Michigan

Allegan County, Muskegon County and Ottawa County

Final Area Designations for the 2015 Ozone National Ambient Air Quality Standards Technical Support Document (TSD) for Counties Remanded to EPA

1.0 Summary

On October 1, 2015, the EPA promulgated revised primary and secondary ozone national ambient air quality standards (NAAQS (80 FR 6592, October 26, 2015)). In that action, the EPA strengthened both standards to a level of 0.070 parts per million (ppm), while retaining their indicators, averaging times, and forms. The EPA revised the ozone standards based on an integrated assessment of an extensive body of new scientific evidence, which substantially strengthens our knowledge regarding ozone-related health and welfare effects, the results of exposure and risk analyses, the advice of the Clean Air Scientific Advisory Committee and consideration of public comments.

Following promulgation of a new or revised NAAQS, the Clean Air Act (CAA) requires EPA to determine if areas in the country meet the new standards. Accordingly, EPA designated all areas of the country as to whether they met, or did not meet, the NAAQS. EPA designated areas for the 2015 Ozone NAAQS in 3 rounds, resulting in 52 nonattainment areas. These are described below:

- Round 1- November 6, 2017: EPA designated 2,646 counties, 2 separate tribal areas and 5 territories as Attainment/Unclassifiable. We also designated 1 Unclassifiable area.
- Round 2- April 30, 2018: EPA designated 51 Nonattainment areas, 1 Unclassifiable area, and all remaining areas as Attainment/Unclassifiable, except for the 8 counties in the San Antonio, TX area.
- Round 3- July 17, 2018: EPA designated 1 county in the San Antonio area as Nonattainment and the other 7 counties as Attainment/Unclassifiable.

Challenges to EPA's Designations

Multiple petitioners (several environmental and public health advocacy groups, 3 local government agencies, and the state of Illinois) filed six petitions for review challenging the EPA's 2015 ozone NAAQS designations promulgated on April 30, 2018. The District of Columbia Circuit Court consolidated the petitions into a single case, *Clean Wisconsin v. EPA* (No. 18-1203).

- Collectively, the petitioners challenged aspects of EPA's final designations associated with 9 nonattainment areas, and involving 17 counties.
- Petitioners primarily argued that EPA improperly designated counties (in whole or part) as attainment that should have been designated as nonattainment based on contributions to nearby counties with violating monitors.
- In its brief, EPA requested voluntary remand of the final designation decisions for 10 counties associated with 4 nonattainment areas to further review those designations.

Court Decision

On July 10, 2020, the District of Columbia Circuit Court issued its decision on the April 30, 2018, designations. The Court granted EPA's request for voluntary remand, as well as remanding a number of other areas to the Agency. In total, the Court remanded 16 counties in 9 nonattainment areas back to EPA. The Court did not vacate the existing designations, but required EPA to "issue revised designations as expeditiously as practicable."

The Court remanded Ottawa County to EPA. The Court agreed that EPA's reasoning for how it chooses which counties are "nearby" and must be considered in a contribution analysis was "plausible," but was a post-hoc rationalization that did not appear in EPA's TSD documents. "On remand, EPA should either analyze Ottawa's contribution potential or explain why that analysis is unnecessary." In light of the Court decision, EPA re-evaluated the existing technical record for Ottawa County for data and information that was used for the initial April 2018 designations in order to analyze Ottawa's contribution potential to violating monitors in neighboring Musekgon and Allegan counties. Based on EPA's technical re-analysis as described in this TSD, the EPA is not modifying the 2018 air quality designation for Ottawa County. Table 1 shows EPA's 2018 designation and any final modification to that designation.

Table 1. Recommended Nonattainment Counties and EPA's Final Designated Nonattainment Area for the 2015 Ozone NAAQS

Area	Recommended Nonattainment Counties September 2016	EPA's Intended Nonattainment Counties December 22, 2017	EPA's Final Nonattainment Counties April 30, 2018	EPA's Final Nonattainment Counties - Remand Response January 15, 2021
Muskegon, MI	Muskegon	Muskegon	Muskegon (partial)	Muskegon (partial)
Allegan, MI	Allegan	Allegan	Allegan (partial)	Allegan (partial)
Ottawa, MI	Attainment	Attainment	Attainment	Attainment

2.0 Nonattainment Area Analyses and Intended Boundary Determination

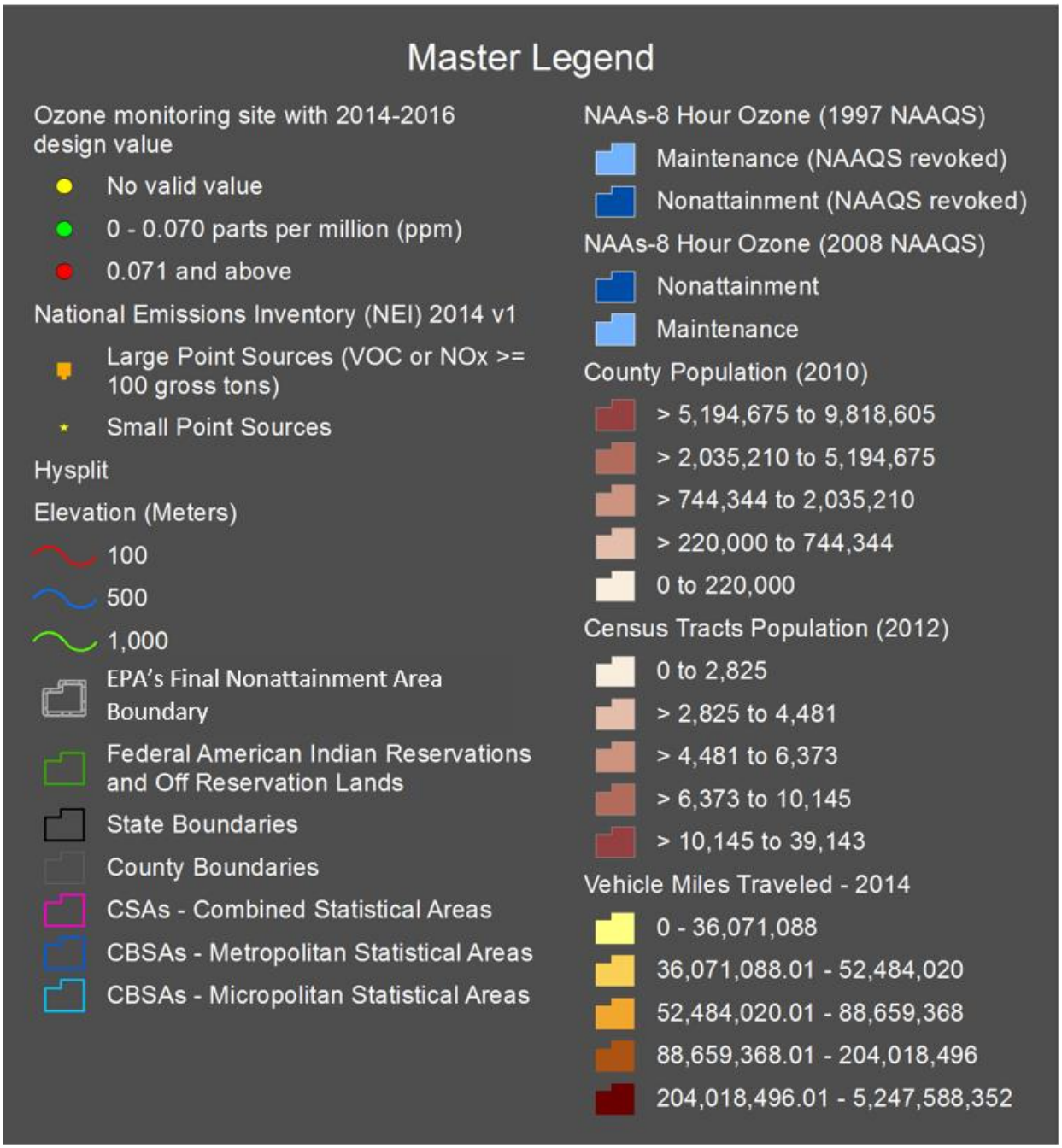
EPA analyzed Ottawa's contribution potential to violating monitors in neighboring Musekgon and Allegan counties considering the specific facts and circumstances of the area using data available at the time of the original designation in April 2018. In accordance with the CAA section 107(d), the EPA intends to designate as nonattainment the areas with the monitors that are violating the 2015 ozone NAAQS and nearby areas with emissions sources (i.e., stationary, mobile, and/or area sources) that contribute to the violations. As described in the EPA's designations guidance for the 2015 NAAQS

(hereafter referred to as the "ozone designations guidance"[1]) after identifying each monitor indicating a violation of the ozone NAAQS in an area, the EPA analyzed those nearby areas with emissions potentially contributing to the violating area. In guidance issued in February 2016, the EPA provided that using the Core Based Statistical Area (CBSA) or Combined Statistical Area (CSA)[2] as a starting point for the contribution analysis is a reasonable approach to ensure that the nearby areas most likely to contribute to a violating area are evaluated. The area-specific analyses may support nonattainment boundaries that are smaller or larger than the CBSA or CSA.

