2025

AirAware

1st Annual AIR QUALITY REPORT

Air Quality Monitoring in Community Spaces

This report establishes baseline, pre-intervention air quality at 3 YMCAs in the Los Angeles area from November 2024 to September 2025. In Fall of 2025, the filtration systems at each of the YMCAs will be upgraded, followed by another year of post-intervention air quality monitoring. Our 2nd Annual Report, will compare the pre and post intervention air quality results. The ultimate goal of the AirAware project is to advance cleaner indoor air and promote better air quality practices at these sites.

AirAware
1st Annual Air Quality Report

Prepared by the AirAware Team

October 22, 2025

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Executive Summary

Indoor and outdoor air monitoring as part of the AirAware Project has been ongoing since early November 2024 at the Corona-Norco Family, Southeast-Rio Vista, and Weingart East LA YMCAs. The primary focus of this project has been indoor and outdoor fine particulate matter ($PM_{2.5}$) at all three YMCAs with the addition of indoor and outdoor black carbon monitoring at the Weingart East LA YMCA. The project has followed routine maintenance and quality control operations to ensure the data being collected is both high quality and meaningful for analysis. This report focuses on the Phase 1 (pre-intervention) period of this project between November 2024 and the end of September 2025. During this period, indoor and outdoor air quality was most impacted in the winter season due to pollution from stagnant weather conditions and smoke from the Eaton and Palisades wildfires. The wildfires, in particular, highlighted the importance of sustained and effective air filtration in maintaining healthy indoor air quality conditions year round. Smoke from 4th of July fireworks also impacted outdoor and indoor levels across the YMCAs[1].

Comparison of indoor to outdoor air quality across the YMCAs shows that their baseline[2] HVAC filtration is generally working effectively at filtering out particles for indoor spaces, but these trends vary across YMCAs as well as between different rooms within each YMCA. On average, baseline indoor levels fall in the middle of the expected baseline range (~50-68% less $PM_{2.5}$ than outdoors), but some rooms within the Weingart East LA and Southeast Rio Vista YMCAs are on the lower end of particle filtration (only 37% to 39% less $PM_{2.5}$ than outdoors). These patterns are likely an indication of differences in HVAC design within each YMCA. An analysis of average hourly and weekly trends indicates that indoor $PM_{2.5}$ and black carbon levels are often more similar to outdoor during typical YMCA hours of operations than when the YMCAs are closed. These trends will be explored further in subsequent reports.

Corona-Norco Family YMCA's HVAC filters were upgraded on September 4, 2025, and an initial comparison of indoor levels before and after the upgrade already indicates the significant impact of the new MERV-16 filters[3] in reducing indoor $PM_{2.5}$ (as compared to their baseline which used MERV-8 filters). The upgrade was predicted to reduce indoor $PM_{2.5}$ levels by at least 80%, and results from the first month after the upgrade show a higher than expected improvement with an average $PM_{2.5}$ reduction of 91%. Air quality levels at this YMCA and other YMCAs that undergo an upgrade will continue to be monitored for the remainder of 2025 and the following year to ensure this trend continues, especially during high pollution days, such as days with wildfire smoke. Monitoring has also revealed possible indoor pollution sources that have caused indoor levels of $PM_{2.5}$ to exceed outdoor conditions, often to a significant amount. This was detected at each YMCA to varying degrees. The Corona-Norco Family YMCA exhibits the most consistent of these patterns across the period, often involving multiple rooms, like the Break Room, Sports Room, and Hallway. At Southeast Rio Vista YMCA, these trends most often occur in Gym 2.

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[1] This is just one piece of the health impact puzzle. Health impacts from PM are also informed by the chemical composition of the particles, which AirAware does not measure, but which will vary for wildfire and firework-related PM emissions.

[2] Baseline here means YMCA HVAC (and coinciding indoor air quality) conditions before any filter upgrades occurred.

[3] Minimum Efficiency Reporting Values (MERV) indicate a filter's ability to filter out particles (0.3µm - 10µm in size). The higher the MERV rating, the better (greater) the filtration.

Introduction

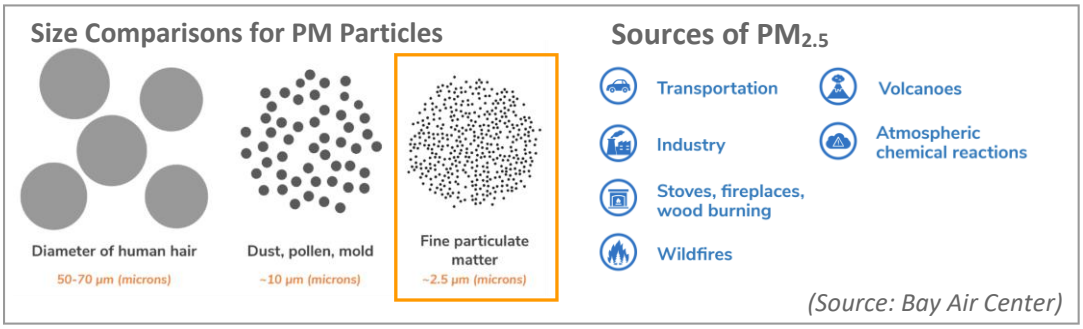
Project Overview

The Coalition for Clean Air (CCA), in partnership with TD Enviro (TDE), IQAir North America (IQAir), and YMCAs in the Greater Los Angeles Area, has developed the AirAware program that tracks indoor and outdoor air quality in historically disadvantaged communities that are located in air quality monitoring "gap-areas" (areas that lack a comprehensive air quality monitoring system). The AirAware program is built on the reality that many of the communities served by these YMCA are historically overlooked as we monitor and address air quality. The AirAware project partnered with three YMCA locations that serve as vital community hubs for many families and individuals across Greater Los Angeles: Corona-Norco Family YMCA, Southeast-Rio Vista YMCA, and Weingart East LA YMCA.

The project's goal is to ensure clean and healthy air for communities by providing real-time data and awareness of indoor and outdoor $PM_{2.5}$ concentrations. This project involves the following elements: Outdoor air quality monitoring, indoor air quality monitoring and mitigation, and education. The AirAware team deployed air monitors to monitor indoor and outdoor air quality at each site from Fall 2024 to Fall 2025 to establish a baseline year of air quality information for each site, which represented the "Phase 1 – Pre-Intervention" period of the project. The "Phase 2 – Post-Intervention" period of the project will commence as each HVAC system is upgraded replacing the existing filters with hospital-grade MERV-16 filters to improve indoor air quality conditions and demonstrate the value of improved air filtration. Phase 2 of this project has already commenced at the Corona-Norco Family YMCA and is in the process of being scheduled at the other two YMCAs. Throughout the project the AirAware team also provided educational materials and optional training for YMCA members and staff on air quality and steps they can take to protect their health when air quality is poor. All outdoor and indoor air quality monitoring collect fine particulate matter ($PM_{2.5}$) and CO_2 (indoor) data. In addition, one site also monitors outdoor and indoor black carbon levels. This report summarizes the baseline air quality trends observed during Phase 1 of the project, focusing on the differences between indoor and outdoor $PM_{2.5}$ and black carbon levels. $PM_{2.5}$ is measured using IQAir's AirVisual Pro (AVP) and AirVisual Pro Outdoor (AVO) models, and black carbon is measured using Met One's C-12 monitor.

Pollutant Background

Particulate matter is an air pollutant made of tiny liquid and solid airborne particles that vary in size. Fine particulate matter ($PM_{2.5}$) describes an important subset of particulate matter that is 2.5 microns and smaller in size (~30x smaller than the diameter of a human hair) and predominantly comes from sources of combustion (burning of fuels), such as wildfires, residential wood burning, transportation, and industry.



Exposure to $PM_{2.5}$ has various detrimental health effects, such as aggravated asthma, decrease in lung function, increase in respiratory symptoms, and nonfatal heart attacks or premature deaths in people with heart and lung disease. It also impacts the environment through reduced visibility, damaged vegetation, and reduced soil nutrients, among many other impacts. Black carbon is a subset of $PM_{2.5}$ emitted from fossil fuel and biomass burning. A relevant urban source of black carbon is diesel exhaust. It has a wide range of negative respiratory, cardiovascular, and other health impacts, as well as detrimental climate effects.

Operations Summary

Ensuring comparability across $PM_{2.5}$ and CO_2 measurements was crucial to achieving quality data and effective data collection. Before deployment, all project air sensors were collocated together outside to assess cross-sensor comparability for $PM_{2.5}$, CO_2, and black carbon. Sensor to sensor collocations for AirVisuals also occurred at the 6-month period (in late May 2025) for each individual YMCA to ensure that AirVisuals were still comparable to each other and that indoor/outdoor $PM_{2.5}$ or indoor CO_2 differences were not due to sensor drift or bias over time (see **Appendix A**). Black carbon devices underwent routine flow and calibration checks every 1-3 months to ensure accurate device performance (see **Appendix A**). To ensure completeness and comparability across all measured indoor and outdoor parameters, individual YMCA monitors were only included in analyses if they satisfied the 80% data completeness criteria and were within the allowable monitor concentration ranges. Data was reviewed on a daily basis through automated alerts and data platform review, as well as on both a monthly and quarterly basis through detailed trend analysis. Quarterly reports were created for each YMCA to summarize major air quality trends, comparisons between outdoor and indoor $PM_{2.5}$, and other data analysis insights. These findings were shared with the full project team, including key YMCA stakeholders at virtual quarterly meetings.

The Phase 1, Pre-intervention findings for each YMCA are included in the sections that follow.

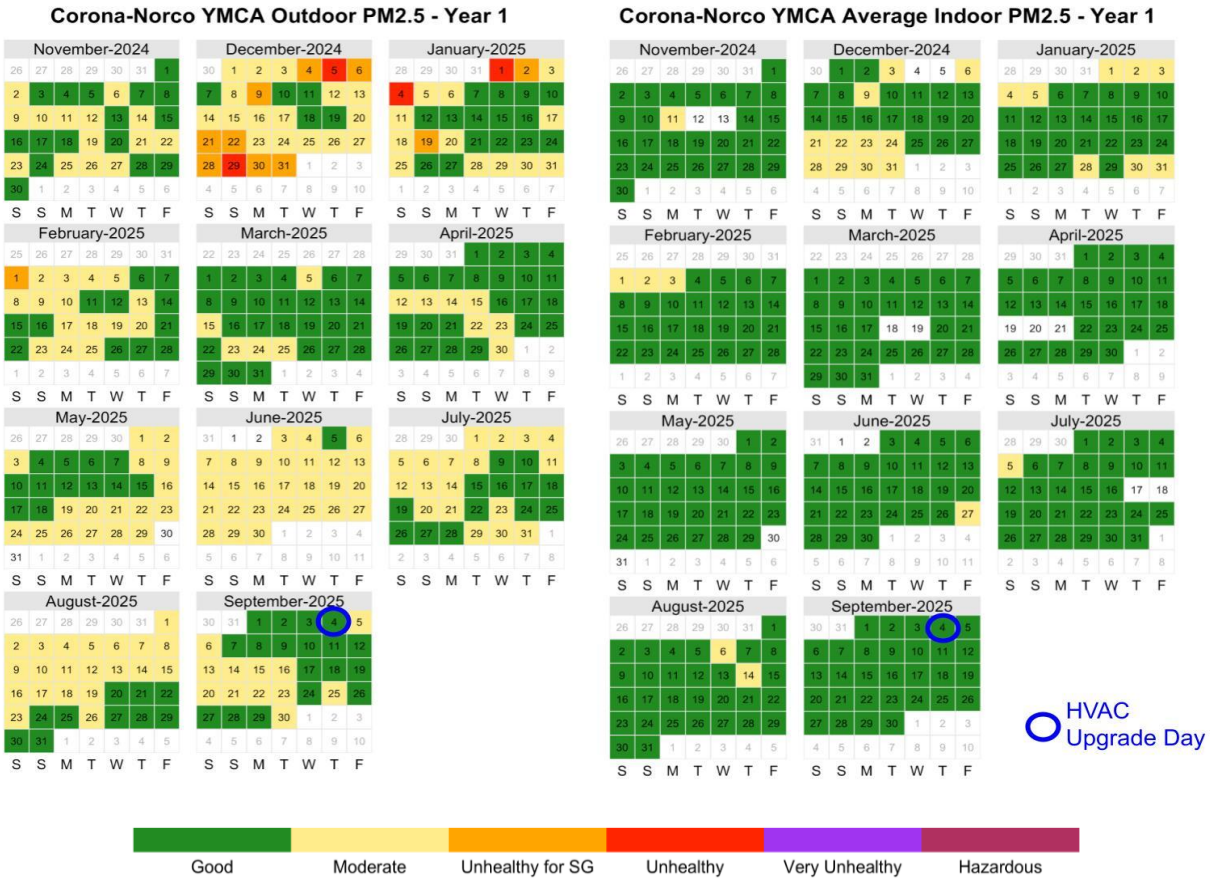
Corona-Norco Family YMCA

This section of the report summarizes the air quality trends observed at the Corona-Norco Family YMCA, focusing on the differences between indoor and outdoor fine particulate matter ($PM_{2.5}$).

Main Takeaways

- $PM_{2.5}$ levels varied across time and largely stayed within the Good and Moderate AQI range for outdoor and predominantly within the Good AQI for indoor conditions.
- Indoor levels during higher outdoor pollution days before the HVAC upgrade showed good filtration of outdoor particles, with Good AQI indoors during Moderate AQI outdoors. The HVAC filters were upgraded on September 4th, 2025. Recent data already show a substantial reduction of indoor $PM_{2.5}$ levels by an average of 91% compared to outdoor.
- Indoor and outdoor air quality was impacted the most in December 2024 and early January 2025, likely due to pollution from stagnant winter weather, not wildfires, which highlights the importance of sustained and effective air filtration in maintaining healthy indoor air quality conditions year round.
- Some trends have emerged over the Phase 1 - Pre-intervention year where indoor $PM_{2.5}$ rose above outdoor levels, often involving the Break Room, Hallway, and Sports Room. This YMCA has been notified about these high indoor PM events and is looking into possible causes for the spikes in indoor PM.

