# Request for Redesignation to Attainment for the 2015 Ozone National Ambient Air Quality Standard and Revision to Michigan's State Implementation Plan and Ozone Maintenance Plan for Berrien County, Michigan

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## Introduction

On October 1, 2015, the United States Environmental Protection Agency (USEPA) promulgated a revised National Ambient Air Quality Standard (NAAQS) for ozone (the 2015 ozone NAAQS). The 2015 ozone NAAQS was revised to an 8-hour standard of 0.070 parts per million (throughout this document, the 2015 ozone NAAQS will be expressed as 70 parts per billion [ppb]).

The USEPA made initial attainment/unclassifiable designations for the 2015 ozone NAAQS for the state of Michigan on November 16, 2017 (82 *Federal Register* [FR] 54232) and made corrections to those designations on October 16, 2018 (83 FR 52157). On June 4, 2018 (83 FR 25776), the USEPA made the final designations and classifications for Michigan, including designating Berrien County as marginal nonattainment, effective August 3, 2018.

Section 107(d)(3)(E) of the Clean Air Act (CAA) allows states to request the redesignation of nonattainment areas to attainment provided certain criteria are met. In addition, Title 40 of the Code of Federal Regulations (CFR), Part 51, contains requirements for State Implementation Plan (SIP) revisions.

This SIP document describes these criteria and Michigan's demonstration of attainment. Therefore, the State of Michigan, through the Department of Environment, Great Lakes, and Energy (EGLE), is asking the USEPA to make a determination that Berrien County is now in attainment with the 2015 ozone NAAQS, to change the status of the area from nonattainment to attainment, and to approve the Section 175A maintenance plan and emissions inventories included in this document as a revision to the Michigan SIP. In addition, EGLE requests approval of the Motor Vehicle Emissions Budgets (MVEBs) for Berrien County, included in this document, for the duration of the maintenance period.

## Background

Under the 2015 ozone NAAQS, areas that had a three-year design value of 71 ppb or higher were considered nonattainment. A design value for the 2015 ozone NAAQS is the three-year average of the 4th highest 8-hour average ozone concentration. The 2015 ozone NAAQS classification level was determined by the amount the design value for an area was above 71 ppb. Design values above 71 ppb and below 81 ppb were identified as a marginal nonattainment classification.

In 2018, Berrien County was designated marginal nonattainment based on air monitoring data from the 2015 through 2017 ozone seasons. The sole air monitor in

Berrien County, Coloma, had a 2015 through 2017 ozone design value of 73 ppb. The Coloma air monitor is now demonstrating attainment of the 2015 ozone NAAQS with a 2017 through 2019 design value of 69 ppb, as demonstrated below.

**Clean Air Act Section 107(d)(3)(E) Requirements and Demonstrations**

1. **Attainment of the NAAQS**
   CAA Section 107(d)(3)(E)(i) sets out requirements to demonstrate attainment of the 2015 ozone NAAQS. There are two components involved in making this demonstration; air quality data and supplemental air quality modeling. According to the USEPA's 1992 Procedures for Processing Requests to Redesignate Areas to Attainment (USEPA Guidance), supplemental USEPA-approved air quality modeling is not required for ozone nonattainment areas seeking redesignation. The air quality data requirements, and Michigan's demonstration of those, are listed in subsections a through c, below.

   a. **Attaining Data**
      Section 107(d)(3)(E)(i) requires three complete, consecutive calendar years of quality-assured air quality monitoring data to demonstrate attainment. This subsection addresses the three complete, consecutive year requirement. Quality assurance is addressed more thoroughly in subsection c, below.

      According to 40 CFR Part 50, Appendix I, the requirement for three complete, consecutive calendar years of data is met if the "daily maximum 8-hour average concentrations are available for at least 90 percent, on average, of the days during the designated ozone monitoring season, with a minimum data completeness in any one year of at least 75 percent of the designated sampling days."

      Ozone monitoring data was collected at the Coloma air monitoring site (Site ID 26-021-0014) in Berrien County for the consecutive years of 2017 through 2019. Table 1 lists the highest four 8-hour average values collected in 2017 through 2019, along with the 2017 through 2019 design value. These values were obtained during the ozone season, which runs March 1 through October 31 in Michigan each year. Table 1 also lists the percentage of days (% Days) during the ozone season that data was obtained from this monitor, demonstrating completeness.

**Table 1.** Coloma Ozone 8-Hour Average, Design Value, and Completeness for 2017 Through 2019.

| Site ID | Year | % Days | 1st 8-hour Average | 2nd 8-hour Average | 3rd 8-hour Average | 4th 8-hour Average | 2017-2019 Design Value |
|---|---|---|---|---|---|---|---|
| 26-021-0014 | 2017 | 99 | 74 | 73 | 71 | 69 | 69 |
| 26-021-0014 | 2018 | 88 | 78 | 77 | 76 | 73 | |
| 26-021-0014 | 2019 | 96 | 74 | 74 | 69 | 66 | |

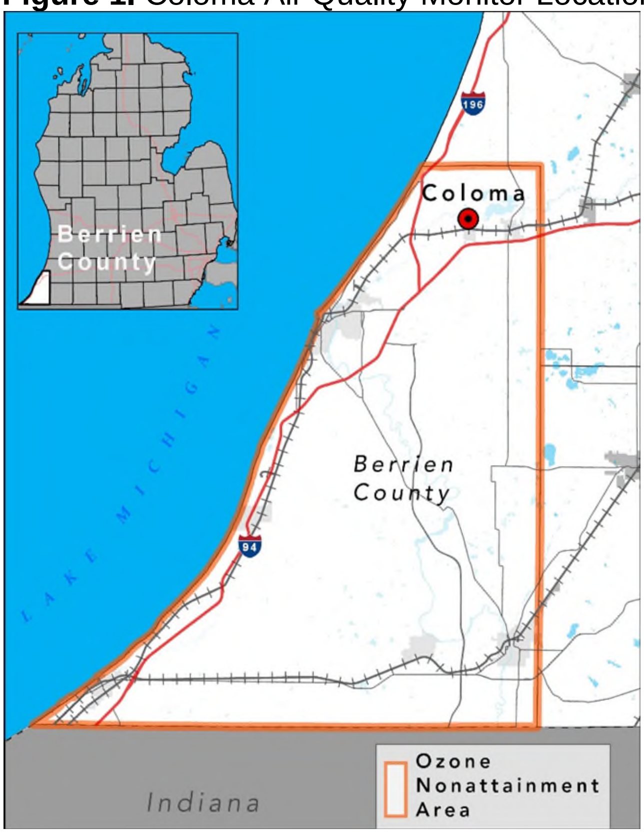
For the years 2017 through 2019, the Coloma monitor had a design value of 69 ppb, a yearly completeness over 88 percent, and an average completeness over 94 percent. These completeness values align with the requirements under 40 CFR Part 50, Appendix I, and the design value is below the 2015 ozone NAAQS set at 70 ppb, therefore, demonstrating the monitoring data is attaining the NAAQS.

**b. Representative Data**

Section 107(d)(3)(E)(i) also requires that the ambient air quality data is representative of the area of highest concentration and the ambient air monitor remained at the same location for the duration of the monitoring period.

As stated above, Berrien County contains one air quality monitor located in the city of Coloma (Figure 1). This monitor is situated between the two major highways in Berrien County and upwind of the major population centers.

**Figure 1.** Coloma Air Quality Monitor Location.




EGLE's air monitoring network, including the Coloma monitor, adheres to the requirements in 40 CFR Part 58. This ensures that the monitors are correctly sited.

The Coloma monitor has remained at the same location for the 2017 through 2019 sampling years as referenced in the 2017 through 2019 Annual Ambient Air Monitoring Network Reviews submitted to the USEPA. The most recent Network Review was submitted on July 1, 2019. A copy of that document is available at EGLE's Air Quality Division (AQD) Webpage: https://www.michigan.gov/documents/egle/egle-aqd-amu-2020_air_monitoring_network_review_654930_7.pdf.

**c. Quality-Assured Data**

Section 107(d)(3)(E)(i) requires that the ambient air quality data was collected and quality-assured in accordance with 40 CFR Part 58 and recorded in the Air Quality System (AQS).

As stated above, EGLE has quality-assured all data shown in Table 1. EGLE submits annual data certification letters to the USEPA, Region 5, certifying the completeness criteria under 40 CFR Part 50 and the quality assurance criteria under 40 CFR Section 58.10. The most recent annual data certification letter was submitted on April 17, 2019, and is available upon request. A certification letter for the 2019 Coloma air monitoring data was submitted to the USEPA on November 14, 2019.

**2. Approved SIP Under Section 110(k)**

CAA Section 107(d)(3)(E)(ii) requires an approved SIP under Section 110(k) for an area to be redesignated to attainment. According to the USEPA Guidance, "[t]he SIP for the area must be fully approved under section 110(k), and must satisfy all requirements that apply to the area." Section 110(k) contains the requirements for USEPA actions on SIP submissions. For marginal ozone areas, the requirements referred to in Section 110(k) are listed in Sections 172(c) and 182(a).

The requirements, and Michigan's demonstration of those requirements, under Section 172(c) for nonattainment area plans in general, are listed in subsections a through d, below. The requirements, and Michigan's demonstration of those requirements, under Section 182(a), are listed under the CAA Section 182(a) Requirements and Demonstration subsections, following the Section 172(c) discussion.

<u>CAA Section 172(c) Requirements and Demonstration</u>

**a. Not Applicable Requirements Under Section 172(c)**

CAA Section 172(c) contains two requirements that are not applicable to marginal nonattainment areas subject to Section 182(a), such as Berrien County. These are the requirement to provide for the implementation of all reasonable control measures to attain the standard under Section 172(c)(1) and the requirement for reasonable further progress toward attainment under Section 172(c)(2).

Also, Berrien County, due to lack of areas identified as economic development zones under Section 173(a)(1)(B), does not have any applicable requirements under Section 172(c)(4). In addition, Michigan has not requested any equivalent techniques from the USEPA for Berrien County. Therefore, there are no applicable requirements under Section 172(a)(8).

Finally, Section 172(c)(6) requires the SIP to include measures to provide for attainment by the attainment date. In addition, Section 172(a)(9) requires contingency measures in case “the area fails to make reasonable further progress, or to attain” the NAAQS by the attainment date. This document details Berrien County’s attainment of the 2015 ozone NAAQS, therefore additional SIP measures to provide for attainment or reasonable further progress are not needed.

**b. Inventory**

Section 172(c)(3) requires each plan to “include a comprehensive, accurate, current inventory of actual emissions from all sources of the relevant pollutant or pollutants in such area...”. The USEPA Guidance states “[f]or $O_3$ nonattainment areas, the inventory should be based on actual *typical summer day* emissions of $O_3$ precursors...during the attainment year.” Michigan submits the following inventory to comply with this requirement.

For onroad emissions, as stated in the Michigan Department of Transportation’s (MDOT) Air Quality Redesignation Onroad Emissions for Berrien County, Michigan Nonattainment Area (MDOT Analysis) (Attachment A), MDOT used the MOVES model with the 2015 platform to interpolate the 2017 data from the years 2015 and 2018, generating data based on July weekday emissions.

For all other emissions, EGLE used the data collected for the USEPA Emissions Modeling platform 2016v1 (2016v1) to estimate the 2017 emissions. The detailed USEPA data can be found at ftp://newftp.epa.gov/air/emismod/2016/v1/reports/. EGLE conducted an analysis (Attachment D) to interpolate, from the 2016v1 platform, the 2017 data, generating tons per day data based on annual emissions. Table 2, below, is the result of these analyses for 2017 and contains the current Berrien County attainment year inventory. In addition, detailed Michigan Air Emissions Reporting System (MAERS) point source data is available in Attachment B.

**Table 2.** Berrien County 2017 Emissions Inventory.

| Emission Sources | NOx Emissions (tons/day) | VOC Emissions (tons/day) |
|---|---|---|
| Onroad | 5.94 | 3.50 |
| Nonroad | 0.97 | 1.22 |
| Point | 1.53 | 1.03 |
| Nonpoint | 1.62 | 6.61 |

**c. Permits for New and Modified Major Sources**

Section 172(c)(5) requires the SIP to “require permits for the construction and operation of new or modified major stationary sources anywhere in the nonattainment area, in accordance with section 173.” Section 173 is the nonattainment permitting program or Nonattainment New Source Review (NNSR).

Michigan’s NNSR rules were approved into the Michigan SIP for Berrien County as part of a redesignation for the Benton Harbor Area for the 1997 8-hour ozone NAAQS on May 16, 2007 (72 FR 27425).

**d. Compliance with Section 110(a)(2)**

Section 172(a)(7) requires compliance with the applicable sections of Section 110(a)(2). This section provides that the infrastructure SIP submitted by a State must have been adopted by the State after reasonable public notice and hearing, and among other things, it must:

- include enforceable emission limitations and other control measures (other than nonattainment emission limitations and measures which are a part of nonattainment area plans and subject to the timing requirements of Section 172);
- include means or techniques necessary to meet the requirements of the CAA;
- provide for establishment and operation of appropriate devices, methods, systems, and procedures necessary to monitor ambient air quality;
- provide for implementation of a source permit program to regulate the modification and construction of any stationary source within the areas covered by the plan;
- include provisions for the implementation of Part C, prevention of significant deterioration and Part D, NNSR permit programs;
- include criteria for stationary source emission control measures, monitoring, and reporting;
- include provisions for air quality modeling; and
- provide for public and local agency participation in planning and emission control rule development.

Michigan verified that the State fulfills the requirements of Section 110(a)(2) through the 2015 ozone NAAQS infrastructure SIP submitted to the USEPA on March 5, 2019.

<u>CAA Section 182(a) Requirements and Demonstration</u>

**a. Not Applicable Requirement Under Section 182(a)**

Section 182(a)(1) states for marginal nonattainment areas, “[w]ithin 2 years after the date of enactment of the [CAA] Amendments of 1990, the State shall submit a comprehensive, accurate, current inventory of actual emissions from all sources, as described in Section 172(c)(3)....”

The Section 182(a)(1) requirement for inventory submittals is due within two years after the nonattainment designation. For Michigan nonattainment areas, that date is June 4, 2020. Once an area is redesignated to attainment, the Section 182(a)(1) requirement no longer applies.

This document details the attainment status of Berrien County, and will be submitted to the USEPA before June 4, 2020, therefore, the Section 182(a)(1) requirement is not applicable.

**b. Corrections to the SIP**

Section 182(a)(2) requires the following updates to a marginal area nonattainment SIP:

1. *Not Applicable Requirements Under Section 182(a)(2)*
   Berrien County was not subject to the requirements under Sections 182(a)(2)(A) and (B) dealing with reasonable available control technology and vehicle inspection and maintenance updates before the CAA Amendments of 1990, therefore, updates to these programs are not applicable.

2. *Permit Programs*
   Section 182(a)(2)(C) requires updates to the NNSR permitting program that were enacted before the CAA Amendments of 1990.

   As stated above, NNSR rules were approved into the Michigan SIP for Berrien County as part of the 1997 8-hour ozone NAAQS Benton Harbor Area redesignation on May 16, 2007 (72 FR 27425). In addition, Michigan's SIP contains all emission control programs under the 1979 1-hour ozone NAAQS related to ozone included in the SIP revisions submitted to the USEPA from March 8, 1994, through August 30, 2000.

**c. Periodic Inventory**

Section 182(a)(3)(A) requires a general inventory. This inventory must meet the requirements of Section 182(a)(1) every three years until attainment. Michigan satisfies the general inventory requirement through the 2017 inventory included above.

Section 182(a)(3)(B) requires the State of Michigan to submit a SIP revision that "require[s] that the owner or operator of each stationary source of oxides of nitrogen or volatile organic compounds provide the State with a statement...showing the actual emissions...from that source." These statements must be submitted at least annually.