As noted above, EPA completed initial area designations in three separate rounds. In accordance with the Court's decision, EPA has re-evaluated the designations for Ottawa County consistent with the designations guidance (and EPA's past practice) regarding the scope of the area EPA would analyze in determining nonattainment boundaries for the ozone NAAQS as outlined above. The Technical Analysis section below contains EPA's re-analysis of the existing technical record for the Western Michigan counties.

[1] The EPA issued guidance on February 25, 2016 that identified important factors that the EPA intends to evaluate in determining appropriate area designations and nonattainment boundaries for the 2015 ozone NAAQS. Available at *https://www.epa.gov/ozone-designations/epa-guidance-area-designations-2015-ozone-naaqs*

[2] Lists of CBSAs and CSAs and their geographic components are provided at www.census.gov/population/www/metroareas/metrodef.html. The Office of Management and Budget (OMB) adopts standards for defining statistical areas. The statistical areas are delineated based on U.S. Census Bureau data. The lists are periodically updated by the OMB. The EPA used the most recent July 2015 update (OMB Bulletin No. 15-01), which is based on application of the 2010 OMB standards to the 2010 Census, 2006-2010 American Community Survey, as well as 2013 Population Estimates Program data.



Figures in the remainder of this document refer to the master legend above.

3.0 Technical Analysis

This technical analysis identifies any monitors in Allegan and Muskegon counties that violate the 2015 ozone NAAQS. It also provides EPA's re-evaluation of Ottawa County to determine whether Ottawa County has emissions sources that potentially contribute to ambient ozone concentrations at nearby violating monitors in the area, based on the weight-of-evidence of the five factors recommended in EPA's ozone designations guidance and any other relevant information. In re-analyzing the designations for

Ottawa County, EPA used the technical data and information available at the time of the initial air quality designations.

The five factors recommended in the EPA's guidance are:

1. Air Quality Data (including the design value calculated for each Federal Reference Method (FRM) or Federal Equivalent Method (FEM) monitor;
2. Emissions and Emissions-Related Data (including locations of sources, population, amount of emissions, and urban growth patterns);
3. Meteorology (weather/transport patterns);
4. Geography/Topography (including mountain ranges or other physical features that may influence the fate and transport of emissions and ozone concentrations); and
5. Jurisdictional Boundaries (e.g., counties, air districts, existing nonattainment areas, areas of Indian country, Metropolitan Planning Organizations (MPOs)).

Below, EPA applies the five factors for Allegan, Muskegon, and Ottawa counties in Western Michigan. For the areas in western Michigan with violating ozone monitors, the EPA acknowledges that these areas are impacted by the unique air flow and meteorology of Lake Michigan and the resulting subregional transport of ozone and ozone-forming emissions from major urban areas in the Lake Michigan area (e.g., Chicago, Gary, and Milwaukee). At shoreline locations, the contribution of ozone-forming emissions from sources in Michigan is negligible. (See EPA report "Western Michigan Ozone Study," April 24, 2009), The EPA has taken these unique facts into account in determining the scope of its approach to analyzing the five factors in these areas in Western Michigan.

3.1 Technical Analysis for Western Michigan Areas

The EPA must designate as nonattainment any area that violates the NAAQS and any nearby areas that contribute to the violation in the violating area. Muskegon and Allegan counties had a monitor in violation of the 2015 ozone NAAQS, therefore these counties were designated nonattainment area. Ottawa County is adjacent to both Muskegon and Allegan counties and EPA has decided to conduct a 5-factor analysis for this county, in line with the *Clean Wisconsin* opinion. The following sections describe the 5-factor analysis for Ottawa County as a potential contributor to violations in Muskegon and Allegan counties. While the factors are presented individually, they are not independent. The 5-factor analysis process carefully considers the interconnections among the different factors and the dependence of each factor on one or more of the others, such as the interaction between emissions and meteorology for the area being evaluated.

Factor Assessment

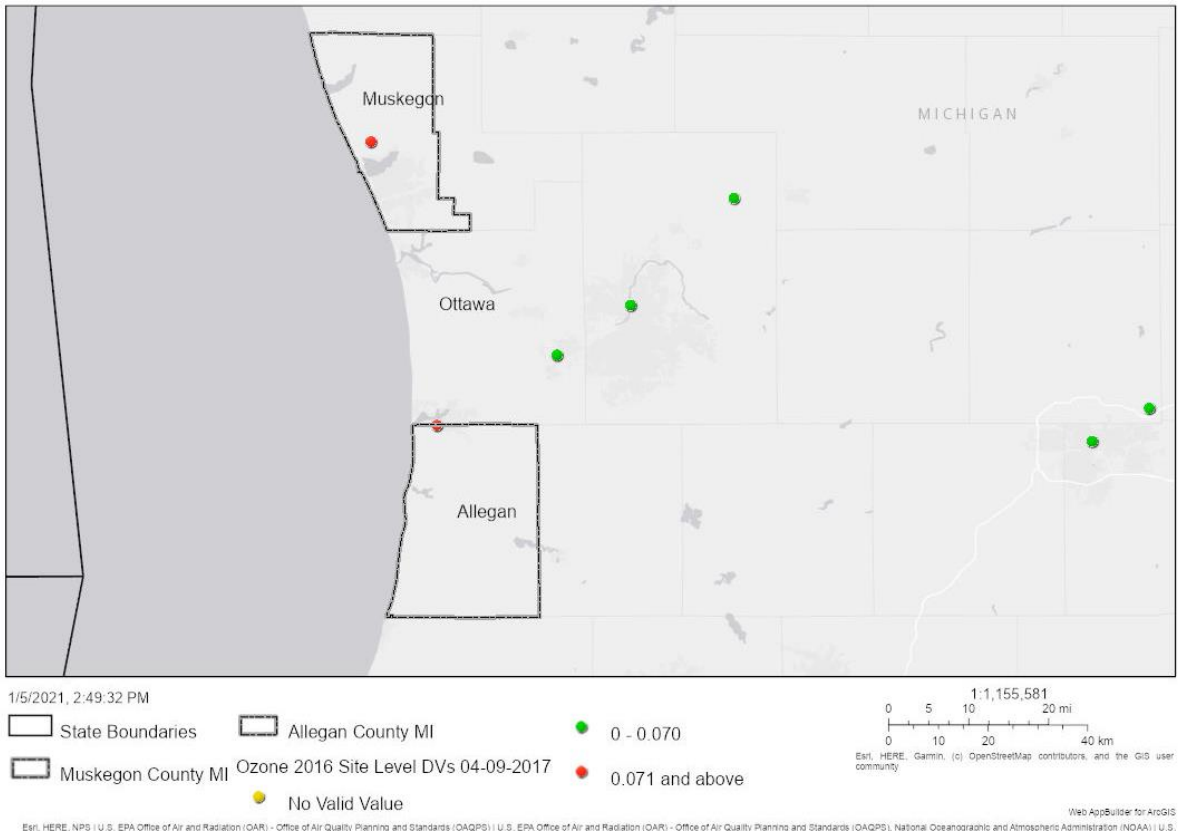
Factor 1: Air Quality Data

The EPA considered 8-hour ozone design values in ppm for the air quality monitor in the Ottawa County area based on data for the 2014-2016 period (i.e., the 2016 design value, or DV). This was the most recent three-year period with fully-certified air quality data at the time of the original 2015 NAAQS designations. The design value is the 3-year average of the annual 4th highest daily maximum 8-hour ave rage ozone concentration. The 2015 NAAQS are met when the design value is 0.070 ppm or less. Only ozone measurement data collected in accordance with the quality assurance (QA) requirements using approved (FRM/FEM) monitors are used for NAAQS compliance determinations. The EPA uses

