ATTAINMENT PLAN

FOR THE

WISCONSIN PORTION OF THE
CHICAGO-NAPERVILLE (IL-IN-WI)
2008 8-HOUR OZONE NONATTAINMENT AREA

Kenosha County (Partial), Wisconsin

Developed by:
The Wisconsin Department of Natural Resources

APRIL 2017

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For Public Review
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEI</td>
<td>WDNR’s Air Emissions Inventory</td>
</tr>
<tr>
<td>Btu</td>
<td>British Thermal Unit</td>
</tr>
<tr>
<td>CAA</td>
<td>Clean Air Act</td>
</tr>
<tr>
<td>CAIR</td>
<td>Clean Air Interstate Rule</td>
</tr>
<tr>
<td>CAMx</td>
<td>Comprehensive Air Quality Model with Extensions</td>
</tr>
<tr>
<td>CART</td>
<td>Classification and Regression Tree Analysis</td>
</tr>
<tr>
<td>CD</td>
<td>Consent Decree</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>CSAPR</td>
<td>Cross-State Air Pollution Rule</td>
</tr>
<tr>
<td>CTG</td>
<td>Control Technology Guideline</td>
</tr>
<tr>
<td>EGU</td>
<td>Electric Generating Unit</td>
</tr>
<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>ERTAC</td>
<td>Eastern Regional Technical Advisory Committee</td>
</tr>
<tr>
<td>FID</td>
<td>Facility Identification Number</td>
</tr>
<tr>
<td>GEO5-CHEM</td>
<td>Goddard Earth Observing Systems Chemistry Model</td>
</tr>
<tr>
<td>GR</td>
<td>Gas Recirculation</td>
</tr>
<tr>
<td>GVWR</td>
<td>Gross Vehicle Weight Rating</td>
</tr>
<tr>
<td>HC</td>
<td>Hydrocarbon</td>
</tr>
<tr>
<td>I/M</td>
<td>Inspection and Maintenance</td>
</tr>
<tr>
<td>ICI</td>
<td>Industrial-Commercial-Institutional</td>
</tr>
<tr>
<td>IDEM</td>
<td>Indiana Department of Environmental Management</td>
</tr>
<tr>
<td>IEPA</td>
<td>Illinois Environmental Protection Agency</td>
</tr>
<tr>
<td>LADCO</td>
<td>Lake Michigan Air Directors Consortium</td>
</tr>
<tr>
<td>LNB</td>
<td>Low NOx Burner</td>
</tr>
<tr>
<td>MACT</td>
<td>Maximum Achievable Control Technology</td>
</tr>
<tr>
<td>MAR</td>
<td>Commercial Marine, Aircraft and Rail Locomotive</td>
</tr>
<tr>
<td>MATS</td>
<td>Mercury and Air Toxics Standards</td>
</tr>
<tr>
<td>MOVES</td>
<td>Modeled Attainment Test Software</td>
</tr>
<tr>
<td>MDA8</td>
<td>Maximum Daily 8-hour Average ozone concentration</td>
</tr>
<tr>
<td>mmBtu</td>
<td>Million British Thermal Units</td>
</tr>
<tr>
<td>MOVES</td>
<td>Motor Vehicle Emission Simulator</td>
</tr>
<tr>
<td>MVEB</td>
<td>Motor Vehicle Emissions Budget</td>
</tr>
<tr>
<td>NAAQS</td>
<td>National Ambient Air Quality Standards</td>
</tr>
<tr>
<td>NEI</td>
<td>National Emissions Inventory</td>
</tr>
<tr>
<td>NESHAP</td>
<td>National Emission Standards for Hazardous Air Pollutants</td>
</tr>
<tr>
<td>NMHC</td>
<td>Non-Methane Hydrocarbon</td>
</tr>
<tr>
<td>NO</td>
<td>Nitric Oxide</td>
</tr>
<tr>
<td>NO₂</td>
<td>Nitrogen Dioxide</td>
</tr>
<tr>
<td>NOₓ</td>
<td>Nitrogen Oxides (NO and NO₂)</td>
</tr>
<tr>
<td>OAQPS</td>
<td>EPA’s Office of Air Quality Planning and Standards</td>
</tr>
<tr>
<td>OBDII</td>
<td>Vehicle On-Board Diagnostic System</td>
</tr>
<tr>
<td>OFA</td>
<td>Overfire Air</td>
</tr>
<tr>
<td>ppb</td>
<td>Parts Per Billion</td>
</tr>
<tr>
<td>PTE</td>
<td>Potential To Emit</td>
</tr>
<tr>
<td>RACM</td>
<td>Reasonably Available Control Measures</td>
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RACT  Reasonably Available Control Technology
RFG   Reformulated gasoline
RFP   Reasonable Further Progress
RICE  Reciprocating Internal Combustion Engines
ROP   Rate of Progress
SCR   Selective Catalytic Reduction
SEWRPC Southeastern Wisconsin Regional Planning Commission
SIP   State Implementation Plan
SMOKE Sparse Matrix Operator Kernel Emissions Modeling System
tpsd  Tons Per Summer Day
VMT   Vehicle Miles of Travel
VOC   Volatile Organic Compound
WDNR  Wisconsin Department of Natural Resources
WRF   Weather Research and Forecasting
1. INTRODUCTION

The Wisconsin Department of Natural Resources (WDNR) has prepared this attainment plan to fulfill the state’s Clean Air Act (CAA) state implementation plan (SIP) requirements for the eastern Kenosha County moderate nonattainment area for the 2008 ozone National Ambient Air Quality Standard (NAAQS). This plan projects that eastern Kenosha County will attain the 2008 ozone NAAQS by the July 20, 2018 moderate area attainment date, as will the rest of the Chicago-Naperville, IL-IN-WI nonattainment area. This document was developed in accordance with the U.S. Environmental Protection Agency (EPA)’s draft modeling guidance and implementation rule for the 2008 ozone NAAQS (80 FR 12264). It includes all required elements for moderate-area attainment plans, including a modeling analysis showing that the area will attain the NAAQS.

1.1. Purpose and Regulatory Requirements

The CAA requires an area not meeting a NAAQS for a specified criteria pollutant to develop or revise its State Implementation Plan (SIP) to expeditiously attain and maintain the NAAQS in that nonattainment area. For moderate nonattainment areas, these SIP requirements include:

1) An attainment plan (required under CAA section 182(b)).
2) Reasonably Available Control Technology (RACT) for volatile organic compounds (VOCs) and nitrogen oxides (NOx; CAA section 182(b)(2)).
3) Reasonably Available Control Measures (RACM; CAA section 172(c)(1)).
4) Reasonable Further Progress (RFP) reductions in VOC and/or NOx emissions in the area (CAA sections 172(c)(2) and 182(b)(1)).
5) Contingency measures to be implemented in the event of failure to attain the standard (CAA section 172(c)(9)).
6) A vehicle inspection and maintenance (I/M) program, as applicable (CAA section 181(b)(4)).
7) NOx and VOC emission offsets at a ratio of 1.15 to 1 for major source permits (CAA section 182(b)(5)).

This document addresses the first six of these requirements for Wisconsin’s eastern Kenosha County ozone nonattainment area under the 2008 ozone NAAQS. This attainment plan includes assessments of measured and modeled air quality data. These analyses demonstrate that eastern Kenosha County, as well as the larger Chicago nonattainment area of which it is part, are forecast to attain the 2008 ozone NAAQS by the required July 20, 2018 attainment date. These areas are projected to attain the NAAQS due to the full implementation of Wisconsin’s ozone SIP, as well as other regional and national emission control measures. In addition, this document describes how permanent and federally-enforceable

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2 Wisconsin has a Nonattainment New Source Review (NNSR) permitting program that has addressed the seventh requirement.
3 These regional measures include implementation of ozone SIPs by the states of Illinois and Indiana.
control measures in Wisconsin have resulted in substantial reductions of ozone precursors in eastern Kenosha County. These controls are projected to yield emission reductions that meet RFP requirements. Supplemental analyses of monitoring data are presented as weight of evidence support. These analyses show that ambient levels of ozone and ozone precursors have been substantially reduced in eastern Wisconsin over the past 15 years. Finally, this document describes how the area has met the all other requirements for moderate nonattainment areas for the 2008 ozone NAAQS.

1.2. The Chicago 2008 Ozone Nonattainment Area

Historically, exceedances of the federal ozone standards have been recorded along the lakeshore of Lake Michigan, including eastern Kenosha County. Kenosha County was designated nonattainment for two previous ozone NAAQS, but has been either redesignated to attainment for, or found to be attaining, each of these standards\(^4\), as shown in Table 1.1.

<table>
<thead>
<tr>
<th>Year Promulgated</th>
<th>1979</th>
<th>1997</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>0.12 ppm</td>
<td>0.08 ppm</td>
<td>0.075 ppm</td>
</tr>
<tr>
<td>Averaging Time</td>
<td>1 hour</td>
<td>8 hours</td>
<td>8 hours</td>
</tr>
<tr>
<td>WI Nonattainment Area*</td>
<td>Milwaukee-Racine Area*</td>
<td>Milwaukee-Racine Area*</td>
<td>Kenosha (partial), part of the Chicago Area</td>
</tr>
<tr>
<td>Classification</td>
<td>Severe-17</td>
<td>Moderate</td>
<td>Marginal (reclassified to Moderate)</td>
</tr>
<tr>
<td>Finding of / Redesignation to Attainment(^4)</td>
<td>4/24/2009 74 FR 18641</td>
<td>7/31/2012 77 FR 45252</td>
<td>TBD</td>
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</tbody>
</table>

*The Milwaukee-Racine Area encompassed Kenosha, Racine, Milwaukee, Ozaukee, Washington and Waukesha Counties for the 1979 and 1997 NAAQS.

In March 2008, EPA finalized a revision to the 8-hour ozone NAAQS (73 FR 16436). The 2008 ozone NAAQS (0.075 parts per million, ppm) is more stringent than the previous 1997 ozone NAAQS (0.08 ppm). In June 2012, EPA published a final rule that designated all or part of eleven counties in the Chicago-Naperville, IL-IN-WI Combined Statistical Area (CSA) as marginal nonattainment for the 2008 ozone NAAQS (77 FR 34221). This nonattainment area (the “Chicago nonattainment area”) is shown in Figure 1.1. This nonattainment area designation was based upon EPA’s review of ozone monitoring data collected during the years 2009-2011 for Illinois and 2008-2010 for Indiana and Wisconsin.\(^5\) On May 4, 2016, EPA reclassified the Chicago nonattainment area from marginal to moderate nonattainment status, effective June 3, 2016. This reclassification was based on 2012-2014 monitoring data.

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\(^4\) EPA issued an attainment determination for the Milwaukee-Racine nonattainment area after the 1979 1-hour NAAQS was revoked, so this area was never formally redesignated to attainment of this standard. The area was redesignated to attainment of the 1997 ozone NAAQS in July 2012.

\(^5\) EPA designated most areas based on 2008-2010 air monitoring data. However, Illinois certified its 2011 ozone monitoring data for the Chicago area early and submitted this data to EPA for consideration. This delayed the designation process for this area, which was designated nonattainment via a separate rulemaking two months after all other areas.
Wisconsin’s part of the Chicago nonattainment area is the eastern portion of Kenosha County. Kenosha County is located in southeastern Wisconsin along the western shoreline of Lake Michigan, just north of the Illinois state line. The nonattainment designation for Kenosha County applies only to the eastern portion of the county, including the townships of Pleasant Prairie and Somers. Kenosha County has a largely service-based and industrial economy, with a 2010 population of 166,426. 77% of the county’s population (128,534) lives in the 2008 ozone NAAQS nonattainment area. Kenosha County is roughly halfway between the cities of Chicago and Milwaukee and is part of the Chicago-Naperville CSA. Most of the CSA is upwind of Kenosha County on high ozone days and contributes to high ozone concentrations in Kenosha County.