Michigan Air Pollution Control Rule (MAPCR) 336.202 requires an annual report from sources of air contaminants. The rule is written broadly enough to require submittal of all pollutants. MAPCR 336.202 was approved into the Michigan SIP on March 8, 1994 (59 FR 10752). Sources subject to MAPCR 336.202 are required to submit their emission estimates to MAERS annually.

In addition, the AQD has created Policy and Procedure AQD-013. It specifies which facilities must report to MAERS. AQD-013 states that sources with NOx emission above 40 tons per year (tpy) or volatile organic compound (VOC) emissions over 10 tpy will be notified to report emissions annually. AQD-013 is available on the AQD Webpage under Emissions/Laws and Rules.

**d. General Offset Requirements**

Section 182(a)(4) requires the general NNSR permit offset ratio for VOCs be set to 1.1 to 1.

For marginal nonattainment areas, MAPCR 336.2908(6)(a)(i) sets the permit offset ratio for VOCs at 1.1 to 1. MAPCR 336.2908 was approved into the Michigan SIP on December 16, 2013 (78 FR 76064).

**3. Permanent and Enforceable Reductions**

CAA Section 107(d)(3)(E) requires that the improvement in air quality is due to permanent and enforceable reductions in emissions. According to the USEPA Guidance, "[t]he State must be able to reasonably attribute the improvement in air quality to emission reductions which are permanent and enforceable." EGLE must demonstrate that the improvement in the air quality between the year the violations occurred, and the year attainment was achieved, is due to permanent and enforceable measures, not to temporary adverse economic conditions or unusually favorable meteorology.

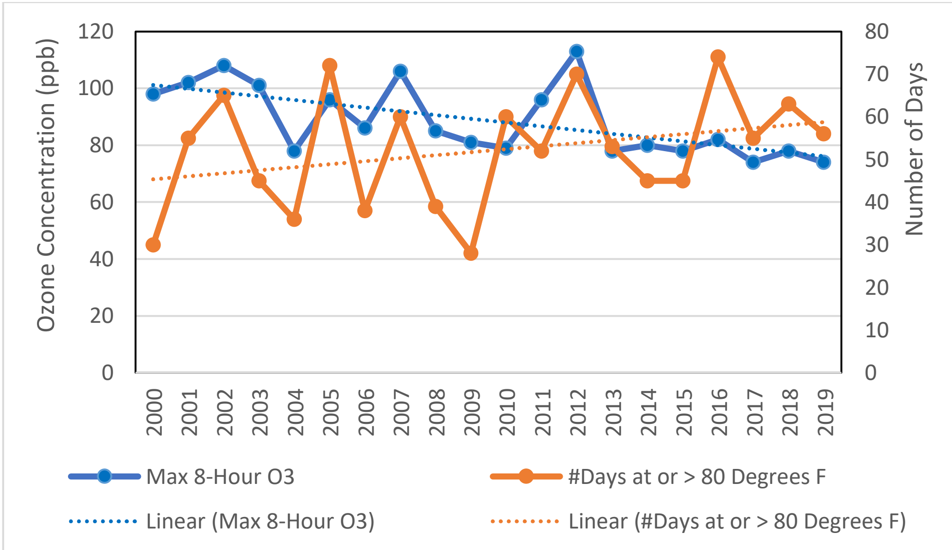
Section 1, above, demonstrates attainment of the 2015 ozone NAAQS for Berrien County. Ozone is typically formed in the presence of VOCs and NOx on sunny, high temperature, low relative humidity days. Consistent with the USEPA Guidance, EGLE demonstrates below that attainment of the 2015 ozone NAAQS in Berrien County is not based on meteorology or temporary adverse economic conditions.

**a. Attainment Not Based on Meteorology**

To demonstrate that the improvement in air quality was not based on unusually favorable meteorology, EGLE analyzed the elements typical of ozone formation.

Ozone typically will form on hotter days. Chart 1 demonstrates the number of days above 80 degrees Fahrenheit (°F) compared to the maximum 8-hour ozone concentration measured at the Coloma site from the years 2000 to 2019.

**Chart 1.** Coloma Days at or Above 80°F vs. Maximum 8-Hour Ozone.

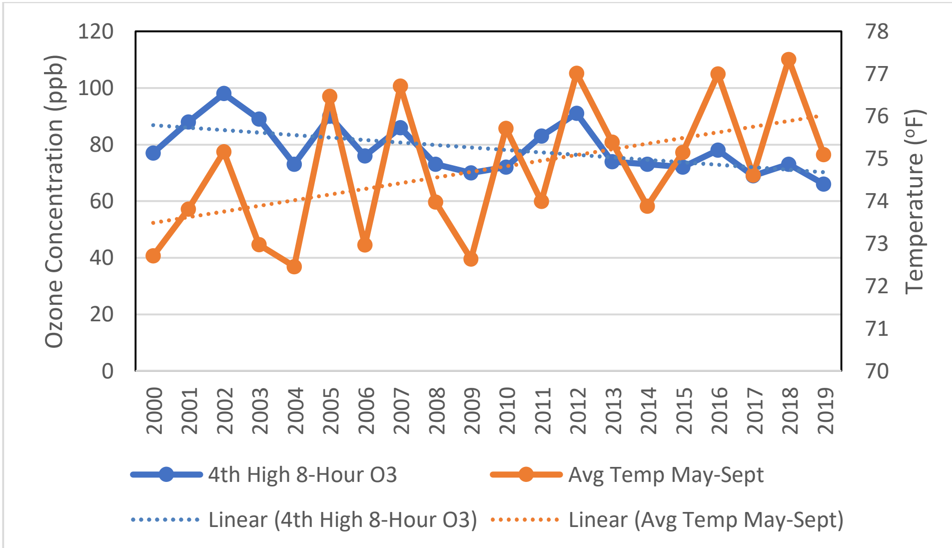



The data indicates that around 2015, the number of hot days, those above 80 degrees, began to increase while the maximum 8-hour ozone concentration remained the same or decreased.

To further demonstrate that temperature was not a driver of ozone production at the Coloma site, EGLE analyzed the average temperature during the ozone season and compared that to the average 4th highest 8-hour ozone concentration during the same 2000 to 2019 period (Chart 2). The 4th highest 8-hour ozone concentration is significant because the USEPA uses the 3-year average of the 4th highest 8-hour ozone concentration to determine attainment or nonattainment.

Originally the ozone season, those months more likely to contain hotter days in Michigan, were determined by the USEPA to be April through September. With the updated 2015 ozone NAAQS, the USEPA changed Michigan's ozone season to March through October. For this analysis, EGLE chose to only include May through September data as those months are more likely to have days over 80 degrees, leading to higher ozone formation, and historically ozone data was not collected in March and October.

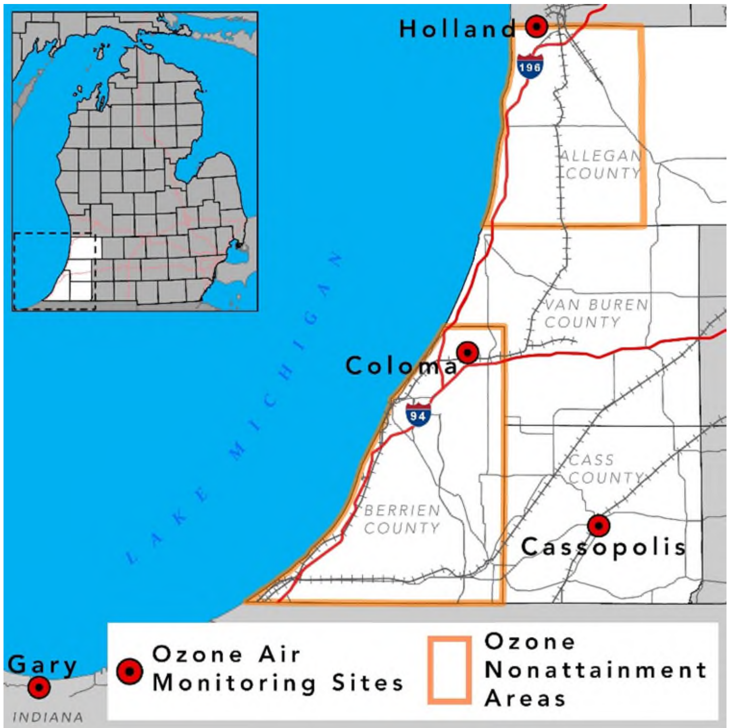
**Chart 2.** Coloma Average May through September Temperature vs. 4th High 8-Hour Ozone ($O_3$) Concentration.




While the average May through September temperature varies from year to year based mainly on warm and cold global cycles, there is a clear warming pattern at the Coloma site. The trendlines on Chart 2 demonstrate around 2012 that the average May through September temperature at Coloma continues to increase while a decreasing trend occurred with the 4th-high 8-hour ozone concentration.

Together, Charts 1 and 2 demonstrate there is no connection between temperature and ozone production at the Coloma site.

**Figure 2.** Ambient Air Monitor Locations in and Near Berrien County.



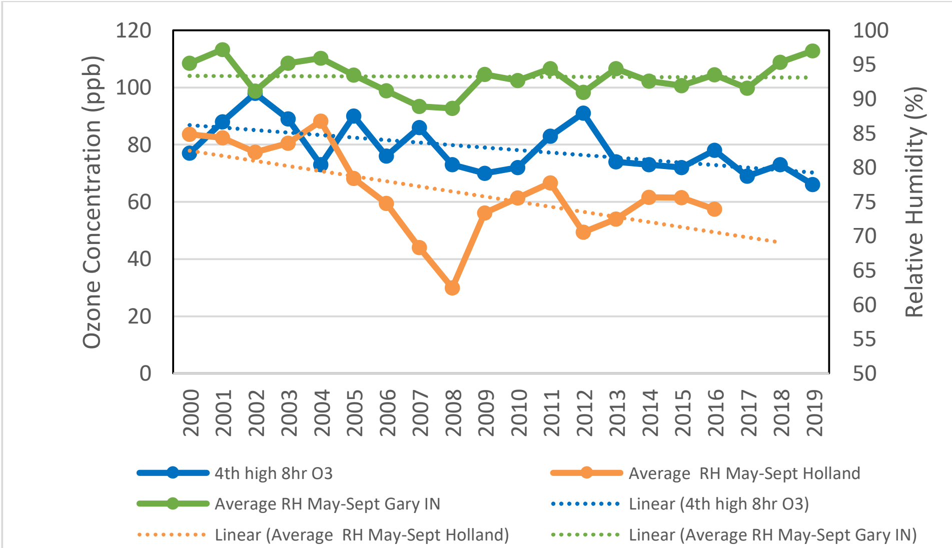

High relative humidity can also be a driver of ozone production. EGLE does not collect relative humidity data at the Coloma air monitoring site; however, EGLE was able to obtain that data from the Holland air monitoring site (Site ID 26-0050-0003) and the Gary, Indiana, air monitoring site (Site ID 18-089-0022). These air monitoring sites are the closest to Coloma that are similarly situated near the Lake Michigan shoreline (Figure 2).

EGLE analyzed the relative humidity data to demonstrate that relative humidity was not a driver for ozone production at the Coloma site.

Chart 3 shows the average percent relative humidity from May through September at both the Holland, Michigan, and Gary, Indiana, sites compared to the 4th highest maximum 8-hour ozone concentration at the Coloma site for the years 2000 through 2019. This chart shows that relative humidity and ozone productions were not correlated at either site.

Also, while Chart 3 shows the ozone production at Coloma dropped while the relative humidity at Holland dropped according to the trendlines, that is not definitive due to the lack of data from the Holland site. The Holland site had a malfunction that resulted in a lack of data availability for the years 2017, 2018, and 2019. For this reason, EGLE also analyzed the Gary, Indiana data. Trendlines between Coloma ozone production and Gary relative humidity show no correlation.

**Chart 3.** Coloma 4th High $O_3$ Concentration vs. Holland and Gary, Indiana, May Through September, Average Relative Humidity (RH).




Together these three charts show decreasing trends connecting weather to the production of ozone at the Coloma site.

In addition, the Lake Michigan Air Directors Consortium (LADCO) has studied ozone production in the Lake Michigan states. One paper, the CART Analysis of Historic Ozone Episodes (Attachment C), supplies a statistical methodology to remove meteorology from the causes of ozone production based on years 1990 through 2002. The paper demonstrated the CART analysis is a valid methodology for assessing meteorology variability and its impacts on ozone production in the Lake Michigan area.

Results from a more recent CART analysis conducted by LADCO were presented at the Southeast Michigan Air Quality meeting on July 25, 2018. Results of that CART analysis presented for West Michigan are shown in Chart 4.

**Chart 4.** West Michigan CART Analysis 2018.

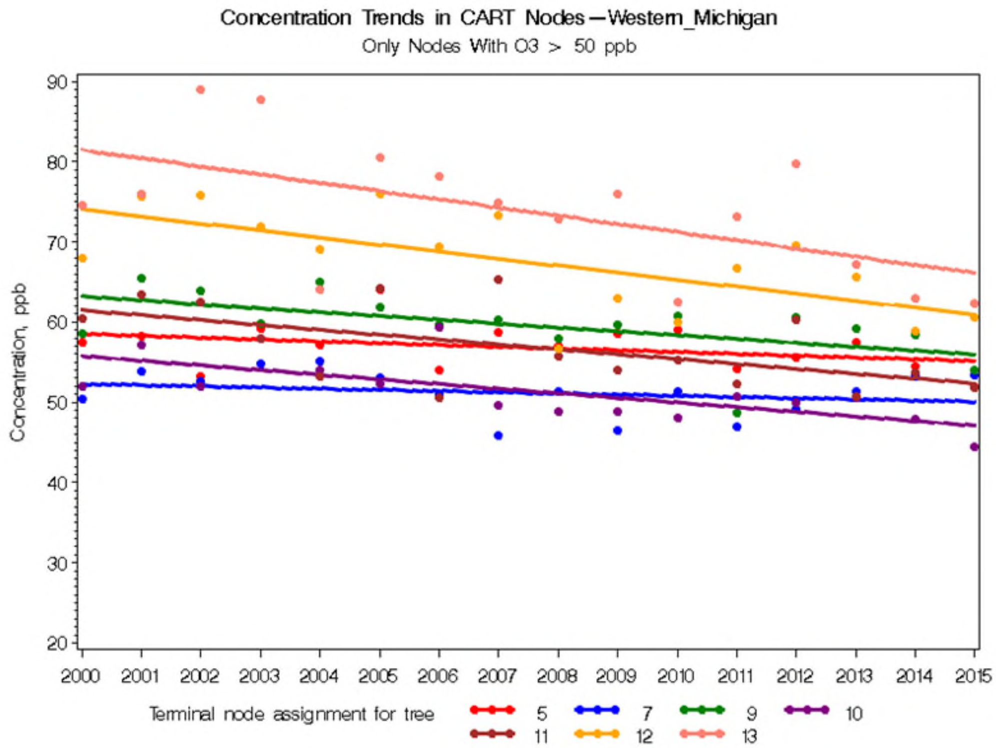



Chart 4 shows CART analysis nodes for ozone values above 50 ppb at the Holland, Muskegon (26-121-0039), and Jenison (26-139-0005) air monitoring sites from 2000 through 2015. Each node defines a set of days with similar meteorological conditions. Looking at trends by node eliminates the effect of changes in meteorology on ozone concentration trends. The downward slope of the nodes in Chart 4 demonstrates that, controlling for meteorological variability, ozone concentrations in western Michigan have declined over time. Because meteorological conditions are held constant, the declining concentrations are most likely due to declining ozone precursor concentrations.