FRM/FEM measurement data residing in the EPA's Air Quality System (AQS) database to calculate the ozone design values. Individual violations of the 2015 ozone NAAQS that the EPA determines have been caused by an exceptional event that meets the administrative and technical criteria in the Exceptional Events Rule are not included in these calculations. Whenever several monitors are located in a county (or designated nonattainment area), the design value for the county or area is determined by the monitor with the highest valid design value. The presence of one or more violating monitors (i.e. monitors with design values greater than 0.070 ppm) in a county or other geographic area forms the basis for designating that county or area as nonattainment. The remaining four factors are then used as the technical basis for determining the spatial extent of the designated nonattainment area surrounding the violating monitor(s) based on a consideration of what nearby areas are contributing to a violation of the NAAQS.

The EPA identified a monitor where the most recent design value violates the NAAQS and examined historical ozone air quality measurement data (including previous design values) to understand the nature of the ozone ambient air quality problem in the area. Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) that are operated in accordance with 40 CFR part 58, appendix A, C, D and E and operating with an FRM or FEM monitor. These requirements must be met in order to be acceptable for comparison to the 2015 ozone NAAQS for designation purposes. All data from Special Purpose Monitors (SPMs) using an FRM or FEM are eligible for comparison to the NAAQS, subject to the requirements given in the March 28, 2016 Revision to Ambient Monitoring Quality Assurance and Other Requirements Rule (81 FR 17248).

Figure 1. EPA's Nonattainment Boundaries for the Western Michigan Nonattainment Areas



The 2014-2016 design values for Western Michigan counties are shown in Table 2.

Table 2. Air Quality Data (all values in ppm)[a]

County, State	State Recommended Nonattainment?	AQS Site ID	2014-2016 DV	2014 4th highest daily max value	2015 4th highest daily max value	2016 4th highest daily max value
Muskegon, MI	Yes	261210039	**0.075**	0.075	0.074	0.076
Ottawa, MI	No	261390005	**0.070**	0.071	0.065	0.074
Allegan, MI	Yes	260050003	**0.075**	0.077	0.072	0.076

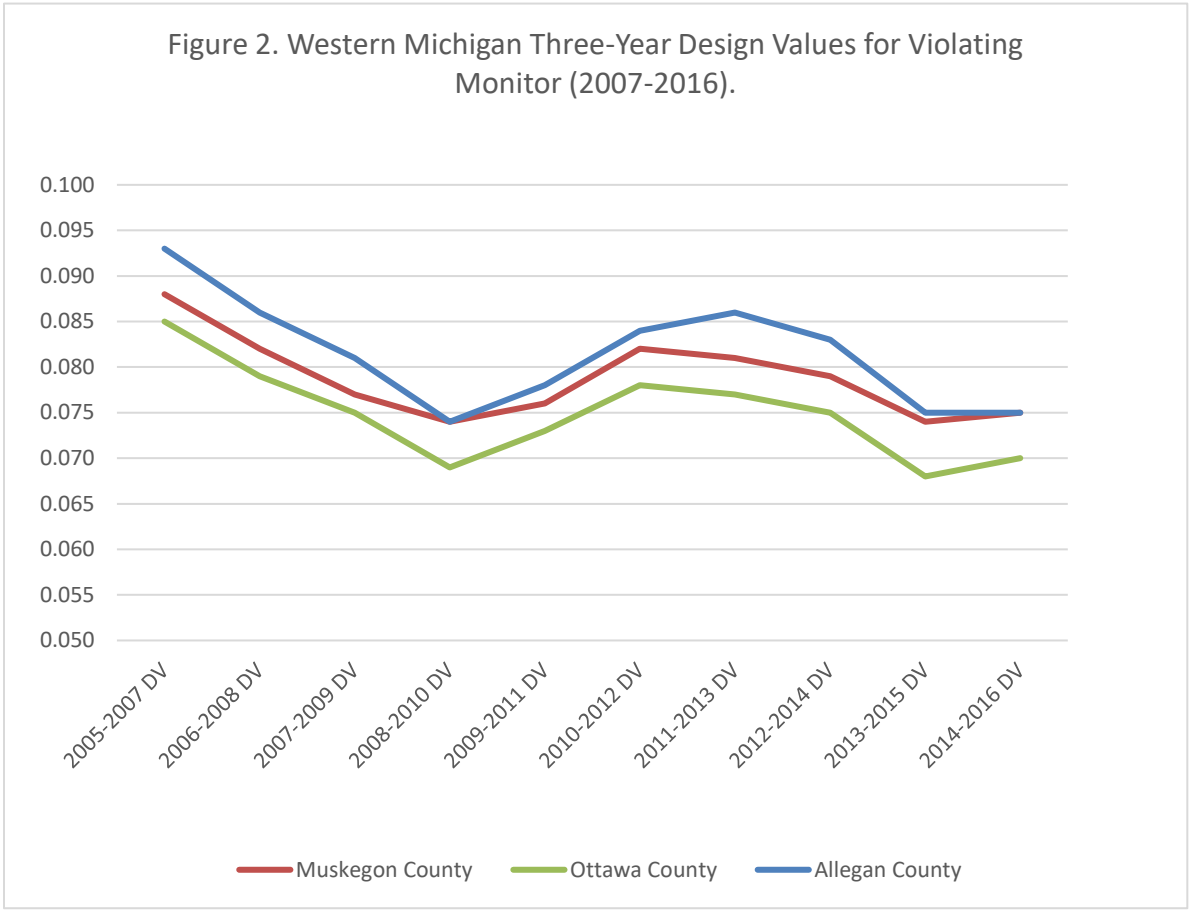
[a] The highest design value in each county is indicated in bold type.
N/A means that the monitor did not meet the completeness criteria described in 40 CFR, part 50, Appendix U, or no data exists for the county.

Muskegon County and Allegan County show a violation of the 2015 ozone NAAQS, therefore were included in the nonattainment area.

Table 2 identifies the design value for the monitor in each area of analysis and Figure 2 shows the historical trend of design values for the violating monitor. As indicated on the map, there are 2 violating monitors that are located close to Lake Michigan in western Muskegon and Allegan counties. The highest monitor in Ottawa County did not have a 3-year 2014-2016 DV above the level of the NAAQS. As shown in Figure 2, with the exception of an increase with the 2012 design value and a slight uptick for the 2016 design value, ozone levels have come down over the last 10 years.

It should also be noted that DVs for both the Muskegon and Allegan counties have decreased since 2011. As shown in Figure 2, the 2010-2012 DVs were 81 ppb and 84 ppb in Muskegon and Allegan counties. These areas DVs were 75 ppb for the 2014-2016 designation period.

Figure 2. Three-Year Design Values for Violating Monitor (2007-2016)



Factor 2: Emissions and Emissions-Related Data

The EPA evaluated ozone precursor emissions of nitrogen oxides (NO_x) and volatile organic compounds (VOC) and other emissions-related data.

Emissions Data

The EPA reviewed data from the 2014 National Emissions Inventory (NEI). The EPA examined the magnitude of large sources (NO_x or VOC emissions greater than 100 tons per year) and small point sources and the magnitude of county-level emissions reported in the NEI. These county-level emissions represent the sum of emissions from the following general source categories: point sources, non-point (i.e., area) sources, non-road mobile, on-road mobile, and fires.