Figure 1.1. Map of the Chicago-Naperville, IL-IN-WI, 2008 ozone nonattainment area (“Chicago nonattainment area”), with locations of ozone monitors shown.
1.3. Overview of this Attainment Plan

This document is structured as follows:

Chapter 2 outlines a conceptual model for ozone formation in the Lake Michigan region, including eastern Kenosha County. This chapter describes how synoptic-scale and mesoscale meteorology combine to create high ozone along the Wisconsin lakeshore under particular conditions.

Chapter 3 presents base and future year inventories for eastern Kenosha County and discusses how these inventories show that the state has met its requirements for RFP and contingency measures. This chapter also outlines the permanent and enforceable emissions reduction measures that have reduced ozone precursor emissions.

Chapter 4 describes the modeled attainment assessment that was completed by the Lake Michigan Air Directors Consortium (LADCO) for the Chicago nonattainment area in support of this analysis. This chapter outlines how emission inventories for the modeling were constructed, how the models were run, and how the results of the modeled attainment test demonstrate the area will attain the NAAQS.

Chapter 5 presents weight of evidence support for this attainment plan. This includes analysis of trends in ozone and ozone precursors, as well as meteorologically adjusted trends in ozone concentrations. This chapter also demonstrates the important roles that transport, meteorology and chemistry play in determining ozone concentrations in eastern Kenosha County.

Chapter 6 describes how the state has met all other moderate nonattainment area SIP requirements. These requirements include transportation conformity, RACT programs for NOx and VOCs, RACM, and a vehicle I/M program.

Chapter 7 describes how the WDNR took public comment on this document.

Chapter 8 presents the conclusions of this analysis.
2. OZONE DYNAMICS IN THE LAKE MICHIGAN REGION

2.1. Introduction

Counties around Lake Michigan have a long history of recording ozone concentrations that exceed the level of the NAAQS. Since the promulgation of the original, 1979 ozone NAAQS, lakeshore counties in Wisconsin, Illinois, Indiana and Michigan have been designated nonattainment with each subsequent standard. While ozone concentrations have decreased dramatically due to implementation of an array of measures controlling emissions of ozone precursors, two Lake Michigan areas are currently designated nonattainment for the 2008 ozone NAAQS: the Chicago nonattainment area and Sheboygan County, WI (Figure 2.1).

Figure 2.1. A map of the Lake Michigan region, with the Chicago and Sheboygan nonattainment areas for the 2008 ozone NAAQS indicated by hatching (from LADCO, Appendix 9).
Wisconsin’s lakeshore monitors most frequently measure ozone concentrations exceeding the 2008 ozone NAAQS from late May through early August, with peak ozone exceedences in late June (Figure 2.2). A smaller number of exceedences occur in late August and early September, but ozone concentrations very rarely exceed the 2008 NAAQS before May 15 or after September 15. Ozone concentrations peak in the late spring and early summer because of the abundance of sunlight and heat, both of which drive ozone formation. In addition, strong land-lake temperature gradients in late spring and early summer drive lake breeze circulations, which contribute to high ozone concentrations, as discussed below.

**Figure 2.2. Distribution of the number of occurrences of maximum daily 8-hour average ozone concentrations (MDA8) exceeding different thresholds at monitors along Wisconsin’s Lake Michigan lakeshore. Data are shown for the years 2005-2014.**

The region’s persistent ozone problems have been shown to be due to the unique meteorology of the Lake Michigan area. This meteorology causes transport of significant amounts of ozone from upwind sources to lakeshore counties in Wisconsin and neighboring states. Two types of meteorological patterns have been shown to affect ozone concentrations in the region:

1) Synoptic scale meteorology\(^6\) transports high concentrations of ozone and ozone precursors northward from source regions to the south and southeast, and

2) Mesoscale meteorology\(^6\) (via land-lake breeze circulation patterns) carries precursors over the lake, where they react to form ozone. Winds then shift to pull the high ozone air onshore.

This chapter explores the meteorology of this region in greater depth and presents a conceptual model for ozone formation in this area. Subsequent chapters then address the regulatory requirements for this attainment plan, required because of the resultant high ozone concentrations in this region.

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\(^6\) Synoptic-scale meteorology refers to weather features of 24-48 hours’ duration, whereas mesoscale meteorology refers to weather features of shorter duration.
2.2. The Role of Synoptic-Scale Meteorology on High-Ozone Days

Research has shown that high pressure systems can generate meteorological conditions favorable to elevated ozone as they move through the region from west to east during late May - early September. These systems are typified by hazy, sunny skies with generally weak, clockwise-rotating winds and relatively shallow mixing such that pollution concentrations are not diluted by mixing. These weather conditions contribute to the buildup of considerable amounts of ozone precursors and facilitate formation of ozone via photochemical reactions.

The location of surface high pressure systems is an important driver of ozone transport into the region. Research has shown that ozone episodes are generally associated with high pressure systems over the eastern United States that transport pollutants and precursors from the south and east into the region. One study estimated that 50% of Wisconsin's ozone exceedance days during 1980-1988 under the 1-hour ozone NAAQS occurred when the center of a high pressure system was situated southeast of the area (i.e., Ohio and east thereof). Under these circumstances, high ozone concentrations in the Lake Michigan region may result when polluted air from high emissions regions such as the Ohio River Valley is transported northward along the western side of a high pressure system. In addition, while emissions from the heavily industrialized Chicago and Milwaukee areas have decreased dramatically in recent decades (see, e.g., Sections 3 and 5.3), sources in these large metropolitan areas still generate significant ozone precursor emissions. Pollution from sources in these areas can add to the pool of pollution transported into the region.

Figure 2.3 shows the synoptic scale weather pattern for one such episode, along with the resulting patterns in ozone concentrations. On this day, a high pressure system was located to the southeast, centered over Virginia. Southeasterly to southerly winds on the western side of this system carried pollutants from the Ohio River Valley to Lake Michigan. This episode shows a common pattern for ozone distributions on episode days: ozone concentrations were lowest in the regions with the highest emissions (in central Chicago and extending into northwestern Indiana) and the highest in rural coastal areas far downwind. During such classic transport episodes, peak ozone concentrations move northward over the course of the day. For example, on the day shown in Figure 2.3, ozone peaked at Wisconsin’s southern Chiwaukee Prairie monitor between 11 a.m. and 1 p.m., at the Kohler Andrae monitor midway up the coast between 2 p.m. and 4 p.m., and at the northern Newport monitor between 4 p.m. and 6 p.m.

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2.3. The Role of Mesoscale Meteorology (Lake Breeze Circulation) on High-Ozone Days

The synoptic meteorological conditions often work in combination with unique lake-induced mesoscale meteorological features to produce the highest ozone concentrations in this region. Wisconsin’s ozone nonattainment areas are positioned along the state’s coastline with Lake Michigan (Figure 2.1). With a surface area of approximately 22,400 square miles, Lake Michigan acts as a huge heat sink during the warm months. Figure 2.4 highlights the considerable difference between the over-land air temperatures (measured at Racine, WI) and over-water air temperatures (measured at a buoy in southern Lake Michigan) during a 5-day ozone episode in June 2002. The strong daytime temperature contrast between the warm land and cold lake can lead to the formation of a thermally-driven circulation cell called the lake breeze, which runs approximately perpendicular to the Lake Michigan shoreline (Figure 2.5). As this figure shows, the lake breeze is generally preceded by an early morning land breeze, driven by relatively warm temperatures over the lake. The land breeze can carry ozone precursors emitted from urban areas, primarily Chicago, out over the lake, where they can react to form ozone. The onshore flow of the lake breeze circulation then transports elevated ozone from over the lake onshore into eastern Wisconsin.
Figure 2.4. Hourly surface air temperatures at Racine, WI and at the South Lake Michigan Buoy during an ozone episode on June 20-25, 2002.

Figure 2.5. Schematic diagrams of the (left) early morning land breeze and (right) late morning/afternoon lake breeze circulations responsible for enhanced ozone production along the Lake Michigan shoreline (modified from Foley et al., 2011).  

2.4. Conceptual model for ozone formation in the Lake Michigan region

Synoptic and mesoscale meteorological patterns together drive ozone formation in the region, as described in a conceptual model in Dye et al. (1995). Dye et al. (1995) described this model with the following series of inter-related steps. This discussion focuses on the conditions impacting Wisconsin’s shoreline:

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1) A shallow but intensely stable conduction inversion exists just above the relatively cold lake surface (Figure 2.5). During the early morning hours the land breeze and general offshore flow (i.e., southerly to west-southwesterly winds) transport ozone and fresh precursor emissions into the stable air in the conduction layer over Lake Michigan. A primary source region is the Chicago area, located at the southern edge of the lake.

2) By midmorning a sharp horizontal temperature gradient forms along the shoreline between the cold lake air and the increasingly warmer air over the land. This gradient effectively “cuts off” air in the conduction layer from additional injections of shore-emitted precursors. Strong stability in the conduction layer limits dispersion, creating high concentrations of ozone precursors, which can react in this layer.

3) By midmorning, the developing convective boundary layer (CBL) grows and the resulting convection mixes ozone vertically, where it combines with ozone transported from sources outside the region. Ozone concentrations in this air are lower due to the dilutive effects of convective mixing. As this air is transported lakeward, it is forced to flow up and over the conduction layer (Figure 2.5).

4) The ozone-rich air in both layers is transported northward over Lake Michigan by the prevailing winds. When a lake breeze is present, it produces southerly to south-southeasterly winds along the western shore of Lake Michigan. This wind pattern transports the ozone originating from sources in the south to downwind receptor regions in eastern Wisconsin. On occasion, areas north of Ozaukee County experience elevated ozone levels as a southerly wind intercepts the shoreline where it juts into Lake Michigan.

5) When the ozone-laden air flows onshore in the downwind receptor regions, air with the highest ozone concentrations, located in the lowest 300 m, mixes down to the surface first. This causes the highest ozone concentrations to be found along the shoreline. Eventually, air from higher altitudes mixes down to the surface further inland, but ozone concentrations in this air are lower. This air mass is the remnant of the ozone-diluted CBL air that flowed up and over the conduction layer during the mid-morning hours.

This complex meteorology leads to the high ozone concentrations and persistent nonattainment issues faced by the counties along the Lake Michigan shoreline. The impact of this meteorology on the transport of ozone, NOx, and VOCs to eastern Kenosha County is explored in more detail in Chapter 5.
3. REASONABLE FURTHER PROGRESS (RFP), CONTINGENCY MEASURES, AND IMPLEMENTED CONTROL MEASURES

3.1. Introduction

Sections 172(c)(2) and 182(b)(1) of the federal CAA require states with ozone nonattainment areas classified as moderate or higher to submit plans that show RFP towards attaining the NAAQS. The implementation rule for the 2008 ozone NAAQS defines RFP for moderate nonattainment areas (e.g., eastern Kenosha County) as a demonstration that there has been at least a 15% emission reduction between the base year (2011) and the attainment year (2017). Because this area has a previously approved 15% VOC rate of progress (ROP) plan (61 FR 11735), the 15% reduction requirement for the 2008 NAAQS can be satisfied with any combination of NOx and VOC reductions. These reductions may come from any SIP-approved or federally promulgated measures implemented after the base year.

States must also submit requirements for contingency measures that will be implemented if the state fails to attain the standard as required by CAA Section 172(c)(9). These contingency measures must represent one year of emissions reduction progress, equivalent to an additional 3% reduction. States may meet contingency measures by demonstrating an additional 3% reduction in combined NOx and VOC emissions within one year beyond that required for RFP. Inventories for 2018 are included to make this demonstration.

Table 3.1 provides a summary of the eastern Kenosha County emission inventories (in tons per summer day, or tpsd) for NOx and VOCs. Sections 3.2 and 3.3 present the emission inventories by sector (i.e., point, area, onroad and nonroad) for eastern Kenosha County for the base (section 3.2) and projected (section 3.3) years. These sections also include the supporting methodology used to develop the inventories. Section 3.4 demonstrates that the state has met its RFP requirement for the eastern Kenosha County nonattainment area, and Section 3.5 outlines contingency measures. Finally, Section 3.6 describes the enforceable control measures that led to the significant reductions in both NOx and VOC emissions.