These results together demonstrate that attainment of the 2015 ozone NAAQS at the Coloma site was not driven by weather.

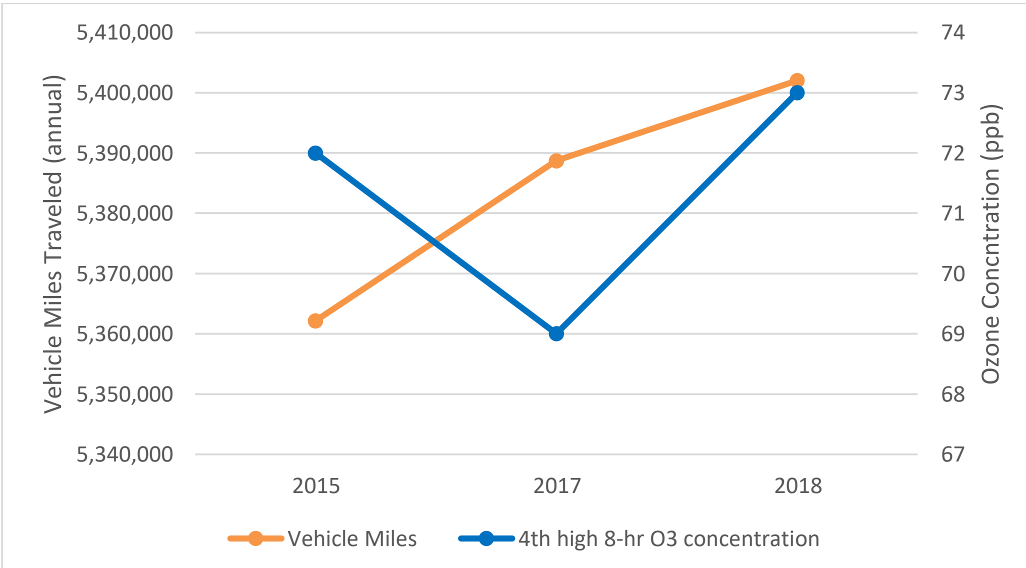
**b. Attainment Not Based on Temporary Adverse Economic Conditions**

To demonstrate the improvement in air quality was not based on temporary adverse economic conditions, EGLE utilized the MDOT Analysis, MAERS data, and the United States Bureau of Labor Statistics (BLS) data. Temporary adverse economic conditions would have been seen in an abrupt reduction in emissions from point sources, vehicle travel, or employment in Berrien County.

The MDOT Analysis (Attachment A) shows the Motor Vehicle Emission Simulator (MOVES) results for vehicle miles of travel (VMT) over the years

2014, 2015, 2017, and 2018, and projected for the years 2020, 2023, and 2030. For purposes of this demonstration, looking at the VMT for 2015 through 2018 (Chart 5) shows an increase in VMT in 2017 compared to a decrease in the 4th highest 8-hour ozone concentration measured at the Coloma site.

**Chart 5.** Berrien County Vehicle Miles Traveled vs. 4th High 8-Hour Average Ozone Concentrations.




From 2010 through 2018, the VOC emitting point sources in Berrien County showed overall downward emissions with a slight upward trend from 2016 through 2018, as shown in Chart 6. Chart 7 shows the downward trend of the highest NOx emitting point source in Berrien County over the 2010 through 2018 period. This source emits 20 times more NOx than any other point source of NOx in the county.

**Chart 6.** Emissions from VOC Point Sources in Berrien County.

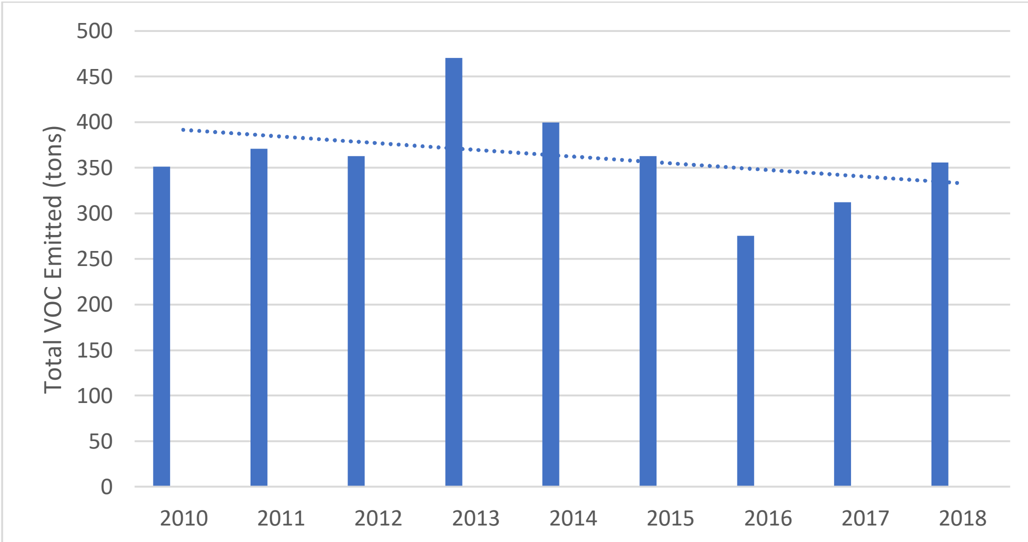
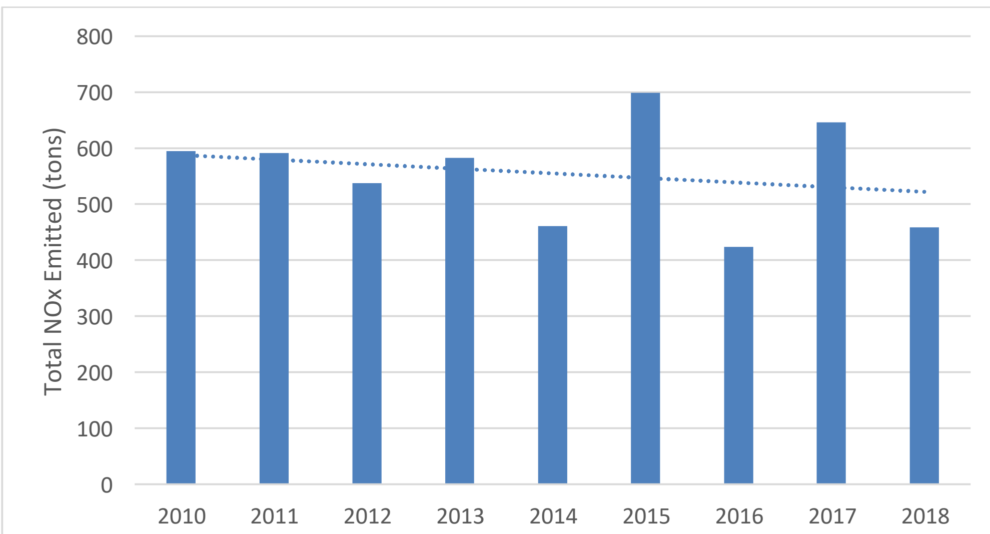


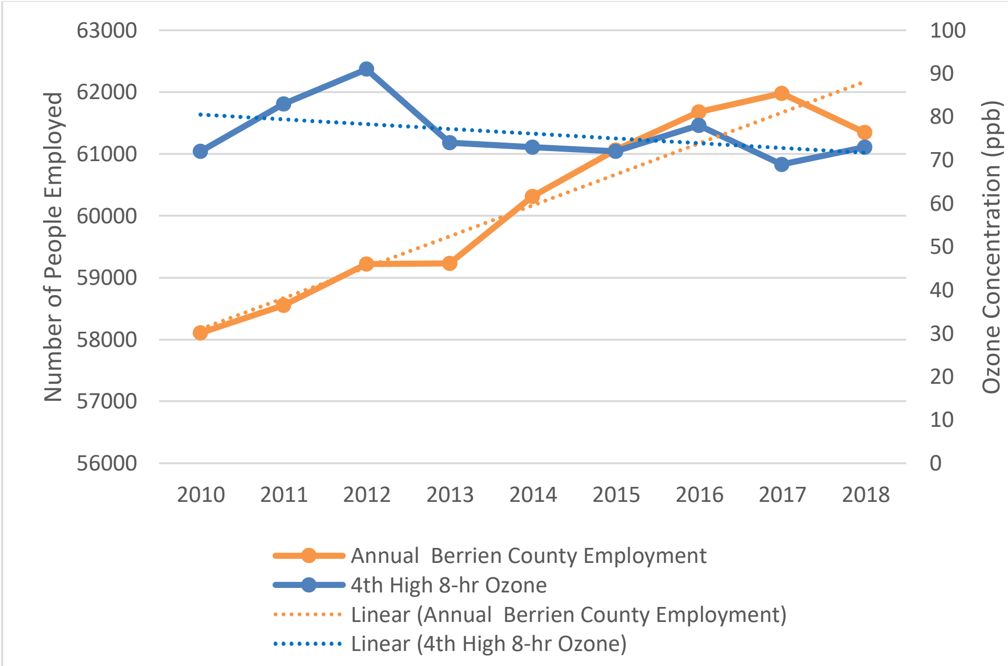

**Chart 7.** Emissions from the Top NOx Point Source in Berrien County.




Charts 5 through 7 show the upward trends in VMT and the stable or slightly decreasing emissions from point sources leading up to and including attainment years.

In addition, looking at the employment data from the attainment years of 2017 and 2018, there does not seem to be a correlation between high ozone and high or low economic activity. Data from the BLS Quarterly Census of Employment and Wages was used for this analysis and can be found on their Website at www.bls.gov/cew/.

**Chart 8.** Berrien County Employment Data vs. 4th High 8-Hour Average Ozone Concentration.




For instance, Chart 8 shows from 2016 to 2017, employment in Berrien County increased while ozone measurements decreased. The inverse occurred from 2017 to 2018 with employment slightly falling but ozone measurements increasing.

Together, the VMT, point source emissions, and employment data demonstrate that temporary adverse economic conditions were not a driving force of the ozone production in Berrien County from 2017 through 2019.

### c. Permanent and Enforceable Conditions

Permanent and enforceable reductions of VOC and NOx emissions have contributed to the attainment of the 2015 ozone NAAQS in Berrien County through the following measures:

1. *Tier II Emission Standards for Vehicles and Gasoline Sulfur Standards with Vehicle Turnover*
   In February 2000, the USEPA finalized a federal rule to significantly reduce emissions from cars and light-duty trucks. Automakers were required to sell cleaner cars and refineries were required to produce cleaner, lower sulfur gasoline. This rule was phased in between 2004 and 2009. The USEPA estimated a 77 percent reduction in NOx from passenger cars; 86 percent reduction for smaller sport utility vehicles (SUVs), light-duty trucks, and minivans; and 65 to 95 percent reduction for larger SUVs, vans, and heavy-duty trucks. The USEPA also estimated VOC reductions of 12 percent for passenger cars; 18 percent for smaller

SUVs, light-duty trucks, and minivans; and 15 percent for larger SUVs, vans, and heavy-duty trucks.

Table 3 demonstrates that emissions from onroad vehicles in Berrien County have declined since 2014, due in part to the Tier II standards and vehicle turnover. More information on the methodology used to determine the emissions in Table 3 is located in the MDOT Analysis (Attachment A).

**Table 3.** Berrien County Onroad Vehicle Emissions.

| Analysis Year | VOC Emissions (tons/day) | NOx Emissions (tons/day) |
|---|---|---|
| 2014 | 4.81 | 9.01 |
| 2017 | 3.50 | 5.94 |

The MDOT Analysis projects continued vehicle turnover in Berrien County through 2030. This means Berrien County will continue to see emission reductions based on the Tier II standards.

2. *Category 3 Marine Diesel Engine Standards*
The USEPA finalized emissions standards for category 3 marine diesel engines, effective June 2010. These standards require more stringent exhaust standards for new large marine diesel engines with per-cylinder displacement at or above 30 liters. The standards apply in two stages: near-term standards from newly built engines, which took effect in 2011, and long-term standards requiring an 80 percent reduction in NOx emissions that began in 2016.

Berrien County borders Lake Michigan (Figure 1). Shipping traffic around Lake Michigan indirectly impacts the formation of ozone within the county, therefore, reductions in those emissions help reduce ozone concentrations. According to 2016v1, Berrien County achieved an 8-ton per year NOx reduction and a 1-ton per year VOC reduction between 2016 and 2018 attributed to these standards.

3. *Emissions Standards for Locomotive and Marine Compression-Ignition Engines*
In 2008, the USEPA published regulations for a comprehensive program to dramatically reduce pollution from locomotives and marine diesel engines. The controls apply to all types of locomotives, including line-haul, switch, and passenger, and all types of marine diesel engines below 30 liters per cylinder displacement, including commercial and recreational, propulsion, and auxiliary. The near-term emission standards for newly built engines phase-in started in 2009. The near-term program also includes new emission limits for existing locomotives and marine diesel engines that apply when they are remanufactured and take effect as soon as certified remanufacture systems are available. The long-term emissions

standards for newly built locomotives and marine diesel engines began in 2015 for locomotives and in 2014 for marine diesel engines.

As stated above, Berrien County is situated on the shores of Lake Michigan, so it benefits from any reductions in marine emissions. The county also contains a heavily used rail line, including the Amtrak passenger line connecting Michigan to Chicago (Figure 2). Therefore, it also benefits from reductions in rail emissions. Between 2016 and 2018, the rail component of the 2016v1 shows a 10-ton per year NOx reduction and 1-ton per year VOC reduction for Berrien County.

4. *Consumer Products Rules*
   In 2007, Michigan adopted MAPCR 336.1660. This rule reduces VOC emissions by regulating the VOC content of consumer products sold, supplied, offered for sale, or manufactured for use in the state of Michigan. This rule adopts by reference a model rule developed by the Ozone Transport Commission. The rule establishes VOC content limitations in products such as sprays, paints, aerosols, waxes, varnishes, and other consumer-oriented products, thereby reducing overall VOC emissions throughout the state.

5. *Diesel Emissions Reduction Act (DERA) Grants*
   EGLE administers the USEPA DERA grant program. This program provides grants to replace older diesel vehicles with more efficient, cleaner vehicles. Vehicles eligible for replacement include school buses, class 5 through 8 heavy-duty highway vehicles, locomotive engines, marine engines, and certain nonroad engines, equipment or vehicles. The program helps reduce NOx emissions through increased vehicle turnover and promoting cleaner energy vehicles.

6. *Area Source Boilers, Major Source Boilers, and Commercial and Industrial Solid Waste Incinerator (CISWI) National Emission Standards for Hazardous Air Pollutants*
   In 2013 the USEPA finalized revisions to the emission standards for large boilers, small boilers, and incinerators. These standards cover more than 200,000 boilers and incinerators nationwide. Large boilers are located at industrial facilities. Small boilers are located at universities, hospitals, hotels, and commercial buildings. A CISWI unit is an incinerator that burns solid waste at a commercial or industrial facility.

   In a separate action, the USEPA revised the non-hazardous secondary materials rule. This rule helps determine which standard applies (boiler or CISWI) to a unit that burns material that is not solid waste. These combined rules will lead to additional NOx and VOC reductions. The compliance deadlines for area boilers, major boilers, and CISWI units was 2014, 2016, and 2018, respectively.

4. **Section 175A Maintenance Plan**
CAA Section 107(d)(3)(E) requires a fully approved Section 175A maintenance plan for a redesignation to attainment. Section 175A of the CAA, and the USEPA Guidance, contains the following requirements for maintenance plans with which EGLE demonstrates compliance. According to the USEPA Guidance, a State may submit both the redesignation request and the maintenance plan at the same time. EGLE submits the following maintenance plan for approval for Berrien County.