Table 3 provides a county-level emissions summary of NO_x and VOC (given in tons per year (tpy)) emissions for Muskegon, Ottawa, and Allegan counties. Ottawa NOx emissions are about twice the magnitude of emissions in Muskegon and about 2.5 as large as NOx emissions in Allegan. Ottawa VOC emissions are about 1.8 times the magnitude of emissions in Muskegon and about twice as VOC emissions in Allegan. Also shown for comparison are emissions from the upwind areas on the western

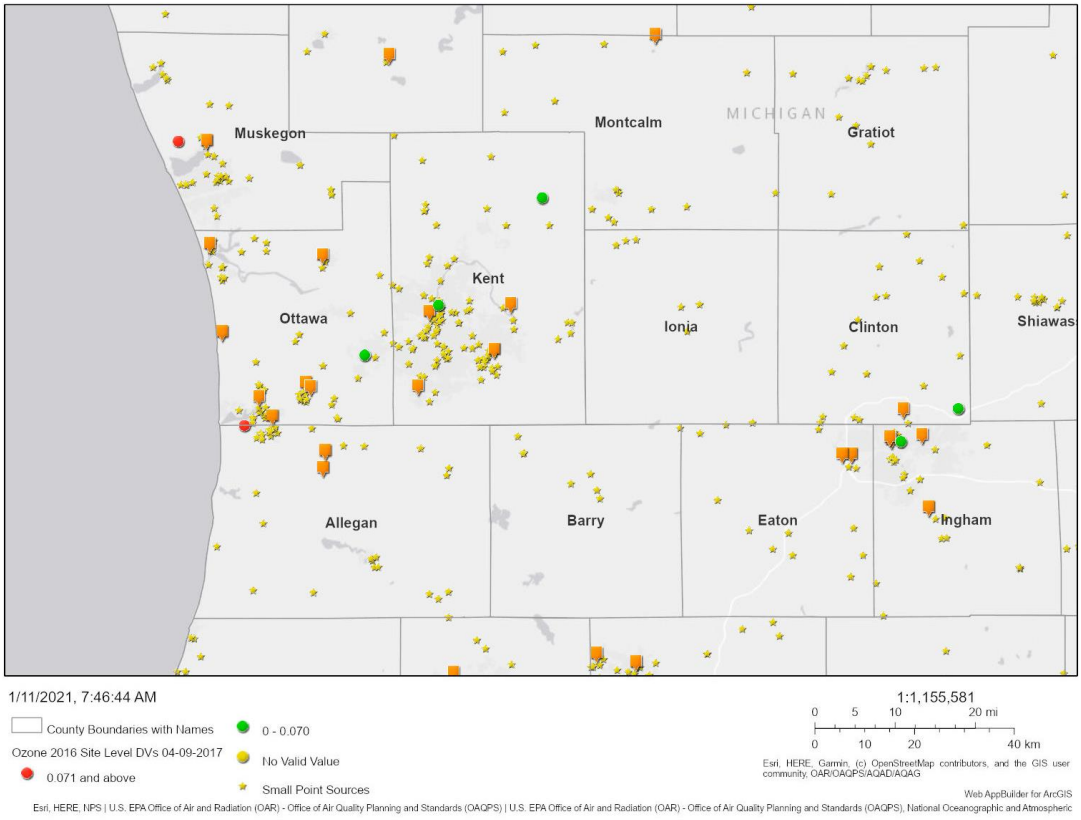
and southern shore of Lake Michigan, indicating nearly 50 times greater NO_x emissions VOC emissions than Muskegon and Allegan counties, and 25 times for Ottawa County.

Table 3. Total County-Level NO_x and VOC Emissions

County	State Recommended Nonattainment?	Total NO_x (tpy)	Total VOC (tpy)
Muskegon, MI	Yes	6,616	5,662
Ottawa, MI	No	12,686	10,077
Allegan, MI	Yes	5,071	5,165
Chicago CSA	n/a	274,440	206,171
Milwaukee CSA	n/a	51,822	49,129

In addition to reviewing county-wide emissions of NO_x and VOC in the area of analysis, the EPA also reviewed emissions from large point sources. The location of these sources, together with the other factors, can help inform nonattainment boundaries. There is one large point source in Muskegon County in addition to numerous smaller sources. There are 5 large point sources in Ottawa County in addition to numerous smaller sources. The JH Campbell generating complex is the more southern of the two large point sources shown along the shore in Ottawa County in Figure 3 and was the subject of air quality modeling analysis submitted to the EPA by Sierra Club (EPA–HQ–OAR–2017–0548-0287). There are two large point sources in Allegan County in addition to numerous smaller sources. Point sources are shown in Figure 3 below.

Figure 3. Point Sources in the Area of Analysis



Population density and degree of urbanization

In this part of the factor analysis, the EPA evaluated the population and vehicle use characteristics and trends of the area as indicators of the probable location and magnitude of non-point source emissions. These include emissions of NO_x and VOC from on-road and non-road vehicles and engines, consumer products, residential fuel combustion, and consumer services. Areas of dense population or commercial development are an indicator of area source and mobile source NO_x and VOC emissions that may contribute to violations of the NAAQS. Table 4 shows the population, population density, and population growth information for Muskegon, Ottawa, and Allegan counties.

Table 4. Population and Growth

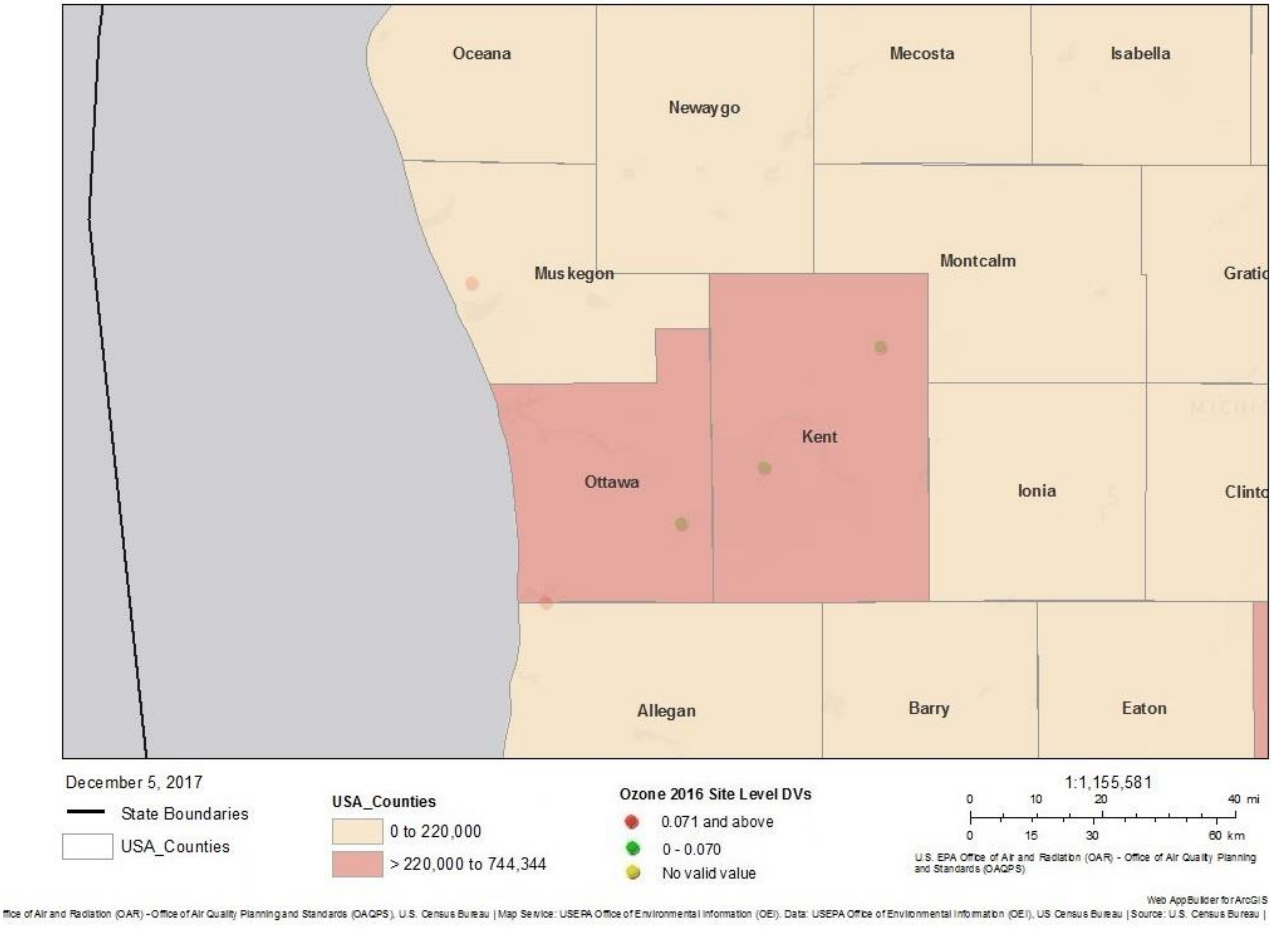
County	State Recommended Nonattainment?	2010 Population	2015 Population	2015 Population Density (per sq. mi.)	Absolute change in population (2010-2015)	Population % change (2010-2015)
Muskegon, MI	Yes	172,188	172,790	346	602	0.3
Ottawa, MI	No	263,801	279,955	497	16,154	6.1
Allegan, MI	Yes	111,408	114,625	139	3217	3