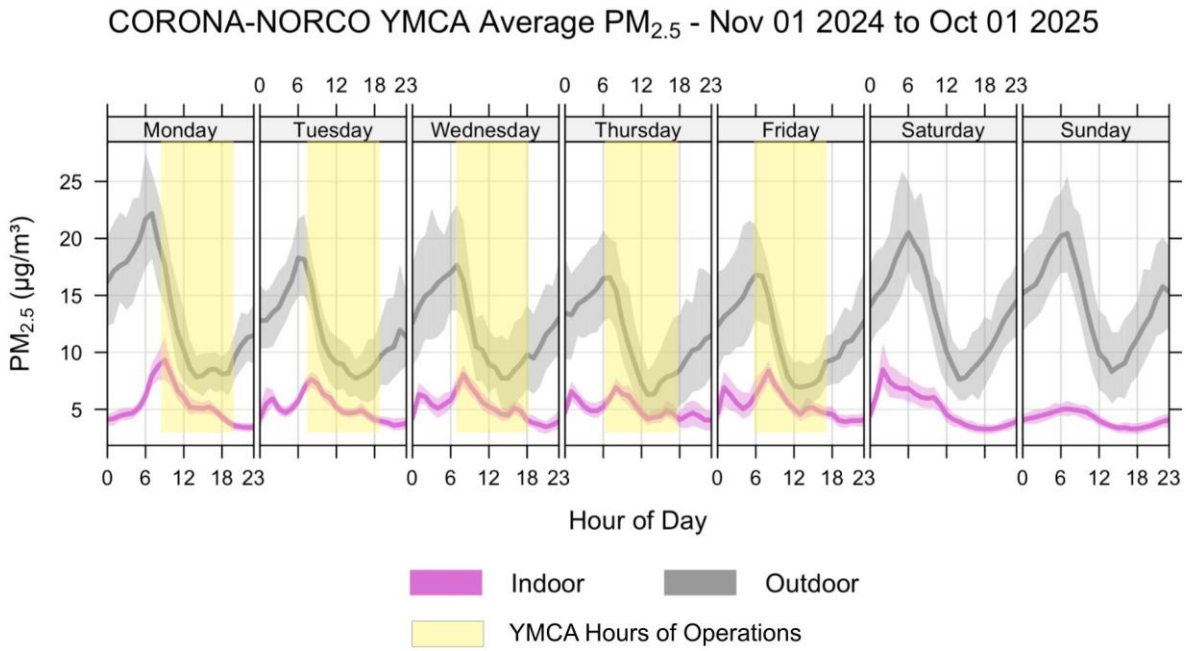
Trends across the Year



These calendars show average daily $PM_{2.5}$ levels across time for both outdoor (left) and indoor (right) from the beginning of November 2024 to the end of September 2025. Indoor levels are based on the average across all five indoor spaces (at least 4 out of the 5 rooms required valid data per day for an average to be calculated). The Air Quality Index (AQI) categories coinciding with $PM_{2.5}$ concentrations are shown on the bottom, helping to provide health context. The YMCA-wide data gap in late May/early June was due to routine project maintenance (6-month collocation). Any additional gaps in the data are due to issues in power or WiFi/cellular connectivity.

What do these calendars tell us?

- From November 2024 to September 2025, $PM_{2.5}$ levels varied across time, and largely stayed within the Good to Moderate AQI range outdoors. Indoor levels followed the patterns in outdoor air pollution, but at lower concentrations, staying predominantly in the Good AQI range.
- Outdoor levels rose to unhealthy levels briefly in December 2024 and early January 2025, likely due to winter temperature inversions, stagnant air masses, and ongoing pollution from vehicles, industrial activities and wood burning, but not wildfires (Corona's worst outdoor air quality occurred days to weeks before the Eaton and Palisades wildfires). The atmospheric conditions combined with the geography of the LA-basin causes these pollutants to become trapped close to the ground, causing increased particulate pollution and smog. This highlights the importance of sustained and effective air filtration in maintaining healthy indoor air quality conditions year round.



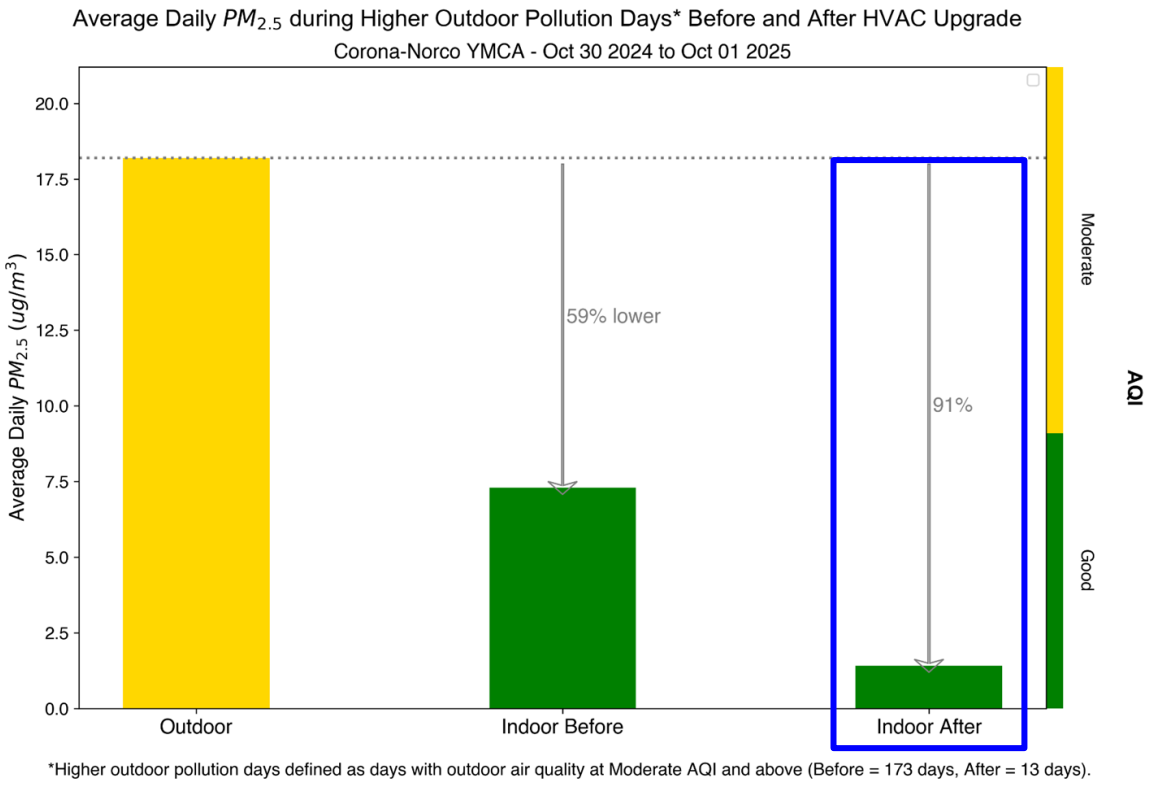
This plot shows the "average week of $PM_{2.5}$" for both outdoor (grey) and average indoor (pink) spaces. Levels are shown across different hours of the day and days of the week. The horizontal (x) axis uses 0-23hr notation, where 0=12AM, 18 = 6PM, and 23 = 11PM. All hours are shown in Standard Time (i.e., not Daylight Savings Time). Yellow boxes indicate the general hours of operation: Mon - Fri 6AM - 6PM.

What does this chart tell us?

- $PM_{2.5}$ levels followed a general trend across the day, rising gradually overnight and lowering in the afternoon. This is due to the natural changes in the atmosphere across the day (there is more 'room' for pollutants to mix during the daytime when temperatures rise and this phenomenon means concentrations are often lower - the opposite is true during the nighttime when there is less 'room').
- The most frequent morning spikes in $PM_{2.5}$ occurred on weekdays, and especially Monday through Saturday. Mondays have the highest morning levels of $PM_{2.5}$. Additionally, indoor levels are most similar to outdoor levels during the YMCA's general operational hours, highlighted in yellow. This could be due to foot traffic in/out of the facility, open doors, or windows that allow more outdoor particles to get inside. This trend will be explored further in future reports.

Comparison of Indoor and Outdoor Trends

The relationship between indoor and outdoor $PM_{2.5}$ is important to explore as it can tell us how effective the YMCA's HVAC system is at filtering out particulate matter from outdoor sources and can help highlight indoor air quality concerns and any needs for HVAC improvement.

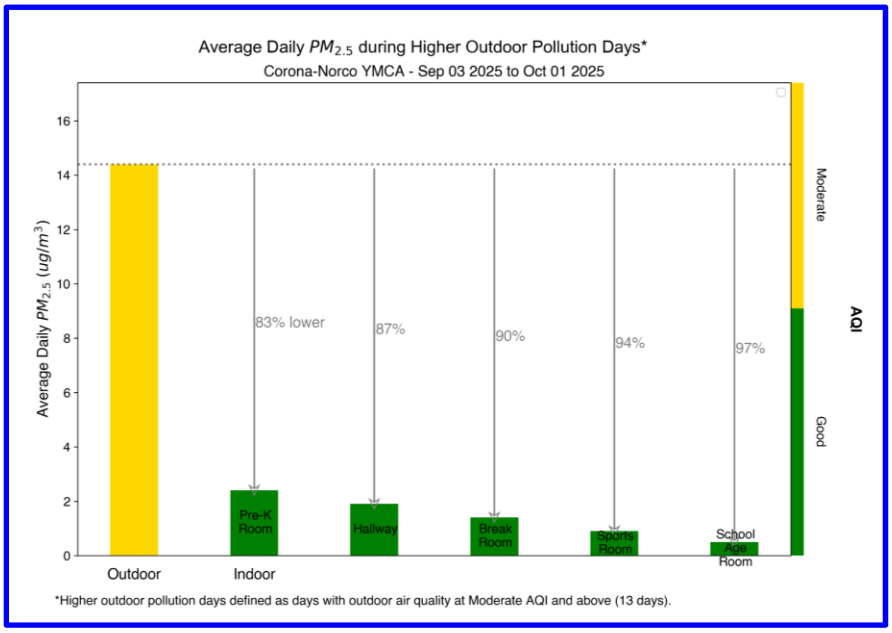


This bar chart compares average daily outdoor (left) and indoor (right) $PM_{2.5}$ levels during higher outdoor pollution days before and after the HVAC upgrade. The color of each bar chart coincides with an AQI category, and the arrows from the grey dashed line and coinciding percentages indicate how much lower average indoor levels are.

What does this chart tell us?

- On average indoor levels during higher pollution days during the Phase 1, Pre-Intervention period before the HVAC systems were upgraded were within the expected range (30% - 80% on average less $PM_{2.5}$ than outdoor levels). An initial comparison of indoor levels before and after the Phase 2 intervention on September 4th, in which the HVAC systems were upgraded from MERV-8 to MERV-16 filters, already indicates the significant impact the new, hospital-grade MERV-16 filters have in reducing indoor $PM_{2.5}$. The HVAC upgrade was predicted to reduce indoor $PM_{2.5}$ levels by at least 80%, and results from the first month after the upgrade exceed these estimates with average $PM_{2.5}$ reductions of up to 91%.
- Air quality levels will continue to be monitored for the remainder of 2025 and the following year to ensure this trend continues, especially during high pollution days, such as those impacted by wildfire smoke.

After HVAC upgrade



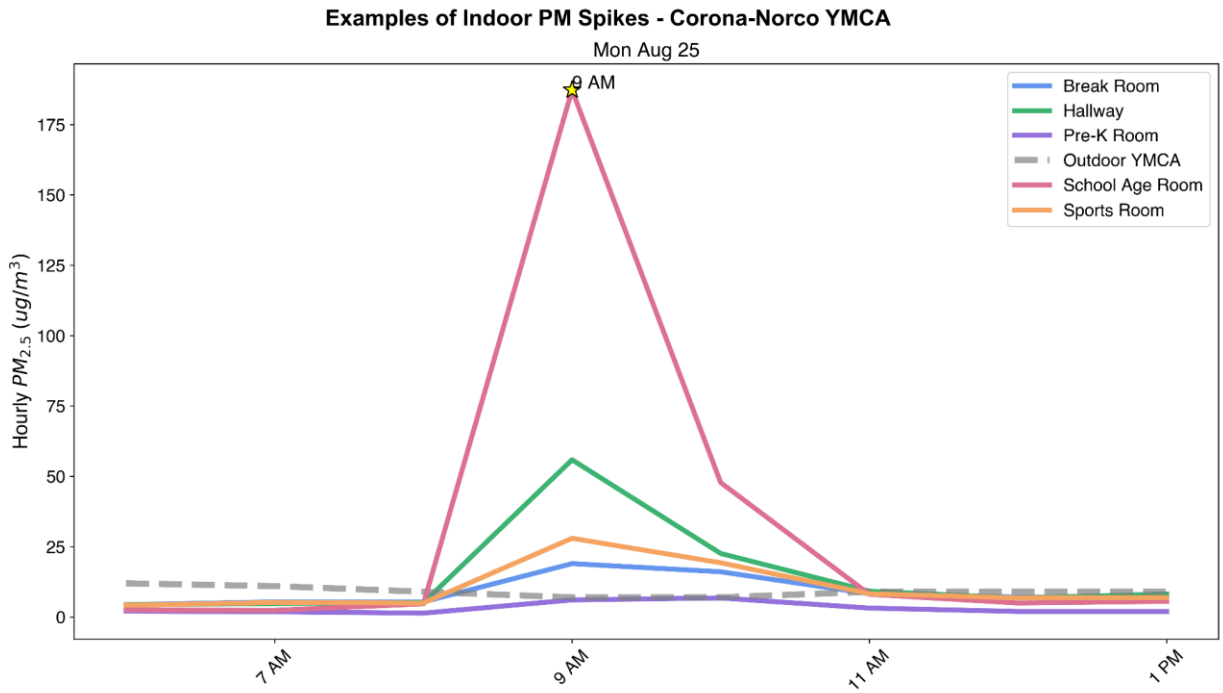
These bar charts compare average daily outdoor (left) and indoor (right) $PM_{2.5}$ levels during higher outdoor pollution days before (upper chart) and after (lower chart) the September 4, 2025 HVAC intervention highlighted in blue. The color of each bar chart coincides with an AQI category, and the arrows from the grey dashed line and coinciding percentages indicate how much lower average indoor levels are per room compared to outdoor. The indoor spaces are ordered from most to least similar to outdoor levels.

