

OVERVIEW

Surface ozone concentrations start to increase beginning in April as the daylight hours become longer and temperatures begin to warm. Surface ozone, also referred to as smog, is typically worst between May and September as more direct sunlight, continued warmth and a weakening of surface winds provide a suitable environment for ozone formation. Unlike stratospheric ozone, which protects us from harmful ultraviolet (UV) radiation emitted by the sun, surface ozone can lead to numerous adverse health effects such as reduced lung function, inflammation of airways, chest tightness and shortness of breath. These are just a few of the harmful side effects of breathing unhealthy levels of ozone. When the daily 8-hour average ozone concentration exceeds 70* parts per billion (ppb), or 100 on the Air Quality Index (AQI) (see bottom of page), the air quality is deemed unhealthy for sensitive groups (USG). The total number of days which meet this criteria in a particular ozone season are referred to as “exceedance days”, and they can be a key

indicator of the ozone season’s severity. The 2016 season experienced 26 exceedance days in Maryland (see Table 1) using the new 2015 70 ppb standard*.

SEASONAL HIGHLIGHTS & QUICK STATS

Maryland Apr-Sep Average Daily Temperature:

Well above normal (7th Warmest) – Warmest on record: 2010

Warmest August on record

Days at or above 90°F at BWI: 48 (on average BWI has 31 days)

Maryland Apr-Sep Precipitation:

Above normal (33rd Wettest) – Wettest on record: 2003

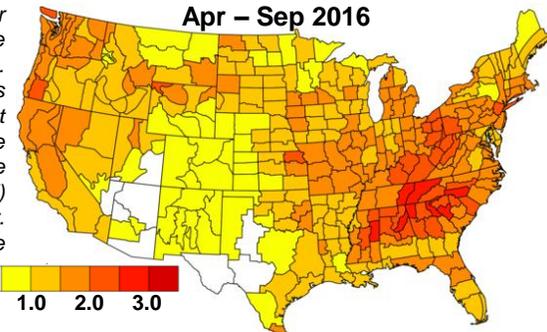
Country-wide Apr-Sep Temperatures: Well above normal (5th Warmest)

Country-wide Apr-Sep Precipitation: Above normal (15th Wettest)

Climate Division Temperature Anomalies (F)

Apr – Sep 2016

Figure 1 (right): April – September 2016 average daily temperature anomalies by climate division. Temperature scale is in degrees Fahrenheit. Temperatures were at or above normal across the entire United States, with well above normal conditions (1.0 – 3.0 ° F) east of the Mississippi River. Source: NOAA/NCDC Climate Division.



THE NEW STANDARD*

On October 1, 2015, the U.S. Environmental Protection Agency (EPA) strengthened the National Ambient Air Quality [Health] Standards (NAAQS) for ground-level ozone, lowering the standard from 75 ppb to 70 ppb. This change was made based on extensive scientific evidence about ozone’s effects on public health and welfare. The updated standard will help improve public health protection and awareness, particularly for at-risk groups. 2016 was the first full year using this new standard. Given the new stricter standard, the number of exceedance days in 2016 went up significantly from previous years. As mentioned previously, during the 2016 ozone season Maryland experienced 26 exceedance days. The number of exceedance days in 2013, 2014 and 2015 for comparative purposes are 9, 5 and 8, respectively. This doesn’t mean air quality has suddenly gotten worse. It simply means a more protective lower standard is now in place.

Maryland 2016 Ozone Exceedance Days			
Date	No. of Monitors	Highest AQI Monitor	8-Hr Average Ozone AQI
18-Apr	1	So. Maryland	108
19-Apr	4	So. Maryland	115
25-May	13	Millington	150
26-May	15	Padonia	147
27-May	1	Aldino	108
28-May	1	Padonia	108
1-Jun	5	So. Carroll & Frederick	122
11-Jun	2	Millington	105
20-Jun	5	Fairhill	133
6-Jul	1	Essex	112
16-Jul	1	Essex	101
19-Jul	2	Hart-Miller Island	119
21-Jul	11	HU-Beltsville & Beltsville	126
22-Jul	6	Hart-Miller Island	159
23-Jul	1	Hart-Miller Island	105
25-Jul	5	Aldino	122
26-Jul	4	Hart-Miller Island	164
27-Jul	9	Hart-Miller Island	204
29-Jul	3	Hart-Miller Island	126
27-Aug	2	Fairhill	115
29-Aug	3	Glen Burnie	140
31-Aug	2	Padonia	108
7-Sep	2	Hart-Miller Island	108
14-Sep	4	Hart-Miller Island	164
22-Sep	4	Fairhill	119
23-Sep	14	Hart-Miller Island	156

Table 1: 2016 Maryland ozone exceedance days. Highest monitor is noted along with its color coded 8-hr AQI value.