Chicago CSA	n/a	9,840,929	9,923,358	933	82,429	1%
Milwaukee CSA	n/a	2,222,938	2,242,067	460	19,129	0.9

* For state recommended partial counties, the emissions shown are for the entire county.
Source: U.S. Census Bureau population estimates for 2010 and 2015. www.census.gov/data.html.

All Western Michigan counties have relatively low population density. Ottawa has the highest density and growth rate.

Figure 4. County-Level Population



Traffic and Vehicle Miles Travelled (VMT)

The EPA evaluated the commuting patterns of residents, as well as the total vehicle miles traveled (VMT) for each county in the area of analysis. In combination with the population/population density data and the location of main transportation arteries, this information helps identify the probable location of non-point source emissions. A county with high VMT and/or a high number of commuters is generally an integral part of an urban area and high VMT and/or high number of commuters indicates the presence of motor vehicle emissions that may contribute to violations of the NAAQS. Rapid population or VMT growth in a county on the urban perimeter may signify increasing integration with the core urban area,

and thus could indicate that the associated area source and mobile source emissions may be appropriate to include in the nonattainment area. In addition to VMT, the EPA evaluated worker data collected by the U.S. Census Bureau[3] for the area of analysis. Table 4 shows the traffic and commuting pattern data, including total VMT for the Western Michigan areas, number of residents who work in the county, number of residents that work in the county with a violating monitor, and the percent of residents working in the county with a violating monitor.

Table 4. Traffic and Commuting Patterns

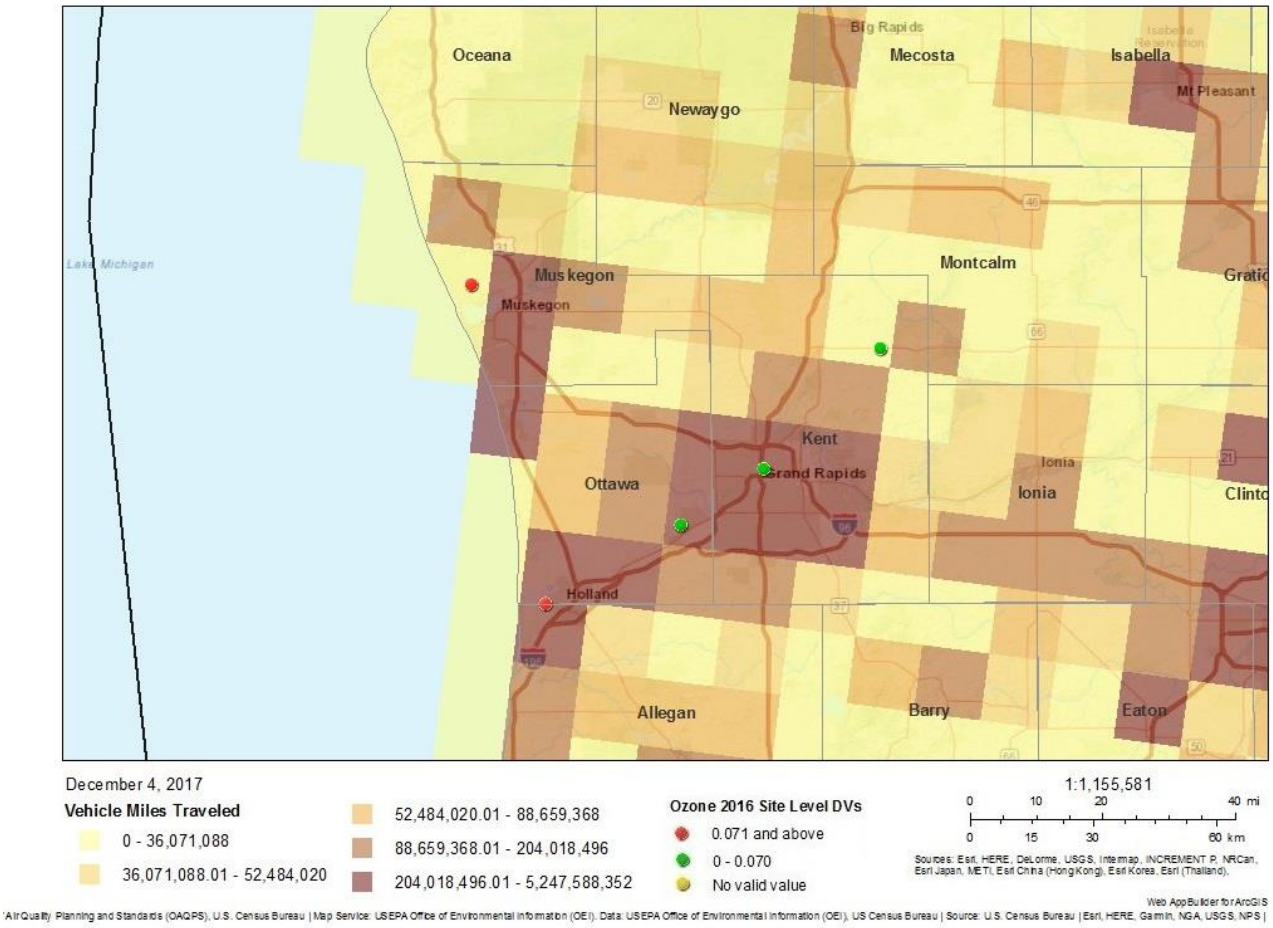
County	State Recommended Nonattainment?	2014 Total VMT (Million Miles)	Number of County Residents Who Work	Number Commuting to or Within Counties with Violating Monitor(s)	Percentage Commuting to or Within Counties with Violating Monitor(s)
Muskegon, MI	Yes	1,680	71,966	36,551	50.8
Ottawa, MI	No	2,340	129,167	13,437	10.4
Allegan, MI	Yes	1,485	54,688	14,862	27.2

* For state recommended partial counties, the data provided are for the entire county.
Counties with a monitor(s) violating the NAAQS are indicated in bold.

To show traffic and commuting patterns, Figure 5 overlays twelve-kilometer gridded VMT from the 2014 NEI with a map of the transportation arteries. Approximately 10% of the Ottawa workers commute to Muskegon and Allegan counties that have violating areas.

[3] The worker data can be accessed at: http://onthemap.ces.census.gov/.

