

OVERVIEW

Maryland continues to see improvements in air quality as the number of ozone exceedance days continue to decrease (*Figure 1*). Climatologically, surface ozone concentrations start to increase beginning in April as the daylight hours become longer and temperatures begin to warm. Surface ozone is typically an issue between May and September as more direct sunlight, continued warmth and a weakening of surface winds provide a suitable environment for ozone formation. Surface ozone concentrations are monitored and forecasted to help protect the public's welfare. Unlike aloft ozone in the upper atmosphere that shields the Earth from harmful solar radiation, ground level ozone adversely affects the human respiratory system. This includes reduced lung function, inflammation of airways, chest tightness and shortness of breath. The Air Quality Index (AQI, see legend at bottom) was developed to easily communicate air quality status to the public. When the daily 8-hour average ozone concentration exceeds 70 parts per billion (ppb), or 100 on the AQI scale, it is deemed unhealthy for sensitive groups (USG). Days in which 8-hour average exceeds this criteria are called "exceedance days". The total number of exceedance days in a particular year provides a good measure of how good or bad an ozone season was. The 2017 ozone season experienced 17 exceedance days (*Figure 1*), the second fewest since ozone measurements began back in 1980.

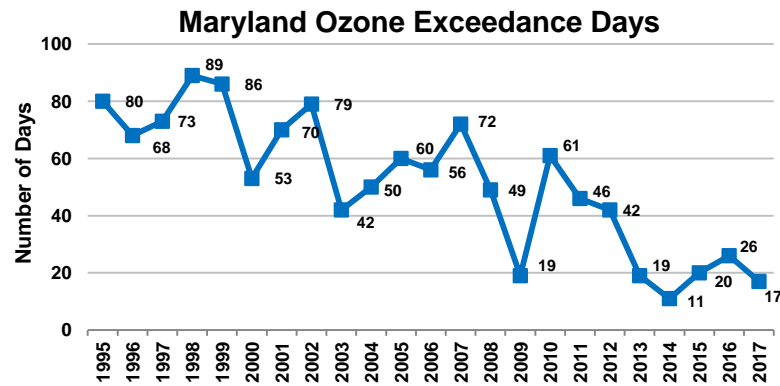


Figure 1: Total number of Maryland ozone exceedance days using the 70 ppb standard, 1995 – 2017.

WEEKDAY VS. WEEKEND

In recent years there's been a continuing trend of fewer and fewer weekend exceedance days. During the 2017 ozone season only 2 of the total 17 exceedance days (~12%) occurred on either a Saturday or Sunday (*See Table 1*). In 2016 just 5 exceedance days out of 27 (~18.5%) occurred on the weekend. Compare these numbers to those just several years earlier during the 2010-2012 time period, ~25% of the exceedance days occurred on the weekend. When looking at just Sunday exceedance days, the results are more interesting. The June 11th 2017 exceedance day was the first to fall on a Sunday since April 28th 2013! Weekend exceedances, especially on Sundays are starting to become a thing of the past. So why is this phenomenon occurring?

One potential answer lies with the regional nitrogen oxide (NO_x) concentrations on weekdays vs. weekends, particularly in regards to vehicle emissions. In order for ozone to be created there needs to be an interaction between NO_x and volatile organic compounds (VOC's). Vehicles are a well known source of NO_x emissions. Therefore when there are more vehicles, there is more NO_x and in turn generally more ozone can be produced. The opposite can be said when there are fewer vehicles.

Figure 3 shows the vehicle counts along a stretch of I-95 between Baltimore and D.C. during the 2017 ozone season. The vertical gray bars highlight weekend days. A pattern is clearly visible as weekday vehicle counts are generally much higher versus Saturday and Sunday. The average weekday morning "rush hour" traffic count is approximately 71,000 vehicles. When compared to the Saturday morning traffic counts, the total drops to about 54,500 vehicles (~23% reduction). Sunday counts are even lower, ~41,000 vehicles. This is a reduction of over 40% versus weekday