Table 3.1. Eastern Kenosha County NOx and VOC emissions (tons per summer day, tpsd).

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>19.45</td>
<td>16.59</td>
<td>16.23</td>
<td>-15.4%</td>
<td>-1.9%</td>
</tr>
<tr>
<td>VOC</td>
<td>9.43</td>
<td>8.09</td>
<td>7.92</td>
<td>-13.0%</td>
<td>-2.0%</td>
</tr>
</tbody>
</table>

*The % change from 2017 to 2018 was calculated relative to 2011 emissions.

3.2. 2011 Base Year Inventory for RFP

The base year (2011) portion of the RFP requirement is a compilation of all anthropogenic sources of NOx and VOCs for an average summer day in 2011, incorporating all control programs in place at that time. The WDNR followed EPA’s requirements and guidance to prepare a comprehensive statewide emission inventory of NOx and VOC emissions for 2011.

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EPA has approved Wisconsin’s 2011 emission inventories for eastern Kenosha County and other nonattainment areas under the 2008 8-hour ozone standard (81 FR 11673). The following is a description of the methodologies used to develop the sector-specific emission inventory estimates. Appendix 1 includes a more thorough discussion of the methodology used to estimate emissions for 2011. Table 3.2 shows the NOx and VOC emissions (in tpsd) in 2011 for the different sectors.

### Table 3.2. Eastern Kenosha County NOx and VOC emissions (tpsd) for nonattainment year 2011.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Point - EGU</th>
<th>Point – Non-EGU</th>
<th>Area</th>
<th>Onroad</th>
<th>Nonroad</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>11.05</td>
<td>0.11</td>
<td>1.09</td>
<td>5.15</td>
<td>2.07</td>
<td>19.47</td>
</tr>
<tr>
<td>VOC</td>
<td>0.54</td>
<td>0.18</td>
<td>4.78</td>
<td>2.42</td>
<td>1.51</td>
<td>9.43</td>
</tr>
</tbody>
</table>

#### 3.2.1. Point Source Inventory

The Pleasant Prairie coal-fired power plant is the only electric generating unit (EGU) point source facility in eastern Kenosha County. For this source, WDNR used the maximum daily heat input reported in EPA’s Clean Air Market Division database as a conservative estimate of summer day heat input during the 2011 ozone season. The summer day emissions were then calculated by multiplying the maximum daily heat input by an average NOx and VOC emission rate. Appendix 2 provides the detailed methodology used to calculate EGU summer day emissions.

The 2011 emission inventory for non-EGU point sources were tabulated using the emissions data reported annually by each facility operator to the WDNR air emissions inventory (AEI). The AEI calculates emissions for each individual emissions unit or process line by multiplying fuel or process throughput by the appropriate emission factor that is derived from mass balance analysis, stack testing, continuous emissions monitoring, engineering analysis, or EPA’s Factor Information Retrieval database. The emission calculations in the AEI also account for any operating control equipment.

Non-EGU facilities located in eastern Kenosha County were identified using the Geographic Information System coordinates reported for each facility in the AEI. Appendix 3 provides a list of non-EGU point source emissions by facility identification number (FID) and facility name for 2011. These non-EGU point source facilities are assumed to operate steadily over 365 days each year. Therefore, summer day emissions are derived by dividing each facility’s annual reported emissions by 365 days.

#### 3.2.2. Area Source Inventory

For 2011, area source emission estimates were based on calculations used for submission to the National Emissions Inventory (NEI), unless otherwise indicated. EPA has approved Wisconsin’s 2011 NEI data. These emissions were typically calculated using population, gasoline

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13 Under Wisconsin rule NR 438.03, Wis. Adm. Code, a facility operator is required to report NOx or VOC emissions data to the WDNR for any facility emitting 5 or more tons of NOx or 3 or more tons of VOC per year. These sources are considered “point” sources. Smaller stationary sources are considered “area” sources.
consumption, employment, crop acreage and other activity surrogates associated with the source categories. These categories mainly include industrial, commercial and institutional fuel combustion, solvent utilization, residential wood combustion and agricultural emissions. For each source category, any point source activity or emissions were subtracted from total category-specific activity or emissions to calculate area category-specific emissions and avoid double counting. Emission factors were derived from local data, local or national surveys and EPA procedural guidance for the development of emission inventories. Appendix 4 includes tables of area source emissions by source category.

In order to obtain the area source emissions for the eastern portion of Kenosha County, the whole county emission estimates were allocated to the partial county nonattainment area based on population data from the Wisconsin Department of Administration. The partial-county population was identified based on the relative population of the Minor Civil Divisions in the nonattainment area compared with the entire county. For 2011, 77% of the county’s population was estimated to live in the nonattainment area.

3.2.3. Onroad Inventory

The 2011 onroad emission estimates were developed using the EPA’s current mobile source emissions model, the Motor Vehicle Emission Simulator (MOVES2014a). All estimates were made in accordance with current EPA technical guidance. The key inputs used for the MOVES2014a modeling include:

- Vehicle age distributions based on registration data from the Wisconsin Department of Transportation;
- Detailed transportation data for the sub-county area provided by the Southeastern Wisconsin Regional Planning Commission (SEWRPC), including vehicle miles of travel (VMT) by vehicle class, road class and hour of day, and average speed distributions; and
- Control measures, including the Wisconsin vehicle I/M and reformulated gasoline (RFG) programs.

Hot summer day temperatures were input to the model (minimum 70 degrees F, maximum 94 degrees F). This temperature range has been used for all onroad ozone SIP modeling in southeastern Wisconsin since the 1990 CAA Amendments and is based on a WDNR analysis of temperatures on high ozone days.

Appendix 5 provides detailed listings of the estimated onroad emissions and activity data.

3.2.4. Nonroad Inventory

For the purpose of inventory calculation, nonroad mobile sources are divided into two major groups:

- Commercial Marine, Aircraft and Rail Locomotive (MAR)
- All other nonroad categories
Nonroad categories other than MAR include:

- Recreational vehicles
- Construction equipment
- Industrial equipment
- Lawn and garden equipment
- Agricultural equipment
- Commercial equipment
- Logging equipment
- Underground mining equipment
- Oil field equipment
- Pleasure craft
- Railway maintenance equipment

The 2011 nonroad emissions for the non-MAR categories were developed using EPA’s MOVES2014a model using hot summer day temperatures (as defined for onroad modeling). The model was run for Kenosha County for the months of June, July and August. Hot summer day emissions were calculated by dividing the total emissions over these three months by 92 (the number of days in the three months). Emissions were then allocated to the eastern Kenosha County area based on surrogates such as population, land area and water area, depending on the category.

Annual emissions for the MAR categories were obtained from EPA’s 2011 Emissions Modeling Platform, Version 6.3. Countywide emissions were allocated to the sub-county nonattainment area based on airport location for aircraft and rail link location for rail locomotives. All commercial marine emissions were allocated to the sub-county nonattainment area, since those emissions originate from Lake Michigan. Summer day emissions were estimated by applying annual-to-summer day ratios from LADCO for the year 2007 to each of the three MAR categories provided in the modeling inventory.

Appendix 6 provides detailed listings of the estimated nonroad emissions data for over 200 subcategories.

**3.3. 2017 & 2018 Projected Year Inventories for RFP**

Emissions for the attainment year (2017) were projected using the methodological approaches described below. The same approaches were used to project emissions for 2018, which will be used to meet the required contingency. Appendix 7 includes more information on emissions projection methodology. Tables 3.3 and 3.4 show the projected NOx and VOC emissions (in tpsd) in 2017 and 2018 for the different sectors. The application of these inventory projection methodologies also forecasts that the current trend of decreasing NOx and VOC emissions will continue into the near future.
Table 3.3. Eastern Kenosha County NOx and VOC emissions (tpsd) for projected attainment year 2017.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Point - EGU</th>
<th>Point – Non-EGU*</th>
<th>Area</th>
<th>Onroad</th>
<th>Nonroad</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>10.75</td>
<td>0.12</td>
<td>1.08</td>
<td>3.05</td>
<td>1.47</td>
<td>16.46</td>
</tr>
<tr>
<td>VOC</td>
<td>0.56</td>
<td>0.31</td>
<td>4.77</td>
<td>1.56</td>
<td>1.00</td>
<td>8.20</td>
</tr>
</tbody>
</table>

* Includes projections of emissions for both existing sources and new/modified sources.

Table 3.4. Eastern Kenosha County NOx and VOC projected 2018 emissions (tpsd) for additional year of attainment.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Point - EGU</th>
<th>Point – Non-EGU*</th>
<th>Area</th>
<th>Onroad</th>
<th>Nonroad</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>10.75</td>
<td>0.12</td>
<td>1.08</td>
<td>2.75</td>
<td>1.40</td>
<td>16.10</td>
</tr>
<tr>
<td>VOC</td>
<td>0.56</td>
<td>0.31</td>
<td>4.74</td>
<td>1.44</td>
<td>0.96</td>
<td>8.02</td>
</tr>
</tbody>
</table>

* Includes projections of emissions for both existing sources and new/modified sources.

3.3.1. Point Source Inventory Projections

As previously stated, the Pleasant Prairie power plant is the only EGU point source in eastern Kenosha County. WDNR conservatively based projections of summer day emissions through 2018 on the 99th percentile highest heat input day from the 2015 ozone season. The 2015 heat input value is the highest value from 2010 through 2015 and is greater than the reported maximum nominal heat input reported for the facility. Therefore, future heat input levels are not reasonably expected to exceed the 2015 heat input level. This projected heat input value was then multiplied by projected emission rates to yield projected summer day emissions. The projected NOx emission rate is based on demonstrated emission rates since 2006 and incorporates the committed continued operation of controls. The projected VOC emission rate assumes the 2014 demonstrated emission rate will continue in the future. The details of the EGU projection methodology and calculations are provided in Appendix 2.

Based on this information, NOx emissions are projected to be 10.75 tpsd and VOC emissions to be 0.56 tpsd in both the 2017 and 2018 inventory years for the Pleasant Prairie power plant (Tables 3.3 and 3.4). These projected emission levels do not represent an enforceable emission requirement for daily emissions. Instead, these values represent the reasonably expected summer day maximum emissions for the EGU sector in eastern Kenosha County.

Non-EGU point source emissions are projected for 2017 and 2018 by applying growth factors to the 2011 base year inventory. These growth factors were developed from Annual Energy Outlook 2014 and 2016 industry-specific energy consumption data. Additional emissions for the non-EGU sector were then factored in by projecting emissions for new and modified sources that have been or may be permitted to start operation by 2017. A more detailed description of the methodology for projecting non-EGU point source emissions is provided in Appendix 7, and a list of sources with the applied growth rates and calculated emissions is provided in Appendix 3.

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It should be noted that Wisconsin’s approach to projecting emissions for non-EGU point sources is more conservative than EPA-projected inventories, which typically assume “no-growth” for non-EGU point sources.

### 3.3.2. Area Source Inventory Projections

EPA’s 2011 Emissions Modeling Platform, Version 6.2 includes projections for the years 2017 and 2025. Wisconsin’s 2017 area source emissions estimates were based on EPA’s 2017 modeling inventory, unless otherwise indicated. Wisconsin’s 2018 area source emissions were estimated by interpolating between EPA’s 2017 and 2025 modeling inventories, unless otherwise indicated. Projected area source emissions can be found in Appendix 4. Appendix 7 includes more information on emissions projection methodology for area source emissions.

In order to obtain area source emissions for the eastern portion of Kenosha County, emission estimates for the whole county were allocated to the partial county nonattainment area based on population data. The Kenosha County population for 2017 and 2018 was estimated by interpolating the population between 2015 and 2020 population projections from the Wisconsin Department of Administration. The partial-county population was identified based on the relative population of the Minor Civil Divisions in the nonattainment area compared with the entire county. For 2017 and 2018, 77% of the county’s population was estimated to live in the nonattainment area.

