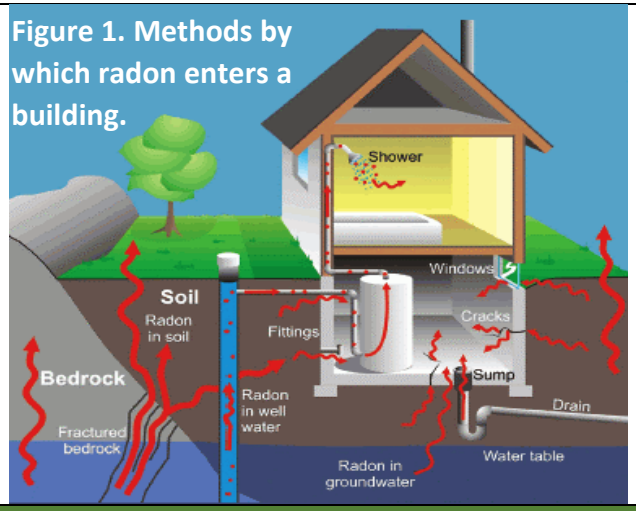



Figure 1. Methods by which radon enters a building.

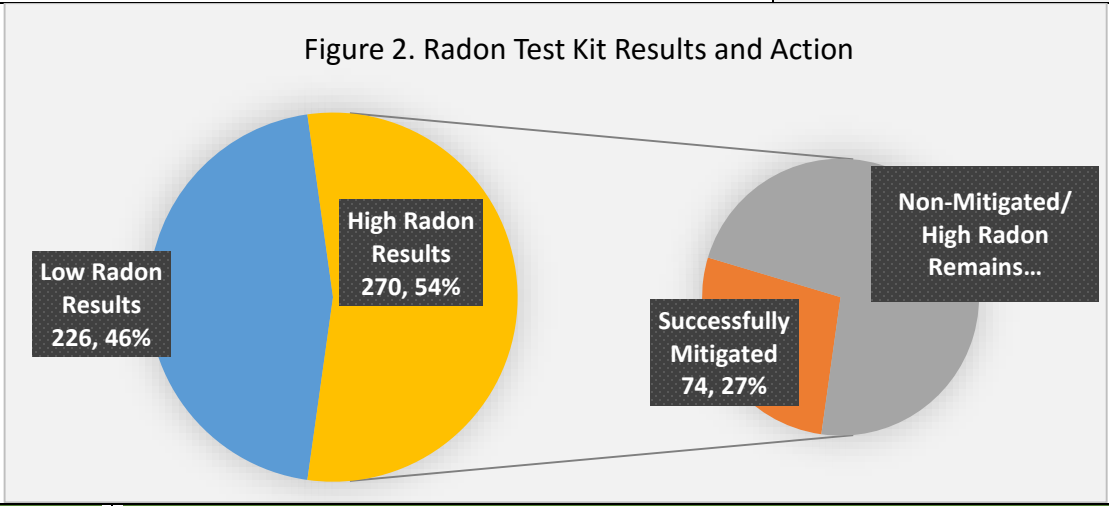



Figure 2. Radon Test Kit Results and Action

## Targets

Aspen's target is that 50% of homes* that test positively for high radon levels (above 4pc/L) will conduct mitigation to bring levels below 4 pCi/L. In 2015, Aspen did not meet its target, as only 27.41% of buildings in the City of Aspen Radon Database that initially returned high results have mitigated down to safe levels.

*This accounts for the homes that have submitted radon results to the City of Aspen, not all houses in the City.

## Data Sourcing and Considerations

The City of Aspen radon database contains only results from radon test kits that the City of Aspen has administered and or which have been voluntarily shared. Consequently, this data is limited by the fact that some residents choose to purchase test kits elsewhere. Additionally, of those who mitigate for radon, not all choose to share post-mitigation results with the City. Finally, some test kit users fail to indicate whether low results are naturally occurring or due to mitigation, which would reduce the number of successful mitigations that appear in this data.

*Sources: [1] [Figures 1,2] City of Aspen Department of Environmental Health [2] A Citizen's Guide to Radon: The Guide to Protecting Your Family and Yourself from Radon. Rep.: Environmental Protection Agency, 2012. [Photo] Armstrong, Laura. 2016.*