**a. Maintenance for 10 Years**
Section 175A(a) requires the maintenance plan must provide for maintenance of the NAAQS for at least 10 years after the redesignation. The USEPA Guidance states that "the State should project emissions for the 10-year period following redesignation...for the purpose of showing that emissions will not increase over the attainment inventory.... The projected inventory should consider future growth, including population and industry, should be consistent with the attainment inventory, and should document data inputs and assumptions."

Tables 4 and 5 below demonstrate Berrien County's maintenance of the 2015 ozone NAAQS through continued decreasing emissions across emissions inventory sectors through 2030. The onroad emissions were derived from the MDOT Analysis (Attachment A). The inputs and assumptions for those projections are detailed in that analysis and are based on July weekday emissions. The nonroad, nonpoint, and point emissions were derived using the EGLE Emissions Analysis in Attachment D utilizing the USEPA 2016v1 projections based on annual emissions.

<u>Projected Maintenance Emissions</u>

**Table 4.** Berrien County NOx Emissions Inventory Projections (tons/day).

| Emission Sectors | 2017 | 2023 | 2030 |
|---|---|---|---|
| Onroad | 5.94 | 3.15 | 1.85 |
| Nonroad | 0.97 | 0.72 | 0.59 |
| Point | 1.53 | 2.24 | 2.23 |
| Nonpoint | 1.62 | 1.58 | 1.54 |
| Total NOx Emissions | 10.06 | 7.69 | 6.21 |

**Table 5.** Berrien County VOC Emissions Inventory Projections (tons/day).

| Emission Sectors | 2017 | 2023 | 2030 |
|---|---|---|---|
| Onroad | 3.50 | 2.24 | 1.57 |
| Nonroad | 1.22 | 0.96 | 0.88 |
| Point | 1.03 | 1.08 | 1.06 |
| Nonpoint | 6.61 | 6.52 | 6.35 |
| Total VOC Emissions | 12.36 | 10.8 | 9.86 |

**b. Monitoring Network Commitment**

The USEPA Guidance states that "[t]he maintenance plan should contain provisions for continued operation of air quality monitors that will provide" verification of the NAAQS.

EGLE commits to continued operation of the Coloma air monitor in accordance with 40 CFR Part 58 for the duration of the maintenance period.

**c. Second Maintenance Plan and Nonattainment Requirements**

Section 175A(b) requires the State of Michigan to submit an additional 10-year maintenance plan 8 years after the redesignation is approved. EGLE commits to submit a revised maintenance plan as required under this section.

Section 175A(c) states that the nonattainment requirements still apply until the area is redesignated and the maintenance plan is approved.

**d. Verification of Continued Attainment**

The USEPA Guidance recommends that "the State submittal should indicate how the State will track the progress of the maintenance plan."

EGLE will continue to track ozone levels through the operation of a USEPA-approved monitoring network as necessary to demonstrate ongoing compliance with the 2015 ozone NAAQS. EGLE will consult with the USEPA prior to making changes to the existing monitoring network, should changes become necessary in the future. EGLE will continue to quality-assure the monitoring data to meet the requirements of 40 CFR Part 58 and all other federal requirements. EGLE will enter all data into the AQS on a timely basis in accordance with federal guidelines.

EGLE will continue to produce periodic emission inventories as required by 40 CFR Part 51, to track levels of emissions in the future.

**e. Contingency Provisions**

1. *Requirement to Maintain Measures in the SIP*

   Section 175A states that contingency provisions "shall include a requirement that the State will implement all measures with respect to the control of the air pollutant concerned which were contained in the [SIP] for the area before redesignation...."

   EGLE commits to maintaining the control measures for VOC and NOx emissions that were contained in the SIP before redesignation of this area to attainment.

2. *Measures to Promptly Correct Any Violation*

   Section 175A(d) requires each maintenance plan to contain contingency provisions "to assure that the State will promptly correct any violation of the standard which occurs after the redesignation of the area as an attainment area." The USEPA Guidance states that "the State should also identify specific ... triggers, which will be used to determine when the contingency measures need to be implemented." The USEPA Guidance also states that "[t]he plan should clearly identify ... a schedule and procedure for adoption and implementation, and a specific time limit for action by the State."

   Michigan commits to adopt and expeditiously implement necessary corrective actions in the following circumstances:

   <u>Warning Level Response</u>:

   A warning level response shall be prompted whenever an annual (1-year) 4th high, 8-hour average, monitored value of 74 ppb or greater occurs in a single ozone season within the maintenance area. A warning level response will consist of a study to determine whether the ozone value indicates a trend toward a higher ozone value or whether emissions appear to be increasing. The study will evaluate whether the trend, if any, is likely to continue and, if so, the control measures necessary to reverse the trend taking into consideration ease and timing for implementation. Implementation of necessary controls in response to a warning level response trigger will take place as expeditiously as possible, but in no event later than 12 months from the conclusion of the most recent ozone season.

   Should it be determined through the warning level study that action is necessary to reverse the noted trend, the procedures for control selection and implementation outlined under "Action Level Response" (below) shall be followed.

Action Level Response:
An action level response shall be prompted whenever a 4th high 8-hour average, monitored value, averaged over two years, of 71 ppb or greater occurs within the maintenance area. A violation of the NAAQS (4th high 8-hour average, averaged over three years, with a value of 71 ppb or greater) shall also prompt an action level response.

In the event the action level is triggered and is not found to be due to an exceptional event, malfunction, or noncompliance with a permit condition or rule requirement, EGLE and MDOT, in consultation with the metropolitan planning organizations or regional council of governments, will determine additional control measures needed to assure future attainment of the 2015 ozone NAAQS. In this case, measures that can be implemented in a short time will be selected to be in place within 18 months from the close of the ozone season that prompted the action level. EGLE will also consider the timing of an action level trigger and determine if additional, significant new regulations not currently included as part of the maintenance provisions will be implemented in a timely manner and will constitute the response.

3. *Adoption of Contingency Measures*

The USEPA Guidance states that "[t]he plan should clearly identify the measures to be adopted, a schedule and procedure for adoption and implementation, and a specific time limit for action by the State."

Michigan commits to the following control measure options, selection, and implementation:

Control Measure Selection and Implementation:
Adoption of any additional control measures is subject to the necessary administrative and legal process. If a new measure is already promulgated and scheduled to be implemented at the federal or state level, and that measure is determined to be sufficient to address the upward trend in air quality, additional local measures may not be necessary. Michigan will submit to the USEPA an analysis to demonstrate the proposed measures are adequate to return the area to attainment.

Control Measure Options:
Michigan may select one of the following control measures, if necessary, to address an upward trend in air quality:

1. Adopt VOC or NOx Reasonable Available Control Technology on existing sources.
2. Apply VOC Reasonable Available Control Technology to smaller existing sources.

3. Alternative fuel and diesel retrofit programs for fleet vehicle operations.
4. Require VOC or NOx control on new minor sources (less than 100 tons per year).
5. Reduced idling programs.
6. Trip reduction programs.
7. Traffic flow and transit improvements.

## 5. Section 110 and Part D Conformity

CAA Section 107(d)(3)(E) requires a determination that all Section 110 and Part D requirements have been met for an area to be redesignated to attainment. The USEPA Guidance suggests the Section 110 requirements listed in Section 107(d)(3)(E) pertain only to Section 110(a)(2). Section 110(a)(2) lists the infrastructure SIP requirements. Part D lists the general requirements for nonattainment areas. These requirements, except the Part D CAA Section 176 requirements, are already addressed in Section 2 above.

### a. Conformity Requirements

The USEPA Guidance states the State must "show that its SIP provisions are consistent with section 176(c)(4) conformity requirements. The redesignation request should include conformity procedures if the State already has these procedures in place."

Section 176(c) of the CAA requires states to establish criteria and procedures to ensure federally supported or funded activities, including highway projects, conform to the air quality planning goals in the applicable SIPs. The two types of conformity requirements and Michigan's demonstration of compliance with them are listed below.

1. *Transportation Conformity Requirements and Motor Vehicle Emission Budgets*

   Transportation conformity under Section 176(c) is the requirement to determine conformity for transportation plans, programs, and projects developed, funded, or approved under Title 23 of the United States Code and the Federal Transit Act. Conformity to a SIP means transportation activities will not produce new air quality violations, worsen existing violations, or delay timely attainment of the NAAQS.

   Michigan's transportation conformity SIP was approved by the USEPA on December 18, 1996 (61 FR 66609), and was updated on April 20, 2017 (82 FR 17134). In addition, EGLE has a Memorandum of Agreement (MOA) among MDOT, the USEPA, and the various state and local agencies involved in the transportation process. The 2016 MOA Regarding Determination of Conformity of Transportation Plans, Programs, and Projects to State Implementation Plans was signed on December 13, 2016, by the USEPA and is available on the AQD Webpage at https://www.michigan.gov/documents/egle/egle-aqd-sdu-transportation_conformity_moa_671525_7.pdf.

Estimates of onroad motor vehicle emissions are projected for the maintenance period (see Section 4 above) to assess emission trends and to ensure continued compliance with the 2015 ozone NAAQS. Onroad emissions include those from cars, buses, and trucks driven on public roadways. These estimates are considered a ceiling or "budget" for emissions and are used to determine whether transportation plans and projects conform to the SIP. Estimated onroad mobile emissions of VOCs and NOx must not exceed the emission budgets contained in the maintenance plan.

A safety margin is utilized to account for potential variation of forecast models used to project emissions for the maintenance period. A safety margin, as defined by the conformity rule, looks at the total emissions from all sources in the nonattainment area. States can apply a percentage of that safety margin to the mobile source categories when creating motor vehicle emission budgets.

Tables 6 and 7 list the 2017 emissions from all sectors along with the projected emissions (from Tables 4 and 5) for 2023 and 2030. Tables 6 and 7 also show the projected decrease in emissions from 2023 to 2017 and from 2030 to 2017. A percentage of the projected decrease (75 percent) is then used to calculate the safety margin for the onroad sector for Berrien County (Table 8).

EGLE chose to use 75 percent of the safety margin to create the motor vehicle emission budget. This percentage was chosen because it allowed for a projected emission decrease that would produce both lower onroad emissions and lower overall emissions for the maintenance period. Table 8 details the final Motor Vehicle Budget for the maintenance period for Berrien County.

**Table 6.** Projected NOx Emission Reductions for Berrien County (tons/day).

| | 2017 Emissions | 2023 Projected Emissions | Projected 2023 Emission Decrease | 2030 Projected Emissions | Projected 2030 Emission Decrease |
|---|---|---|---|---|---|
| Onroad | 5.94 | 3.15 | -- | 1.85 | -- |
| Nonroad | 0.97 | 0.72 | -- | 0.59 | -- |
| Point | 1.53 | 2.24 | -- | 2.23 | -- |
| Nonpoint | 1.62 | 1.58 | -- | 1.54 | -- |
| Total | 10.06 | 7.69 | 2.37 | 6.21 | 3.85 |

**Table 7.** Projected VOC Emission Reductions for Berrien County (tons/day).

| | 2017 Emissions | 2023 Projected Emissions | Projected 2023 Emission Decrease | 2030 Projected Emissions | Projected 2030 Emission Decrease |
|---|---|---|---|---|---|
| Onroad | 3.50 | 2.24 | -- | 1.57 | -- |
| Nonroad | 1.22 | 0.96 | -- | 0.88 | -- |
| Point | 1.03 | 1.08 | -- | 1.06 | -- |
| Nonpoint | 6.61 | 6.52 | -- | 6.35 | -- |
| Total | 12.36 | 10.80 | 1.56 | 9.86 | 2.50 |

**Table 8.** Motor Vehicle Emissions Budget for Berrien County (tons/day).

| | 2023 Estimated Onroad Emissions | 75% Safety Margin | 2023 Total MVEB | 2030 Estimated Onroad Emissions | 75% Safety Margin | 2030 Total MVEB |
|---|---|---|---|---|---|---|
| NOx | 3.15 | 1.78 | 4.93 | 1.85 | 2.89 | 4.74 |
| VOC | 2.24 | 1.17 | 3.41 | 1.57 | 1.87 | 3.44 |

2. *General Conformity Requirements*
General conformity under Section 176(c) also requires conformity for all other non-transportation, federally supported or funded projects.

Michigan's general conformity SIP was approved by the USEPA on December 18, 1996 (61 FR 66607).

**Title 40, Code of Federal Regulations, Part 51, Appendix V Requirements**

40 CFR Part 51, Appendix V, contains requirements EGLE must follow to revise the SIP. The applicable requirements and the EGLE's fulfillment of them are as follows:

1. **A Formal Request**
Appendix V requires all SIP submittals contain a formal letter of submittal from the governor or the governor's designee requesting the USEPA approval of the SIP revision.

A letter dated July 3, 2019, from Governor Gretchen Whitmer to the USEPA, Region 5, delegates authority from the Governor to EGLE's Director to make any SIP submittal, request, or application under the CAA. This letter was submitted to the USEPA on July 30, 2019, for inclusion in the Michigan SIP, and is available upon request. This delegation of authority and the cover letter included with this SIP submittal to the USEPA satisfies the formal request requirement.

2. **Necessary Legal Authority**
Appendix V requires states submit evidence the State has the necessary legal authority under state law to adopt and implement the requested SIP revision.

Part 55, Air Pollution Control, of the Natural Resources and Environmental Protection Act, 1994 Public Act 451, as amended, and Executive Reorganization Order 2011-1 provide EGLE with the legal authority under state law to implement and enforce the provisions of the Michigan SIP. A copy has been submitted to the USEPA through previous SIP submittals and is available upon request.

3. **Sufficient Public Notice**
   Appendix V requires the State of Michigan to submit evidence that public notice was given of the proposed change consistent with procedures approved by the USEPA, including the date of publication of such notice.

   The notice of this SIP revision and an opportunity for public comment and hearing is provided in Attachment E.

4. **Valid Public Hearing**
   Appendix V requires the State submit a certification that a public hearing, if held, was held in accordance with the information provided in the public notice and the State's Administrative Procedures Act.

   According to the public notice in Attachment E, EGLE provided an opportunity for a public hearing upon request. As stated in the public notice, requests for a public hearing needed to be submitted to the AQD by January 15, 2020. By January 16, 2020, the AQD had not received any request for public hearing, therefore, no hearing was held. As stated in the public notice, the AQD posted on the AQD Website on January 16, 2020, that no hearing would be held as no hearing was requested.

5. **Public Comments**
   Appendix V requires the State to compile any public comments and the State's responses to them in the SIP submittal.

   The AQD did not receive any public comments on this SIP submittal. This is noted in Attachment E.

## Conclusion

The Berrien County ozone nonattainment area has attained the 2015 ozone NAAQS and complied with the applicable provisions of the 1990 Amendments to the CAA regarding redesignations of ozone nonattainment areas. Documentation to that effect is contained herein. EGLE has prepared a redesignation request and maintenance plan that meets the requirements of Section 110(a)(1) of the 1990 CAA.

Based on this document, the Berrien County ozone nonattainment area meets the requirements for redesignation under the CAA and the USEPA Guidance. Michigan has performed an analysis demonstrating the air quality improvements are due to permanent and enforceable measures. The State of Michigan hereby requests the Berrien County ozone nonattainment area be redesignated to attainment, simultaneously with the USEPA's approval of the maintenance plan provisions contained herein. In addition, EGLE requests the USEPA's approval that this maintenance plan satisfies the requirements of CAA Section 175A(b), for subsequent plan revisions required for areas redesignated for the 2015 ozone NAAQS.