### 3.3.3. Onroad Inventory Projections

The 2017 and 2018 projected onroad emissions were developed using the MOVES2014a model, as was the case for the 2011 emissions. Vehicle age distributions were projected using a spreadsheet program developed by EPA. SEWRPC provided projected transportation data assuming their “high economic growth” scenario. The speed distributions provided by SEWRPC reflected the 5 mph speed limit increase (65 mph to 70 mph) which took effect in 2015 on certain restricted access roadways. WDNR increased the onroad mobile source portions of the 2017 and 2018 projected VOC and NOx emissions inventories by 7.5% to account for uncertainties in future mobile source emission factors as well as activity levels, as agreed upon through the transportation conformity consultative process. The motor vehicle I/M program and RFG program were both assumed to remain in effect.

Detailed listings of the projected onroad emissions and activity data are provided in Appendix 5.

### 3.3.4. Nonroad Inventory Projections

The methodology for the 2017 and 2018 projected nonroad emissions is parallel to the methodology used for the 2011 estimates. For the non-MAR categories, the MOVES2014a model was run at hot summer day temperatures (as defined for 2011 modeling), assuming the model’s default growth projections.

For the MAR categories, the 2017 emissions were directly obtained from EPA’s Version 6.3 Modeling Platform. The 2018 emissions were linearly extrapolated from the 2011 and 2017 emissions.

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emissions on that platform. Detailed listings of the projected nonroad emissions for over 200 subcategories are provided in Appendix 6.

### 3.4. Demonstration of RFP

Because Kenosha County has already met the 15% VOC ROP requirement in addressing a prior ozone NAAQS, the required 15% RFP reduction can come from any combination of NOx and VOC reductions occurring between 2011 and 2017. WDNR compared actual emissions from 2011 to emission estimates from the projected attainment year (2017) and the additional year of attainment (2018) for eastern Kenosha County, as shown in Tables 3.5 and 3.6 and Figure 3.1. NOx emissions are projected to decrease by 15.4% (3.01 tpsd) between 2011 and 2017. The largest reductions in NOx for the 2011–2017 period are projected from the onroad mobile sector (2.10 tpsd), followed by the nonroad mobile sector (0.60 tpsd). These reductions are due to the federal and state mobile source control programs detailed in Section 3.6. VOC emissions are projected to decrease by 13.0% (1.23 tpsd) over this same time period. As with NOx emissions, the largest VOC reductions are from the onroad mobile sector (0.86 tpsd) followed by the nonroad mobile sector (0.51 tpsd).

Overall, the combined reduction in NOx and VOC emissions on a percent basis between the base year (2011) and the projected attainment year (2017) is 28.4%. This reduction is well in excess of the required 15% reduction, demonstrating that the RFP requirement is satisfied for the eastern Kenosha portion of the nonattainment area.

#### Table 3.5. Eastern Kenosha County comparison of NOx emissions (tpsd) by source type.

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Point - EGU</td>
<td>11.05</td>
<td>10.75</td>
<td>10.75</td>
<td>-2.7%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Point - Non-EGU</td>
<td>0.11</td>
<td>0.12</td>
<td>0.12</td>
<td>+6.3%</td>
<td>-0.2%</td>
</tr>
<tr>
<td>Area</td>
<td>1.09</td>
<td>1.08</td>
<td>1.08</td>
<td>-1.1%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Onroad</td>
<td>5.15</td>
<td>3.05</td>
<td>2.75</td>
<td>-40.8%</td>
<td>-5.7%</td>
</tr>
<tr>
<td>Nonroad</td>
<td>2.07</td>
<td>1.47</td>
<td>1.40</td>
<td>-28.9%</td>
<td>-3.4%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>19.47</strong></td>
<td><strong>16.46</strong></td>
<td><strong>16.10</strong></td>
<td><strong>-15.4%</strong></td>
<td><strong>-1.9%</strong></td>
</tr>
</tbody>
</table>

*The percent changes from 2011-2017 and 2017-2018 were calculated relative to 2011 emissions.*
Table 3.6. Eastern Kenosha County comparison of VOC emissions (tpsd) by source type.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Point - EGU</td>
<td>0.54</td>
<td>0.56</td>
<td>0.56</td>
<td>+3.7%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Point - Non-EGU†</td>
<td>0.18</td>
<td>0.31</td>
<td>0.31</td>
<td>+73.6%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Area</td>
<td>4.78</td>
<td>4.77</td>
<td>4.74</td>
<td>-0.1%</td>
<td>-0.6%</td>
</tr>
<tr>
<td>Onroad</td>
<td>2.42</td>
<td>1.56</td>
<td>1.44</td>
<td>-35.5%</td>
<td>-5.1%</td>
</tr>
<tr>
<td>Nonroad</td>
<td>1.51</td>
<td>1.00</td>
<td>0.96</td>
<td>-33.8%</td>
<td>-2.4%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>9.43</td>
<td>8.20</td>
<td>8.02</td>
<td>-13.0%</td>
<td>-2.0%</td>
</tr>
</tbody>
</table>

*The percent changes from 2011-2017 and 2017-2018 were calculated relative to 2011 emissions.
†The large increase in non-EGU VOC emissions after 2011 is due to inclusion of projected emissions (0.14 tpsd) for new/modified sources.

3.5. Contingency Measures

The state must also include contingency measures representing one year of emissions reduction progress, equivalent to an additional 3% reduction. These measures must be implemented within one year of an area failing to attain the NAAQS. Table 3.5 shows that NOx emissions are projected to decrease an additional 1.9% from 2017 to 2018. Similarly, Table 3.6 shows that VOC emissions are projected to decrease an additional 2.0% from 2017 to 2018. Overall, NOx and VOC emissions are projected to decrease by a combined 3.9% from 2017 to 2018. This means that even if eastern Kenosha County does not attain the 2008 NAAQS in the 2017 attainment year, NOx and VOC emissions are projected to decrease by more than 3% in the following year without the state needing to do anything to trigger such reductions. Accordingly, these emissions reductions serve as the progress-related contingency measures for the eastern Kenosha County portion of the nonattainment area under the 2008 ozone NAAQS.
3.6. Control Strategies for Ozone Precursor Emissions

This section documents the permanent and enforceable control measures that reduced emissions in eastern Kenosha County. Many of the control measures listed have been implemented under long-standing programs that began prior to 2011. These measures will continue to contribute to emissions reductions through the 2017 ozone season and beyond, allowing attainment by the July 20, 2018 attainment date. However, this discussion highlights those control measures and

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17 Section 5.3 shows emission trends extending back to 2002.
emission reductions that have occurred since 2011. Other federal control programs reducing emissions in both the larger nonattainment area and transport regions are also discussed.

It is important to note that the total NOx and VOC emissions from eastern Kenosha County are very small in relation to the aggregate Chicago nonattainment area; in addition, major Wisconsin point sources of these emissions are already very well-controlled. Because of this, even though control programs continue to decrease emissions, the overall reduction is relatively small within eastern Kenosha County.18

3.6.1. Point Source Control Measures

NOx Control Measures

Wisconsin NOx RACT – Wisconsin has implemented RACT for major NOx sources (sources with a potential to emit (PTE) of 100 tons or greater per year) in a number of areas, including all of Kenosha County, as part of compliance requirements for the 1997 ozone NAAQS.19 The NOx RACT requirements are codified under ss. NR 428.20 to 428.25, Wis. Adm. Code. Affected facilities were required to first comply with NOx RACT emission limitations beginning May 1, 2009.

Table 3.7 shows that approximately 98% of annual point source NOx emissions in eastern Kenosha County during 2015 originated from two coal-fired boilers operated by WE Energies at the Pleasant Prairie electric utility plant. These boilers have been subject to a consent decree (CD) since 2007, which limited NOx emissions to 0.10 pounds per million British thermal units (Btu) of heat input on a 30-day rolling basis. The Wisconsin NOx RACT program implemented the same emission limitation in 2009. Under the CD, the Pleasant Prairie coal boilers became subject to a second, more stringent, NOx limit on January 1, 2015 of 0.08 pound per million Btu (mmBtu) of heat input, on a 12-month rolling average. The CD control requirements are permanent and federally enforceable under the Title I permit 15-RSG-006.

In 2015, approximately 47 individual emission units were responsible for the remaining 1.9% of NOx emitted by point sources in the eastern Kenosha County nonattainment area. These emission units are at smaller facilities that do not have PTEs above major source thresholds or are individual emissions units that are relatively small in PTE or operate infrequently (e.g., batch heat treat furnaces, emergency generators, auxiliary boilers) and therefore are not subject to NOx RACT requirements. If the owners of these facilities modify or add sources such that total facility potential emissions increase above 100 tons per year, the facilities and emission units become subject to state NOx RACT requirements. In addition, any new emission units at these facilities would be subject to performance standards under s. NR 428.05, Wis. Adm. Code, as discussed in section 6.2.

18 The two coal-fired boilers operating at the Pleasant Prairie electric utility generating plant are responsible for the majority of NOx and VOC point source emissions in eastern Kenosha County. However, it is important to note that the Pleasant Prairie boilers have been well controlled since 2006 for both NOx and VOC. Pleasant Prairie emissions and controls are documented in section 6.1.

19 Wisconsin’s NOx RACT program is described in greater detail in Section 6.2.
On the whole, emission reductions due to control measures applied to point source NOx emissions in eastern Kenosha County occurred prior to 2011. Any change in emissions between 2011 and 2015 is due to a change in activity levels or due to normal fluctuations in operation or to the actual fuels utilized.

Table 3.7: 2008-2015 NOx emissions and requirements for point sources in the eastern Kenosha County nonattainment area.

<table>
<thead>
<tr>
<th>FID</th>
<th>Facility</th>
<th>2008 NOx (Annual Tons)</th>
<th>2011 NOx (Annual Tons)</th>
<th>2015 NOx (Annual Tons)</th>
<th>2008 – 2015 Emissions Change</th>
<th>Permanent and Enforceable Control Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>230006260</td>
<td>We Energies - Pleasant Prairie Power Plant: Boilers B21 &amp; B22</td>
<td>2,852.8</td>
<td>2,489.5</td>
<td>2,513.6</td>
<td>-11.9%</td>
<td>2007 – 0.1 lbs/mmBtu 2015 – 0.08 lbs/mmBtu</td>
</tr>
<tr>
<td></td>
<td>Percent of Total Emissions</td>
<td>97.7%</td>
<td>98.3%</td>
<td>98.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple</td>
<td>Balance of Emission Units (NOx tons)</td>
<td>68.1</td>
<td>44.0</td>
<td>49.6</td>
<td>-27.1%</td>
<td>Emission units become subject to NOx RACT if facilities exceed 100 TPY PTE in the future.</td>
</tr>
<tr>
<td></td>
<td>Percent of Total Emissions</td>
<td>2.3%</td>
<td>1.7%</td>
<td>1.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number of Emission Units</td>
<td>66</td>
<td>41</td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>2,920.9</td>
<td>2,533.5</td>
<td>2,563.2</td>
<td>-12.2%</td>
<td></td>
</tr>
</tbody>
</table>

**Wisconsin NOx Control** - Wisconsin codified NOx rules under ss. NR 428.04 to 428.12. Affected sources were required to first comply with the NOx emission limitations beginning February 1, 2001. The ch. NR 428 codified NOx limitations contributed to the NOx emission reductions as shown in Table 3.7. The Wisconsin NOx control program in ch. NR 428 also implemented emission limitations ensuring that any new source is installed with NOx emissions control equipment.

**Federal NOx Transport Rules** – Beginning January 1, 2009, EGUs in 22 states east of the Mississippi (including Wisconsin) became subject to ozone season NOx emission budgets under the Clean Air Interstate Rule (CAIR). CAIR addresses the broad regional interstate transport of NOx affecting attainment and maintenance of the 1997 ozone NAAQS, as required under CAA s. 110(a)(2)(D). CAIR resulted in a significant reduction of NOx emissions during the ozone season in areas contributing to eastern Kenosha County over the 2009-2014 period.