What does this chart tell us?

- When outdoor air quality was in the Moderate AQI before the HVAC upgrade, all indoor spaces were on average in the Good AQI, except for the Hallway, which remained in the Moderate AQI. After the HVAC upgrade, the rooms all lowered to Good AQI and remained statistically similar.

Indoor Sources of Pollution

Indoor sources and activities can also contribute to higher indoor air quality levels, and exploring these trends can help identify contributing indoor activities or behaviors and provide insight on possible changes to improve indoor air quality.



This plot shows examples of hourly indoor (solid color lines) and outdoor (dashed grey line) $PM_{2.5}$ levels at the YMCA that are characteristic of indoor sources or activities that contribute to higher indoor air quality. All times are shown in Standard Time (i.e. one hour behind Daylight Savings Time).

What does this chart tell us?

- Across November 2024 to the end of September 2025, all indoor spaces are shown rising above outdoor levels to varying degrees. These indoor trends were seen predominantly in the Break Room, Hallway, and Sports Room, but sometimes impacted all indoor spaces (see **Appendix B** for more detail). We are still trying to determine what could be causing these periodic indoor spikes in $PM_{2.5}$.

- The most recent example of an indoor source occurred on August 25th 2025, where one distinct morning peak in indoor $PM_{2.5}$ was seen across most indoor spaces. The School Age Room showed the highest levels during this time, over two times the levels shown in other rooms. The Pre-K room was the least impacted.

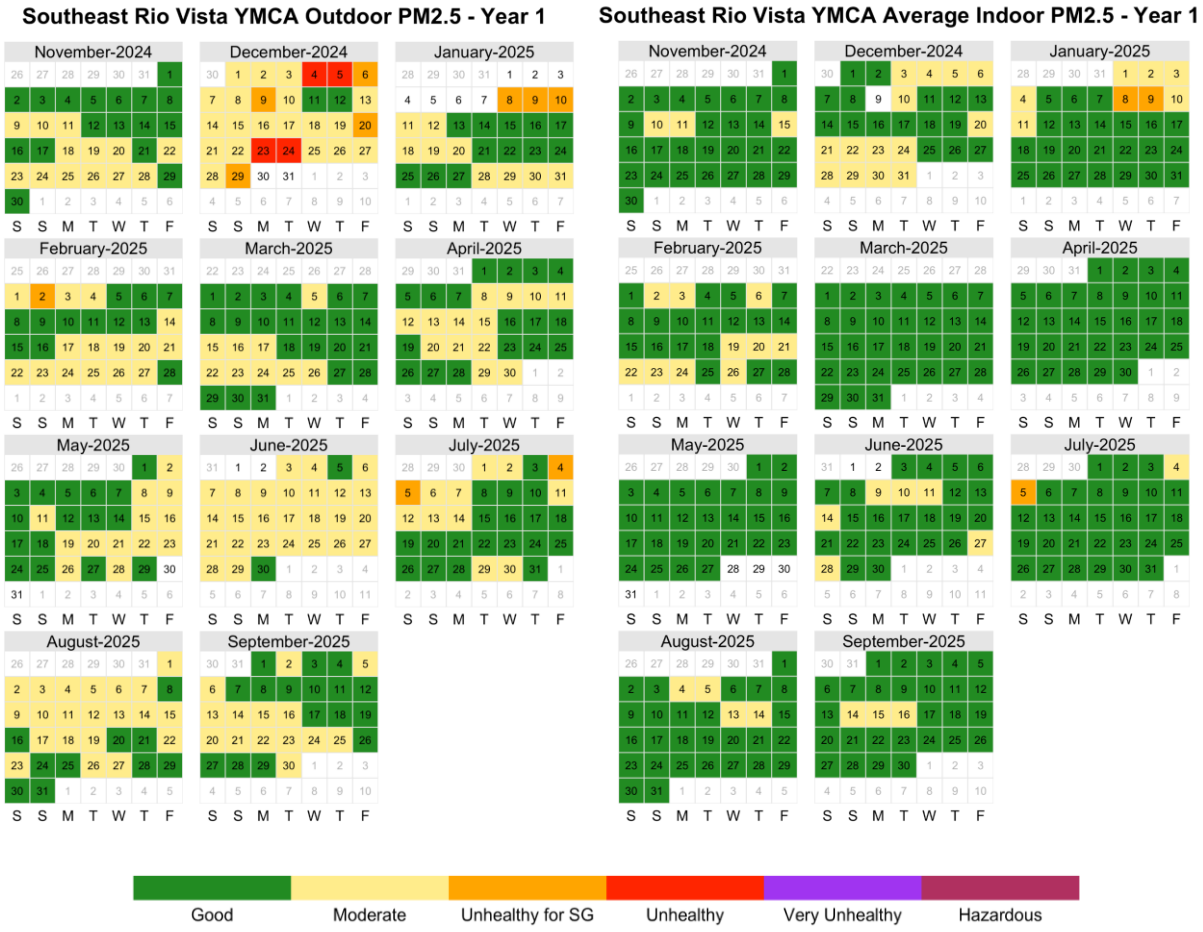
Southeast Rio Vista YMCA

This section of the report summarizes the air quality trends observed at the Southeast Rio Vista Family YMCA, focusing on the differences between indoor and outdoor fine particulate matter ($PM_{2.5}$).

Main Takeaways

- $PM_{2.5}$ levels varied across time and largely stayed within the Good and Moderate AQI range for outdoor and indoor conditions.
- Indoor levels during higher outdoor pollution days showed good filtration of outdoor particles with their current HVAC filters, showing Good AQI indoors during Moderate AQI conditions outdoors. Indoor air quality levels should improve after the HVAC filters are upgraded in Phase 2 of the project (at least 80% reduction compared to outdoors).
- Poor air quality conditions during stagnant winter conditions as well as smoke from the Eaton and Palisades wildfires severely impacted outdoor and indoor air quality earlier in the period.
- Some trends have emerged over this period where indoor $PM_{2.5}$ rises above outdoor levels, often involving Gym 2. The room had the highest indoor average during higher pollution days than other indoor spaces. Gym 2 functions as a large, multi-court basketball stadium and may not have an effective HVAC setup to filter the large air volume of this room. This may require further investigation by the YMCA.

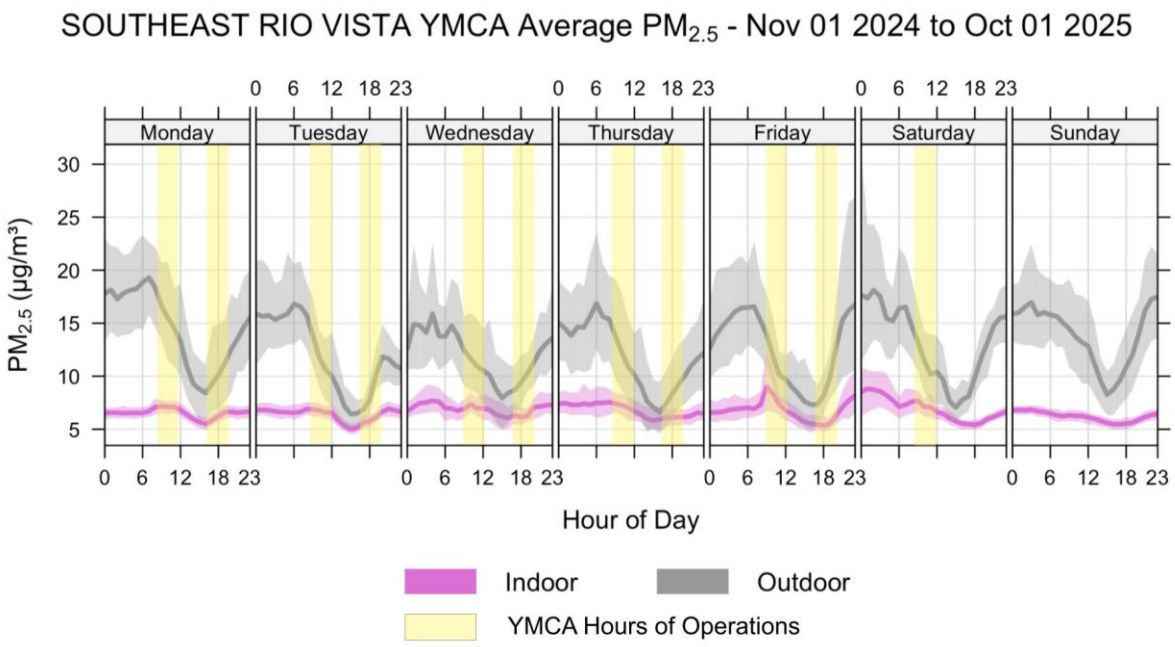
Trends across the Year



These calendars show average daily $PM_{2.5}$ levels across time for both outdoor (left) and indoor (right) from the beginning of November 2024 to the end of September 2025. Indoor levels are based on the average across all five indoor spaces (at least 4 out of the 5 rooms required valid data per day for an average to be calculated). The Air Quality Index (AQI) categories coinciding with $PM_{2.5}$ concentrations are shown on the bottom, helping to provide health context. Any additional gaps in the data are due to issues in power or WiFi/cellular connectivity.

What do these calendars tell us?

- From November 2024 to September 2025, $PM_{2.5}$ levels varied across time, and largely stayed within the Good to Moderate AQI range outdoors. Indoor levels followed the patterns in outdoor air pollution, but at lower concentrations, staying predominantly in the Good AQI range.
- Outdoor levels rose to unhealthy levels briefly in December 2024 and early January 2025, likely due to pollution from stagnant winter weather and wildfires. The early July peak from Fourth of July Fireworks also caused levels to reach Unhealthy for Sensitive groups both outside and inside of the YMCA. These events highlight the importance of sustained and effective air filtration in maintaining healthy indoor air quality conditions year round.



This plot shows the "average week of $PM_{2.5}$*" for both outdoor (grey) and average indoor (pink) spaces. Levels are shown across different hours of the day and days of the week. The horizontal (x) axis uses 0-23hr notation, where 0=12AM, 18 = 6PM, and 23 = 11PM. All hours are shown in Standard Time (i.e., not Daylight Savings Time). Yellow boxes indicate the general hours of operation: Mon - Fri 8AM - 12PM and 4PM - 10PM:00, Saturday 8AM - 12PM.*

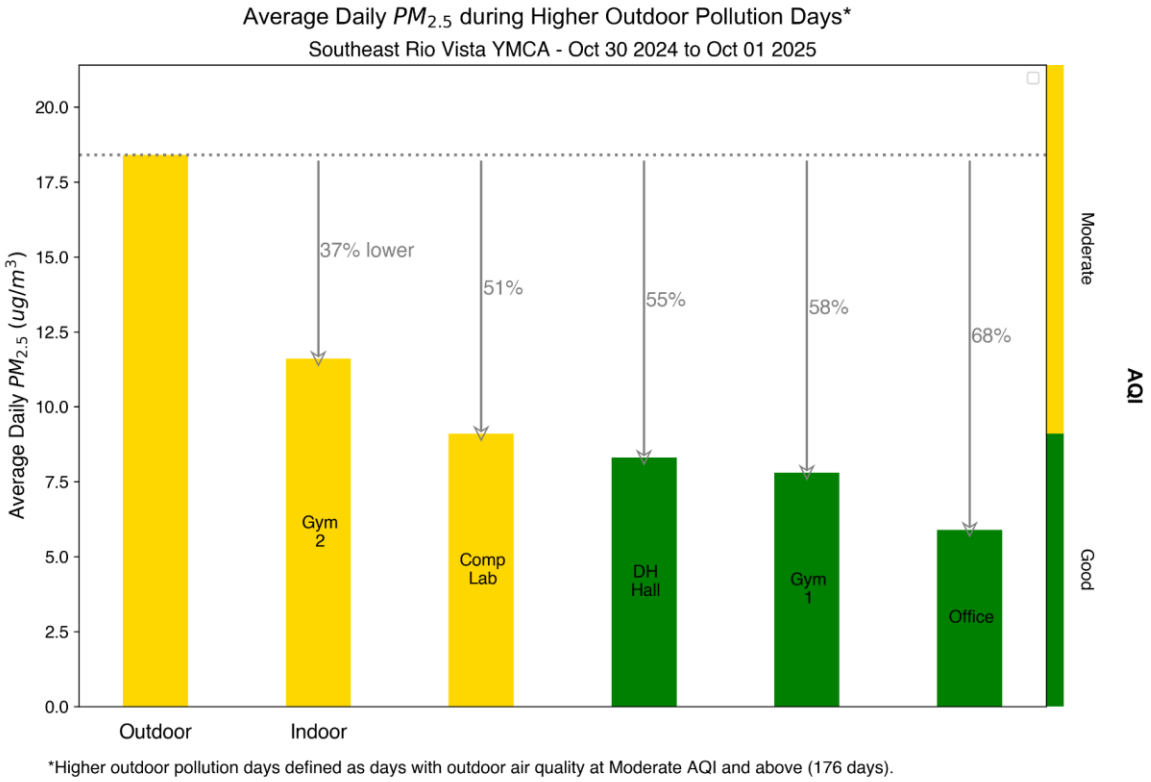
What does this chart tell us?