# ATTACHMENT A

# Air Quality Redesignation
# Onroad Emissions
# For
# Berrien County, Michigan
# Nonattainment Area

**October 11, 2019**

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**List of Tables:**

# 1.0 Introduction

The Michigan Department of Transportation (MDOT) prepared this report to describe the process used to determine the on-road mobile emissions for Berrien County, MI, as part of a redesignation to attainment request for the 2015 ozone National Ambient Air Quality Standard (NAAQS) by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) to the US Environmental Protection Agency (EPA.)

# 2.0 Geographic Area

Berrien County is a nonattainment area for the 2015 ozone NAAQS and an orphan maintenance area for the 1997 ozone NAAQS. Within the county boundary are the metropolitan planning organizations (MPOs) of the Twin Cities Area Transportation Study (TwinCATS) and part of the Niles-Buchanan-Cass Area Transportation Study (NATS), as well as rural areas contained in the State Transportation Improvement Program (STIP).

# 3.0 Attainment Status

On April 15, 2004, the EPA issued final designations of areas not attaining the 1997 ozone NAAQS. Berrien County was designated nonattainment.

On May 16, 2007, the EPA redesignated the area attainment/maintenance, approving and finding adequate motor vehicle emissions budgets for volatile organic compounds (VOC) and nitrogen oxides (NOx) for the year 2018. Placing the area into maintenance, this requires conformity emission to be compared to the motor vehicle emission budgets contained in the state implementation plan (SIP).

On July 20, 2012, the EPA designated all of Michigan as attainment for the strengthened 2008 ozone NAAQS.

On July 20, 2013, the EPA partially revoked the 1997 ozone NAAQS, revoking the requirement to do transportation conformity for areas that were in maintenance. On April 6, 2015, the EPA completely revoked the 1997 ozone NAAQS, which resulted in removal of all transportation conformity requirements.

On Aug. 3, 2018, the EPA designated Berrien County as a nonattainment area for the strengthened 2015 ozone NAAQS. MPOs in these nonattainment areas had one year from the designation date to show conformity of the existing or new LRTPs.

On April 23, 2018, the Federal Highway Administration (FHWA), complying with the court's decision in *South Coast Air Quality Management District v. EPA*, started requiring areas in the country that were maintenance for the 1997 ozone NAAQS to conduct conformity. This was later modified in September 2018 to allow areas until Feb. 16, 2019, to have a conformity analysis and determination completed.

# 4.0 Analysis

The vehicle emissions estimates derived from this analysis use the methodology developed and utilized to perform transportation conformity analysis for Berrien County. This methodology has been accepted by the FHWA and the EPA. Estimates of emissions were generated by the Motor Vehicle Emission Simulator (MOVES) and incorporate numerous variables. The travel demand forecasting models provide vehicle miles of travel (VMT), vehicle hours of travel (VHT), and speeds. Other essential variables will be described in the section on emission modeling. The Air Quality Conformity Analysis for Berrien County, MI, Nonattainment Area dated Jan. 4, 2019 provided the base data for three of the four analysis years. The platform built for year 2015 was used for years 2017, 2023, and 2030. A platform built for year 2014 was used for analysis year 2014.

## 4.1 Analysis Years

Emissions were estimated for analysis years 2014, 2017, 2023, and 2030. The methodology to develop each is described below.

## 4.2 Transportation Modeling

### 4.2.1 Development of Vehicle Miles of Travel for Years 2017, 2023, and 2030.

To derive the daily VMT and corresponding VHT for year 2017, data was interpolated from years 2015 and 2018 provided by the travel demand forecasting models. The daily VMT and VHT for 2023 was interpolated from years 2020 and 2030. The VMT is provided in Table 1 and VHT in Table 2. The travel demand models are described below and the normalizing process to the Highway Performance Monitoring System (HPMS). Development of VMT for year 2014 is described in section 4.2.8.

*Table 1: Berrien County 2014, 2017, 2023, and 2030 Vehicle Miles of Travel*

| MOVES Road Type | VMT 2014 | VMT 2015* | VMT 2017 | VMT 2018* | VMT 2020* | VMT 2023 | VMT 2030* |
|---|---|---|---|---|---|---|---|
| Rural restricted access | 1,097,044 | 1,114,638 | 1,121,803 | 1,125,385 | 1,127,960 | 1,150,316 | 1,202,480 |
| Rural unrestricted access | 1,091,883 | 1,102,111 | 1,107,465 | 1,110,143 | 1,101,774 | 1,095,956 | 1,082,378 |
| Urban restricted access | 1,364,672 | 1,256,249 | 1,269,157 | 1,275,611 | 1,262,505 | 1,272,094 | 1,294,468 |
| Urban unrestricted access | 1,844,560 | 1,889,143 | 1,890,311 | 1,890,896 | 1,891,156 | 1,886,887 | 1,876,926 |
| Total | 5,398,158 | 5,362,141 | 5,388,737 | 5,402,035 | 5,383,394 | 5,405,252 | 5,456,252 |

Source: *Air Quality Conformity Analysis for Berrien County, MI Nonattainment Area, dated Jan.4, 2019.

Table 2*: Berrien County 2014,2017, 2023, and 2030 Vehicle Hours of Travel*

| MOVES Road Type | VHT 2014 | VHT 2015* | VHT 2017 | VHT 2018* | VHT 2020* | VHT 2023 | VHT 2030* |
|---|---|---|---|---|---|---|---|
| Rural restricted access | 16,162 | 16,413 | 16,519 | 16,572 | 16,610 | 16,933 | 17,688 |
| Rural unrestricted access | 24,450 | 24,604 | 24,732 | 24,796 | 24,592 | 24,422 | 24,027 |
| Urban restricted access | 21,970 | 20,216 | 20,429 | 20,535 | 20,312 | 20,467 | 20,829 |
| Urban unrestricted access | 58,274 | 59,738 | 59,766 | 59,781 | 59,785 | 59,595 | 59,150 |
| Total | 120,856 | 120,970 | 121,445 | 121,683 | 121,299 | 121,417 | 121,694 |

Source: *Air Quality Conformity Analysis for Berrien County, MI Nonattainment Area, dated Jan. 4, 2019.

### 4.2.2 Travel Demand Forecasting Models

Nonattainment areas are established independent of MPO boundaries. The Berrien County nonattainment area is covered by three travel demand forecasting models: the TwinCATS model, the South Bend/Niles regional model, and the statewide model covering the rural areas. Each of these models were developed in TransCAD modeling software. Both the travel demand models for the MPO areas were developed in 2018 using the latest demographic and employment data available to generate estimates of travel, VMT and speeds. The statewide model used the latest socioeconomic data available at the time.

### 4.2.3 TwinCATS Model

The TwinCATS model covers the greater Benton Harbor, St. Joseph, and Berrien Springs area. It was developed by MDOT and is a standard four-step model with time of day, a base year of 2015 and a horizon year of 2045. Each of the four steps - trip generation, trip distribution, mode choice, and traffic assignment - are checked for reasonableness against national standards. Final model validation verifies that the assigned volumes replicate actual traffic counts. The decennial 2010 census and 2015 five-year American Community Survey are the sources of population and household base data. Employment data was developed from a private business database verified with local knowledge. Future data was based on the Regional Economic Models, Inc. (REMI) economic and demographic forecasts. The University of Michigan and MDOT jointly develop county-specific forecast data.

#### 4.2.4 Niles/South Bend Regional Model

This model is a regional model developed by a consultant and covers the NATS MPO and the Michiana Area Council of Governments (MACOG) MPO areas. The model reflects the interconnected travel patterns experienced in the Niles, Michigan, and South Bend, Indiana, region. The model is a hybrid, blending a traditional four-step model with an activity-based model, with a base year of 2015 and horizon year of 2045. Census data was used to develop base population and household data, employment data was developed from a private business database verified with local knowledge, and REMI was used to develop future year socioeconomic data.

#### 4.2.5 Statewide Model

The statewide model developed by MDOT covers all counties in the state and was used for the non-urban parts of Berrien County. The model is a standard three-step, trip generation, trip distribution, and assignment model, with a base year 2010 and a 2045 future year. Trip assignment uses an equilibrium method and was validated against traffic counts using MDOT standards and those suggested by FHWA.

#### 4.2.6 Coding Travel Demand Model Links for NFC by Urban and Rural

For emission modeling, the National Functional Classification (NFC) system is used to determine the function of roads; however, NFCs do not distinguish roads by urban and rural. The emission model, MOVES, requires roads to be classified as urban or rural. MOVES requires roads to be grouped into one of four road types: rural restricted, rural unrestricted, urban restricted, or urban unrestricted. To determine a road's urban or rural status, roads within the adjusted census urban boundary were considered urban and those outside as rural. NFCs designated as interstate and other freeways are considered restricted while all others are considered unrestricted. The Michigan Geographic Framework (GIS digital base map) was used to combine NFC with adjusted census urban boundary to generate MOVES road types for the network.

#### 4.2.7 Highway Performance Monitoring System (HPMS)

The EPA and FHWA endorse HPMS as the source of VMT estimates. The travel demand modeling VMT are aggregated by NFC road types for the county then normalized to 2015 HPMS data, which is the base year/validation years of the travel demand forecasting models. Normalization factors were applied to future analysis years.

#### 4.2.8 Development of Vehicle Miles of Travel for Year 2014

The 2014 VMT was derived by taking the 2015 VMT from the travel demand models and normalizing it to 2014 HPMS. The normalized VMT data was utilized with 2014 vehicle population and vehicle age data to obtain inputs needed for MOVES.

#### 4.2.9 Model Networks

The networks contain projects from the 2045 long range transportation plans and 2020-2023 transportation improvement programs (TIPs). The 2030 network includes the completion of US-31, connecting it with I-94.

# 5.0 Emission Modeling

## 5.1 MOVES Specifications

The EPA's MOVES version MOVES2014b was used to generate emissions. Ozone is formed in the presence of heat and sunlight, so the highest ozone concentrations are monitored during the summer. This analysis involves generating summer (July) weekday emissions to simulate the meteorology of a high-ozone summer day.

## 5.2 Road Type Distribution

HPMS data is used to create MOVES road-type distribution fractions. Berrien County HPMS passenger data is used for motorcycle and passenger vehicles, and commercial HPMS is used for trucks and buses. HPMS VMT is aggregated to MOVES road types then converted to a fraction, generating a road-type distribution.

## 5.3 Average Speed

Speed distributions are created using a method developed by EPA for taking a single average speed and creating a distribution. The method generates an average speed fraction by MOVES road type, by day, by hour, and speed bin from speeds generated by the travel demand forecasting models. The same distribution was used for each vehicle type.

## 5.4 Ramp Fraction

The default vehicle hours traveled ramp fraction of 8 percent was used.

## 5.5 Average Weekday VMT to Annual VMT

Monthly VMT adjustment factors were obtained from MDOT's data collection area. The EPA's AADVMT Converter-Tool MOVES 2014 was used to convert annual average daily VMT to annual VMT, monthly VMT fractions, and daily VMT fractions. Hourly VMT fractions use MOVES default data. For motorcycles, the monthly fractions use MOVES defaults since local data is limited. Future analysis years utilize the same fractions.

## 5.6 Vehicle Population

### 5.6.1 Vehicle Population Years 2017, 2023, and 2030

The source of the vehicle population is the Michigan Secretary of State (SOS) vehicle registration database on Oct. 1, 2015. The database was supplemented with school bus data from the Michigan Department of Education and MDOT Public Transit bus data. The EPA's default distributions were used to determine intercity bus, refuse trucks, single-unit trucks categories, and combination trucks categories. The SOS data must be converted to MOVES source (vehicle) types. Table 3 shows how vehicle body style combined with plate type and company code is used to obtain MOVES vehicle types. Future analysis year 2017, 2023, and 2030 vehicle populations are based on growth in VMT from the base year (2015) to analysis year. For each year the growth rate is applied to all MOVES vehicle types. Table 4 shows the VMT for each analysis year and growth rate.

### 5.6.2 Vehicle Population Year 2014

The source of the vehicle population for analysis year 2014 was SOS vehicle registration database on Oct. 1, 2014. The same process is followed as above, VMT and growth rate are shown in Table 4.

## Table 3: *MOVES Source Types from SOS Body Style*

| MOVES Source Type | SOS Body Style, Plate Type, and Company code |
|---|---|
| 11 – Motorcycles | Motorcycles |
| 21 – Passenger Cars | Two-Door<br>Four-Door<br>Convertible<br>Roadster<br>Low-Speed |
| 31 – Passenger Trucks | Station Wagon<br>Pickup<br>Van<br>Hearse with Plate Type, Personal<br>Ambulance with Plate Type, Personal<br>Panel Van with Plate Type, Personal |
| 32 – Light Commercial Trucks<br>40 – Buses<br>(MOVES: 41*, 42, 43)<br>50 – Single-Unit Trucks*<br>(MOVES: 51, 52, 53)<br>54 – Motorhomes<br>60 – Combination Trucks*<br>(MOVES: 61, 62) | Pickup Commercial or Company<br>Van Commercial or Company<br>Hearse Commercial or Company<br>Ambulance Commercial or Company<br>Panel Van Commercial or Company<br>Utility Truck<br>Wrecker<br>Bus; Supplemented with Other Data Sources<br>Dump Truck<br>Mixer Truck<br>Stake Truck<br>Motorhome<br>Tractor Trailer<br>Tanker |

* The EPA default age distribution is applied to calculate individual MOVES Source Type categories.

Table 4: *Growth Rate for Vehicle Population by Year and VMT*

| | Analysis year | | | | |
|---|---|---|---|---|---|
| | Base Year HPMS 2014 | Base Year HPMS 2015 | 2017 | 2023 | 2030 |
| VMT | 5,398,158 | 5,362,141 | 5,388,737 | 5,405,252 | 5,456,252 |
| Growth Rate | 1.00000 | 1.00000 | 1.00496 | 1.00804 | 1.01755 |

## 5.7 Vehicle Age Distribution

### 5.7.1 Analysis Years 2017, 2023, and 2030

MOVES requires vehicle age as one of the local data inputs. The Michigan SOS vehicle registration database, as of Oct. 1, 2015, was the source of vehicle ages. Vehicle are assigned to an age group, from 0 to 30-plus, based on model year indicated in the SOS database, with 0 being the newest vehicles (2015 or newer) and each year is its own group until vehicles are 30 years and older, which are aggregated into the 30-plus group. The SOS database is sorted by MOVES vehicle types and age. For intercity buses, refuse trucks, single-unit trucks, and combination trucks, the EPA's default age distribution are used to calculate splits in population because of limited numbers. Base-year age distribution fractions were used for all future years.

### 5.7.2 Analysis Year 2014:

The Michigan SOS vehicle registration database, as of Oct. 1, 2014, was the source of vehicle ages. Vehicle are assigned to an age group, from 0 to 30-plus, based on model year indicated in the SOS database, with 0 being the newest vehicles (2014 or newer) and each year is its own group until vehicles are 30 years and older, which are aggregated into the 30-plus group. Then the same process is followed as above.

## 5.8 Other Local Data

The MOVES model allows input for other types of local data. This analysis used default meteorology, hoteling, and starts data. The default fuel data is correct for Michigan and there are no inspection/maintenance (I/M) programs in Michigan.

# 6.0 Results of Analysis

Volatile organic compounds (VOC) and nitrogen oxides (NOx) emission estimations for on-road mobile sources for Berrien County are shown in Table 5 for analysis years 2014, 2017, 2023, and 2030.