Table 3.8 shows emission levels for EGUs affected by the CAIR rule through 2014 for states upwind of the eastern Kenosha County area. The states listed (in decreasing order of

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20 The first transport rule promulgated by EPA was the NOx SIP Call in 2003. The EGU requirements are subsumed by the CAIR rule. However, NOx emissions for some larger industrial sources in states contributing to Wisconsin continue to be regulated under the NOx SIP Call.
contribution) are those states contributing more than 1% of the 2008 standard (0.75 parts per billion, ppb) to the Chiwaukee Prairie monitor\textsuperscript{21}. Between 2008 and 2014, total EGU emissions across these states decreased by approximately 24%. Emission reductions were proportionately larger, ranging from 24% to 54.4%, for the three-state region contributing the most to eastern Kenosha County ozone concentrations: Illinois, Indiana, and Wisconsin.

Starting with the 2015 ozone season, the Cross-State Air Pollution Rule (CSAPR) replaced CAIR to reduce interstate NOx transport relative to the 1997 ozone NAAQS. CSAPR implemented NOx budgets for the impacted states in two phases. Phase I limits NOx emissions in 2015 and 2016. EPA published the CSAPR Update (81 FR 74504) in 2016 to address NOx transport affecting the attainment and maintenance of the 2008 ozone NAAQS (79 FR 16436). The CSAPR Update establishes Phase II NOx budgets starting with the 2017 ozone season.

Table 3.8. EGU NOx emitted under the CAIR program in states contributing > 0.75 ppb (1% of the 2008 NAAQS) in Kenosha County.

<table>
<thead>
<tr>
<th>State</th>
<th>CSAPR Modeled Contribution to Kenosha County\textsuperscript{a} (ppb)</th>
<th>Ozone Season NOx Emissions (Tons)</th>
<th>Percent Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illinois</td>
<td>31.090</td>
<td>29,891</td>
<td>25,755</td>
</tr>
<tr>
<td>Indiana</td>
<td>12.888</td>
<td>53,016</td>
<td>48,926</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>3.990</td>
<td>19,947</td>
<td>13,818</td>
</tr>
<tr>
<td>Michigan</td>
<td>3.336</td>
<td>38,437</td>
<td>32,780</td>
</tr>
<tr>
<td>Ohio</td>
<td>2.354</td>
<td>52,479</td>
<td>43,346</td>
</tr>
<tr>
<td>Kentucky</td>
<td>1.875</td>
<td>39,324</td>
<td>40,055</td>
</tr>
<tr>
<td>Missouri</td>
<td>1.349</td>
<td>34,820</td>
<td>26,912</td>
</tr>
<tr>
<td>W. Virginia</td>
<td>1.069</td>
<td>25,398</td>
<td>23,431</td>
</tr>
<tr>
<td>Virginia</td>
<td>0.958</td>
<td>17,392</td>
<td>15,620</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>0.878</td>
<td>53,545</td>
<td>64,885</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>364,250</td>
<td>335,527</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Ozone contributions as determined by EPA in the final CSAPR rule, 76 FR 48208, August 8, 2011.

Source: EPA Clean Air Markets Division, Database of reported emissions.

Wisconsin VOC Control Measures

**VOC RACT/CTG** – Wisconsin has implemented VOC RACT to fulfill control technology guideline (CTG) requirements for the Wisconsin nonattainment areas under the 1997 ozone NAAQS, which includes all of Kenosha County\textsuperscript{22}. These VOC RACT/CTG requirements are codified under chapters NR 419 through 424, Wis. Adm. Code. The list of the CTGs in place in Wisconsin is provided in Appendix 8. All of these CTG requirements were implemented and effective prior to the 2011 base year.

\textsuperscript{21} Contributions as determined by EPA in the final CSAPR rule, 76 FR 48208, August 8, 2011.

\textsuperscript{22} Wisconsin’s VOC RACT program is described in greater detail in Section 6.3.
Table 3.9. lists the point sources emitting VOCs in the eastern Kenosha County nonattainment area in 2015. This assessment shows that approximately 92% of 2015 VOC emissions come from combustion sources. These combustion sources include two utility boilers, which accounted for 88% of total VOC emissions. The remaining combustion emissions originated from a number of industrial boilers, reciprocating engines, and various large space and process heating units. As indicated in Table 3.9, the majority of these combustion-related emissions are subject to various National Emission Standards for Hazardous Air Pollutant (NESHAP) rules that have become effective since 2011. These NESHAP rules implement good combustion practices that minimize VOC emissions or apply direct emission limitations on total hydrocarbons (including VOCs). The specifics of each NESHAP rule is further described below in the section “Federal VOC Control Measures for Point Sources”. It should be noted, however, that although the good combustion NESHAP requirements are expected to minimize VOC emissions, the incremental emission reductions due to these rules are expected to be relatively small and hard to quantify.

Table 3.9 shows that approximately 8% of VOC point source emissions in 2015 came from non-combustion activities or processes, typically involving some form of fugitive evaporative-based emissions. The non-combustion VOC sources are subject to RACT/CTG rules as applicable. These rules aid in controlling VOC emissions, but these rules were implemented prior to 2011 with no additional incremental reduction expected between 2011 and 2017.

Federal VOC Control Measures for Point Sources

A number of federal NESHAP rules have been implemented to control hazardous pollutants. These rules include requirements to control hazardous organic pollutants through ensuring complete combustion of fuels or implementing requirements for emissions of total hydrocarbons. Under either approach, the rules act to reduce total VOC emitted by the affected sources. These NESHAP rules apply to both major and area source facilities. Major sources are those facilities emitting more than 10 tons per year of a single hazardous air pollutant or more than 25 tons per year of all hazardous air pollutants in total. Area sources are those facilities that emit less than the major source thresholds for hazardous air pollutants.
Table 3.9. 2015 VOC emissions and requirements for point sources in the eastern Kenosha County nonattainment area.

<table>
<thead>
<tr>
<th>FID</th>
<th>Facility</th>
<th>Unit</th>
<th>Annual VOC (Tons)</th>
<th>Percent of Total</th>
<th>Permanent and Enforceable Control Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combustion Sources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>230006260</td>
<td>We-Energies Pleasant Prairie Power Plant</td>
<td>B20 &amp; B21</td>
<td>133.1</td>
<td>88.4%</td>
<td>MATS Combustion Requirements</td>
</tr>
<tr>
<td></td>
<td>Multiple</td>
<td>Natural gas-fired boilers</td>
<td>17 units</td>
<td>1.8</td>
<td>1.2%</td>
</tr>
<tr>
<td></td>
<td>Multiple</td>
<td>Fuel oil-fired boilers</td>
<td>8 units</td>
<td>0.03</td>
<td>0.02%</td>
</tr>
<tr>
<td></td>
<td>Multiple</td>
<td>Reciprocating Engines</td>
<td>5 units</td>
<td>0.01</td>
<td>0.01%</td>
</tr>
<tr>
<td></td>
<td>Multiple</td>
<td>Process Heaters</td>
<td>19 units</td>
<td>3.6</td>
<td>2.4%</td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td></td>
<td></td>
<td>138.5</td>
<td>92.0%</td>
</tr>
<tr>
<td>Non-Combustion Sources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple</td>
<td>Non-Combustion Sources</td>
<td>24 units</td>
<td>12.0</td>
<td>8.0%</td>
<td>Individual emission units subject to VOC RACT/CTGs as applicable</td>
</tr>
<tr>
<td>Total =</td>
<td></td>
<td></td>
<td></td>
<td>150.5</td>
<td>100%</td>
</tr>
</tbody>
</table>

\(^a\) The emissions units are subject to either major source or area source NESHAP emission requirements based on size thresholds. The applicability of requirements and exemptions for each unit has not been determined for purposes of this assessment. Natural gas-fired boilers and processes at area sources are not subject to requirements.

These NESHAP measures apply not only to sources within the eastern Kenosha County nonattainment area, but also nationally, thereby reducing the transport of VOC emissions into the nonattainment areas. The NESHAP rules that will likely contribute to VOC emission reductions in the 2017 ozone season include the following:

- **Mercury and Air Toxics (MATS) NESHAP** – On February 16, 2012, EPA promulgated the MATS rule under part 63 subpart UUUUUU. Emission requirements were fully applicable by April 16, 2015. Affected sources were required to conduct energy assessments and combustion tuning to ensure complete combustion.

- **Major Source Industrial, Commercial, and Institutional (ICI) Boiler and Process Heater NESHAP** – On March 21, 2011, EPA promulgated the “National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters” under part 63 subpart DDDDD. This NESHAP requires all boilers and process heaters, including natural gas fired units, at major source facilities to
perform an initial energy assessment and perform periodic tune-ups by January 31, 2016. This action is intended to ensure complete combustion.

- **Area Source (non-major point sources) ICI Boiler and Process Heater NESHAP** – On March 21, 2011 EPA promulgated the “National Emission Standards for Hazardous Air Pollutants for Area Sources: Industrial, Commercial, and Institutional Boilers” under part 63 subpart JJJJJJJ. This NESHAP requires solid fuel and oil fuel fired boilers operated by sources that are below the major source threshold to begin periodic combustion tuning by March 21, 2014.

- **Internal Combustion Engine Rules** – EPA has promulgated three rules that limit the total amount of hydrocarbon emissions from internal combustion engines - the “National Emission Standards for Hazardous Pollutants for Reciprocating Internal Combustion Engines” (RICE Maximum Achievable Control Technology, MACT) was promulgated on June 15, 2004 under Part 63, subpart ZZZZZZ and revised in January 2008 and March 2010, with the two revisions impacting additional RICE units; the “Standards of Performance for Stationary Spark Ignition Internal Combustion Engines” promulgated on January 18, 2008 under Part 60, subpart JJJJ; and “Standards of Performance for Stationary Compression Ignition Internal Combustion Engines promulgated on July 11, 2006 under Part 60, subpart IIII. These rules implement hydrocarbon emission limitations prior to and after 2011 based on compliance dates. These rules also act to continuously reduce emissions as existing stationary engines are replaced by new, cleaner-burning engines.

### 3.6.2. Area Source Control Measures

**Area source VOC controls** - As noted for point sources, Wisconsin has implemented all of the necessary VOC RACT/CTG rules under chs. NR 419 through 424, Wis. Adm. Code. A number of these rules limit VOC emissions from area sources as well, as noted in Appendix 8. In addition to Stage 1 fuel delivery vapor controls (the loading of underground storage tanks at gas stations), Wisconsin previously had a Stage 2 vehicle refueling vapor recovery program in place. However, the Stage 2 program was removed from Wisconsin’s ozone SIP on November 4, 2013 (78 FR 65875) with EPA approval because the equipment was found to interface negatively with the onboard vapor recovery systems required on gasoline fueled new vehicles after 1998. As stage 2 equipment was removed, refueling facility VOC emissions decreased slightly due to reduced fugitive underground storage tank VOC venting. This SIP revision was based on a technical showing of net benefit as required under CAA Sections 110(l) and 193 in order to prevent SIP backsliding.

There are also a number of federal programs in place which reduce area source VOC emissions. VOC emission standards for consumer and commercial products were promulgated under 40 CFR Part 59. This program was implemented prior to 2011 and will continue to maintain reduced VOCs emitted from this source category. Future emission levels will vary depending on population and activity use factors. Another federal rule, the area source hazardous air pollutant control rule, also controls area VOC emissions associated with fuel storage and transfer activities (40 CFR 63, Subpart R, BBBBBBB, and CCCCCC). Kenosha County remains a part of the federal RFG program, which meets a more refined set of gasoline fuel formulation characteristics,
3.6.3. Onroad Source Control Measures

Both NOx and VOC emissions from onroad mobile sources are substantially controlled through federal new vehicle emission standards programs and fuel standards that impact both tailpipe emissions and evaporative losses. Although initial compliance dates in many cases were prior to 2011, these regulations have continued to reduce areawide emissions as fleets turn over to newer vehicles. All of these programs apply nationally and have reduced emissions both within the nonattainment areas and in contributing ozone precursor transport areas. The federal programs contributing to reductions in ozone precursor emissions include those listed in Table 3.10.