Figure 5. Twelve Kilometer Gridded VMT (Miles) Overlaid with Transportation Arteries



Factor 3: Meteorology

Evaluation of meteorological data helps to assess the fate and transport of emissions contributing to ozone concentrations and to identify areas potentially contributing to the monitored violations. Results of meteorological data analysis may inform the determination of nonattainment area boundaries. In order to determine how meteorological conditions, including, but not limited to, weather, transport patterns, and stagnation conditions, could affect the fate and transport of ozone and precursor emissions from sources in the area., the EPA evaluated 2014-2016 HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) trajectories at 100, 500, and 1000 meters above ground level (AGL) that illustrate the three-dimensional paths traveled by air parcels to a violating monitor. Figures 6 and 7 show the 24-hour HYSPLIT back trajectories for each exceedance day (i.e., daily maximum 8-hour values that exceed the 2015 ozone NAAQS) for the monitors in Muskegon and Allegan counties.

Figure 6. HYSPLIT Back Trajectories for Muskegon Violating Monitors

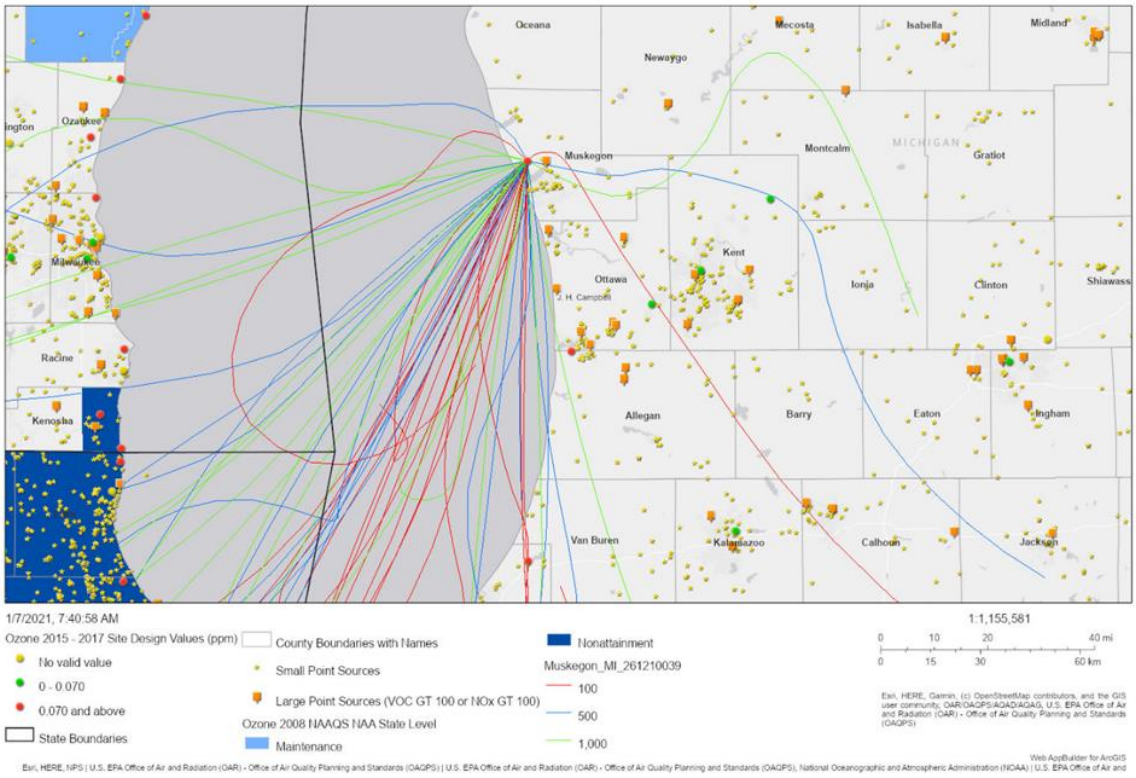
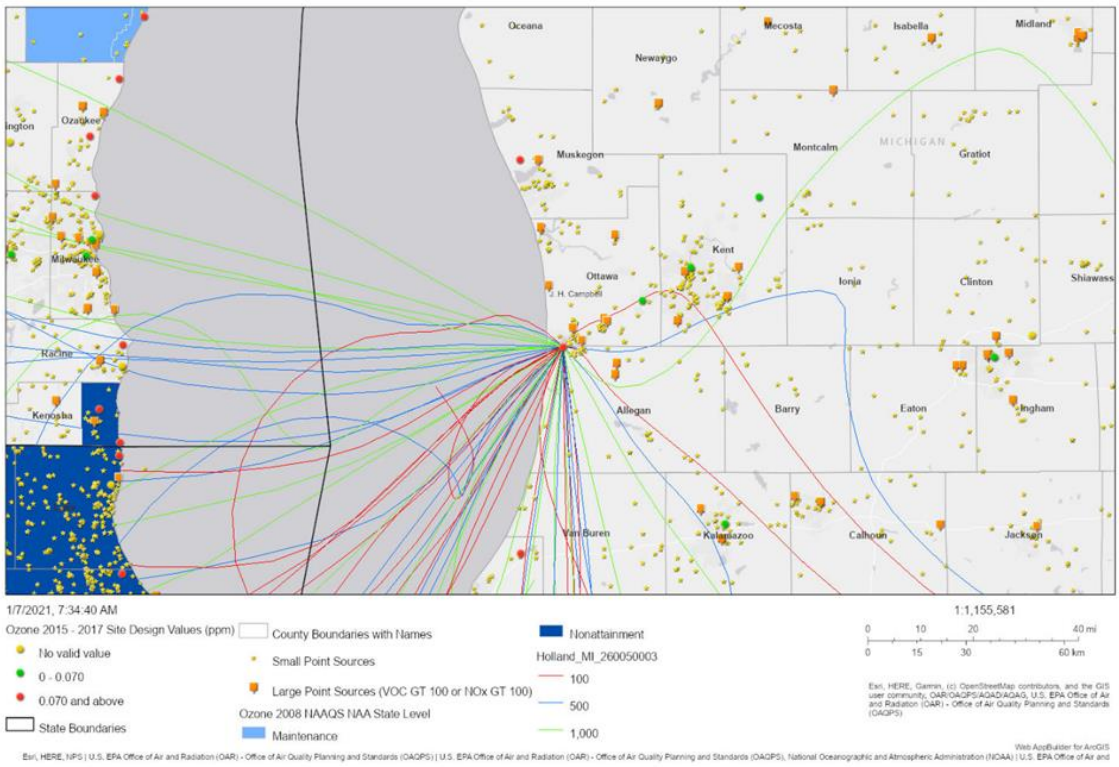


Figure 7. HYSPLIT Back Trajectories for Allegan Violating Monitors



The western boundaries of Muskegon, Allegan, and Ottawa counties follow the shoreline of Lake Michigan. Due to their proximity to the lake, these counties have the potential to be impacted by lake breeze meteorology. The land breeze and lake breeze occur when wind blows from the land and lake, respectively, due to air pressure differences caused by the different heating capacities of the land and the water. Land absorbs and loses solar radiation much faster than water. The land breeze typically occurs overnight and in the early morning after air above the relatively warm nighttime water of Lake Michigan heats and rises, setting up an area of low pressure which is filled by the cooler air being transported from the land. The lake breeze typically occurs in the afternoon when the area of low pressure is created by rising air over the heated land, creating winds blowing off the cooler lake onto the shore. The land/lake breeze is typically more localized than the prevailing (synoptic) winds. Studies indicate the land/lake breeze can trap, stratify, and recirculate offshore air, sometimes in a helical pattern. Daytime inversions over the lake can create shallow, stable layers of precursor plumes, which, on warm sunny days, are conducive to ozone formation. The afternoon lake breeze can carry photochemically-aged, ozone-rich air toward the land from nearby and upwind emissions sources along the Lakeshore, to nearby and downwind areas like Western Michigan where violations of the ozone standard can be measured at locations along the shoreline. Additionally, large scale, summertime, stagnant high pressure systems centered to the south and southeast of Lake Michigan have been implicated in high ozone episodes for areas near the shoreline of Lake Michigan, because they can produce southerly and southeasterly flows over Lake Michigan, which can enhance the flow of photochemically-aged air. The relative role of each (the land/land breeze and synoptic flow) is episode-specific and not fully understood.[4, 5, 6, 7, 8]

The HYSPLIT trajectories (Figures 6 and 7) for Western Michigan indicate that exceedance day air masses generally traveled from the south, southwest, and west prior to being detected at the violating monitors. Scientific studies indicate ozone can be preferentially transported over the Great Lakes relative

[4] Cleary, P. A., Fuhrman, N., Schulz, L., Schafer, J., Fillingham, J., Bootsma, H., McQueen, J., Tang, Y., Langel, T., McKeen, S., Williams, E. J., and Brown, S. S.: Ozone distributions over southern Lake Michigan: comparisons between ferry-based observations, shoreline-based DOAS observations and model forecasts, Atmos. Chem. Phys., 15, 5109–5122, 2015.