- $PM_{2.5}$ outdoor levels follow a general trend across the day, rising gradually overnight and lowering in the afternoon. This is due to the natural changes in the atmosphere across the day (there is more 'room' for pollutants to mix during the daytime when temperatures rise and this phenomenon means concentrations are often lower - the opposite is true during the nighttime when there is less 'room').

- $PM_{2.5}$ indoor levels remain relatively steady, with the most frequent morning spikes occurring on Friday with some higher levels on Saturday morning before the YMCA is open. Additionally, indoor levels are most similar to outdoor levels during the YMCA's general operational hours, highlighted in yellow. This could be due to foot traffic in/out of the facility, open doors, or windows that allow more outdoor particles to get inside. This trend will be explored further in future reports.

Comparison of Indoor and Outdoor Trends

The relationship between indoor and outdoor $PM_{2.5}$ is important to explore as it can tell us how effective the YMCA is at currently filtering out particulate matter from outdoor sources and can help highlight indoor air quality concerns and any needs for HVAC improvement.



This bar chart compares average daily outdoor (left) and indoor (right) $PM_{2.5}$ levels during higher outdoor pollution days. The color of each bar chart coincides with an AQI category, and the arrows from the grey dashed line and coinciding percentages indicate how much lower average indoor levels are per room compared to outdoor. The indoor spaces are ordered from most to least similar to outdoor levels.

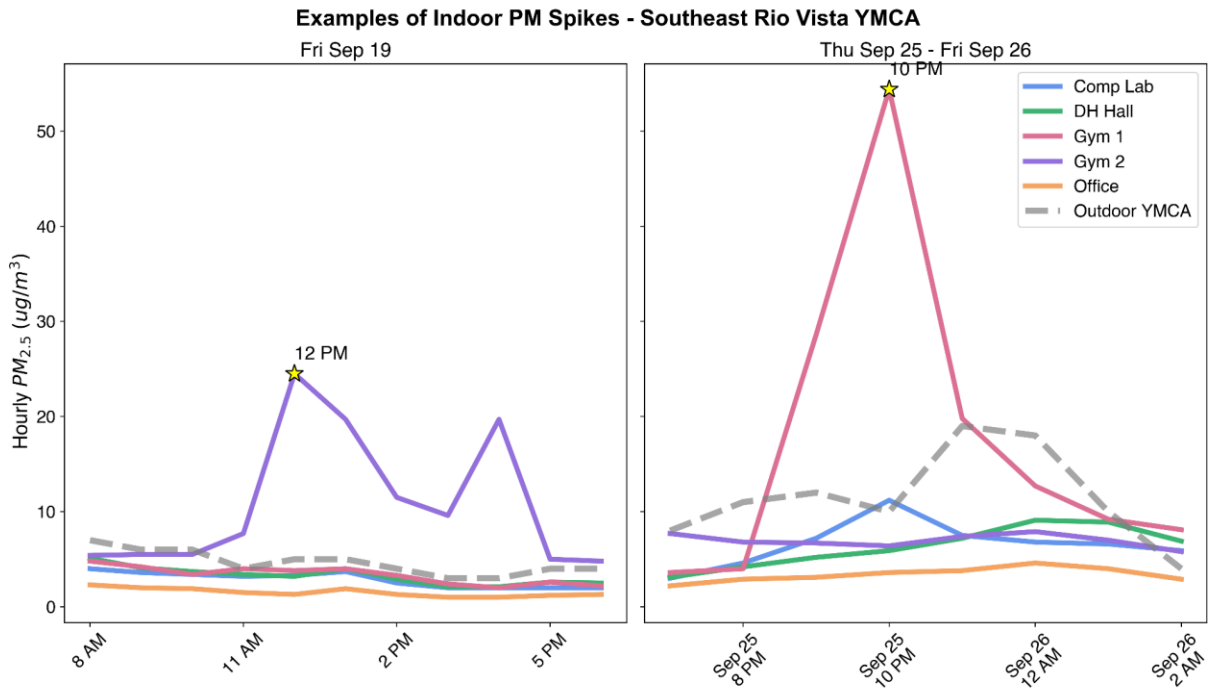
What does this chart tell us?

- On average, we would expect indoor levels to be between 30% and 80% lower than outdoor levels, depending on the level of HVAC filtration in use at this location. On average indoor levels during higher pollution days were within this expected range, indicating that the current HVAC filtration system is generally working as expected.

- Gym 2 and the Comp Lab continue to be most similar to outdoor conditions and on average show $PM_{2.5}$ levels in the same higher AQI category as outdoors. Statistical analysis showed that the DH hall and Gym 1 averages were likely similar, while the Office continues to measure the cleanest on average air (68% lower than outdoors). Many factors may be causing these differences, such as building and HVAC design.

Indoor Sources of Pollution

Indoor sources and activities can also contribute to higher indoor air quality levels, and exploring these trends can help identify contributing indoor activities or behaviors and provide insight on possible changes to improve indoor air quality.



This plot shows examples of hourly indoor (solid color lines) and outdoor (dashed grey line) $PM_{2.5}$ levels at the YMCA that are characteristic of indoor sources or activities that contribute to higher indoor air quality. All times are shown in Standard Time (i.e. one hour behind Daylight Savings Time).

What does this chart tell us?

- Across November 2024 to the end of September 2025, indoor spaces periodically rose above outdoor levels. This was most often seen in Gym 2 (first floor court) (see **Appendix C** for all examples).

- In the most recent month, $PM_{2.5}$ levels in Gym 2 rose again during the duration of the YMCA's Friday operations on September 19th. Gym 1 (upstairs weight room) also spiked in late September, in the nighttime. We are still trying to determine what could be causing these periodic indoor spikes in $PM_{2.5}$.

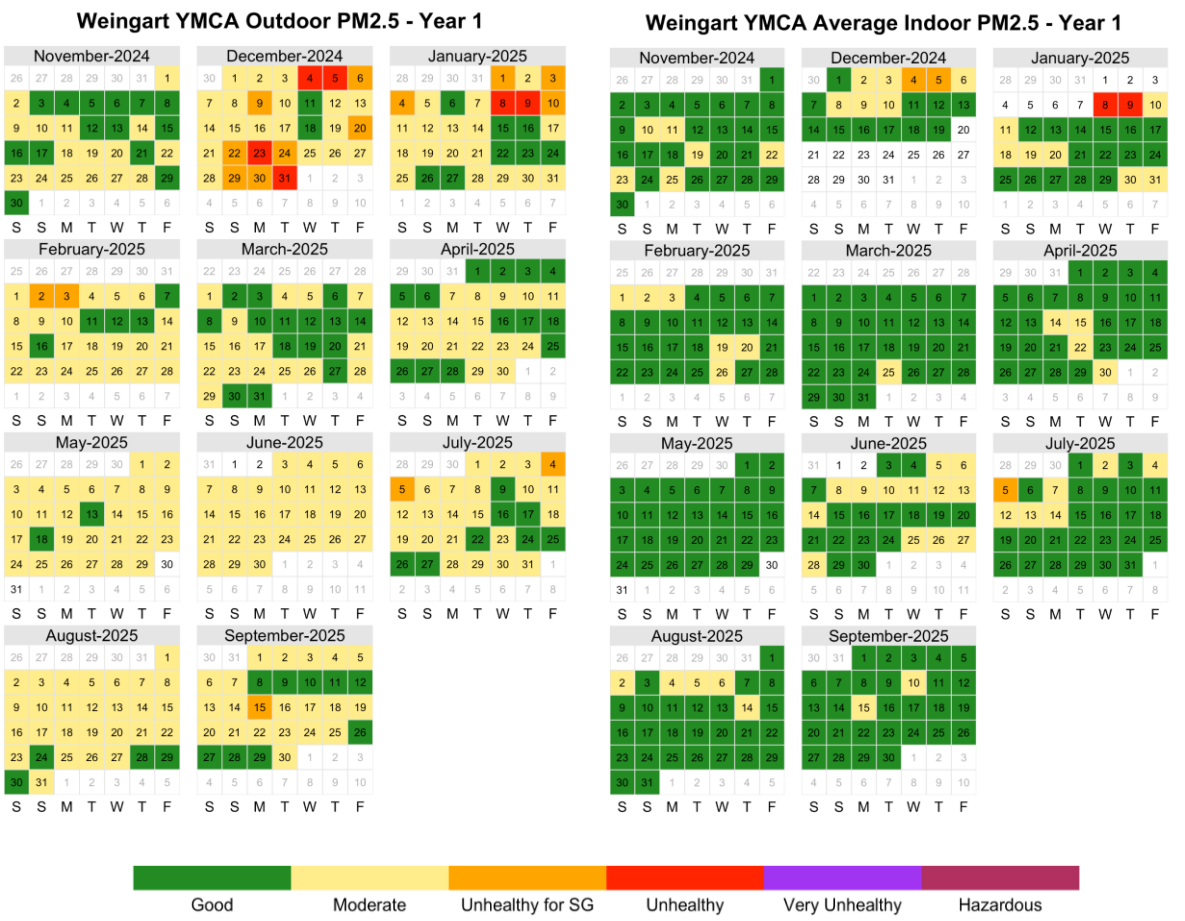
Weingart East LA YMCA

This section of the report summarizes the air quality trends observed at the Weingart East LA YMCA, focusing on the differences between indoor and outdoor fine particulate matter ($PM_{2.5}$) and black carbon.

Main Takeaways

- $PM_{2.5}$ levels varied across time and largely stayed within the Good to Moderate AQI range for outdoor and indoor conditions, with a few days in the Unhealthy for Sensitive Groups AQI and above.
- Indoor levels during higher outdoor pollution days generally showed good filtration of outdoor particles with their current HVAC filters for both $PM_{2.5}$ and black carbon. Most rooms experienced Good AQI indoors for $PM_{2.5}$ during Moderate AQI conditions outdoors, except for the two Multi-Purpose Rooms (MPR1 and MPR2). Poor air quality conditions in these two spaces may be from room-specific activities or less effective HVAC filtration.
- The poor air quality conditions during the Eaton and Palisades wildfires severely impacted indoor air quality, leading to Unhealthy indoor levels.
- Black carbon levels often rose on weekday mornings, likely caused by early morning traffic in the area.
- Indoor air quality levels should improve after the HVAC filters are upgraded (at least 80% reduction compared to outdoors is expected).

Trends across the Year



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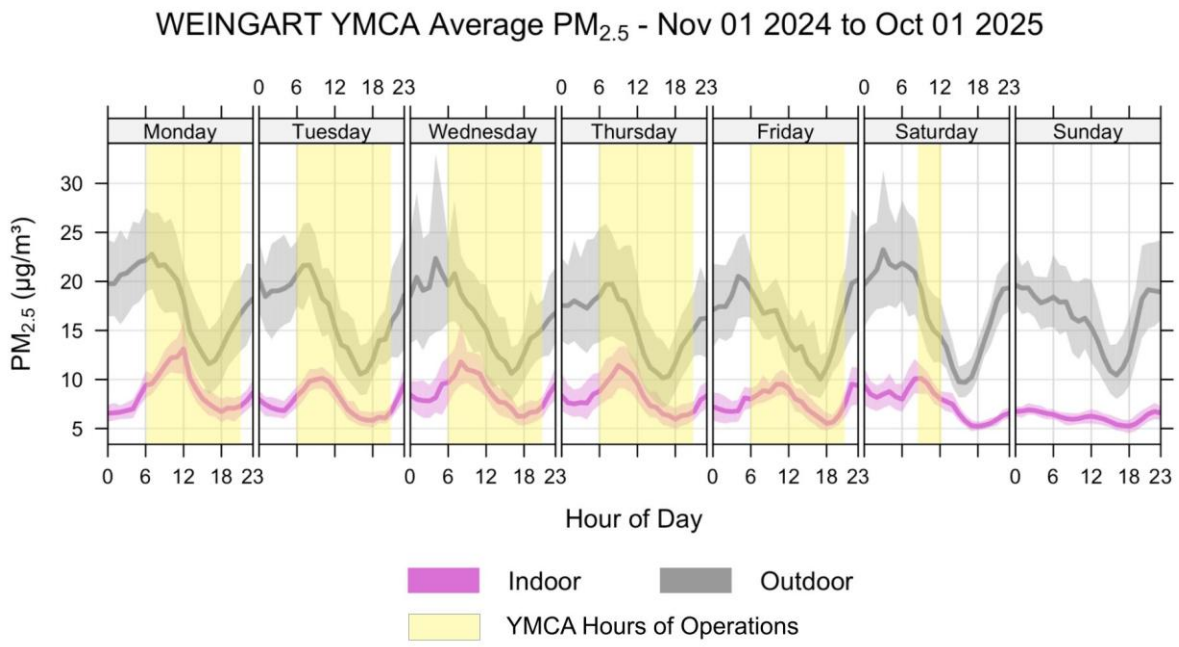
What do these calendars tell us?

- From November 2024 to September 2025, $PM_{2.5}$ levels varied across time, and largely stayed within the Moderate AQI range outdoors. Indoor levels followed the patterns in outdoor air pollution, but at lower concentrations, staying predominantly in the Good AQI range.
- Outdoor and indoor levels were significantly impacted by stagnant winter conditions in December 2024 and the January Eaton and Palisade wildfires. The early July peak from Fourth of July fireworks also caused levels to reach Unhealthy for Sensitive groups both outside and inside of the YMCA. These events highlight the importance of sustained and effective air filtration in maintaining healthy indoor air quality conditions year round.