Table 5: *Emission Estimations for On-Road Mobile Sources for Berrien County*

| Analysis Year | Emissions (tons/day) | |
|---|---|---|
| | VOC | NOx |
| 2014 | 4.81 | 9.01 |
| 2017 | 3.50 | 5.94 |
| 2023 | 2.24 | 3.15 |
| 2030 | 1.57 | 1.85 |

# ATTACHMENT B

## 2017 Attainment Year Point Source Emissions Units Berrien County, Michigan – VOC & NMOC

**NMOC sources are classified as VOC sources in National Emissions Inventories, therefore they are included in this appendix.*

| SRN | Facility | Substance | NAICS | NAICS Description | Address | City | Zip | VOC (tpy) |
|---|---|---|---|---|---|---|---|---|
| B9073 | MPLX Terminals LLC - Niles Terminal | VOC | 424710 | Petroleum Bulk Stations and Terminals | 2216 S. 3rd Street | NILES | 49120 | 42.715615 |
| B9132 | Buckeye Terminals, LLC - Niles Terminal | VOC | 493110 | General Warehousing and Storage | 2303 S. 3rd Street | NILES | 49120 | 38.5092877 |
| N5575 | ANR Pipeline Company - Bridgman Compressor Station | VOC | 486210 | Pipeline Transportation of Natural Gas | 3372 Browntown Road | BRIDGMAN | 49106 | 35.077515 |
| B9043 | Citgo Petroleum Corp. | VOC | 424710 | Petroleum Bulk Stations and Terminals | 2233 S. 3rd Street | NILES | 49120 | 33.681 |
| N5790 | Regal Fishing Company, Inc. | VOC | 326199 | All Other Plastics Product Manufacturing | 3927 Bessemer Road | COLOMA | 49038 | 32.79 |
| N2407 | Forest Lawn Landfill | VOC | 562212 | Solid Waste Landfill | 8230 W Forest Lawn Road | THREE OAKS | 49128 | 24.30925 |
| N7486 | Pratt Industries Inc. | VOC | 336212 | Truck Trailer Manufacturing | 11365 Red Arrow Highway | BRIDGMAN | 49106 | 18.927595 |
| P0491 | Pratt Industries Inc. | VOC | 336212 | Truck Trailer Manufacturing | 2070 S. 3rd Street | NILES | 49120 | 15.85852 |
| N2610 | Toefco Engineered Coating Systems | VOC | 332812 | Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers | 1220 N 14th Street | NILES | 49120 | 12.3 |
| N1698 | Walsworth Publishing Company (formerly IPC) | VOC | 323111 | Commercial Printing (except Screen and Books) | 2180 Maiden Lane | SAINT JOSEPH | 49085 | 10.37436 |
| N2352 | NCP Coatings, Inc. | VOC | 325510 | Paint and Coating Manufacturing | 225 Fort Street | NILES | 49120 | 8.56495 |
| N5719 | Orchard Hill Sanitary Landfill | VOC | 562212 | Solid Waste Landfill | 3290 Hennesey Road | WATERVLIET | 49098 | 7.109255 |
| N5432 | Southeast Berrien County Landfill Authority | VOC | 562212 | Solid Waste Landfill | 3200 Chamberlain Road | BUCHANAN | 49107 | 5.568526372 |
| N6364 | Pilkington-NSG North America, Inc. | VOC | 326199 | All Other Plastics Product Manufacturing | 2121 W. Chicago Road, Suite E | NILES | 49120 | 5.49185 |
| N3747 | JVIS MFG., LLC | VOC | 336390 | Other Motor Vehicle Parts Manufacturing | 1285 N Crystal Avenue | BENTON HARBOR | 49022 | 5.400315 |

## 2017 Attainment Year Point Source Emissions Units Berrien County, Michigan – VOC & NMOC

**NMOC sources are classified as VOC sources in National Emissions Inventories, therefore they are included in this appendix.*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| P0708 | Toefco Engineered Coating Systems, Inc. | VOC | 332812 | Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers | 1919 Industrial Drive | NILES | 49120 | 4.8355 |
| B5838 | Rieth Riley Construction CO., Inc. | VOC | 324121 | Asphalt Paving Mixture and Block Manufacturing | 1589 Townline Road | BENTON HARBOR | 49022 | 3.907365 |
| N5719 | Orchard Hill Sanitary Landfill | NMOC | 562212 | Solid Waste Landfill | 3290 Hennesey Road | WATERVLIET | 49098 | 3.4285 |
| B9085 | Buckeye Terminals, LLC - Niles West Terminal | VOC | 493110 | General Warehousing and Storage | 2150 S. 3rd Street | NILES | 49120 | 2.74432235 |
| SRN | Facility | Substance | NAICS | NAICS Description | Address | City | Zip | VOC (tpy) |
| B5417 | DW-National Standard-Niles, LLC | VOC | 331222 | Steel Wire Drawing | 1631 Lake Street | NILES | 49120 | 1.1593425 |
| N6931 | Tanks R Us | VOC | 424710 | Petroleum Bulk Stations and Terminals | 2217 3rd Street | NILES | 49120 | 1.0377 |
| B6608 | Thelamco Inc. | VOC | 322220 | Paper Bag and Coated and Treated Paper Manufacturing | 1202 Territorial Road, P.O. Box 456 | BENTON HARBOR | 49022 | 0.51868 |
| B4238 | French Paper Company | VOC | 322121 | Paper (except Newsprint) Mills | 100 French Street, P.O. Box 398 | NILES | 49120 | 0.40818 |
| C5728 | Andrews University | VOC | 611310 | Colleges, Universities, and Professional Schools | 4150 Administration Dr. Suite 102, 8363 Farm Oval | BERRIEN SPRGS | 49104 | 0.35927 |
| A0402 | Menasha Packaging Company, LLC - Coloma Plant | VOC | 322211 | Corrugated and Solid Fiber Box Manufacturing | 238 N West Street, P.O. Box 490 | COLOMA | 49038 | 0.323895 |
| B4252 | AEP Cook Nuclear Plant | VOC | 221113 | Nuclear Electric Power Generation | One Cook Place | BRIDGMAN | 49106 | 0.30079 |
| N2575 | Massee Products LTD | VOC | 339112 | Surgical and Medical Instrument Manufacturing | 2612 N 5TH Street | NILES | 49120 | 0.098765 |
| C5704 | Lakeland Medical Center (Former Memorial Hospital) | VOC | 622110 | General Medical and Surgical Hospitals | 1234 Napier Avenue | SAINT JOSEPH | 49085 | 0.03681 |
| N5432 | Southeast Berrien County Landfill Authority | NMOC | 562212 | Solid Waste Landfill | 3200 Chamberlain Road | BUCHANAN | 49107 | 0.02926 |

# 2017 Attainment Year Point Source Emissions Units Berrien County, Michigan – NOx

| SRN | Facility Name | NAICS | NAICS Description | Address | City | Zip | NOx (tpy) |
|---|---|---|---|---|---|---|---|
| N5575 | ANR Pipeline Company - Bridgman Compressor Station | 486210 | Pipeline Transportation of Natural Gas | 3372 Browntown Road | BRIDGMAN | 49106 | 646.632175 |
| N2407 | Forest Lawn Landfill | 562212 | Solid Waste Landfill | 8230 W. Forest Lawn Road | THREE OAKS | 49128 | 32.09348 |
| N5432 | Southeast Berrien County Landfill Authority | 562212 | Solid Waste Landfill | 3200 Chamberlain Road | BUCHANAN | 49107 | 26.165835 |
| B5417 | DW-National Standard-Niles, LLC | 331222 | Steel Wire Drawing | 1631 Lake Street | NILES | 49120 | 14.3087 |
| N5719 | ORCHARD HILL SANITARY LANDFILL | 562212 | Solid Waste Landfill | 3290 Hennesey Road | WATERVLIET | 49098 | 13.81375 |
| B4252 | AEP COOK NUCLEAR PLANT | 221113 | Nuclear Electric Power Generation | One Cook Place | BRIDGMAN | 49106 | 8.430825 |
| B4238 | FRENCH PAPER COMPANY | 322121 | Paper (except Newsprint) Mills | 100 French Street, P.O. Box 398 | NILES | 49120 | 7.42143 |
| C5728 | ANDREWS UNIVERSITY | 611310 | Colleges, Universities, and Professional Schools | 4150 Administration Dr. Suite 102, 8363 Farm Oval | BERRIEN SPRGS | 49104 | 6.53215 |
| B5838 | RIETH RILEY CONSTRUCTION CO., INC. | 324121 | Asphalt Paving Mixture and Block Manufacturing | 1589 Townline Road | BENTON HARBOR | 49022 | 3.33905 |
| B9132 | Buckeye Terminals, LLC - NILES TERMINAL | 493110 | General Warehousing and Storage | 2303 South 3rd Street | NILES | 49120 | 2.69486155 |
| A0402 | MENASHA PACKAGING COMPANY, LLC - COLOMA PLANT | 322211 | Corrugated and Solid Fiber Box Manufacturing | 238 N. West Street, P.O. Box 490 | COLOMA | 49038 | 2.0865 |
| N2352 | NCP Coatings, Inc. | 325510 | Paint and Coating Manufacturing | 225 Fort Street | NILES | 49120 | 0.6811 |
| C5704 | Lakeland Medical Center (Former Memorial Hospital) | 622110 | General Medical and Surgical Hospitals | 1234 Napier Avenue | SAINT JOSEPH | 49085 | 0.26821 |
| B6608 | THELAMCO INC | 322220 | Paper Bag and Coated and Treated Paper Manufacturing | 1202 Territorial Road, P.O. Box 456 | BENTON HARBOR | 49022 | 0.181445 |
| B9085 | BUCKEYE TERMINALS- NILES WEST TERMINAL | 493110 | General Warehousing and Storage | 2150 South 3rd Street | NILES | 49120 | 0.0395338 |

# ATTACHMENT C

# CART Analysis of Historic Ozone Episodes

**Control #261**

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## ABSTRACT

Classification and Regression Tree (CART) analysis is a statistical technique used to partition data sets into logically similar groups based on either numeric or categorical variables. CART produces decision trees, based on simple yes/no questions, to reveal relationships that are sometimes hidden in extremely complex datasets. While the relationships between ozone and meteorological variables are well understood in a general sense, CART offers the ability to quantify the unique relationship among those variables at a specific geographic location. Regression trees were calculated for eight Midwestern cities for ozone. The meteorological variables tested in the model included surface and aloft wind direction (converted to north/south and east/west components), wind speed, relative humidity, temperature, dewpoint , pressure, mixing height, solar radiation, and cloud cover. Ozone data were examined from 1990-2002. CART-identified ozone episodes are compared to assess meteorological variability over the 13-year period and its impact on ozone trends.

## INTRODUCTION

Meteorological conditions affect pollutant concentrations in myriad ways, complicating the process of modeling formation and transport and determining responses to control measures. Ozone is particularly dependent on meteorology, since its production is driven by high temperatures and sunlight as well as concentrations of its precursors, nitrogen oxides and hydrocarbons. The nonlinearity of these relationships adds to the difficulty in developing predictive models.

One novel method of quantifying the relationship between multiple meteorological variables and ozone is Classification and Regression Tree (CART) analysis. This technique, also known as binary recursive partitioning, was developed in 1984 by Breiman and Friedman.[1] It has several advantages as a tool for data mining and predictive modeling. The tree produced represents a model or decision tree in which each node (branch) is determined by splitting the dataset on the basis of the one variable that results in the best separation as defined by values of the dependent variable (in this case, ozone concentration). The splitting rule is expressed in natural language – for example, is temperature less than 75ºF – so the output trees are easy to interpret. At every branch, every variable is tested for its usefulness in further splitting. This exhaustive search for splitters can make CART computationally intensive.

## METHODOLOGY

A CART analysis (regression tree) was applied to the 1990-2002 ozone and meteorology data for 8 Midwestern urban areas. The purpose was threefold: (1) to categorize specific ozone-conducive conditions for each city, (2) determine how representative each year was in terms of ozone-forming potential, and (3) based on the CART results, determine meteorologically similar episodes from several years that could be candidates for photochemical modeling. The application of the regression tree was straightforward, using CART software from Salford Systems[2]. Trees selected in this analysis were generally smaller than the optimal trees (i.e., with fewer terminal nodes or branches) and contained 10 to 20 terminal nodes. Emphasis was on finding trees that were able to distinguish the extreme ozone days and also several subsets of moderately high ozone days. Low ozone conditions were of less interest. Trees were tested using v-fold cross-validation because the highest ozone days were so infrequent, despite the reasonably large number of observations per city (~2500).

In order to determine the 'representativeness' of each year, a metric was developed based on the number of days assigned to each node. First the average number of days per node-year was calculated for the entire 12 year period. An index of each year's variability from the average was then calculated as the sum (over all nodes) of the squares of the difference between each year and the 12-year average, divided by the average:

$$\text{Representativeness of year i} = \sum_{j} \left( \frac{n_{i,j} - \mu_j}{\mu_j} \right)^2$$

where

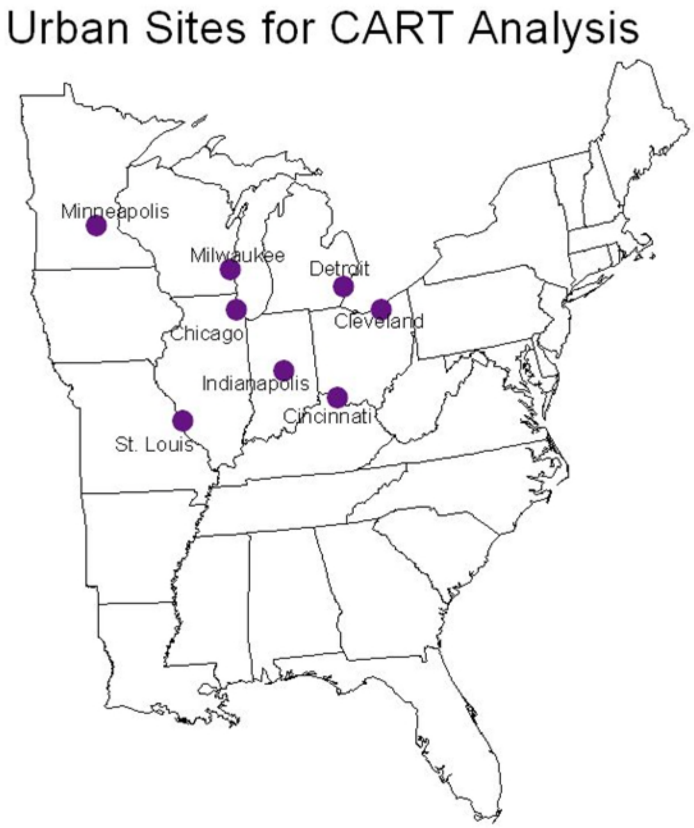
$n_i$ = number of days in years *i* in node *j*

$\mu_j$= average number of days in node *j* over 12-year period

## DATA

The cities of interest were Chicago, Detroit, Milwaukee, St. Louis, Indianapolis, Cincinnati, Cleveland, and Minneapolis (Fig. 1). Meteorological data were collected from National Weather Service TDL hourly observation tapes. In each city the primary airport data were used to represent daily conditions. Daily maximum ozone concentration was the dependent variable, calculated as the maximum of all hourly ozone observed at any monitoring site in the urban area. Mean daily ozone was calculated as the average of all average daily ozone observations at the same set of monitors.