Table 3.10. Federal onroad mobile source regulations contributing to attainment.

<table>
<thead>
<tr>
<th>On-road Control Program</th>
<th>Pollutants</th>
<th>Model Yeara</th>
<th>Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger vehicles, SUVs, and light duty trucks – emissions and fuel standards</td>
<td>VOC &amp; NOx</td>
<td>2004 – 2009+ (Tier 2) 2017+ (Tier 3)</td>
<td>40 CFR Part 85 &amp; 86</td>
</tr>
<tr>
<td>Light-duty trucks and medium duty passenger vehicle – evaporative standards</td>
<td>VOC</td>
<td>2004 - 2010</td>
<td>40 CFR Part 86</td>
</tr>
<tr>
<td>Heavy-duty highway compression engines</td>
<td>VOC &amp; NOx</td>
<td>2007+</td>
<td>40 CFR Part 86</td>
</tr>
<tr>
<td>Heavy-duty spark ignition engines</td>
<td>VOC &amp; NOx</td>
<td>2005 – 2008+</td>
<td>40 CFR Part 86</td>
</tr>
<tr>
<td>Motorcycles</td>
<td>VOC &amp; NOx</td>
<td>2006 – 2010 (Tier 1 &amp; 2)</td>
<td>40 CFR Part 86</td>
</tr>
<tr>
<td>Light duty vehicle corporate average fuel economy standards</td>
<td>Fuel efficiency (VOC and NOx)</td>
<td>2012-2016 &amp; 2017-2025</td>
<td>40 CFR Part 600</td>
</tr>
</tbody>
</table>

a The range in model years affected can reflect phasing of requirements based on engine size or initial years for replacing earlier tier requirements.

b The range in model years reflects phased implementation of fuel, passenger vehicle, and portable container emission requirements as well as the phasing by vehicle size and type.

Two additional ongoing CAA-required programs limit onroad VOC and NOx emissions. The first program, administered by EPA, has required the use of RFG in southeast Wisconsin (including Kenosha County) and the Chicago nonattainment area since 1995. The second program is the Wisconsin-administered I/M program and is required for Kenosha County. The Wisconsin I/M program was first implemented in 1984 and has gone through several
modifications and enhancements since that time. The I/M program requirements are codified in ch. NR 485, Wis. Adm. Code. Both the RFG and the I/M programs reduce average vehicle VOC and NOx emissions and garner some level of continued incremental reduction as fleets turn over to new vehicles.

3.6.4. Nonroad Source Control Measures

Similar to on-road sources, VOC and NOx emitted by nonroad mobile sources are significantly controlled via federal standards for new engines. These programs therefore reduce ozone precursor emissions generated within Kenosha County and in the broader regional areas contributing to ozone transport. Table 3.11 lists the nonroad source categories and applicable federal regulations. The nonroad regulations continue to slowly lower average unit and total sector total emissions as equipment fleets are replaced each year (it takes approximately 20 years for complete fleet turnover), pulling the highest emitting equipment out of circulation or substantially reducing its use. The new engine requirements are implemented in conjunction with fuel programs regulating fuel sulfur content. The fuel programs enable achievement of various new engine tier VOC and NOx emission limits.

The RFG program noted in the onroad control measures also contributes to lower NOx and VOC emissions from the nonroad mobile sector.

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23 Wisconsin’s I/M program is described in greater detail in Section 6.5.
Table 3.11. Federal nonroad mobile source regulations contributing to attainment.

<table>
<thead>
<tr>
<th>Nonroad Control Program</th>
<th>Pollutants</th>
<th>Model Year&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft</td>
<td>HC &amp; NOx</td>
<td>2000 – 2005+</td>
<td>40 CFR Part 87</td>
</tr>
<tr>
<td>Compression Ignition&lt;sup&gt;b&lt;/sup&gt;</td>
<td>NMHC &amp; NOx</td>
<td>2000 – 2015+ (Tier 4)</td>
<td>40 CFR Part 89 &amp; 1039</td>
</tr>
<tr>
<td>Large Spark Ignition</td>
<td>HC &amp; NOx</td>
<td>2007+</td>
<td>40 CFR Part 1048</td>
</tr>
<tr>
<td>Locomotive Engines</td>
<td>HC &amp; NOx</td>
<td>2012 – 2014 (Tier 3)</td>
<td>40 CFR Part 1033</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2015+ (Tier 4)</td>
<td></td>
</tr>
<tr>
<td>Marine Compression Ignition</td>
<td>HC &amp; NOx</td>
<td>2012 – 2018</td>
<td>40 CFR Part 1042</td>
</tr>
<tr>
<td>Marine Spark Ignition</td>
<td>HC &amp; NOx</td>
<td>2010+</td>
<td>40 CFR Part 1045</td>
</tr>
<tr>
<td>Recreational Vehicle&lt;sup&gt;c&lt;/sup&gt;</td>
<td>HC &amp; NOx</td>
<td>2006 – 2012 (Tier 1 – 3) (phasing dependent on vehicle type)</td>
<td>40 CFR Part 1051</td>
</tr>
<tr>
<td>Small Spark Ignition Engine &lt; 19&lt;sup&gt;d&lt;/sup&gt; Kw – emission standards</td>
<td>HC &amp; NOx</td>
<td>2005 – 2012 (Tier 2 &amp; 3) (phasing based on both Tier and engine size)</td>
<td>40 CFR Part 90 &amp; 1054</td>
</tr>
</tbody>
</table>

HC – Hydrocarbon (VOCs)
NMHC – Non-Methane Hydrocarbon (VOCs)
<sup>a</sup> The range in model years affected can reflect phasing of requirements based on engine size or initial years for replacing earlier tier requirements.
<sup>b</sup> Compression ignition applies to diesel non-road compression engines including engines operated in construction, agricultural, and mining equipment.
<sup>c</sup> Recreational vehicles include snowmobiles, off-road motorcycles, and all-terrain vehicles.
<sup>d</sup> Small spark ignition engines include engines operated in lawn and hand-held equipment.
4. MODELED ATTAINMENT ASSESSMENT

One of the central requirements for moderate nonattainment areas is a modeled demonstration that a nonattainment area will attain the NAAQS. Wisconsin, Illinois, and Indiana are relying on photochemical modeling conducted by LADCO to make this modeled attainment assessment for the Chicago nonattainment area under the 2008 ozone NAAQS. LADCO developed an air quality modeling platform to evaluate the adequacy of current and potential emissions reduction strategies for allowing attainment of the 2008 ozone NAAQS by the 2017 attainment deadline. The technical support document for this modeling analysis is included as Appendix 9. In addition to discussing how the model was set up, evaluated and run (including the emissions inventories used), this appendix presents additional regional data analyses and weight of evidence support for the modeled attainment finding. This chapter provides a high-level overview of this modeled attainment demonstration for the Chicago nonattainment area. This analysis demonstrates that all monitoring sites within the Chicago nonattainment area are projected to attain the 2008 ozone NAAQS by the 2017 ozone season.

4.1. Emission Inventories for Photochemical Modeling

The emission inventories used for the photochemical modeling rely heavily on emissions and other model inputs prepared by EPA. Both EPA and LADCO extensively quality assure their emission inventories. LADCO’s emissions modeling quality assurance procedures include reviewing emissions model output files for errors, comparing emissions between processing steps, checking that speciation, temporal, and spatial allocation factors are applied correctly, and reviewing the air quality model emissions inputs and stack parameters.

4.1.1. Base Case Modeling for 2011 and 2017

LADCO utilized emissions inventories compiled by EPA for the years 2011 and 2017 as the starting point for the modeling inventories used in this analysis. EPA’s 2011 emission inventory (Version 2011EH) is based on the 2011 NEI, version 2 (2011NEIv2), which was speciated, temporalized and gridded to provide hourly emissions inputs to support photochemical modeling. Emissions include all criteria pollutants and precursors, and some hazardous air pollutants. See EPA’s Technical Support Document for a thorough description of the methodology used to develop the 2011EH emissions inventory. EPA’s projected future emission inventory for the year 2017 is based on the 2011 baseline inventory and incorporates current “on-the-books” emission control measures and sector-specific forecasts for activity changes from 2011-2017.

LADCO updated the 2011 and 2017 EPA inventories for regional onroad mobile sources and EGUs. EGU emissions were updated to use outputs from the Eastern Regional Technical Advisory Committee (ERTAC) EGU Forecast Tool. LADCO used improved outputs to the MOVES emissions model for 2011 and 2017 to update the onroad mobile source emissions estimates. These updates are described in greater detail in Appendix 9.

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4.1.2. Modeling with Additional Control Measures for 2017

LADCO also modeled a scenario for 2017 that considered additional emission reductions due to implementation of the CSAPR Update (see section 3.6.1). This rule is expected to further reduce NO\textsubscript{X} emissions from EGUs in 22 states in the eastern U.S., including five of the states in the LADCO region. These emissions reductions are required to be in place by the beginning of the 2017 ozone season. LADCO used the ERTAC EGU Forecast Tool to project likely NO\textsubscript{X} emissions reductions from the CSAPR Update. LADCO’s approach assumed that electric utilities would likely optimize their use of existing controls (selective catalytic reduction, SCR, and selective non-catalytic reduction systems) and shift electric generation from higher emitting units to cleaner ones to in order to comply with reduced 2017 CSAPR state ozone season NO\textsubscript{X} budgets. See Appendix 9 for more information.

In addition to CSAPR, EPA has adopted a number of national rules over the past few years that require or will require VOC and NO\textsubscript{X} emission reductions. Emissions standards established for mobile sources have been phased in over recent years, but fleet turnover will ensure continued emissions reductions for many years in the future. For the LADCO states, these rules have provided emissions reductions between 2011 and 2017 and have been factored into the modeling assessment.

Figure 4.1 compares projected VOC and NO\textsubscript{X} emissions for 2017 (considering all control measures) with 2011 base year emissions for all emissions categories. Emissions of VOCs and NO\textsubscript{X} are expected to decrease substantially from each state in the Chicago nonattainment area and regionally between 2011 and 2017 due to “on-the-books,” enforceable control measures.

4.2. Photochemical Modeling for Ozone

LADCO, in cooperation with the Illinois Environmental Protection Agency (IEPA), the Indiana Department of Environmental Management (IDEM), and WDNR, conducted the modeling assessment described here to support the development of the states’ ozone attainment SIPs. The modeling analyses were conducted in accordance with EPA’s attainment demonstration and related modeling guidelines.\textsuperscript{25}

4.2.1. Selection of Base Year

The calendar year 2011 was selected as the base year for regional ozone modeling, based on the following considerations:

- The 2011 base year is representative of the observed baseline design values for the time period (2009-2011) when EPA established the final air quality designations for the Chicago area for the 2008 ozone NAAQS.

- There are extensive air quality, meteorological, and emissions databases that have been developed for 2011 by EPA, and others, for regulatory purposes.\textsuperscript{24}

The 2011 ozone season was typical in terms of meteorology and ozone conduciveness in the Lake Michigan region.

Figure 4.1. Base year (2011) and future year (2017) emissions of (top) NOx and (bottom) VOCs from the three states in the Chicago nonattainment area. Emissions are shown in tons per year for the entire state (not just the nonattainment area). Data for 2017 include reductions due to the CSAPR Update rule (From LADCO, Appendix 9)

4.2.2. Modeling Platform

The modeling platform consists of emissions and transport models that reflect the spatial and temporal characteristics of the study region. A summary of the models used in the 2011 modeling platform are shown in Table 4.1. Meteorological modeling for the 2011 modeling platform was performed with the Weather Research and Forecast (WRF-ARW V3.4) model operated by EPA’s Office of Air Quality Planning and Standards (OAQPS). LADCO’s modeling

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26 It should be noted that a large majority of Wisconsin emissions do not contribute to ozone in the Chicago nonattainment area due to the regional transport patterns described in Chapter 2. However, emissions from sources in Illinois and Indiana upwind of the nonattainment area significantly contribute to ozone in the area.
assessment utilized the WRF meteorological outputs developed by EPA. The 2011 WRF meteorological data has been extensively evaluated on a national scale by EPA. Appendix 9 describes the meteorological inputs in greater detail.