This plot shows the "average week of $PM_{2.5}$*" for both outdoor (grey) and indoor (pink) spaces. Levels are shown across different hours of the day and days of the week. The horizontal (x) axis uses 0-23hr notation, where 0=12AM, 18 = 6PM, and 23 = 11PM. All hours are shown in Standard Time (i.e., not Daylight Savings Time). Yellow boxes indicate the general hours of operation: Mon - Fri 6AM - 9PM and Saturday 8AM - 12PM.*

What does this chart tell us?

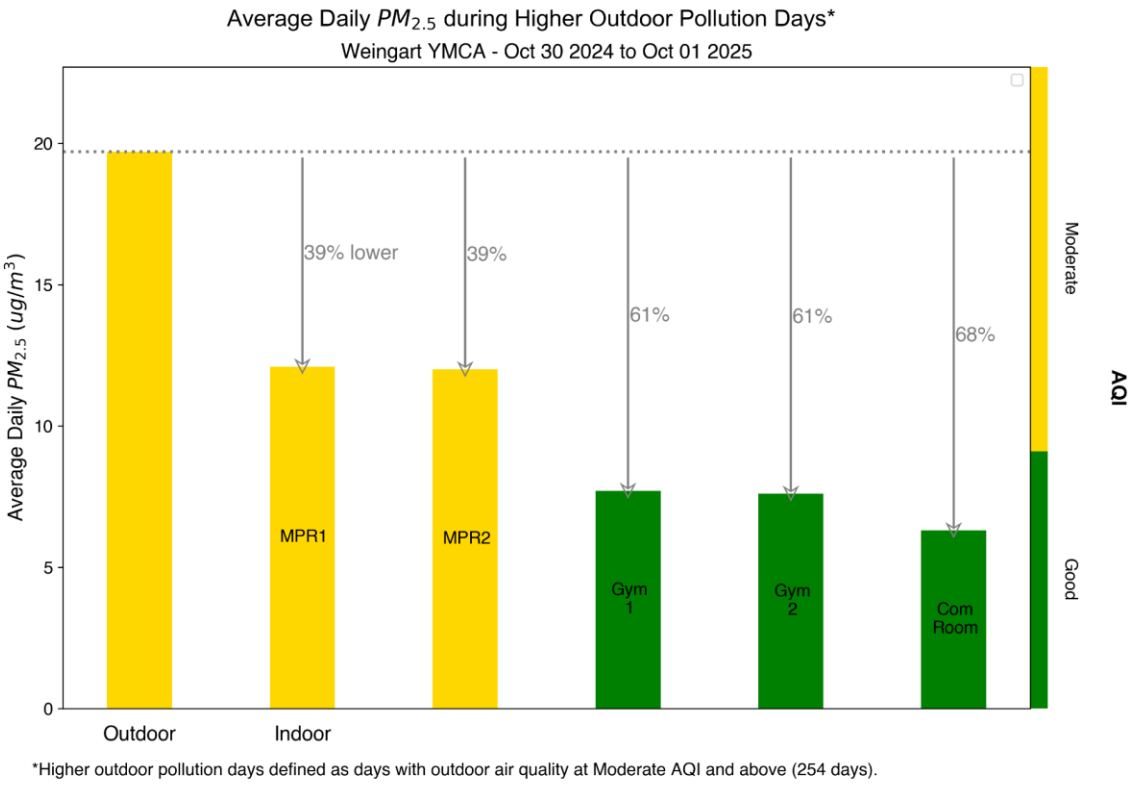
- $PM_{2.5}$ levels follow a general trend across the day, rising gradually overnight and lowering in the afternoon. This is due to the natural changes in the atmosphere across the day (there is more 'room' for pollutants to mix during the daytime when temperatures rise and this phenomenon means concentrations are often lower - the opposite is true during the nighttime when there is less 'room').

- The most frequent morning spikes in $PM_{2.5}$ occurred on weekdays, and especially Monday through Saturday. Mondays have the highest morning levels of $PM_{2.5}$, followed by Wednesday and Thursday.

- Indoor levels are most similar to outdoor levels during the YMCA's general operational hours, highlighted in yellow. This could be due to foot traffic in/out of the facility, open doors, or windows that allow more outdoor particles to get inside. The opposite is seen on Sundays when the YMCA is closed and indoor levels are lower and steady across the day (no major peaks). This trend will be explored further in future reports.

Comparison of Indoor and Outdoor Trends

The relationship between indoor and outdoor $PM_{2.5}$ is important to explore as it can tell us how effective the YMCA's HVAC system is at filtering out particulate matter from outdoor sources and can help highlight indoor air quality concerns and any needs for HVAC improvement.



This bar chart compares average daily outdoor (left) and indoor (right) $PM_{2.5}$ levels during higher outdoor pollution days. The color of each bar chart coincides with an AQI category, and the arrows from the grey dashed line and coinciding percentages indicate how much lower average indoor levels are per room compared to outdoor. The indoor spaces are ordered from most to least similar to outdoor levels.

What does this chart tell us?

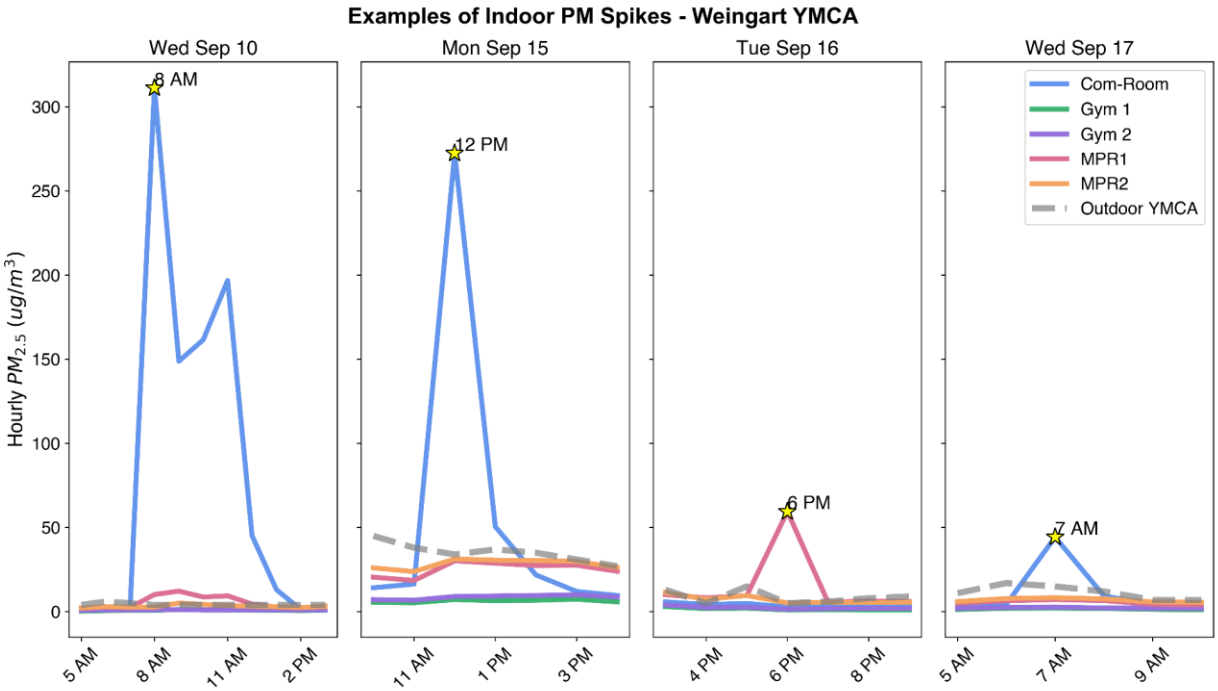
- On average, we would expect indoor $PM_{2.5}$ levels to be between 30% and 80% lower than outdoor levels, depending on the level of HVAC filtration in place. On average, indoor levels during higher pollution days were within this expected range, except in MPR1 and MPR2. This means the HVAC filtration system is generally working as expected, but should be examined in MPR1 and MPR2 as these rooms consistently experience levels within the same higher AQI category as outdoors.

- Of the five indoor spaces being monitored, both Multi-Purpose Rooms (MPR1 and MPR2) are the only rooms without windows or external doors, which, with inadequate HVAC filtration, could be contributing to the poor air quality conditions in these rooms. During a site visit in May 2025, the team also noticed that air conditions felt stagnant in both MPR1 and MPR2.

- The Common Room (Com Room) continues to have the cleanest on average air (68% lower than outdoors). This room has an air purifier, which was running during the team's site visit in May 2025; this is likely a contributing factor to the improved air quality in this room.

Indoor Sources of Pollution

Indoor sources and activities can also contribute to higher indoor air quality levels, and exploring these trends can help identify contributing indoor activities or behaviors and provide insight on possible changes to improve indoor air quality.



This plot shows examples of hourly indoor (solid color lines) and outdoor (dashed grey line) $PM_{2.5}$ levels at the YMCA that are characteristic of indoor sources or activities that contribute to higher indoor air quality. All times are shown in Standard Time (i.e. one hour behind Daylight Savings Time).

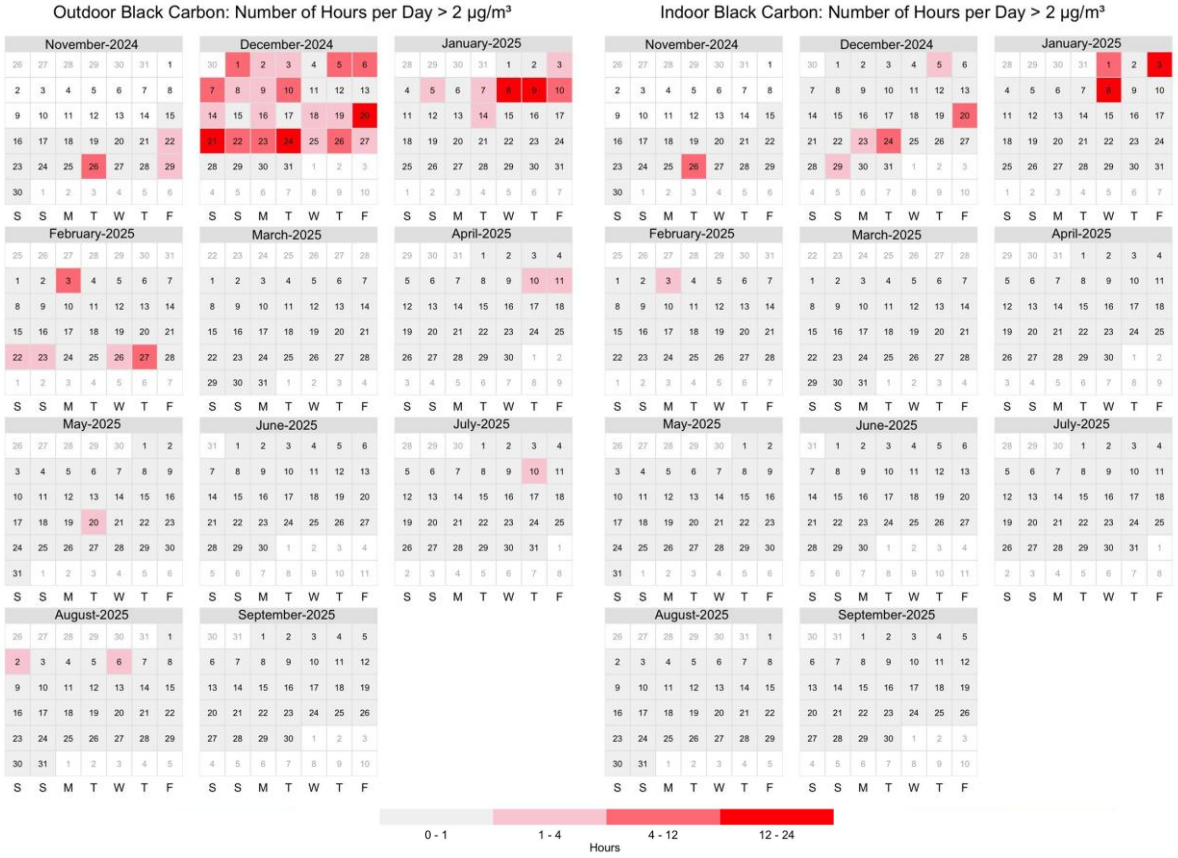
What does this chart tell us?

- Indoor $PM_{2.5}$ rose above outdoor levels only a few times during this period at the beginning of the year. The recent month did see a couple of days where the Com-Room rose to very high levels of $PM_{2.5}$ on September 10 and September 15, but at varying times. The following days saw comparatively minor peaks in MPR1 and the Com-Room. We are still trying to determine what could have caused these higher indoor peaks in September. The spikes in the air quality of the Com-Room could be caused by the use of the room's microwave, as both spikes occurred during typical meal times.
- From December 2024 through early February 2025, spikes in indoor black carbon occurred routinely overnight around 11PM local standard time, accompanied sometimes

by $PM_{2.5}$ spikes across the other indoor spaces, but did not reappear in the rest of the period. These examples are illustrated in the **Appendix D** in more detail.

Trends in Black Carbon

Indoor and outdoor black carbon monitoring at the Weingart East LA YMCA has been underway since early November 2024. This section explores the trends across time and space from early November 2024 to the end of September 2025. **Note:** $PM_{2.5}$ concentrations can be compared to the AQI, but black carbon does not have official health standards for comparison yet, which limits our review to concentrations only. While black carbon may appear lower in comparison than $PM_{2.5}$, health studies have shown that continued exposure at these lower levels can have detrimental health impacts.