**Figure 1  Analysis Sites**

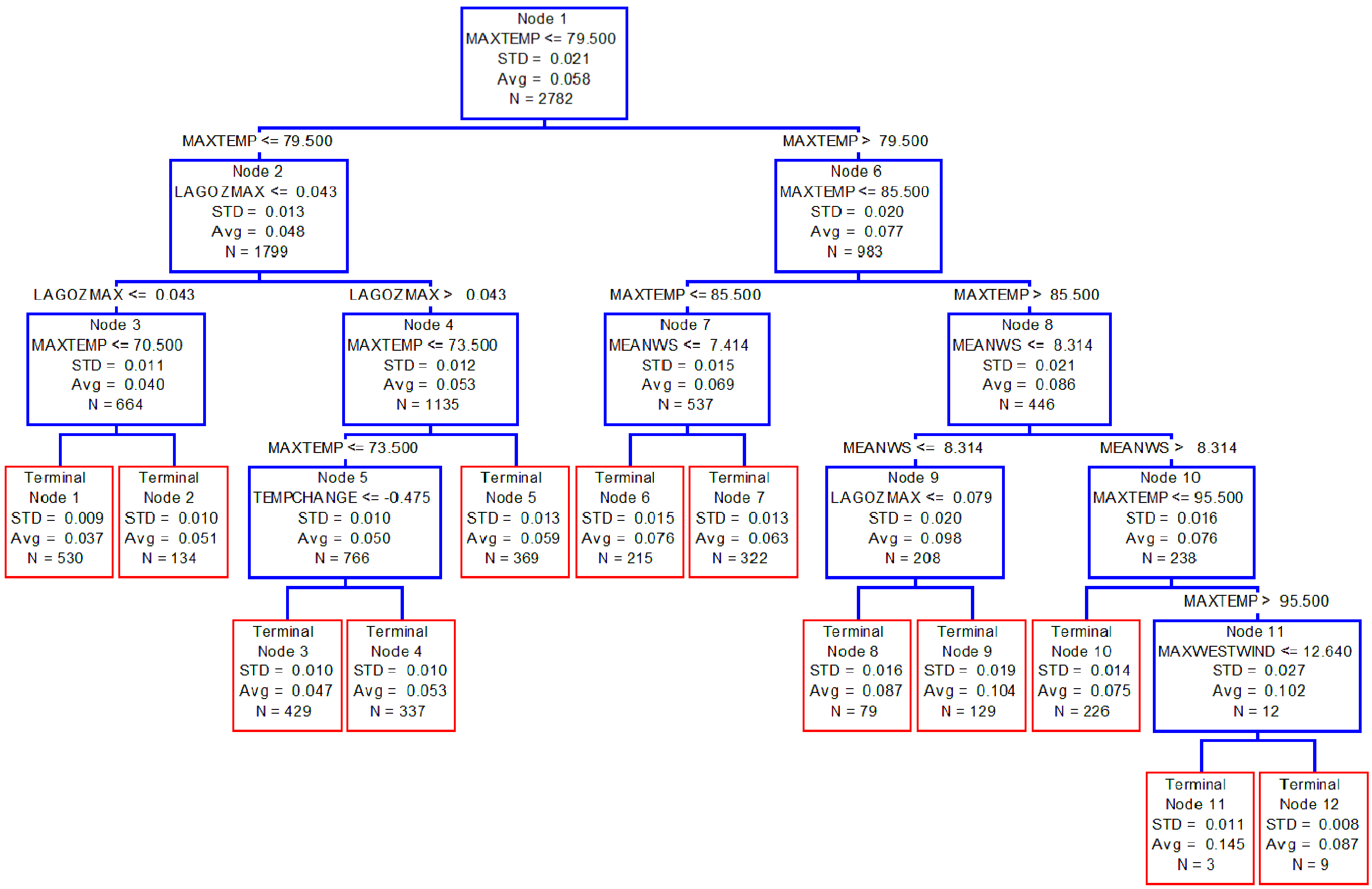



Meteorological and air quality variables used in the model were as follows:
Maximum and mean daily temperature (F); maximum and mean daily wind speed (mph); wind direction (vectorized to easterly and northerly components, average and maximum); maximum and mean daily dew point (F); maximum and mean daily pressure (mb); precipitation (in); morning (7-10 am), afternoon (1-5 pm), and evening (8-10 pm) dew point, pressure, and wind direction; previous day's maximum and mean temperature, dew point, pressure, wind speed, wind direction, and ozone; and direction of temperature and pressure change from previous day (rising or falling). The model period was restricted to the months of April through October since ozone does not exceed the National Ambient Air Quality Standard during the colder months in the target cities.

## RESULTS

The regression tree for Chicago is presented as an example in Figure 2. The splitting criterion for each node is given within the blue boxes. If the condition is true (maximum temperature is less than 75.5), follow the left branch, otherwise follow the right branch. Terminal nodes (red boxes) give an average concentration and standard deviation of all the ozone concentrations that fall into that node.

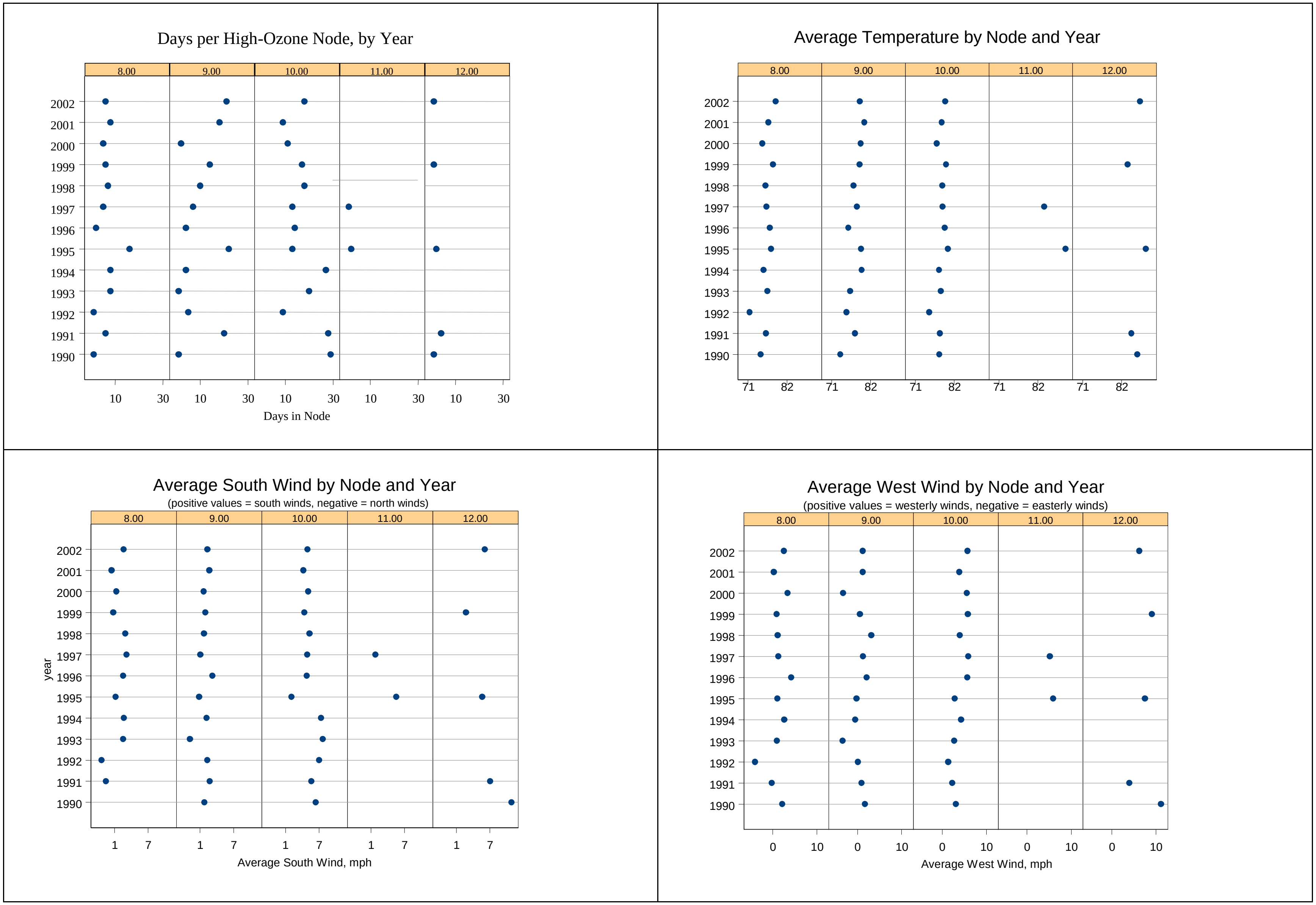
*Figure 2 Chicago Ozone Tree*




In all eight cities, maximum daily temperature was the most important variable for categorizing ozone, followed in importance by the previous day's temperature, dew point, previous day's maximum ozone concentration, and mean wind speed. Not all of these variables appear as splitters in every tree; the relative importance of each variable is assessed based on its importance over all possible nodes and splits. In any one node, only one variable will be the best splitter although another may be a close second best (a good surrogate). The second-best variable may be a good surrogate for numerous splits without ever being selected as the best primary splitter. Its usefulness as a surrogate for multiple splits leads to its higher importance.

For the Chicago data, node 11 was the extreme-ozone node. The average ozone concentration was 145 ppb, with only 3 days meeting the conditions prescribed by this branch. These are probably not good candidate episode days because there are too few days to make valid statistical comparisons. Node 9 contains more days (129) and is characterized by average ozone of 104 ppb. Days in this node are more likely to lend themselves to episodic analysis since they are better distributed (at least several Node 9 days occur in each year). The importance of previous-day ozone as a splitter in this branch hints that these days are probably part of multiday

**Figure 3 Distribution of Days, Temperature, and Wind Direction by Node and Year**



episodes. Nodes 8, 10, and 12 are characterized by more moderate ozone concentrations in the 75-85 ppb range.

Figure 3 shows the characteristics of several key variables by year and node for the higher ozone nodes. The upper left shows the days per node per year. Comparison within each node from year to year gives an impression of how similar or different one year is compared to others. Keep in mind that each node is defined by a collection of meteorological conditions that presumably lead to the average ozone concentration described in the tree diagram in Fig. 2. Thus this comparison encompasses differences in those meteorological conditions – temperature, dew point, wind speed, wind direction, etc. The remaining three plots show the distributions of selected variables -- temperature, southerly winds, and westerly winds -- by node and year and can be compared similarly. Figure 4 shows the Chicago tree's performance for each node by plotting the distribution of ozone concentrations in each node. (Note that better performance can be achieved with larger trees, but this study limited the number of nodes in order to have more days per node for later analysis). Residual analysis shows that the tree predictions are unbiased and within 12 ppb of measured values.

Figure 4. Ozone Response by Node (Chicago)

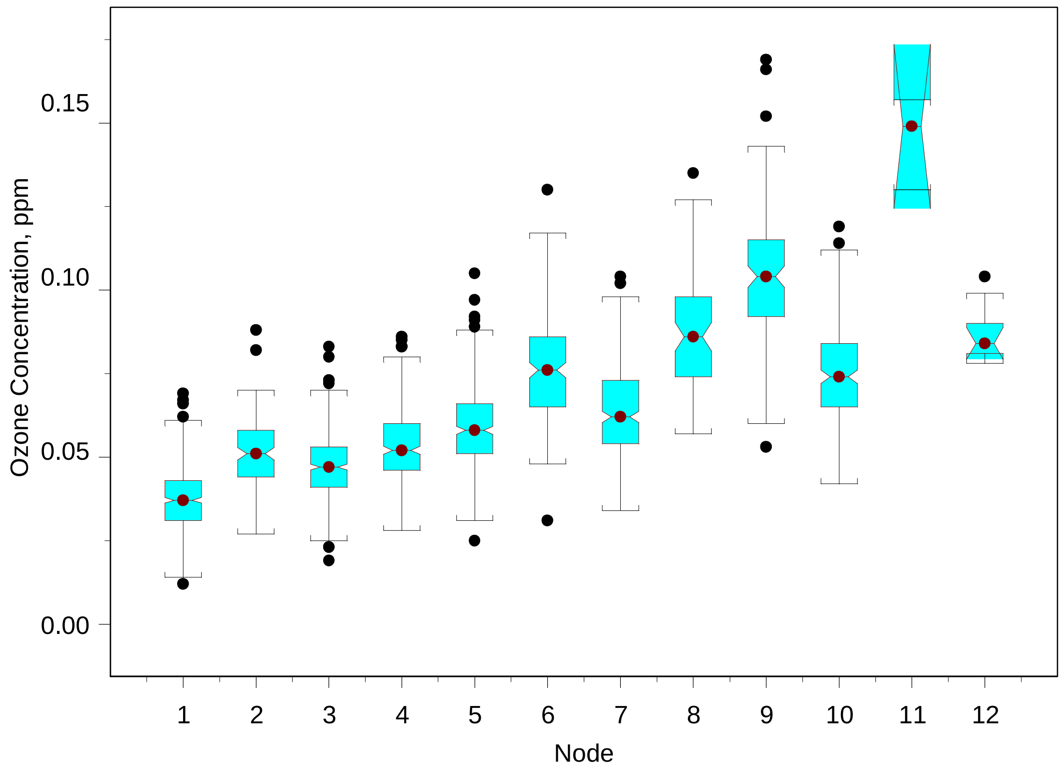



Table 1 gives values for the representativeness index for each year for Chicago. Lower values indicate years that are most similar to average conditions (defined as average of the 12 year period), and larger numbers indicate years that deviate more strongly from average. These deviations could indicate that either a particular year was more ozone conducive (hotter years = more ozone episodes = more days in the extreme ozone nodes) or less ozone conducive than average. Despite some variation from city to city, there is general consistency in the overall ranking of years. The representativeness indexes for each year were summed across cities to generate a region-wide index for each year. These yearly indexes were then ranked, as shown in Table 1. The years 1995 and 1991 stand out as being significantly different from average, while the 1999-2001 period is closest to average in terms of ozone forming conditions. The analysis was repeated for just the high ozone nodes with very similar results, given in Table 2.

Finally, trends over the 1990-2002 period were examined within nodes. Ozone trend analysis is invariably complicated by its dependence on meteorology. Researchers are interested in determining the response of ozone to the many control measures that have been implemented to reduce its concentrations. However, a trend in ozone can be masked by a concurrent trend in temperature. Examining concentration changes by node over time essentially holds meteorological conditions constant and can reveal trends in underlying ozone response to controls. Figure 5 shows these trends for Chicago. Trend analysis was restricted to nodes with an average concentration of 0.75 ppm or greater and more than 25 days total. Among the cities studied, only Chicago had a clear downward trend. Cleveland showed increases in ozone. Detroit, St. Louis, Indianapolis, and Milwaukee had no trend (no changes in ozone concentrations). Cincinnati and Milwaukee had mixed results – some nodes showed increasing trends and some showed decreasing trends.