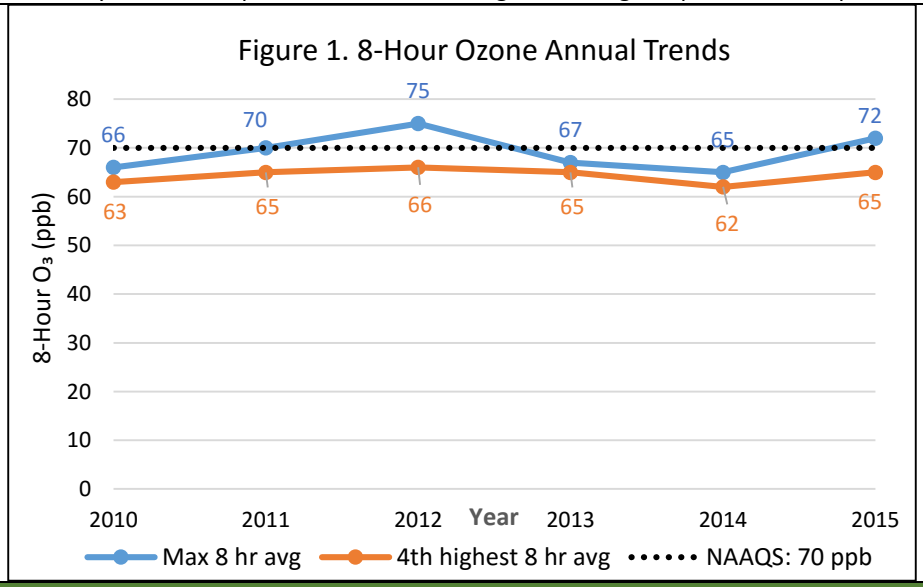
# Levels of Ozone

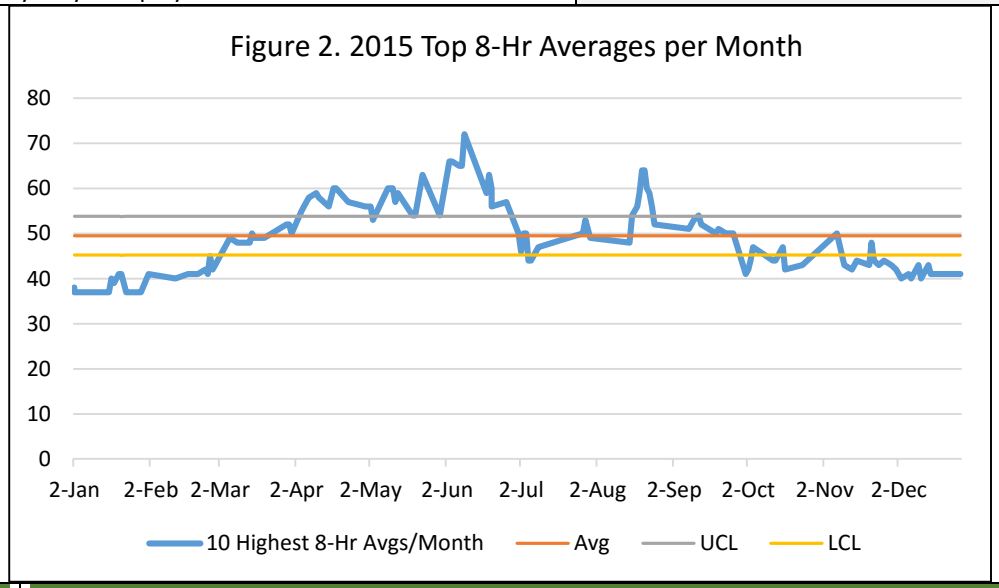
## What is it? Why is it important?

Ground level ozone ($O_3$) reduces visibility and is a respiratory irritant and illness promoter. It forms in the air when Nitrogen Oxides (NOx) and Volatile Organics (VOC) get "cooked" by sunlight or UV. High levels of $O_3$ are often caused by regional activity including traffic, oil and gas development, or natural weather and fire events. Unlike in many urban environments, Aspen's largest source of VOCs are terpenes released by trees budding in springtime. Stratospheric intrusions also influence ozone in Aspen. $O_3$ levels are reported in a top 8-hour average per day and are measured in parts per billion (ppb). The National Ambient Air Quality Standards (NAAQS) established by the EPA and Clean Air Act state that a city's annual fourth-highest daily maximum 8-hour concentration of ozone, averaged over 3 years, should not exceed 70 ppb.

## What does the data/trend say?

Figure 1 displays that while several of 8-hr averages between 2010-2015 did exceed the NAAQS, none of the fourth-highest daily max 8-hour concentrations of $O_3$ were in excess of that level. The 4th highest 8-hr average has ranged from 8 ppb below the NAAQS in 2014 to 4 ppb below in 2012. At this time, no specific incidents can be linked to these fluctuations. Figure 2 shows the seasonality of $O_3$ in 2015. The highest $O_3$ measurements were recorded in the spring months between April and June, which is most likely a reflection of the terpenes (a VOC) released by the natural process of trees budding. Increasing temperatures and photo-activity may also play a role.[2]




## Targets

Aspen's target is to meet the EPA's National Ambient Air Quality Standard for ozone. From 2010-2015, Aspen's fourth-highest daily maximum 8-hour concentrations of ozone have been lower than 70 ppb and thereby meeting the national standard.

## Data Sourcing and Considerations

Reliable ozone data collection began in Aspen in 2010. The upper control limit (UCL) and lower control limit (LCL) are not distributed above and below the majority of data points because the data is not distributed normally, but rather reflects seasonal variation.

*Sources: [1]* EPA NAAQS Table: *https://www.epa.gov/criteria-air-pollutants/naaqs-table [2] Jannette Whitcomb, City of Aspen Air Quality Expert and a Senior Environmental Health Specialist; City of Aspen Department of Environmental Health [Photo] Armstrong, Laura. 2016.*