[5] Dye, T. S., Roberts, P. T., and Korc, M. E.: Observations of transport processes for ozone and ozone precursors during the 1991 Lake Michigan Ozone Study, J. Appl. Meteorol., 34, 1877–1889, 1995.

[6] Foley, T., Betterton, E. A., Jacko, P. E. R., and Hillery, J.: Lake Michigan air quality: The 1994–2003 LADCO Aircraft Project (LAP), Atmos. Environ., 45, 3192–3202, 2011.

[7] Hanna, S. R. and Chang, J. C.: Relations between meteorology and ozone in the Lake Michigan region, J. Appl. Meteorol., 34, 670–678, 1995.

[8] Lennartson, G. J., and Schwartz, M. D.: A synoptic climatology of surface-level ozone in Eastern Wisconsin, USA, Climate Research, 13, 207-220, 1999.

to the land surface.[9, 10, 11, 12, 13, 14] Any precursor emissions that flow out over the lake with the overnight and morning land breeze from upwind areas on the western and southern shore of Lake Michigan have the potential to photochemically react to form ozone, which has the potential to be transported by the afternoon lake breeze to the monitors in western Michigan as corroborated by the studies cited above and by the HYSPLIT trajectories.

The HYSPLIT trajectories are just one piece of evidence corroborating the body of scientific literature on the potential for lake breeze meteorology, and lake breeze meteorology combined with synoptic meteorology, to transport photochemically-aged, ozone-rich air masses from nearby and upwind areas to nearby and downwind areas near the shoreline of Lake Michigan. Evidence of the potential for land/lake breeze and synoptic meteorology to transport ozone to areas along the shoreline of Lake Michigan is documented in the peer-reviewed scientific literature from study data specific to Lake Michigan collected mostly in the early 1990's. It is important to reiterate that the relative role of the land/lake breeze and synoptic flow on ozone transport in the Lake Michigan area is episode-specific and not fully understood. The recent 2017 Lake Michigan Ozone Study (LMOS) specifies details on the factors and mechanisms by which a large body of water like Lake Michigan can impact photochemical ozone production are still an active area of research (e.g. changes in precursor mixes, changes in radical concentrations, relative importance of multi-day ozone formation versus same day formation, lake breeze inland penetration distances, the extent to which shallow inversions above the cool lake water prevent vertical mixing, etc.).[15]

While there are still gaps in the peer-reviewed scientific literature on details of the various factors regarding how the local lake breeze (alone or combined with synoptic-scale meteorology) influences ozone production and transport around Lake Michigan, the basic concepts of lake breeze meteorology and its potential to influence ozone production and transport are understood well enough to place great weight on the meteorology factor in our analysis of western Michigan areas. The peer-reviewed results from the Lake Michigan-specific ozone studies and the HYSPLIT trajectories presented here both provide evidence that lake breeze meteorology plays an important role in ozone production and transport to

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[9] Brook, J. R., Makar, P.A., Sills D. M. L., Hayden, K. L. and McLaren, R. Exploring the nature of air quality over southwestern Ontario: main findings from the Border Air Quality and Meteorology Study, Atmos. Chem. Phys., 13, 10461–10482, 2013.

[10] Lyons, W. A. and Cole, H. S., Fumigation and plume trapping on the shores of Lake Michigan during stable onshore flow, J. Appl. Meteor., 12, 494–510, 1973.

[11] Lyons, W. A. and Cole, H. S.: Photochemical oxidant transport–mesoscale lake breeze and synoptic-scale aspects, J. Appl. Meteor., 15, 733–743, 1976.

[12] Sillman, S., Samson, P. J., and Masters, J. M.: Ozone formation in urban plumes transported over water: photochemical model and case studies in the northeastern and midwestern U.S., J. Geophys. Res., 98, 12687–12699, 1993.

[13] Lyons, W. A., Pielke, R. A., Tremback, C. J., Walko, R. L., Moon, D. A., and Keen, C. S.: Modeling impacts of mesoscale vertical motions upon coastal zone air pollution dispersion, Atmos. Environ., 29, 283–301, 1995a.

[14] Lyons, W. A., Tremback, C. J., and Pielke, R. A.: Applications of the Regional Atmospheric Modeling System (RAMS) to provide input to photochemical grid models for the Lake Michigan Ozone Study (LMOS), J. Appl. Meteor., 34, 1762–1786, 1995b.

[15] Pierce, B., Kaleel, R., Dickens, A., Bertram T., and Stanier, C., Kenski D.: White Paper: Lake Michigan Ozone Study 2017 (LMOS 2017), http://www.ladco.org/, 2016.

western Michigan counties. This factor shows that the violating monitors are mainly affected by emissions coming from the west and southwest over Lake Michigan.

The HYSPLIT trajectories (Figures 6 and 7) indicate that exceedance day air masses generally traveled from the south and southwest prior to being reaching the violating monitor. The HYSPLIT trajectories indicate that the majority of exceedance day air masses traveled over upwind areas (such as Chicago and Milwaukee) and Lake Michigan to reach the violating monitor in Muskegon County and Allegan County. A smaller number of back trajectories traveled from locations South and East of the monitors either along the Western Michigan shoreline or over more inland areas of Michigan including portions of Ottawa County.

The HYSPLIT results for the violating monitors in Muskegon and Allegan counties indicate that air is primarily transported from across Lake Michigan on high ozone days. In particular, for air masses modeled at the 100 meter height (red lines), the Muskegon and Allegan counties monitors show the primary source of air to be from the direction of the Chicago, Illinois - Gary, Indiana area. This indicates that the majority of air parcels being transported over a short distance came from those metropolitan areas. Higher altitude air masses are projected to come from the west and south, which represents the direction of long-range transport to these monitors. Throughout the long-distance travel, these air parcels may pick up emissions from a number of sources before reaching western Michigan. While many of the HYSPLIT trajectories do not originate in areas immediately across Lake Michigan, the majority of the parcels are projected to pass over high emitting counties in Wisconsin, Illinois, and Indiana before reaching western Michigan. The HYSPLIT results projecting air parcels are passing over out-of-state counties across Lake Michigan, coupled with emissions data showing higher emissions of the NO_x and VOC ozone precursors in those same out-of-state counties, provide strong evidence for the conclusion that transported ozone from sources outside of Michigan is the primary cause of elevated ozone in western Michigan.

As previously indicated, the peer-reviewed results from the Lake Michigan-specific ozone studies and the HYSPLIT trajectories presented here both provide evidence that lake breeze meteorology plays a role in ozone production and transport to Muskegon County. This factor shows that the violating monitors are mainly affected by emissions coming from the southwest over Lake Michigan.

Factor 4: Geography/topography

Consideration of geography or topography can provide additional information relevant to defining nonattainment area boundaries. Analyses should examine the physical features of the land that might define the airshed. Mountains or other physical features may influence the fate and transport of emissions as well as the formation and distribution of ozone concentrations. The absence of any such geographic or topographic features may also be a relevant consideration in selecting boundaries for a given area.

The EPA used geography/topography analysis to evaluate the physical features of the land that might affect the airshed and, therefore, the distribution of ozone over the area.