### Table 4.1. Modeling platform components.

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>Managing Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRF</td>
<td>Meteorology</td>
<td>EPA OAQPS&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>GEOS-CHEM</td>
<td>Global Chemical Transport</td>
<td>EPA OAQPS</td>
</tr>
<tr>
<td>SMOKE</td>
<td>Emissions</td>
<td>EPA OAQPS / LADCO</td>
</tr>
<tr>
<td>CAMx</td>
<td>Regional Photochemical</td>
<td>LADCO</td>
</tr>
</tbody>
</table>

<sup>a</sup> OAQPS is EPA’s Office of Air Quality Planning and Standards.

Photochemical modeling of criteria air pollutants is performed with the Comprehensive Air quality Model with Extensions (CAMx V6.30). CAMx is commonly used for attainment plans, has been extensively peer reviewed and has performed well in previous applications. Emissions inventory data is converted into the formatted emission files required by the CAMx model using the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system. Initial and boundary conditions are derived from a 2011 global simulation run using the Goddard Earth Observing Systems Chemistry (GEOS-CHEM) model. The CAMx photochemical model outputs hourly concentrations of tropospheric pollutants including ozone, NOx, and various groupings of VOCs. Hourly results are post-processed to daily averages, maximum daily 8-hour average (MDA8) ozone concentrations, or annual averages for the purpose of assessing and projecting monitor design values in the context of regional attainment demonstrations. Appendix 9 describes the model configuration in greater detail.

#### 4.2.3. Summary of Model Performance Evaluation

LADCO evaluated the 2011 base case modeling to assess the model's ability to reproduce observed ozone and precursor concentrations regionally and in the Lake Michigan area. The model performance evaluation examines the platform’s ability to replicate the magnitude, spatial, and temporal pattern of measured concentrations. This exercise is intended to assess whether confidence in the model is warranted and, if so, to what degree. Model performance is assessed by comparing paired modeled and monitored concentrations.

EPA’s modeling guidance does not specify rigid acceptance/rejection criteria for model performance. However, ozone model performance is generally considered good if bias is within

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<sup>28</sup> Available at [http://www.camx.com/home.aspx](http://www.camx.com/home.aspx)


15% (positive or negative) and error is within 30% for MDA8 values. Simon et al.\textsuperscript{31} present a thorough discussion and summary of regional modeling performance statistics. The model’s bias is within 15% at virtually all ozone monitor locations in the Lake Michigan region and in the Midwest, which shows that the model is performing well at predicting MDA8. The mean fractional error is within 20% at all locations near Lake Michigan. The relatively low error and bias suggest that the model is performing adequately for the immediate attainment assessment purpose. See Appendix 9 for more information about model performance.

4.2.4. Modeled Attainment Test

CAA Section 182(b) requires states to use an attainment demonstration based on air quality modeling to determine whether identified emissions reduction measures are sufficient to reduce projected pollutant concentrations to a level that meets the NAAQS by the statutory deadline established by EPA. This modeling analysis uses 2017 as the projection year to demonstrate attainment of the 2008 ozone NAAQS. The emissions scenarios previously discussed were evaluated using the CAMx model to determine the likelihood that the 2008 ozone NAAQS will be achieved in the Chicago nonattainment area in 2017. LADCO performed this modeling assessment consistent with the draft guidance issued by EPA in 2014.\textsuperscript{25} LADCO has estimated the amount of emission reductions expected by 2017 and has applied the CAMx photochemical model to simulate both base year and future year ozone concentrations.

The model attainment test uses the photochemical model to estimate future year design values via the Modeled Attainment Test Software (MATS).\textsuperscript{32} The MATS software computes the fractional changes, or relative response factors, of ozone concentrations at each monitor location based on a comparison of the modeled air quality in the base and future years. Meteorological conditions are assumed to be unchanged for the base and projection years. Modeled relative reduction factors are then applied to a weighted baseline 2011 design value, which is determined by averaging three successive three-year design values centered on 2011 (i.e., 2009-2011, 2010-2012, 2011-2013). The resulting estimates of future ozone design values are then compared to the NAAQS. If the future ozone design values are less than or equal to the NAAQS, then the analysis suggests that attainment will be reached. LADCO has used the MATS software according to EPA’s recommended approach.\textsuperscript{25,33}

Table 4.2 summarizes the results of the model attainment test for the 2017 future year with LADCO’s projection of the impact of EPA’s CSAPR Update. As shown in Table 4.2, all monitoring locations in the Chicago nonattainment area are projected to meet the level of the 2008 ozone NAAQS (75 ppb) by 2017. Projected design values range from 53.9 ppb to 66.4 ppb. Accordingly, all monitors in the Chicago nonattainment area are projected to have ozone concentrations at least 9 ppb below the level of the 2008 ozone NAAQS. This demonstrates that the modeling predicts that the Chicago area should easily attain the 2008 ozone NAAQS by the July 2018 attainment date.

\textsuperscript{32} Available at http://www.epa.gov/scram001/modelingapps_mats.htm

Table 4.2. Projected ozone design values (ppb) for 2017 in the Chicago nonattainment area.

<table>
<thead>
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<th>AQS ID</th>
<th>State</th>
<th>County</th>
<th>LADCO 2017</th>
<th>EPA 2017</th>
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<td>Cook</td>
<td>55.1</td>
<td>55.9</td>
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4.3. Modeling-Related Weight of Evidence Support for Attainment

A number of other types of analyses support the modeled projection of attainment for the Chicago area in 2017. These analyses suggest that ozone precursor emissions may be overestimated in the modeling, that the attainment finding is not sensitive to the choice of base year, and support the finding of attainment through a separate modeling effort, as described below.

Appendix 9 describes a number of reasons why the modeled projections for 2017 ozone concentrations may overestimate emissions of ozone precursors, and thus ozone concentrations, in 2017. Several of the emissions projections used are considered conservative, meaning that they overestimate future emissions from these sources. The sectors that are believed to have conservative emissions forecasts include EGUs and future coal utilization at EGUs.

LADCO also projected ozone design values assuming a range of 2011 baseline design values, as shown in Table 4.4 of Appendix 9. In all of these scenarios, projected 2017 design values for all monitors in the Chicago nonattainment area were well below the 2008 NAAQS. This suggests that the modeled projection of attainment for the Chicago area is not sensitive to the selection of the base year.
EPA conducted modeling in 2015 in support of regulatory initiatives regarding the revised ozone NAAQS and interstate transport. The projections from EPA’s modeling are shown in Table 4.2, along with LADCO’s modeling results. EPA’s model projections are very similar to LADCO’s projections, with a range of ozone design values of 54.1 ppb to 66.7 ppb, with the high and low values at the same monitors. These projections support the modeled demonstration of attainment of the 2008 ozone NAAQS for the Chicago nonattainment area in 2017.

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5. WEIGHT OF EVIDENCE ANALYSIS: OZONE AND OZONE PRECURSOR TRENDS

5.1. Introduction

EPA recommends that states submit supplemental analyses in support of any attainment plan. These analyses are intended to provide additional support for a finding of attainment based on the required modeled attainment assessment. Such supplemental analyses are part of a “weight of evidence” demonstration that an area will attain a standard. This section presents and discusses trends in ambient ozone and ozone precursor concentrations and forms the core of such a weight of evidence demonstration.

These weight of evidence analyses support the projection of attainment from the modeled attainment demonstration for the Chiwaukee Prairie monitor, along with all of the other ozone monitors in the Chicago nonattainment area. The MATS modeling analysis projects attainment in the Chicago area by a wide margin (Section 4 and Table 5.1). Monitoring data shows that the Chiwaukee Prairie monitor (the highest-ozone monitor in the Chicago area) is very close to attainment. A fourth high value of 71 ppb or lower in 2017 would allow the area to attain the 2008 ozone NAAQS (Table 5.1). This value was last measured as a fourth high value at this monitor in 2009, at a point in time when aggregate ozone precursor emissions from the major source categories were higher than they are today.

Table 5.1. Comparison of modeled 2017 design values, recent monitored values and 2017 critical values for the Chiwaukee Prairie monitor in Kenosha County.

<table>
<thead>
<tr>
<th>Modeled 2017 DV (ppb)</th>
<th>Monitored 4th highs (ppb)</th>
<th>2017 critical values</th>
</tr>
</thead>
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</table>

This chapter shows that emissions of ozone precursors have decreased regionally since at least 2002 and are currently roughly half of their 2002 levels. As a result of these emissions reductions, monitored concentrations of NOx and VOCs in Wisconsin have decreased by similar proportions and are continuing to decrease. Ozone concentrations adjusted for meteorology are also continuing to decrease. Section 5.4 of this chapter also demonstrates the crucial role of transport of ozone and ozone precursors to the Chiwaukee Prairie monitor, which severely limits Wisconsin’s ability to reduce ozone concentrations in Kenosha County. Overall, this weight of evidence analysis supports a finding of forecast attainment of the 2008 ozone NAAQS in Kenosha County.

5.2. Trends in Ambient Ozone Concentrations

WDNR currently monitors ozone at two locations within the eastern Kenosha nonattainment area (Figure 1.1). In addition, IEPA operates an additional 15 ozone monitors within the larger Chicago nonattainment area, and IDEM operates five monitors within this area.
5.2.1. Trends in Monitored Ozone Concentrations

Figure 5.1 shows trends in the annual fourth high MDA8 ozone concentration and design values for Wisconsin’s monitors in the Chicago nonattainment area. Since 1998, ozone concentrations have decreased considerably. Annual fourth high values at the Chiwaukee Prairie monitor have decreased from 86-116 ppb before 2004 to 75-81 ppb since 2013. Design values have decreased from 93-101 ppb before 2004 to 75-77 ppb in 2015 and 2016. The largest reductions occurred during the early years of this period, with design values decreasing by 15 ppb from 2000 to 2008 but only 1 ppb from 2008 to 2016 (Table 5.2). Meteorological variability significantly affects ozone concentrations and can obscure trends over shorter time periods. For example, 2012 had an extremely hot summer with a high frequency of elevated ozone concentrations, 2008 and 2009 had relatively cool summers with a lower frequency of elevated ozone concentrations. The next two sections discuss the impact of meteorology on ozone concentrations at these locations and show that when adjusted for meteorology, ozone concentrations are continuing to decrease.36

Figure 5.1. Trends in annual fourth high maximum daily 8-hour ozone concentrations and design values for the monitors in Kenosha County, Wisconsin.

Ozone concentrations followed similar trends at the other monitors in the Chicago nonattainment area (Figure 5.2; Table 5.2). The Chiwaukee Prairie monitor almost always had the highest annual fourth high concentration and always had the highest design value (Figure 5.2) across the Chicago area. Table 5.2 shows design values for 2000, 2008 and 2016 for all monitors currently operating in the area. Ozone design values decreased by an average of 11.5 ppb across the entire nonattainment area from 2000 to 2016. The largest reductions occurred south of

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35 Ozone design values are the three-year average of the annual fourth high MDA8 value.
36 WDNR began operating a new monitor, Kenosha Water Tower, a few miles inland from the lakeshore in 2013. Fourth high MDA8 concentrations at this monitor have been consistently 5-7 ppb lower than those on the lakeshore, although the interannual trends are similar.
37 Values for 2008 are shown because this year is the midpoint of the record shown here. Recent trends would show steeper decreases if starting with an earlier year and variable trends if starting with a more recent year. Because the impacts of meteorological variability tend to dwarf long-term trends when assessed over short time periods, it is difficult to meaningfully assess trends in ozone concentrations over short (less than a decade) time periods without controlling for meteorological factors.
Chicago (including monitors in Indiana and Illinois’s Braidwood and Chicago-SWFP monitors), with these monitors having 16-23% reductions in ozone concentrations. The smallest reductions occurred in and around Chicago itself, which saw changes varying from a 1% increase in ozone to a 6% reduction. Most of the reductions in ozone occurred prior to the 2006-2008 design value year, except at a few monitors within the city of Chicago.