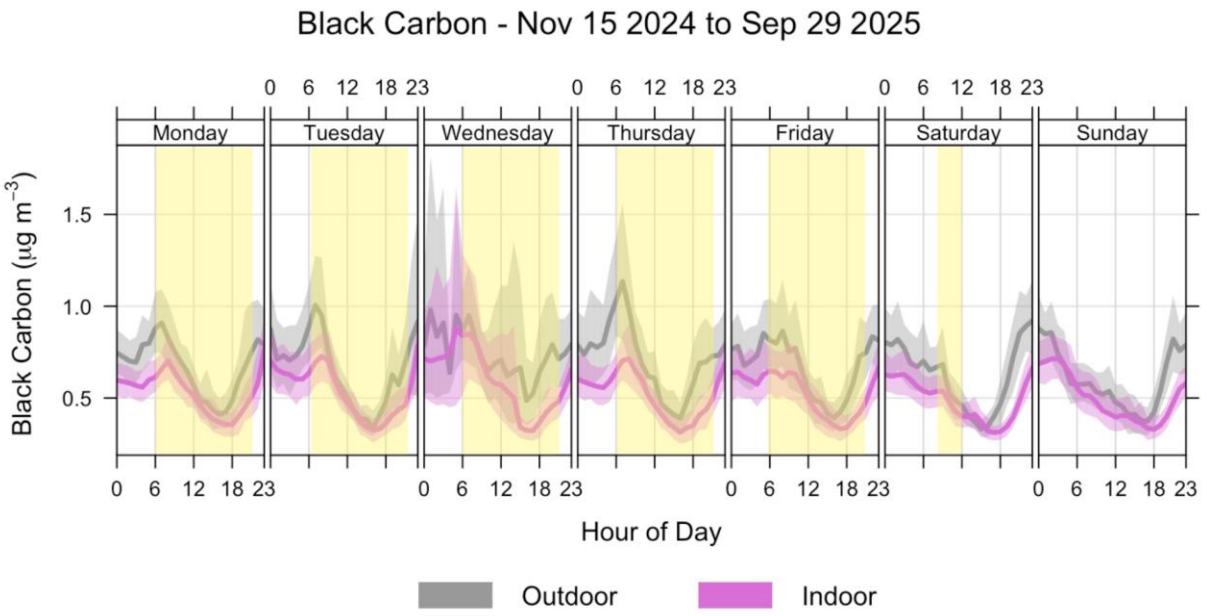
These calendars show the number of hours black carbon levels were high (> 2 ug/m^3) across time for both outdoor (left) and indoor (right) from the beginning of November 2024 to the end of September 2025. The categories coinciding with black carbon levels are shown on the bottom, helping to provide exposure context.

What do these calendars tell us?

- Black carbon levels varied across time, fluctuating across the months. Indoor levels often followed outdoor patterns, but were lower in concentration to varying extents and

therefore resulted in less hours per day above the 2 µg/m^3 threshold shown in the calendars. This relationship is explored more in the next chart. A time series of this data is also available in the **Appendix D**.

- Wildfires in late December 2024 and early January 2025 did contribute to a rise in black carbon, but levels during the rest of the period were likely more consistently impacted by local diesel traffic.



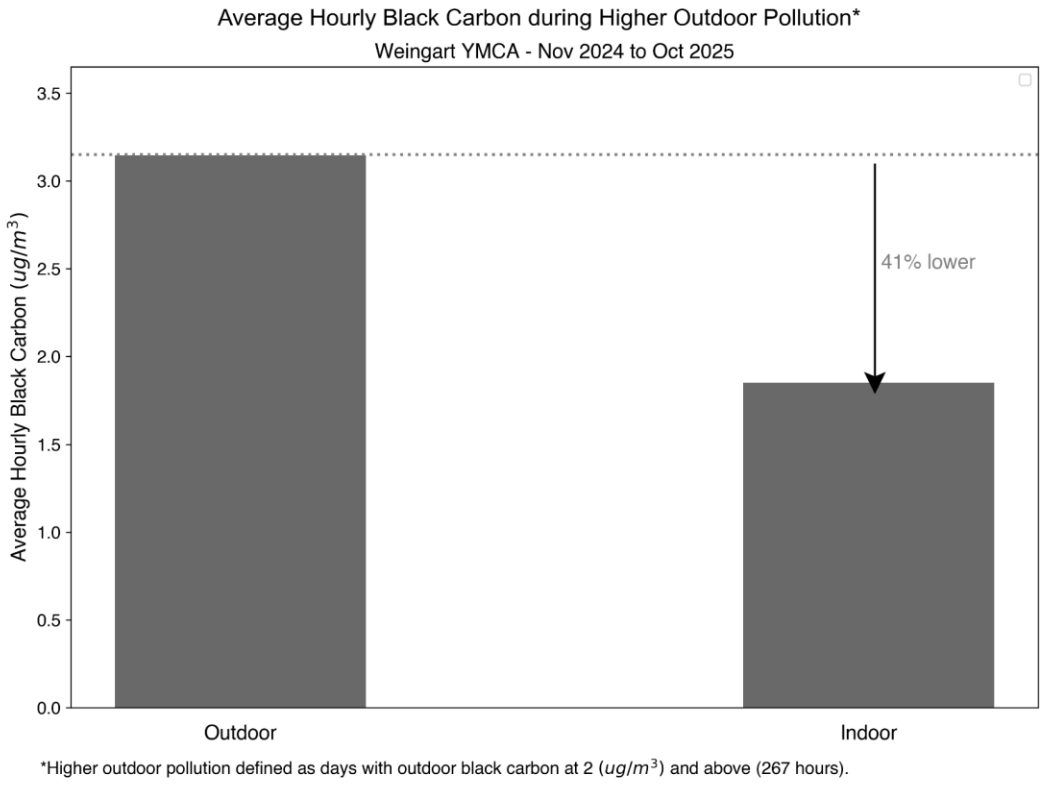
This plot shows the "average week of black carbon" for both outdoor (grey) and indoor (pink) monitors. Levels are shown across different hours of the day and days of the week. The horizontal (x) axis uses 0-23hr notation, where 0=12AM, 18 = 6PM, and 23 = 11PM. All hours are shown in Standard Time (i.e., not Daylight Savings Time). Yellow boxes indicate the hours of operation: Mon - Fri 6AM - 9PM and Saturday 8AM - 12PM.

What does this chart tell us?

- Black carbon levels follow a general trend across the day, rising gradually overnight and lowering in the afternoon. This is due to the natural changes in the atmosphere across the day (there is more 'room' for pollutants to mix during the daytime when temperatures rise and this phenomenon means concentrations are often lower - the opposite is true during the nighttime).

- The most frequent morning spikes in black carbon occurred on weekdays, and especially Monday through Thursday. Wednesdays appear to have the highest morning to afternoon levels of black carbon. This trend will be explored further with the YMCA.

- Similarly to $PM_{2.5}$, indoor black carbon levels are most similar to outdoor levels during the middle of the day, which often coincides with the YMCA's general operational hours, highlighted in yellow, but also extends to patterns seen on the weekend. This trend will be explored further in future reports.



This bar chart compares average daily outdoor (left) and indoor (right) black carbon levels during periods of higher outdoor pollution. The arrow from the grey dashed line and coinciding percentage indicates how much lower the average indoor level is compared to outdoor black carbon.

What does this chart tell us?

- In general, we would expect indoor black carbon levels to be between 30% and 80% lower than outdoor levels on average, depending on currently installed HVAC filtration. For this period, the average indoor level during higher outdoor pollution was within this expected range, but continues to be on the lower end. Indoor black carbon levels are expected to substantially improve (lower) after the HVAC filter upgrade.

Conclusion

Indoor and outdoor air monitoring at the Corona-Norco Family, Southeast Rio Vista, and Weingart East LA YMCAs has provided a clear picture of air quality conditions over the past year. Each site shows that baseline HVAC filtration systems can help reduce indoor levels of $PM_{2.5}$ and black carbon, although results differ between facilities and among rooms within each location. On average, indoor $PM_{2.5}$ was about 50-68% lower than outdoor levels. Some rooms, particularly in Weingart East LA and Southeast Rio Vista, achieved only 37-39% lower $PM_{2.5}$ compared to outside, likely due to HVAC design and how the areas are used.

Pollution events from wildfire and holiday fireworks stand out in the data at all sites, pointing to the importance of strong air filtration and the need for ongoing upgrades and responsive action during periods of high outdoor pollution. At Corona-Norco Family YMCA, the upgrade to MERV-16 filters showed an average indoor $PM_{2.5}$ reduction up to 91%. These results exceeded initial expectations and emphasize the value of targeted improvements.

This project demonstrates how routine monitoring and data sharing with the YMCA communities supports informed decisions to protect health on an everyday basis. Continued attention to HVAC maintenance and responsive interventions can help maintain healthy indoor spaces, especially during high pollution events. Together, these findings highlight the value of monitoring and improvements in filtration to support healthy air quality for all YMCA members and staff across locations.

Appendix A

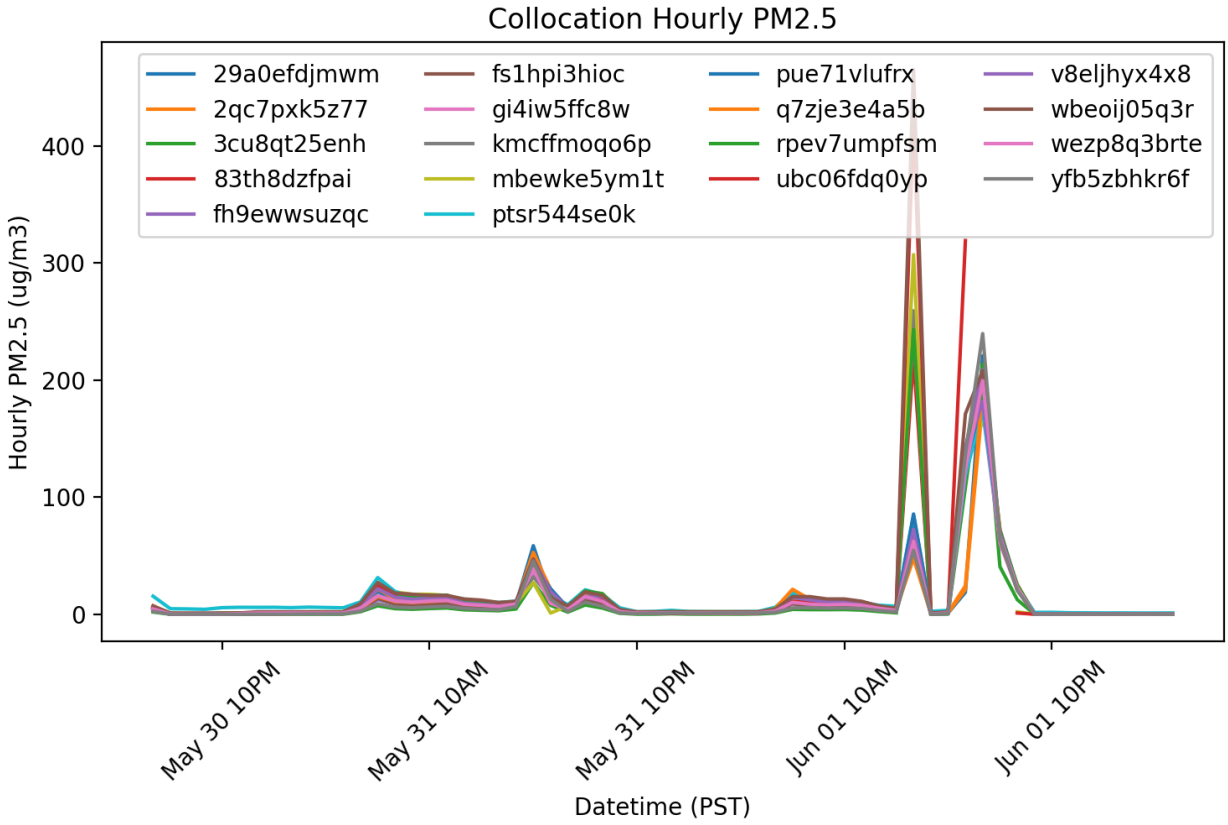
Pre-Deployment Collocation (June 21 - June 27, 2024)

Initial pre-deployment collocation results matched our project cross-sensor performance criteria for CO_2, temperature, and humidity, but exceeded criteria for $PM_{2.5}$ (20-30% average cross-sensor differences compared to our ≤10% (or ≤10 ug/m^3) criteria). We shared results with the manufacturer, IQAir, who informed us that the devices were programmed to incorrect firmware versions which was impacting the $PM_{2.5}$ results. IQAir corrected these programming issues and conducted another collocation to ensure the update resolved the device performance. The C-12 black carbon devices were also collocated pre-deployment and met defined performance criteria.

Initial pre-deployment outdoor collocation of all AirVisual Pro and Outdoor devices from June 21 to June 27, 2024.

Routine 6-Month Collocation (May 30 - June 2, 2025)

All AirVisual monitors underwent a brief routine collocation to ensure cross-sensor differences had not developed since deployment. The monitors were collocated in an indoor environment and exposed to planned pollution events (e.g., candle burning, grilling) to ensure the devices were responding comparatively to higher particle concentrations. These events occurred on June 1, and the higher $PM_{2.5}$ levels can be seen in the time series below (left peak is related to candle smoke and the right most peak is grilling). Average collocation results for $PM_{2.5}$, CO_2, temperature, and humidity met data quality requirements described in the project Quality Assurance Project Plan (QAPP), and any minor differences were likely due to the air not being fully mixed in the indoor collocation environment.