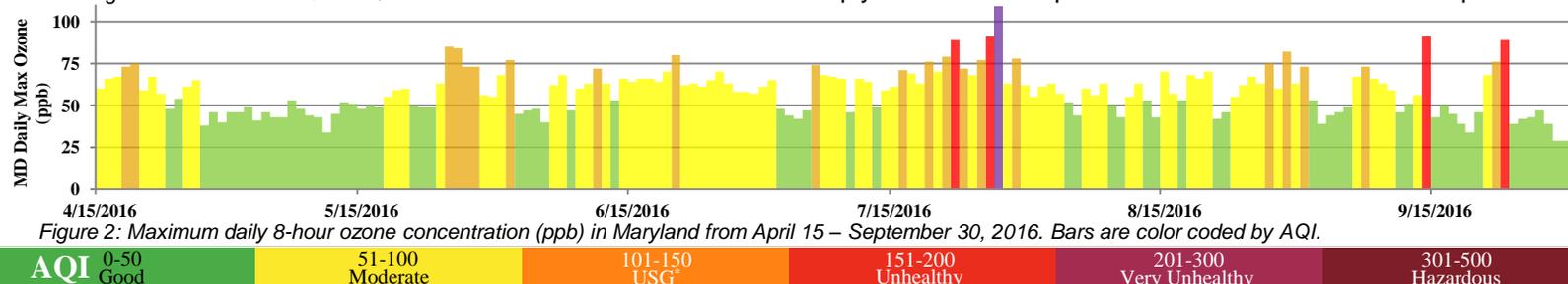


Figure 2: Maximum daily 8-hour ozone concentration (ppb) in Maryland from April 15 – September 30, 2016. Bars are color coded by AQI.



*Unhealthy for Sensitive Groups
Based on 2015 8-hour ozone NAAQS



THE NEW STANDARD (cont.) – What is Normal Anymore?

With emissions drastically reduced in recent years along with a new ozone exceedance threshold, it can be confusing to understand what the average number of exceedance days in an ozone season means. Remember, it is important to compare years using the same standard to better decipher what is average or “normal”. In 2016, Maryland experienced 26 days which surpassed the NAAQS threshold of 70 ppb. In 2015, the number of exceedance days was 8 and in 2014 this number was only 5. Strictly comparing exceedance numbers from years past, 2016 looks to be well above normal. These previous years of course were using the old NAAQS of 75 ppb. *Figure 3* shows the number of exceedance days in recent years using the old (75 ppb) and new (70 ppb) NAAQS. Using the new standard, the annual number of exceedance days in 2015 jumped to 20 with 2014 climbing to 11. A computed 7-year average using the new standard suggests the yearly number of exceedances to be around 32 days. However, doing the same calculation from 2012-2016 (5-year average) suggests that this number is closer to 24 days.

Despite an ozone conducive meteorological setup for most of the 2016 season, the total exceedance days were still around the 5 and 7-year averages. This goes to show that the continued NO_x reductions have been an overwhelming success and in all likelihood the 2016 ozone season could have been a lot worse than just slightly above average as far as the total number of exceedance days.

HART-MILLER ISLAND

The tendency for air quality forecast models is to over predict ozone concentrations over water bodies such as the Chesapeake Bay. It has been hypothesized that this is due to the model's excessively low boundary layer heights over the water which would in turn lead to an inaccurate overestimation of surface ozone concentrations. In order to prove or debunk air quality model overestimations, an ozone monitor was located on Hart-Miller Island, a small island in the middle of the Chesapeake Bay just east of Baltimore City. *Figure 4* shows the study area with Hart-Miller Island starred in yellow. The island monitor site is in an ideal location to provide the most accurate ozone concentrations over the bay. The monitor became operational on July 6th, 2016 and almost immediately started sending back some interesting data.

Of the 80 days the Hart-Miller Island monitor was operational, 28 measured the highest 8-hour ozone concentration in the state (35%). The next highest monitor was Padonia with only 10 days (12%). Of the 18 exceedance days which occurred across the state while the Hart-Miller Island monitor was operational, Hart-Miller Island observed the highest ozone concentration in the state 9 of those days (50%). In total, Hart-Miller Island experienced 13 days of at least USG conditions. Four of those days reached the Unhealthy AQI category with one of those reaching the Very Unhealthy category. The 8-hour ozone concentration of 109 ppb on July 27th was the first time Maryland observed Very Unhealthy levels since July 9th 2007!