Maryland 2017 Ozone Exceedance Days				
Date	Day	No. of Monitors	Highest AQI Monitor	8-Hr Average Ozone AQI
11-Apr	Tue	3	Fairhill	108
17-May	Wed	13	Aldino	147
18-May	Thur	7	Fairhill	161
10-Jun	Sat	3	Glen Burnie	108
11-Jun	Sun	1	Hart-Miller Island	122
12-Jun	Mon	5	Hart-Miller Island	147
13-Jun	Tue	6	Hart-Miller Island	166
15-Jun	Thur	1	Hagerstown	101
22-Jun	Thur	2	Aldino & Fairhill	101
3-Jul	Mon	1	Hart-Miller Island	119
4-Jul	Tue	1	Hart-Miller Island	115
19-Jul	Wed	7	Hart-Miller Island	136
20-Jul	Thur	6	Edgewood	151
21-Jul	Fri	3	Hart-Miller Island & Glen Burnie	108
1-Aug	Tue	1	Hart-Miller Island	101
16-Aug	Wed	1	Hart-Miller Island	105
25-Sep	Fri	1	Fairhill	115

Table 1: 2017 Maryland ozone exceedance days. Day of week is noted along with highest monitor and its color coded 8-hr AQI value.

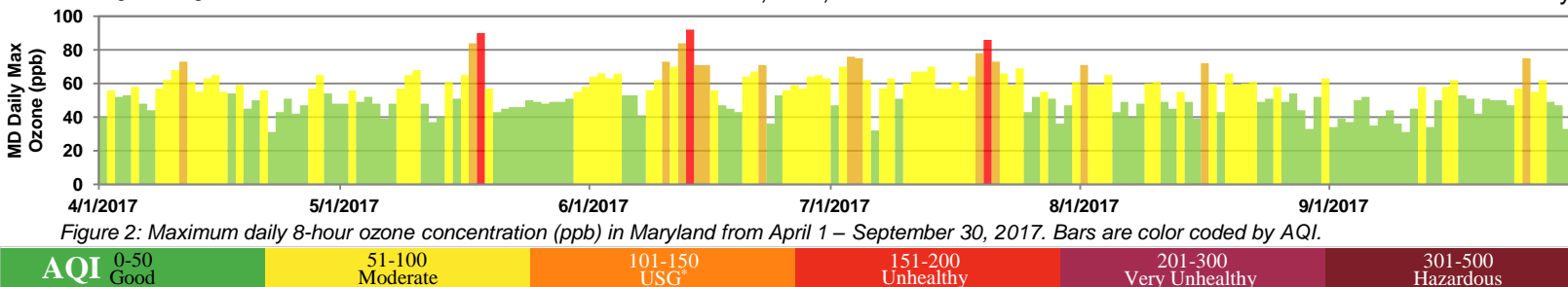


Figure 2: Maximum daily 8-hour ozone concentration (ppb) in Maryland from April 1 – September 30, 2017. Bars are color coded by AQI.

AQI 0-50 Good	51-100 Moderate	101-150 USG*	151-200 Unhealthy	201-300 Very Unhealthy	301-500 Hazardous
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*Unhealthy for Sensitive Groups
Based on 2015 8-hour ozone NAAQS



WEEKDAY VS. WEEKEND (cont.)

counts! With fewer vehicles (especially on Sundays) there is less NO_x regionally and in turn less ozone which can be produced. With weekday versus weekend traffic counts being pretty consistent on a year to year basis, why is this pattern just now surfacing?

Electricity generating units (EGUs) are another large emitter of NO_x. Over the past 15-20 years there have been dramatic reductions in the amount of NO_x emitted by these sources. In years past, the atmosphere had plenty of readily available NO_x to produce ozone. The role of NO_x emitted by cars and trucks was not as significant. However as NO_x levels have continued to decrease, the dependence of vehicle NO_x in the production of ozone has increased. The theory is that with fewer (and cleaner) vehicles on the road, there is just not enough NO_x available to push ozone contributions into the USG range. This is particularly true on Sundays, when vehicle counts are at their lowest.