**Table 1.** Representativeness Index, All Nodes (smaller numbers are closer to average conditions)

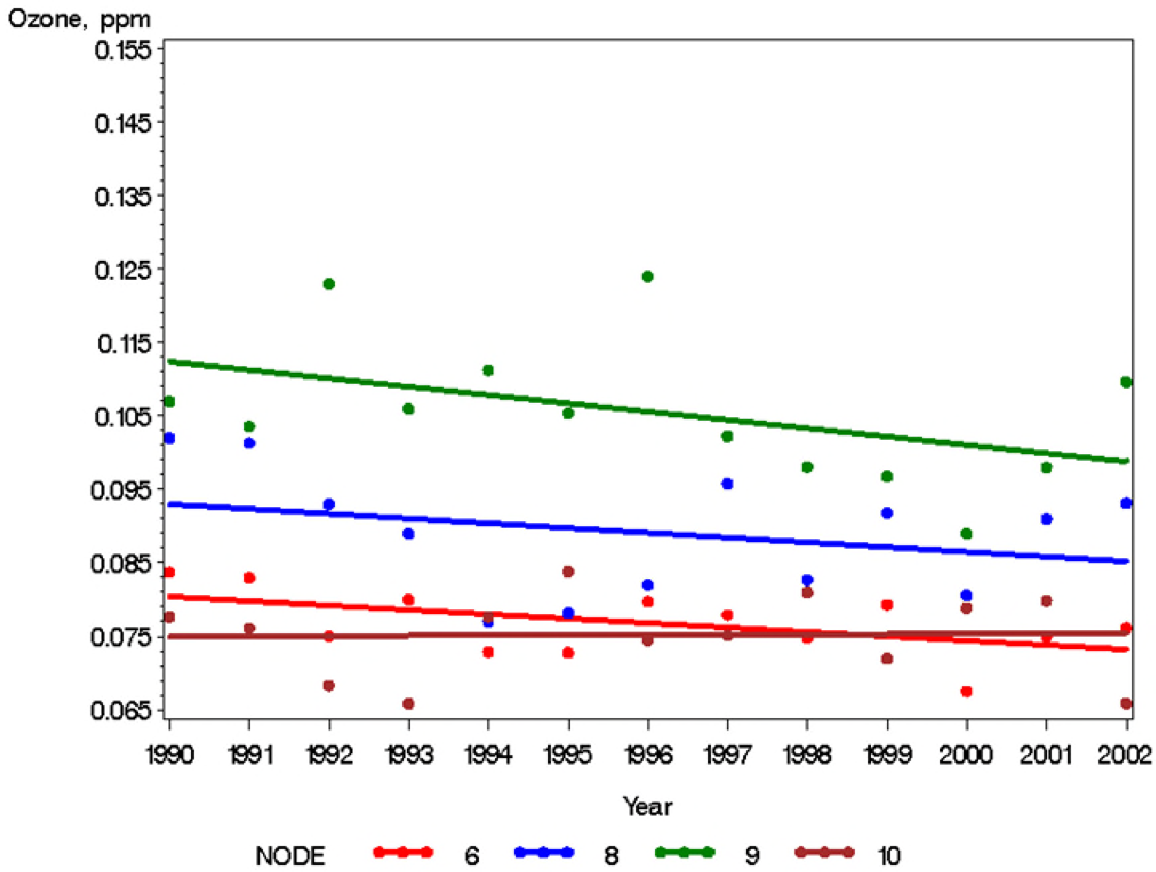
| Year | Chic. | Detr. | Milw. | St.L. | Ind. | Cinn. | Clev. | Minn. | Rank[a] |
|---|---|---|---|---|---|---|---|---|---|
| 1990 | 2.5 | 1.9 | 3.1 | 7.7 | 1.9 | 0.3 | 1.2 | 0.5 | 7 |
| 1991 | 20.3 | 4.9 | 36.1 | 6.8 | 3.4 | 2.4 | 5.5 | 1.1 | 12 |
| 1992 | 1.9 | 4.4 | 6.5 | 4.0 | 2.5 | 1.5 | 3.1 | 2.5 | 10 |
| 1993 | 1.6 | 1.4 | 16.6 | 9.7 | 0.9 | 2.3 | 1.6 | 2.0 | 5 |
| 1994 | 1.1 | 1.3 | 6.6 | 1.7 | 4.4 | 1.5 | 1.1 | 0.3 | 8 |
| 1995 | 55.5 | 5.7 | 8.8 | 4.9 | 3.9 | 1.2 | 7.7 | 5.6 | 13 |
| 1996 | 1.3 | 1.2 | 1.7 | 2.7 | 3.6 | 1.1 | 3.5 | 0.3 | 4 |
| 1997 | 10.2 | 2.8 | 2.1 | 1.3 | 1.3 | 0.9 | 2.9 | 0.4 | 9 |
| 1998 | 1.2 | 1.7 | 2.6 | 2.2 | 11.8 | 1.9 | 2.8 | 1.6 | 6 |
| 1999 | 0.5 | 1.6 | 4.1 | 1.3 | 2.3 | 3.2 | 1.0 | 1.2 | 3 |
| 2000 | 1.0 | 1.1 | 0.6 | 1.4 | 3.3 | 0.8 | 3.6 | 1.1 | 1 |
| 2001 | 1.0 | 1.9 | 1.9 | 0.9 | 1.5 | 2.0 | 1.1 | 2.3 | 2 |
| 2002 | 1.3 | 1.8 | 2.7 | 2.3 | 11.4 | 4.4 | 7.0 | 1.8 | 11 |

[a]Ranked from 13=most different to 1=most average.

**Table 2**. Representativeness Index, High Nodes (Ozone>.75 ppb; smaller numbers are closer to average conditions)

| Year | Chic. | Detr. | Milw. | St.L. | Ind. | Cin. | Clev | Minn. | Rank[a] |
|---|---|---|---|---|---|---|---|---|---|
| 1990 | 2.1 | 0.7 | 0.7 | 6.7 | 0.7 | 0.1 | 0.6 | 0.1 | 7 |
| 1991 | 19.8 | 1.6 | 35.2 | 0.2 | 1.1 | 0.3 | 3.8 | 0.1 | 12 |
| 1992 | 1.3 | 1.7 | 1.9 | 0.6 | 1.7 | 0.8 | 1.1 | 0.7 | 5 |
| 1993 | 1.5 | 0.1 | 15.5 | 0.2 | 0.5 | 1.6 | 0.2 | 0.0 | 10 |
| 1994 | 0.8 | 0.1 | 5.9 | 0.0 | 3.5 | 0.8 | 0.2 | 0.1 | 6 |
| 1995 | 55.0 | 1.3 | 4.5 | 2.3 | 2.8 | 0.7 | 6.2 | 4.9 | 13 |
| 1996 | 1.1 | 0.6 | 0.7 | 0.3 | 3.2 | 0.7 | 2.8 | 0.0 | 4 |
| 1997 | 9.3 | 0.9 | 1.0 | 0.2 | 0.6 | 0.2 | 1.9 | 0.0 | 8 |
| 1998 | 0.7 | 0.2 | 1.1 | 0.1 | 10.3 | 0.5 | 2.2 | 0.3 | 9 |
| 1999 | 0.2 | 0.3 | 1.4 | 0.2 | 0.5 | 2.1 | 0.1 | 0.5 | 1 |
| 2000 | 0.9 | 0.6 | 0.1 | 0.5 | 2.4 | 0.6 | 1.3 | 0.6 | 2 |
| 2001 | 0.8 | 0.6 | 0.5 | 0.3 | 0.9 | 0.7 | 0.5 | 3.8 | 3 |
| 2002 | 1.0 | 1.1 | 1.4 | 1.3 | 10.5 | 3.2 | 5.1 | 0.7 | 11 |

Figure 5. Ozone Trends by Node in Chicago



## CONCLUSIONS

Regression trees developed for eight Midwestern cities revealed similar patterns of ozone formation dependence on meteorological variables. As expected, temperature and prior-day conditions are important predictors of ozone concentration. However, the CART analysis captures the nonlinearity of these relationships, along with wind speed, wind direction, and other meteorological variables in a natural language decision tree that can be used for predictions. Another use for these outputs is as a classification tool to track meteorologically similar episodes across years. By restricting a trend analysis to meteorologically similar days, the effects of meteorological variability are removed and the remaining trend reflects the underlying changes in ozone that are driven by changes in precursor emissions or source activity. Trends were mixed across the Midwest; a downward trend was apparent in Chicago and an upward trend was present in Cleveland. Detroit, St. Louis, Indianapolis, and Minneapolis had no increase or decrease, and Cincinnati and Milwaukee were mixed (some nodes increasing, some nodes decreasing).

## REFERENCES

1. Breiman, L., J. Friedman, R. Olshen, and C. Stone, Classification and Regression Trees, Pacific Grove, CA: Wadsworth (1984).

2. Steinberg, D. and P. Colla, CART—Classification and Regression Trees, San Diego, CA, Salford Systems (1997)

# ATTACHMENT D

**EGLE Emissions Projection Analysis**

EGLE obtained NOx and VOC emissions for the years 2016, 2023, and 2028 through USEPA-projected inventories. These inventories are based off the 2014 National Emissions Inventory, Version 2. EGLE then used the following analysis to derive the 2017 attainment year and 2030 projected maintenance year inventories.

Data from 2016v1 for Berrien County was collected by applying a filter for Berrien County, Michigan (FIPS Code 26021) to the 2016v1_2014v71_2011v63_county_summary_09-Oct-2019.xlsx file. This file is available at [www.epa.gov/air-emissions-modeling/2016v1-platform](www.epa.gov/air-emissions-modeling/2016v1-platform). EGLE used 2016fh, 2023fh, and 2028fh versions of the 2016v1 platform for this analysis. The fh versions are the final published results from the 2016v1 platform.

In order to interpolate and extrapolate the 2017 and 2030 data points from the 2016v1 data, EGLE first created a linear pattern with the 2016, 2023, and 2028 data. The data was transformed by applying the “$LOG_{10}$” function to each value. This transformation resulted in a much more linear pattern. Still, to deliver a more respective and accurate interpolation, the data was analyzed in two sections; 2016 through 2023 and 2023 through 2028. Therefore, the 2017 attainment year emissions inventories were derived by interpolating between years 2016 and 2023 of the USEPA 2016v1 platform data (2016fh and 2023fh) and the 2030 maintenance year emissions inventories were derived by extrapolating from the years 2023 and 2028 of the USEPA 2016v1 platform data (2023fh and 2028fh).

To derive the 2017 data, several steps were taken to best interpolate between the 2016 and 2023 points. First, the 2016 and 2023 data were converted to their $Log_{10}$ values thus creating a more linear function to the data. Second, the difference between the 2016 and 2023 $Log_{10}$ values was calculated. The difference was divided by the number of years within the interval (7) and multiplied by the number of years between base year 2016 and the year of interest 2017 (1). This value was then subtracted from the 2016 $Log_{10}$ value (since the difference is negative). Lastly, in order to convert this $Log_{10}$ value back into tons, the anti-$Log_{10}$ was calculated. Figure 1 details these steps for the 2017 VOC point source emission data point.

**Figure 1.** 2017 VOC Point Source Emissions Interpolation from 2016 and 2023 Data Points.

Step 1. $Log_{10}$ Transformation:

$$\log_{10}(2016\text{fh}) = 2.569374$$
$$log_{10}(2023\text{fh}) = 2.597695$$
$$a = \text{number of years between base year and year of interest}$$

$$\log_{10}(2017) = \log_{10}(2016\text{fh}) - \left[\frac{a \times (\log_{10}(2016\text{fh}) - \log_{10}(2023\text{fh}))}{(\text{number of years between interval})}\right]$$

$$\log_{10}(2017) = 2.569374 - \left[\frac{1 \times (2.569374 - 2.597695)}{7}\right]$$

$$\log_{10}(2017) = 2.57342$$

Step 2. Anti-$Log_{10}$ Transformation:

$$\log_{10}(2017) = 2.57342$$

$$\text{Anti-Log10}(2017) = 10^{\log_{10}(2017)}$$

$$\text{Anti-Log10}(2017) = 10^{2.57342}$$

$$\text{Anti-Log10}(2017) = 374.4724$$

Therefore, the 2017 VOC point source emissions = 374.4724 tpy.

To derive the 2030 data, EGLE extrapolated from the 2023 and 2028 USEPA-projected emissions. As previously stated, the 2016, 2023, and 2028 USEPA-projected emissions data did not represent an overall linear pattern and was analyzed in two separate sections, post $LOG_{10}$-based data transformation, to get a better linear function. In order to derive the 2030 data point, the difference between 2023 and 2028 $Log_{10}$ values were multiplied by the number of years within the interval (5) and multiplied by the number of years between base year 2016 and the year of interest 2023 (7). This value was then subtracted from the 2016 $Log_{10}$ value (since the difference is negative). The resulting number was then converted back into tons by calculating the anti-$Log_{10}$. Figure 2 details these steps for the 2030 VOC point source data point.

**Figure 2.** 2030 VOC Point Source Emission Extrapolation from 2023 and 2028 Data Points.

Step 1. $\text{Log}_{10}$ Transformation:

$$\log_{10}(2023\text{fh}) = 2.597695$$
$$\log_{10}(2028\text{fh}) = 2.591065$$
$a$ = number of years between base year and year of interest

$$\log_{10}(2030) = \log_{10}(2023\text{fh}) - \left[\frac{a \times (\log_{10}(2023\text{fh}) - \log_{10}(2028\text{fh}))}{number\ of\ years\ between\ interval}\right]$$

$$\log_{10}(2030) = 2.597595 - \left[\frac{7 \times (2.597595 - 2.591065)}{5}\right]$$

$$\log_{10}(2030) = 2.588412$$

Step 2. Anti-Log10 Transformation:

$$\log_{10}(2030) = 2.588412$$

$$\text{Anti-Log10}(2030) = 10^{\log_{10}(2030)}$$

$$\text{Anti-Log10}(2030) = 10^{2.588412}$$

$$\text{Anti-Log10}(2030) = 387.6255$$

Therefore, the 2030 VOC point source emissions equal 387.6255 tpy.

No adjustments were made to the 2016, 2023, or 2028 projections for point, non-point, and non-road VOC or NOx emissions. However, one source, ANR Pipeline Company – Bridgman Compressor Station (N5575), represented 80-85% of Berrien County's total annual point source NOx emissions. After examining the actual reported NOx emissions from MAERS for years 2010 through 2018 (Redesignation Document Chart 6) it is clear there is a high degree of variation in annual emissions from this source mostly due to weather and energy demands. 2016 was the lowest-reported value for NOx for this source in recent years and therefore, the predicted growth from 2017 to 2023 (Redesignation Document Table 7) might be a reflection of the inherent variability of emissions from this source and sector in the selected base year.

# ATTACHMENT E

Public Notice Requirements:

The AQD posted the following public notice on the EGLE Calendar and the AQD website throughout the comment period:

**Dept. of Environment, Great Lakes, and Energy**

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### Berrien County Request for Redesignation to Attainment and Revision to Michigan's State Implementation Plan

WEDNESDAY, DECEMBER 18, 2019 – FRIDAY, JANUARY 17, 2020

The Michigan Department of Environment, Great Lakes, and Energy (EGLE), Air Quality Division is accepting written comments on the proposed redesignation to attainment for Berrien County for the 2015 ozone National Ambient Air Quality Standard (NAAQS) and the proposed revision to the Michigan State Implementation Plan (SIP) for the ozone maintenance plan for Berrien County. Berrien County has achieved three years of air monitoring data showing attainment of the 2015 ozone NAAQS supporting the proposed redesignation to attainment. The proposed maintenance plan projects maintenance of the 2015 ozone NAAQS into 2030. If requested in writing by January 15, 2020, a public hearing will be held on Friday, January 17, 2020, at 1:00 PM at EGLE's Kalamazoo District Office, Northwest Watershed Room, 7953 Adobe Road, Kalamazoo, Michigan 49009. If no request for a public hearing is received by 8:00 AM on January 15, 2020, the hearing will be cancelled, and information posted on www.michigan.gov/air. This comment period will close at 5:00 PM on Friday, January 17, 2020. Written comments or requests for a public hearing are to be submitted to ***Erica Wolf***, EGLE, Air Quality Division, P.O. Box 30260, Lansing, Michigan 48909-7760. Fax: 517-241-7499. E-Mail: wolfe1@michigan.gov. Information Contact: ***Erica Wolf,*** Air Quality Division, wolfe1@michigan.gov or 517 284-6766. This public notice is given in accordance with federal regulations for the SIP. The proposed request for redesignation and maintenance plan can be viewed at Michigan.gov/Air.

**Event Type** Public Comment Deadlines, Public Hearings and Meetings

**Counties** Berrien

**Divisions** Air Quality Division

**Link** www.michigan.gov...

Events calendar powered by Trumba

Printed: Tuesday, January 21, 2020 at 10:30 AM PST

As of January 15, 2020, the AQD did not receive any request for a public hearing. The public hearing was canceled and notice of that cancellation was posted on the AQD website. As of January 21, 2020, EGLE did not receive any comments on this SIP submittal.