Despite the air quality forecast models predicted ozone concentrations agreeing with the Hart-Miller Island monitor, in the average daily 8-hour maximum ozone concentration in and around the Bay was still over predicted by the air quality forecast model. On average the air quality model over-predicted the daily 8-hour maximum ozone concentration by nearly 7 ppb. However, the air quality model showed day-to-day variations from overestimates of 20-30+ppb to even slight underestimates.

Even though the Hart-Miller Island monitor was only in operation for 80 days, it produced some interesting findings. There is still much to be learned regarding the complex interaction between the land and water. This “special purpose” monitor is expected to be operational for the full 2017 ozone season.

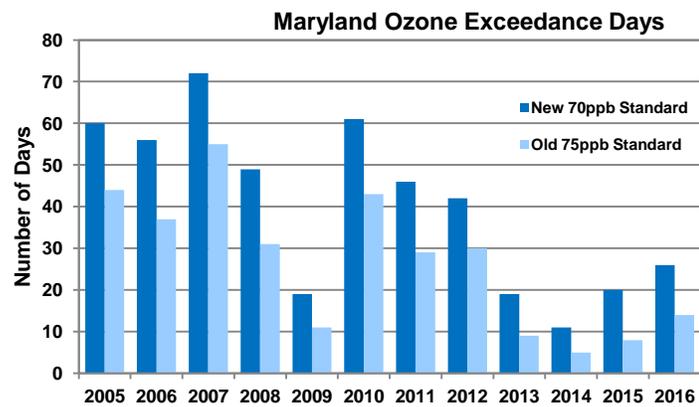


Figure 3: Number of Maryland ozone exceedance days by standard per year 2005 - 2016. Dark blue bars being the new, 70ppb standard. Light blue bars showing the old, 75ppb standard.

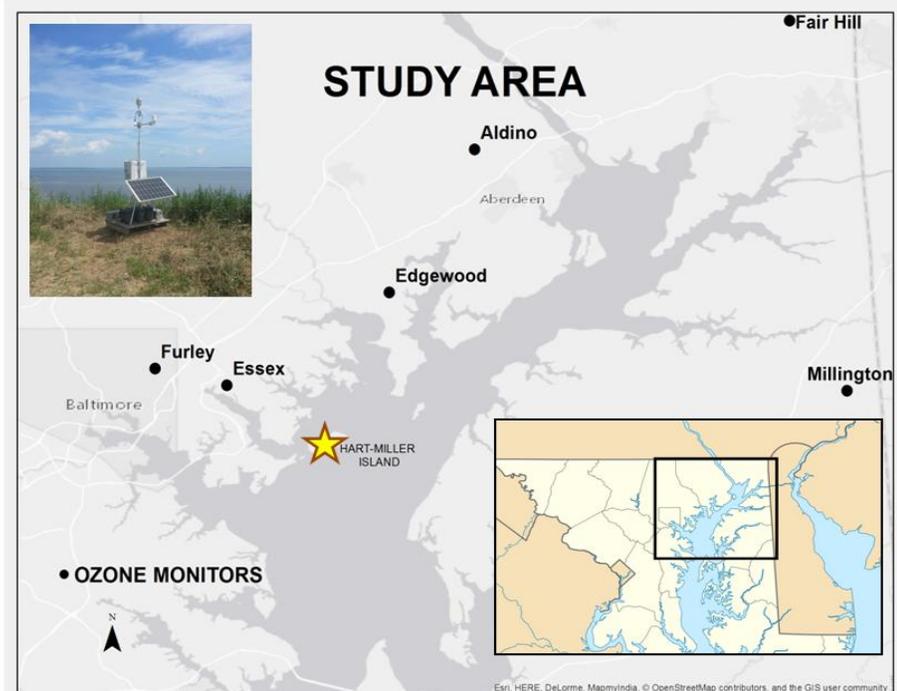


Figure 4: Map showing the study area in reference to Hart-Miller Island. Hart-Miller Island is starred in yellow. Bottom right image shows a zoomed out look of Maryland with inner black box representing the spatial view of the main image. Image on the top left shows the actual monitor instrumentation. Photograph is looking directly east towards the Chesapeake Bay.

AQI 0-50 Good	51-100 Moderate	101-150 USG*	151-200 Unhealthy	201-300 Very Unhealthy	301-500 Hazardous
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