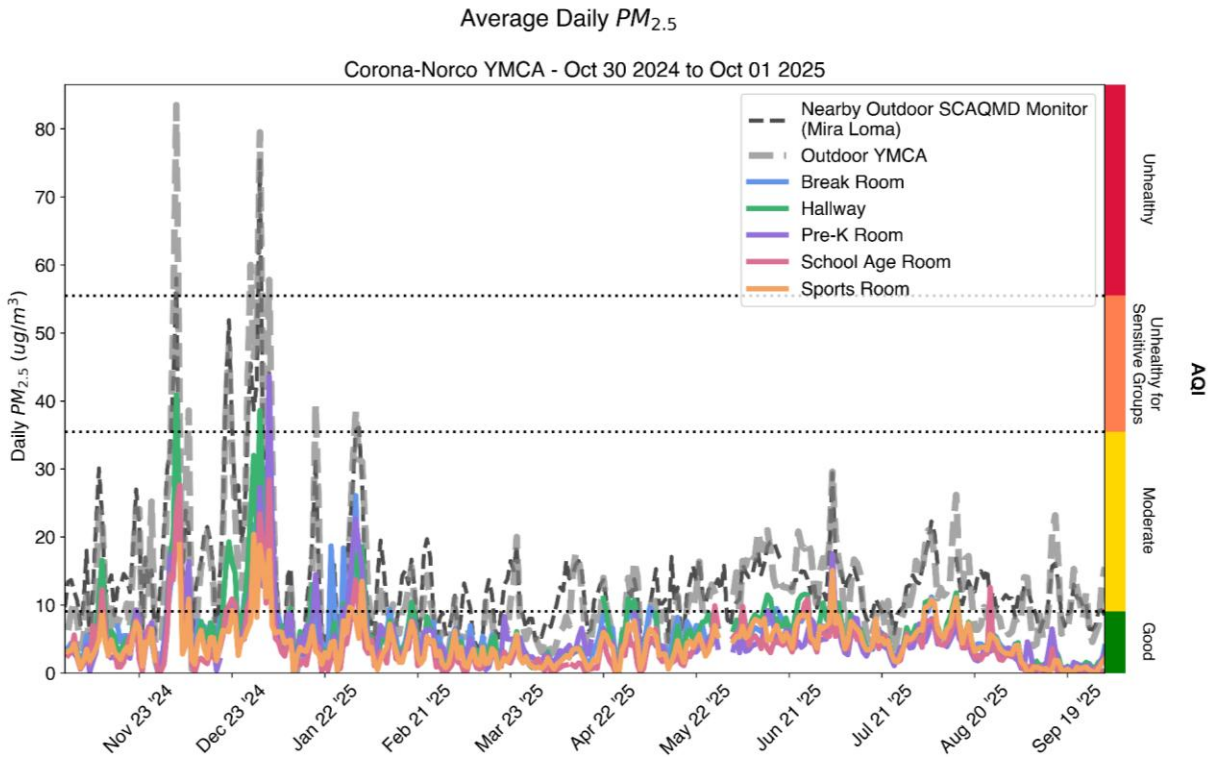
Time series of hourly average $PM_{2.5}$ across all AirVisual Pro and Outdoor project monitors during collocation from May 30 to June 2 2025.

Routine Black Carbon Device Maintenance

The C-12 black carbon monitors underwent routine monthly maintenance consisting of visual site check ups, flow audit and calibration as well as a concentration audit calibration every third month. All maintenance results are stored in this spreadsheet.

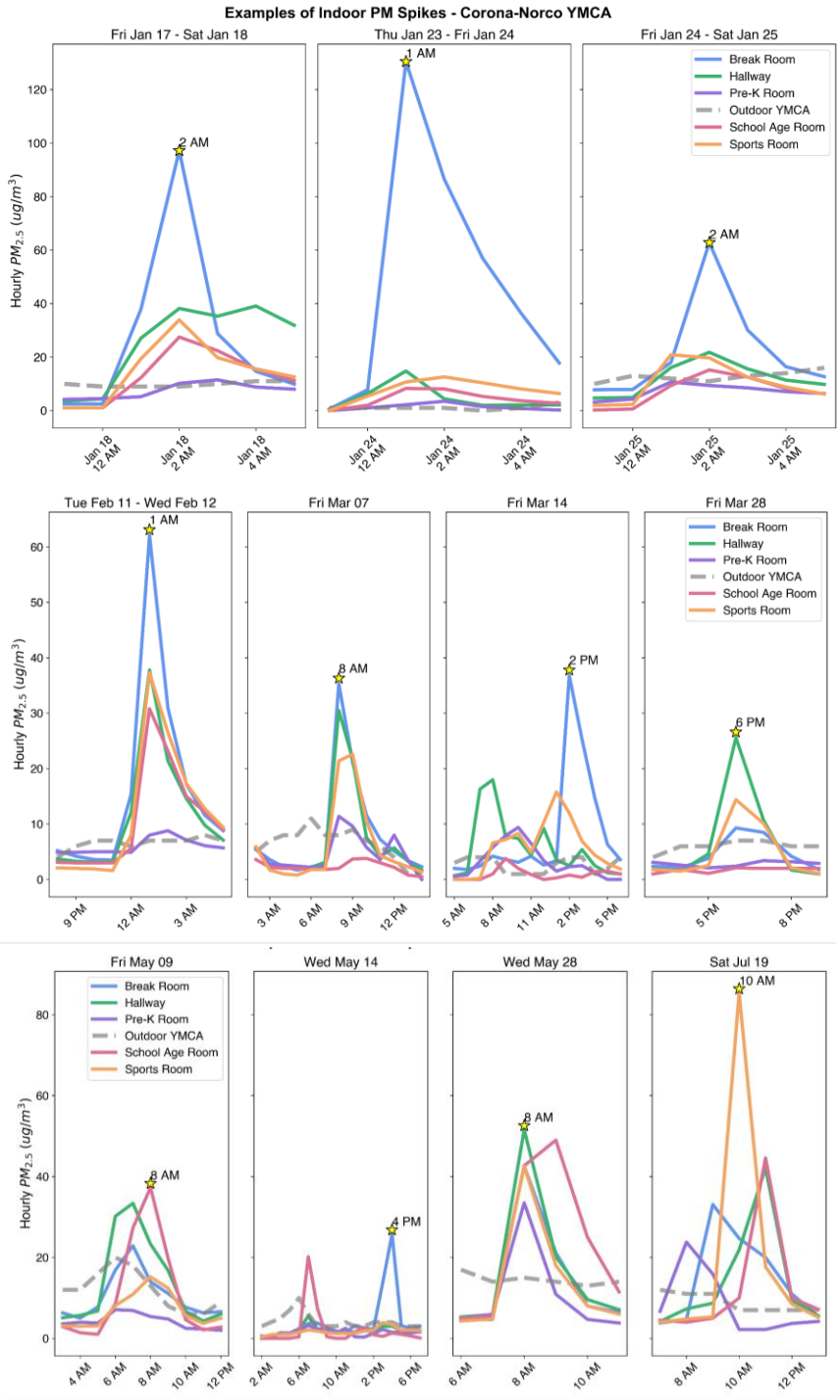
Appendix B - Corona-Norco YMCA

Daily $PM_{2.5}$ Trends



This plot shows average daily $PM_{2.5}$ levels across time for both the indoor (solid color lines) and outdoor (dashed grey lines) monitors from the beginning of November 2024 to the end of September 2025. The Air Quality Index (AQI) categories coinciding with $PM_{2.5}$ concentrations are shown on the right with bounds shown across the plot in dashed black lines, helping to provide health context. Any gaps in the data are due to issues in power or WiFi/cellular connectivity.

Examples of Indoor PM Spikes

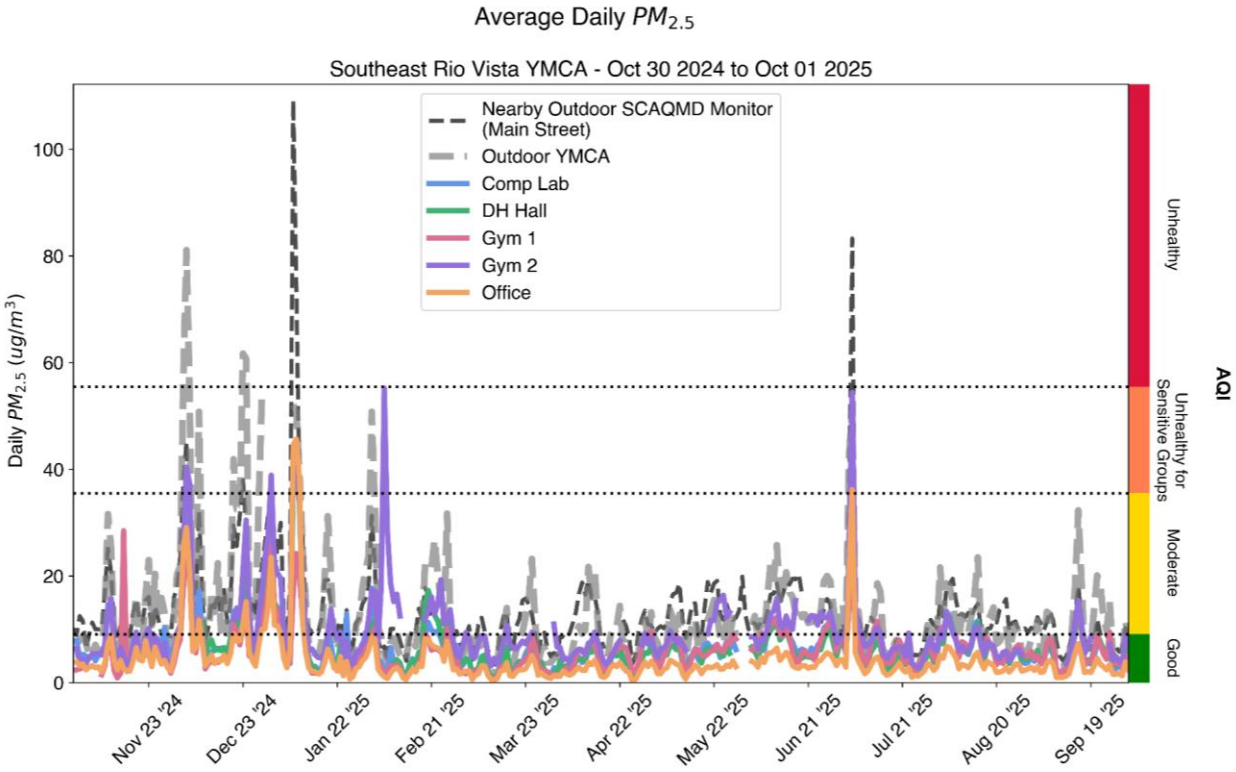


These plots show examples of hourly indoor $PM_{2.5}$ levels that are characteristic of indoor sources or activities that contribute to higher indoor air quality.

Indoor $PM_{2.5}$ rose higher than outdoor levels occurred periodically across the year, often occurring in the early morning and involving the Break Room.

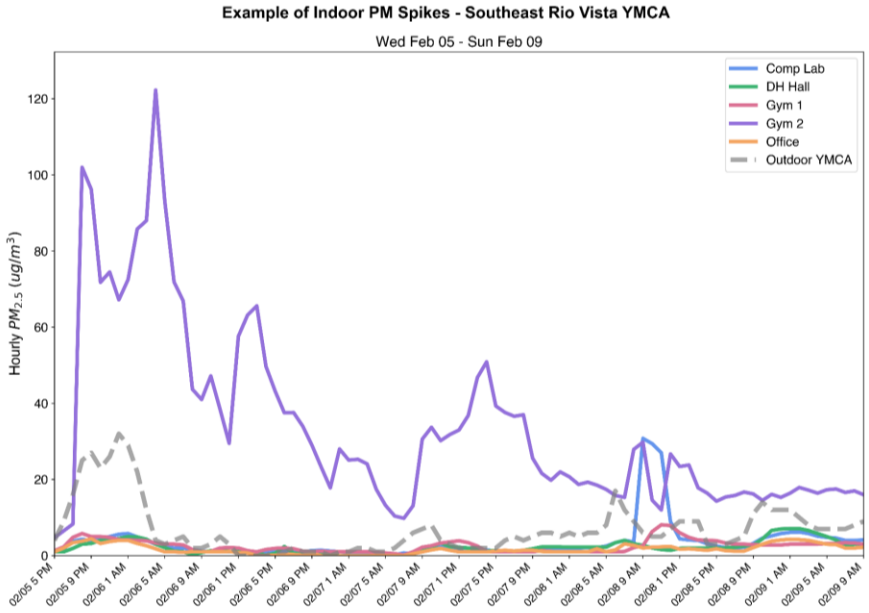
Appendix C - Southeast-Rio Vista YMCA

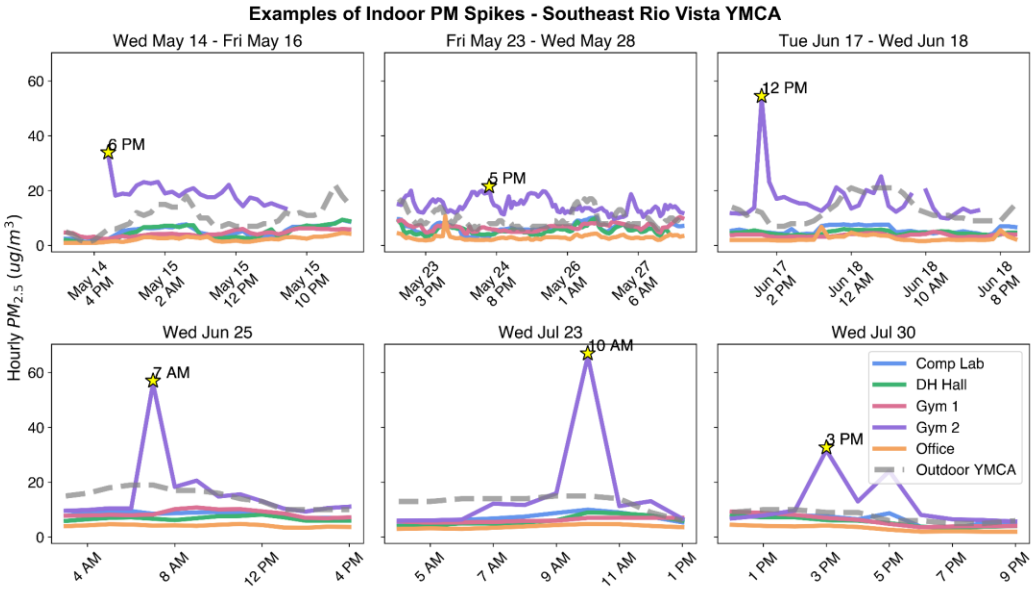
Daily $PM_{2.5}$ Trends



This plot shows average daily $PM_{2.5}$ levels across time for both the indoor (solid color lines) and outdoor (dashed grey lines) monitors from the beginning of November 2024 to the end of September 2025. The Air Quality Index (AQI) categories coinciding with $PM_{2.5}$ concentrations are shown on the right with bounds shown across the plot in dashed black lines, helping to provide health context. Any gaps in the data are due to issues in power or WiFi/cellular connectivity.