5AM - 11AM Total Vehicle Count: Apr 1st - Sept 30th 2017

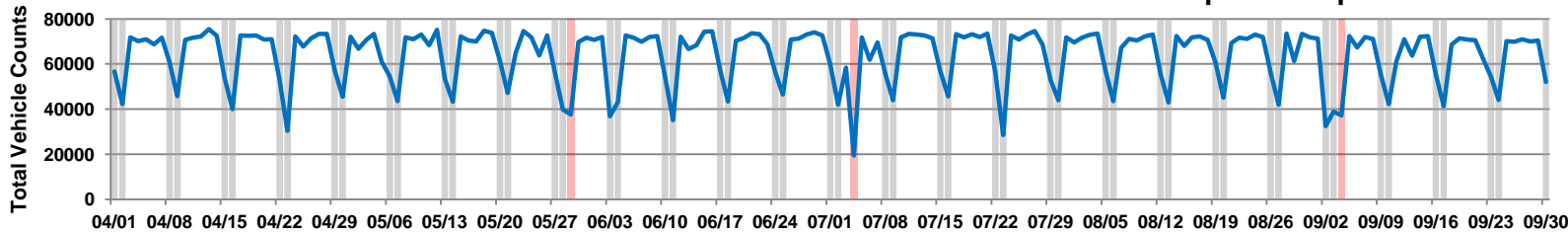


Figure 3: Vehicle counts along I-95 between D.C. and Baltimore at the Howard County Near Road Station. Vertical gray bars highlight weekend days (Saturday and Sunday). Red bars highlight outliers to the pattern. All three days in red were federal holidays: 5/29 (Memorial Day), 7/4 (Independence Day) and 9/5 (Labor Day).

Featured Event – May 17-18, 2017

High pressure off the Atlantic coast persisted for several days prior to this event. Generally weak southwest winds, stagnation and pollutant emissions gradually degraded the air mass for several days leading up to May 17th. High elevation monitors across the region were showing rising ozone concentrations on May 16th. These high elevation monitors have proven to be a valuable tool to show ozone transport into Maryland. This dirty air mass to our south and west was aided by numerous small agricultural fires that affected the region. Diffuse smoke was analyzed to Maryland's south and west by the Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPPLIT) smoke and dust forecast product for May 16th. Several ozone exceedances were already observed in North Carolina on the 16th.

By the early morning hours of May 17th, the high elevation Shenandoah National Park (SNP) ozone monitor in Virginia was consistently measuring hourly ozone concentrations around 60-65 ppb (Figure 4). With the southwest flow persisting, dirty air was continually being transported into Maryland. In addition, warm temperatures along with minimal cloud coverage created ripe conditions for ozone formation. The maximum temperature at BWI airport reached 93° F, well above the normal for that time of year. With a regionally dirty air mass and very favorable meteorological support, widespread USG conditions were seen across the state. In total 13 of Maryland's 21 ozone monitors surpassed the 70 ppb threshold on May 17th. The peak maximum 8-hour ozone concentration was 84 ppb at Aldino, with a maximum 1-hour concentration also at Aldino reaching 103 ppb!

High pressure continued to linger off the Atlantic coast on May 18th. A warm southwest flow and ample sunshine pushed temperatures into the low 90s F across the region once again. Regionally, the dirty air mass that was to Maryland's south and west on the previous day was slowly improving. This was evident at the SNP hill top monitor, as there was a fairly steady drop in ozone concentrations throughout the day (Figure 4).

With cleaner air slowly moving in, it was a race against the clock. Locations to the south and west, where the mixing began earlier in the day, allowed conditions to remain relatively clean despite a favorable meteorological setup. In fact, western Maryland monitors remained in the Good AQI range for ozone. Points north and east of the Baltimore area aided by significant local transport from D.C. to Baltimore, still had enough dirty air in place to result in widespread USG conditions. The highest AQI values were primarily north and east of Baltimore with the highest maximum 8-hour ozone concentrations occurring in the far northeast corner of the state (Fairhill). In total there were 7 monitors that reached USG or greater. Fairhill took the honors being the monitor with the highest 8-hour ozone concentration of 90 ppb with AQI values in the Unhealthy range.

Shenandoah NP Hourly Ozone May 16-18 2017

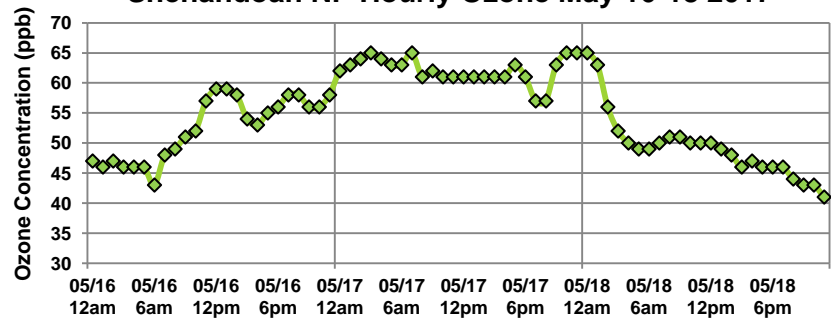


Figure 4: (Top): Hourly ozone concentrations at Shenandoah National Park, VA from May 16th – 18th 2017. (Right): Map focused on the Maryland and Virginia area. Yellow star is identifying the location of the Shenandoah National Park monitor.



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