The Western Michigan areas do not have any geographical or topographical features significantly limiting air pollution transport within the county. However, it is largely affected by lake breeze effects contributing to ozone transport across Lake Michigan.

Factor 5: Jurisdictional boundaries

Once the geographic extent of the violating area and the nearby area contributing to violations is determined, the EPA considered existing jurisdictional boundaries for the purposes of providing a clearly defined legal boundary to carry out the air quality planning and enforcement functions for nonattainment areas. In defining the boundaries of the intended Muskegon and Allegan nonattainment areas, the EPA considered existing jurisdictional boundaries, which can provide easily identifiable and recognized boundaries for purposes of implementing the NAAQS. Examples of jurisdictional boundaries include, but are not limited to: counties, air districts, areas of Indian country, metropolitan planning organizations, and existing nonattainment areas. If an existing jurisdictional boundary is used to help define the nonattainment area, it must encompass all of the area that has been identified as meeting the nonattainment definition. Where existing jurisdictional boundaries are not adequate or appropriate to describe the nonattainment area, the EPA considered other clearly defined and permanent landmarks or geographic coordinates for purposes of identifying the boundaries of the intended designated areas.

For the 1997 ozone NAAQS, Muskegon and Allegan counties were designated nonattainment with the county boundary being the boundary of the nonattainment area. For the 2015 ozone NAAQS, EPA designated the western portions of Muskegon and Allegan counties which accounted for a majority of emissions for these violating counties. EPA use a combination of townships, villages and cities to define the partial nonattainment area boundaries.

For the 1997 ozone NAAQS, Ottawa County was designated nonattainment as part of the Grand Rapids area. For the 2015 ozone NAAQS, EPA designated the Ottawa as attainment. Ottawa County was remanded by the court because it was not included in the area of analysis for the nearby any nonattainment areas.

Sierra Club's Source Apportionment Modeling (SAM)

In addition to the 5 Factor analysis, the EPA is considering source apportionment modeling (SAM) submitted by Sierra Club using the Comprehensive Air Quality Model with eXtensions (CAMx) with its Anthropogenic Precursor Culpability Assessment (APCA) tool. Attachment III to the EPA's February 25, 2016, "Area Designations for the 2015 Ozone National Ambient Air Quality Standards," guidance states that SAM is not required for designations but that it may be used to "help identify possible areas for inclusion in the nonattainment area because of their contribution to violations in nearby areas with violating monitors." When available, the EPA considers SAM as one part of the total weight of evidence that makes up the overall assessment of the potential nonattainment area boundaries. The guidance further states that SAM "can be a useful technique for comparing the relative contribution of individual county emissions of ozone precursor emissions."

Sierra Club prepared SAM to evaluate the contribution of Ottawa County on the violating monitors in Muskegon and Allegan counties. Sierra Club reported that their modeling predicted that JH Campbell contributed more than 0.7 ppb to ozone at the Muskegon monitor on 21 days in 2011 and more than 0.7 ppb to ozone at the Allegan monitor 22 days in 2011. The data submitted by Sierra Club showed a maximum ozone contribution from JH Campbell of 4.7 ppb at Muskegon and 3.8 ppb at Allegan. It should be noted that many of the days included in the Sierra Club submission were not days predicted or

observed to exceed the 70 ppb ozone standard. The largest modeled contribution to the Muskegon monitor on days modeled above 70 ppb[16] was 3.9 ppb and the largest modeled contribution to Allegan on days modeled above 70 ppb was 1.1 ppb. Sierra Club argues that emissions from this major NOx source in Ottawa County impact the nearby monitors, and that Ottawa County should, therefore, be designated as nonattainment for the 2015 ozone NAAQS.

Sierra Club's SAM was based on EPA's 2011v6.1 modeling platform. Sierra Club's analysis focused on contributions from the J H Campbell EGU located along the shoreline in Ottawa county which is between Muskegon and Allegan. The emissions from the J H Campbell EGU have dropped significantly since 2011. The facility placed selective catalytic reduction (SCR) on 2 of their 3 units in 2013. This dropped ozone season NO_x emissions from 3600 tons in 2011 to an average of approximately 1600 tons for the 2014-2016 period. The 2011 modeling relied on by the Sierra Club does not reflect these controls. The SCR on these units must be run as part of the approved control equipment in J.H. Campbell's current operation permit (MI-ROP-B2835-2020a). Since JH Campbell's annual emissions dropped by approximately a factor of 2 between the modeled episode in 2011 and the 2014-2016 data years considered in the ozone designation process, it is expected that contributions to ozone from JH Campbell would have been substantially lower in 2014-2016 than they were in the 2011 modeling.

In its comment letter on EPA's December 2017 initial designation for Ottawa County, Sierra Club states that the J.H. Campbell plant continues to emit NOx on some days at levels similar to or above daily emissions from the 2011 modeling. Sierra Club identifies two days (May 29 and June 13) in 2011 when the modeled daily emissions were at a level similar to the daily emissions levels in 2017. While they report modeled contributions of 0.8-1.2 at the Muskegon and Allegan monitors on those days, both modeled and observed ozone concentrations on those days were well below the 2015 ozone NAAQS.[17]

Hysplit back trajectories, as shown in Figure 6, from Allegan on days that exceed the 70 ppb NAAQS for the on 2014-2016 designation period do not traverse locations near the J H Campbell plant for which Sierra Club's source apportionment modeling is focused. Hysplit back trajectories shown in Figure 7 from the Muskegon monitor on days that exceed 70 ppb in the 2014-2016 designation period originate primarily from the South and West. While several trajectories do skirt the Michigan coastline near the JH Campbell facility, there are far more trajectories that traverse locations farther offshore and are therefore less likely to be impacted by the JH Campbell plume (see Figure 7).

Conclusion for the Ottawa County Area

EPA has considered all of the information from the 5-factor analysis in addition to the information submitted by the Sierra Club.

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[16] Sierra Club did not submit modeled total ozone values at the Muskegon and Allegan monitors. However, since Sierra Club stated that its contractor used EPA's model inputs, configurations and domain from EPA's own transport assessment, statements about modeled total ozone concentrations are derived from EPA outputs for the modeling described here: U.S. Environmental Protection Agency (2014) Regulatory impact analysis of the proposed revisions to The national ambient air quality standards for ground-level ozone. Prepared by the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, EPA-452/P-14-006, November. Available at http://www.epa.gov/ttnecas1/regdata/RIAs/20141125ria.pdf.

[17] On May 29, 2011, the modeled and observed ozone concentrations were 36 ppb and 46 ppb at the Muskegon monitor and 32 ppb and 56 ppb at the Allegan monitor. On June 13, 2011, the modeled and observed ozone concentrations were 40 ppb and 43 ppb at the Muskegon monitor.

The meteorological data strongly indicates that the violating monitors in Muskegon and Allegan counties are predominantly affected by the transport of emissions over Lake Michigan. The HYSPLIT trajectories indicate that the exceedance day air masses often traveled over these upwind areas and Lake Michigan to reach the violating monitors. As a result, these western Michigan counties are downwind of the Chicago CSA (total reported CSA NO_x = 274,440 tons, VOC = 206,171 tons) which includes counties in Northeast Illinois, Northwest Indiana and Southeast Wisconsin, and also the Milwaukee CSA (total reported CSA NOx = 51,822 tons, VOC = 49,129 tons). These emissions greatly exceed the emissions from the western Michigan counties. The emissions data from Ottawa County were evaluated in the context of the predominant transport patterns and the substantially larger emissions from large upwind urban areas along Lake Michigan. Given the substantial emissions reductions at the JH Campbell facility between the 2011 modeled episode and the 2014-2016 designations period, the Sierra Club source apportionment modeling does not definitively show contributions from the JH Campbell power plant to the monitors at Allegan and Muskegon on days that exceed the ozone standard. Taking all of these factors in combination, EPA has determined that it will not modify the State's recommendation and is retaining a designating of Attainment/Unclassifiable for Ottawa County.