Examples of Indoor PM Spikes



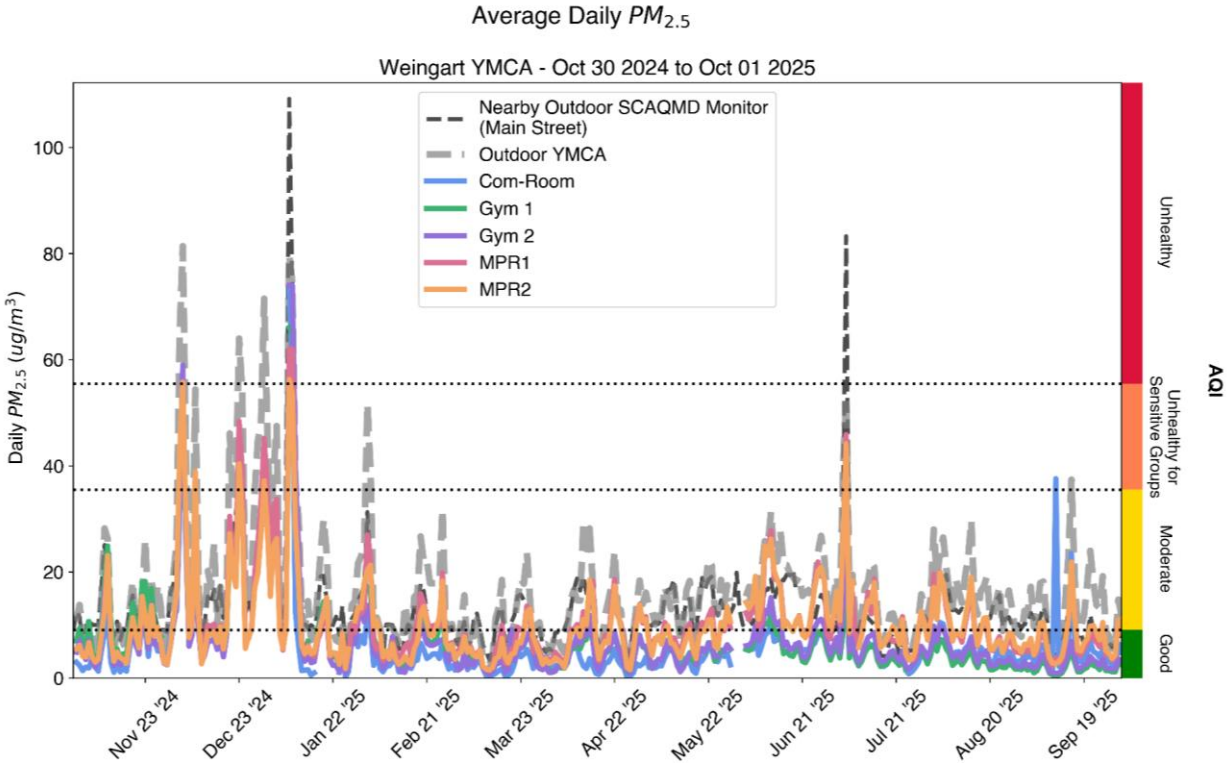


These plots show examples of hourly indoor $PM_{2.5}$ levels that are characteristic of indoor sources or activities that contribute to higher indoor air quality.

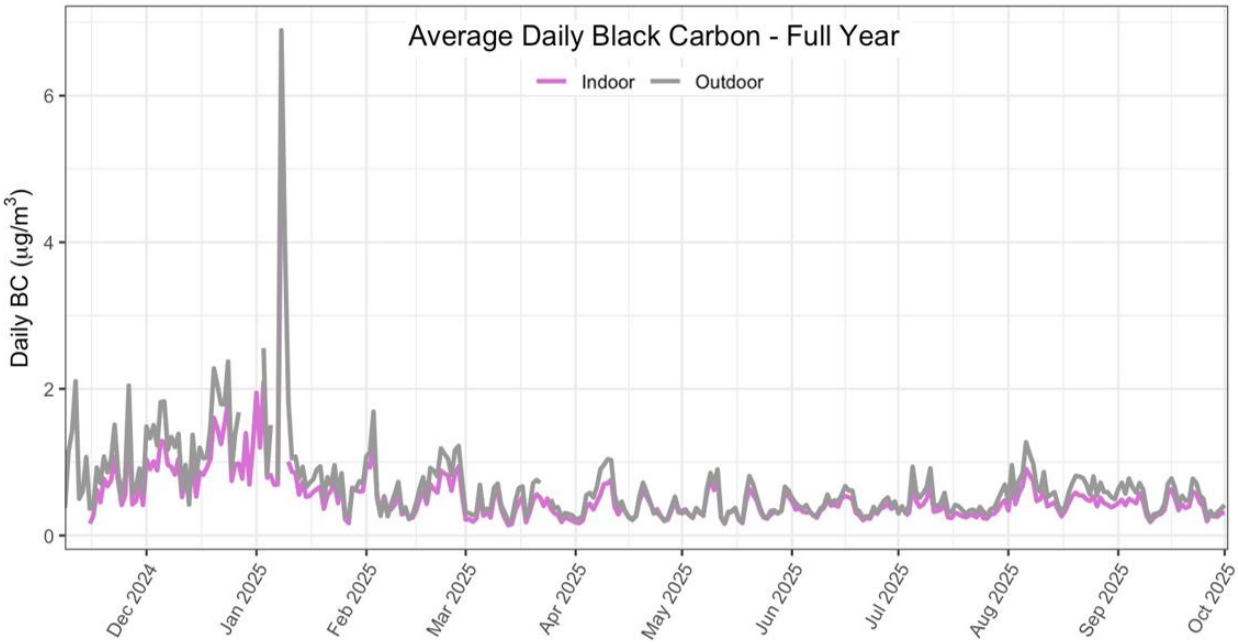
Indoor spikes in $PM_{2.5}$ often occurred in Gym 2 and predominantly in the summer months, though one period in early February shows an example of prolonged higher $PM_{2.5}$ than both other indoor spaces and the outdoors.

Appendix D - Weingart YMCA

Daily Trends

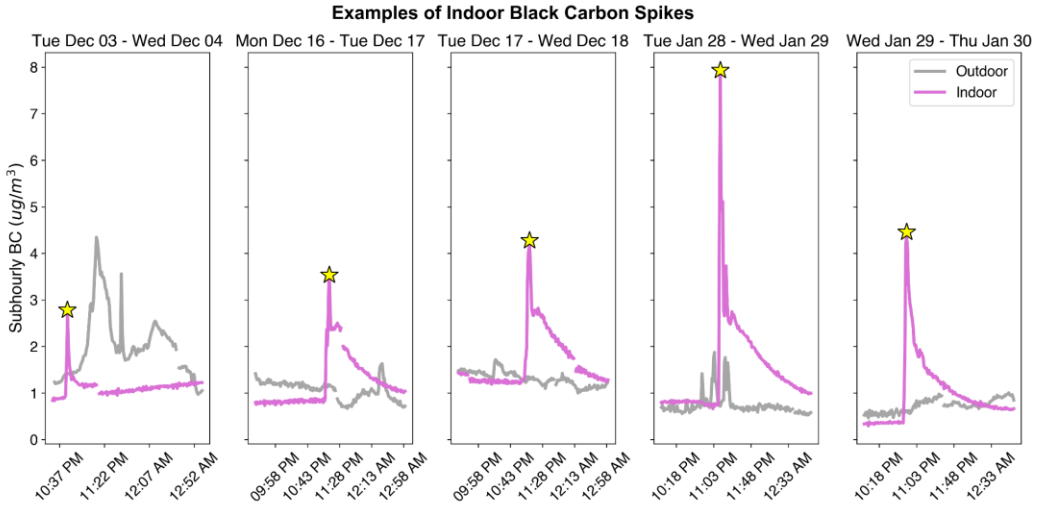


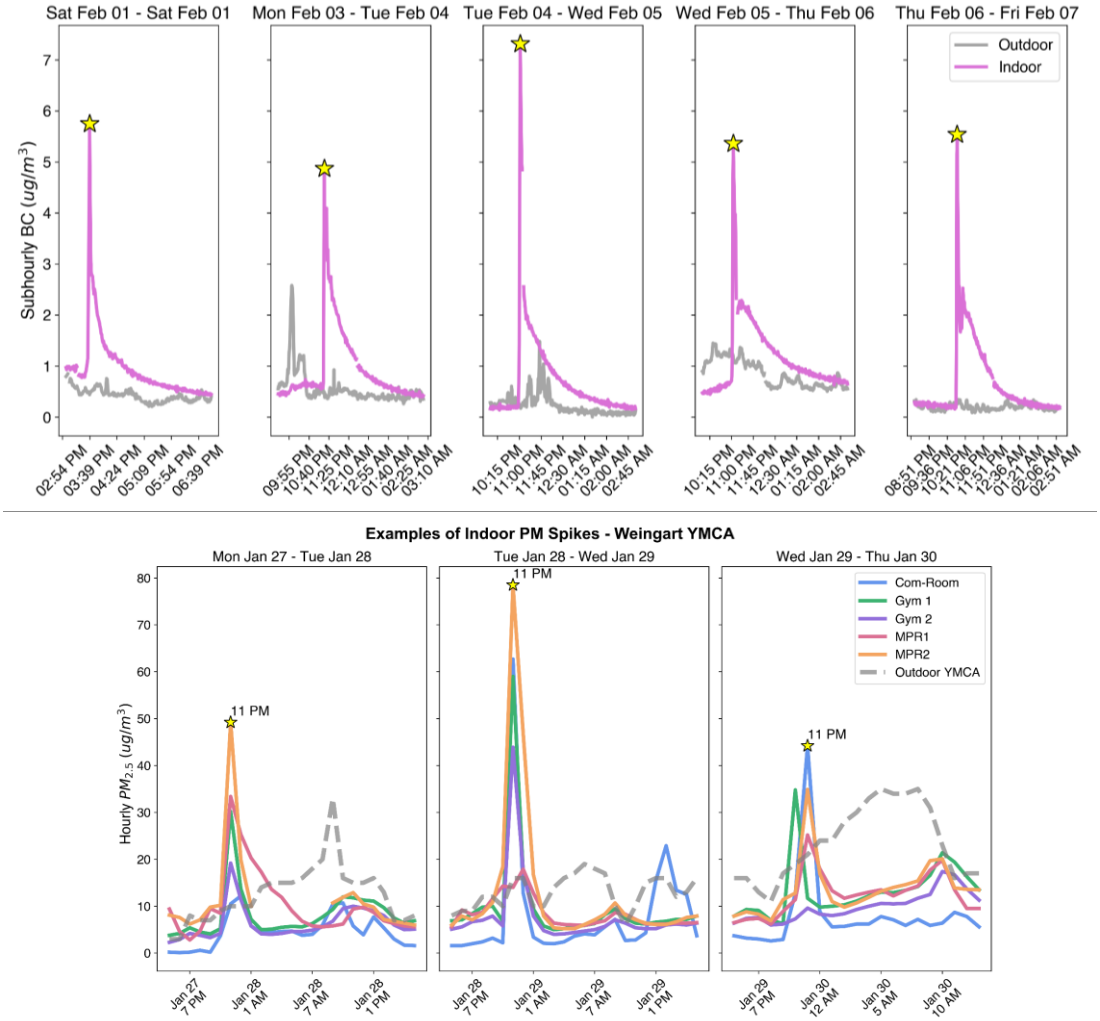
This plot shows average daily $PM_{2.5}$ levels across time for both the indoor (solid color lines) and outdoor (dashed grey lines) monitors from the beginning of November 2024 to the end of September 2025. The Air Quality Index (AQI) categories coinciding with $PM_{2.5}$ concentrations are shown on the right with bounds shown across the plot in dashed black lines, helping to provide health context. Any gaps in the data are due to issues in power or WiFi/cellular connectivity.



This plot shows average daily black carbon (BC) levels across time for both indoor (pink) and outdoor (grey) from the beginning of November 2024 to the end of September 2025. Any gaps in the data are due to routine maintenance.

Examples of Indoor Spikes





These plots show examples of sub-hourly (1-min) indoor black carbon and hourly indoor $PM_{2.5}$ levels that are characteristic of indoor sources or activities that contribute to higher indoor air quality.

Spikes in indoor black carbon often occurred routinely overnight around 11PM local time from December 2024 through early February 2025, but did not reappear in spring, summer or early Fall.

AirAware is a collaborative, grant funded project with the following project partners:

COALITION FOR CLEAN AIR

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