Table 5.2. Ozone design values for Chicago nonattainment area monitors for 1998-2000, 2006-2008, and 2014-2016 (preliminary), along with the change between these values. Data for 2008 are shown because this is the midpoint in the record.37

<table>
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*2016 data is preliminary and is subject to change.
Figure 5.2. Trends in the average (left) fourth high maximum daily 8-hour average (MDA8) ozone concentration and (right) design value for ozone monitors in the Chicago nonattainment area. The shaded area shows the range of values. The values for the Chiwaukee Prairie, WI, monitor are shown for reference.

5.2.2. Influence of Temperature on Ozone Concentrations

Temperature is an important and well-known driver of ozone formation, with much more ozone produced at high temperatures than at low temperatures. Figure 5.3 compares annual fourth high MDA8 concentrations at Chiwaukee Prairie with two different measures of temperature at the Milwaukee Airport. Cooling degree days give a measure of how warm the whole year was, with higher overall temperatures leading to higher cooling degree days. In comparison, the count of days with temperatures over 90° indicates how often extreme temperatures occurred in a year. The correlations between ozone concentrations and temperature are very clear from Figure 5.3. The highest ozone concentrations occurred in years with the highest temperatures, measured using both parameters, and vice versa. This figure also suggests that the amount of ozone produced for a given temperature level has decreased over time. For example, comparison of the years 2002 with 2012 shows that the fourth high MDA8 value was much lower in 2012 relative to 2002 (92 ppb versus 116 ppb) even though temperatures were similar between the years. These reductions are presumably due to reduced emissions of ozone precursors, as described in Chapter 3 and Section 5.3. The next part of this document explores these relationships in more detail and attempts to adjust ozone concentrations for different meteorological factors.

38 Cooling degree days are measured in degree-days relative to 65° (in this case) and are a measure of the difference between the average temperature of a day and 65°, summed over an entire year. Cooling degree days are used as a relative measure of how much you would need to cool a space to keep temperatures steady at 65°.
Figure 5.3. Trends in (top) cooling degree days (relative to 65 °F) and (bottom) days with temperatures above 90 °F at Milwaukee Airport, plotted with annual 4th high maximum daily 8-hour average (MDA8) ozone concentrations. Climatological data is from the Wisconsin State Climatology Office website (http://www.aos.wisc.edu/~sco/clim-history/index.html).
5.2.3. Ozone Trends Adjusted for Meteorology

Because of the large effect of meteorology, particularly temperature, on ozone concentrations, meteorologically driven variability in ozone concentrations often obscures trends in ozone due to factors such as permanently reduced rates of precursor emissions. For this reason, it is important to adjust ozone concentrations for meteorology in order to examine trends in ozone concentrations due to precursor emission reductions and other factors. This section describes two such efforts to remove the effect of meteorology from ozone trends. Both sets of analyses show that when adjusted for meteorology, ozone concentrations in the Chicago nonattainment area are continuing to decrease.

CART Analysis

Classification and Regression Tree (CART) analysis allows comparison of ozone concentrations on days with similar meteorological conditions. This analysis partially controls for the influence of year-to-year meteorological variability on ozone concentrations. CART analysis produces average ozone concentrations for a number of different classes of days (determined by meteorology) for each year under review. This analysis therefore allows examination of ozone concentration trends over long periods resulting from non-meteorological factors, including permanent and enforceable reductions in emissions of ozone precursors impacting the sites.

A CART analysis conducted by LADCO visualized changes in ozone concentrations under different meteorological conditions over 16 years from 2000-2015. Figure 5.4 shows average ozone concentrations for the four sets of meteorological conditions (“nodes”) with the highest ozone concentrations for two monitors in the northern part of the Chicago nonattainment area. The data shown for each node are the average ozone concentrations on all days with a particular set of meteorological conditions. (Note that this timeframe analyzed incorporates a period predating the 2008 standard.) Average ozone concentrations decreased under all of these meteorological conditions over this time period (the one exception is node 8, which remained relatively flat at concentrations around 60 ppb). The greatest decrease came from the nodes with the highest concentrations in the early 2000s (nodes 11 and 12). This analysis suggests that the observed long-term decreases in ozone concentrations are due to reductions in ozone precursors (discussed in Chapter 3 and section 5.3) rather than solely due to meteorological factors. This analysis is presented in more detail in Appendix 10, which presents the meteorological conditions represented by each node along with a CART analysis of monitors from Cook County, IL.

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39 For example, Node 11 in Figure 5.4 shows the average ozone concentrations for days characterized by maximum temperatures and average morning temperatures above 76.5 °F and 77.56 °F, respectively, average afternoon winds of greater than 2.41 m/s from the south, and no precipitation.
Figure 5.4. Concentration trends from the CART analysis for Lake County, IL, and Kenosha County, WI monitors. Data points show the average ozone concentration for days sharing certain meteorological conditions (“nodes”). Only meteorological nodes with an average ozone concentration above 50 ppb are shown. (From LADCO, Appendix 9)

Ozone-Temperature Correlations

Plots of ozone versus temperature, separated by time period, also show reductions over time in the “conduciveness” of the atmosphere to form ozone given a certain amount of heat. Figure 5.5 shows plots of two ozone parameters versus four temperature parameters for individual months, with data grouped into three-year blocks.40 (Appendix 10 shows many more of these plots, comparing different ozone and temperature parameters and comparing with temperatures at another location. The graphs shown here are those that had the best correlation coefficients.) These graphs confirm the earlier observations that ozone concentrations tend to increase with increasing temperature (Section 5.2.2). They also show that the amount of ozone produced at a given temperature level has decreased between almost every 3-year period. For example, comparison of trends in mean MDA8 values with the number of days above 80 degrees suggests that the mean MDA8 value for a month with 15 days above 80 degrees has decreased in almost every progressive time period. These values decreased from around 62 ppb in 1995-98 to 60 ppb in 1999-2001, 58 ppb in 2002-2004, 53 ppb in 2005-07, and 49 ppb in 2008-10. The exception to this trend is that the ozone values for 2008-10 generally were lower than those for 2011-13 and above or very near those for 2014-16. It is likely that ozone during the years 2008-10 was lower

40 Temperature data is shown for the inland Lake Geneva monitor rather than for the Chiwaukee Prairie monitor itself because temperature at the lakeshore monitor can be greatly affected by localized lake breeze events, which would not impact temperature and precursor emission rates sensitive to temperature in upwind areas where the ozone is formed. Using Lake Geneva temperatures removes localized impacts and should be reflective of regional temperatures. Correlations between ozone parameters and temperatures at the Milwaukee Airport were conducted and are shown in Appendix 10. However, the correlations with temperatures at Lake Geneva were stronger.
than during the other years because of the economic recession, which lowered emissions because of less economic activity. This impact is apparent in monitored NOx (Figure 5.9) and VOC (Figure 5.10) concentrations and was confirmed by a recent research study\textsuperscript{41}.

**Figure 5.5.** Trends in monthly averages of two ozone concentration parameters (mean maximum daily 8-hour average, MDA8, and maximum MDA8) plotted versus four different temperature parameters. Data are grouped into three- or four-year groups. Ozone was measured at the Chiwaukee Prairie monitor whereas temperature was measured at the inland Lake Geneva monitor.\textsuperscript{40}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure5_5.png}
\caption{Trends in monthly averages of two ozone concentration parameters (mean maximum daily 8-hour average, MDA8, and maximum MDA8) plotted versus four different temperature parameters. Data are grouped into three- or four-year groups. Ozone was measured at the Chiwaukee Prairie monitor whereas temperature was measured at the inland Lake Geneva monitor.}
\end{figure}

In all of these graphs, the trend line for the most recent set of years, 2014-16, is either the lowest or among the lowest (with the low-ozone recession years, 2008-10), indicating that these years yielded the lowest amount of ozone for a given amount of warmth. This analysis confirms the conclusion of the CART analysis that ozone concentrations, when controlled for meteorology, have continued to decrease, even in the last few years. These findings suggest that, independent

of meteorology, reductions in ozone precursor emissions (discussed in Chapter 3 and section 5.3) are continuing to drive decreases in ambient ozone concentrations. The analysis furthermore suggests that the apparent “flatness” of the trend in monitored ozone concentrations since 2008 likely reflects variable meteorology, in concert with a return to more typical economic activity levels, rather than a true leveling off in the pattern of declining ozone concentrations. This is evident from the finding that 2014-16 showed reduced relative ozone compared to the 2011-2013 period and similar concentrations relative to 2008-10, a unique period of both lower ozone formation propensity and lowered relative economic activity.

5.3. Trends in Ambient Ozone Precursor Concentrations

5.3.1. NOx and VOC Roles in Ozone Formation and Emission Trends

Ozone is formed from the reaction of NOx and VOCs in the presence of sunlight. Ozone formation involves a number of different reactions. Partly because of the interactions between these different reactions, rates of ozone formation often respond non-linearly to reductions in ozone precursor concentrations. For example, under some circumstances, ozone formation may be NOx-limited, such that reductions in NOx emission cause reductions in ozone concentrations. Under NOx-limited conditions, VOC reductions may not affect ozone concentrations. Under other conditions, ozone formations may be VOC-limited. Currently, ozone formation in most of the eastern U.S. is believed to be NOx-limited\(^\text{42}\). The primary exception to this assumed NOx-limitation is in the largest urban centers, which often have high NOx concentrations and where ozone formation may be limited by the concentrations of the less-abundant VOCs. Because of this complex chemistry, approaches to decreasing ozone concentrations have relied on reductions in both NOx and VOC emissions.

NOx consists of nitric oxide (NO) and nitrogen dioxide (NO\(_2\)). Most NOx is emitted as NO, which reacts fairly rapidly in the atmosphere to form NO\(_2\), which has a longer lifetime in the atmosphere and can be transported longer distances. VOCs are a complex mixture of hundreds of different types of organic compounds, including compounds that contain only carbon and hydrogen (“hydrocarbons”) and compounds that also include oxygen, nitrogen, sulfur and/or other elements. Some VOCs are emitted directly by anthropogenic sources, including benzene and toluene, whereas others are formed in the atmosphere from reaction of other VOCs. These “secondary VOCs” include formaldehyde and acetaldehyde, which are important “carbonyl” compounds.\(^\text{43}\)

Emissions of both NOx and VOCs have decreased dramatically in the last few decades from Wisconsin and other U.S. states. Emissions of NOx from sources in Wisconsin decreased by 51% from 2002 to 2014, and emissions of VOCs decreased 50% in this same timeframe (Figure 5.6). These reductions resulted from the control programs described in Section 3.6, as well as earlier programs. Most of the NOx reductions came from the utility, highway vehicle, and off-highway vehicle sectors, whose emissions have decreased by 76%, 56% and 46%, respectively. VOC emissions reductions primarily occurred in the solvent utilization, highway vehicle, off-highway vehicle and other combustion sectors, whose emissions decreased by 41%, 48%, 35%.


\(^{43}\) Carbonyl compounds contain a carbon-oxygen double bond.
and 63%, respectively. Vehicle VOC emission reductions resulted from reduced evaporative losses and reduced exhaust levels.

Emissions from sources in Illinois and Indiana have decreased by similar proportions (Figure 5.7)\textsuperscript{44}, although VOC emissions from these states remained relatively constant from 2011 to 2014. Table 5.3 shows that emissions from the Wisconsin portion of the Chicago nonattainment area are only a tiny fraction of total emissions from the area, accounting for 1.5% to 3.4% of NOx and VOC emissions. Emissions inventories for 2011 and projections for 2017 are discussed in more detail in Chapters 3 and 4. Emissions of both pollutants are projected to continue to decrease through 2017 and beyond, both inside the nonattainment area and throughout the remainder of the three-state area.

**Figure 5.6.** Statewide annual NOx (top) and VOC (bottom) emissions by sector for the years 2002 through 2014. Data from the National Emissions Inventory (NEI), with updates to the mobile source sectors by EPA.\textsuperscript{45}

\textsuperscript{44} NOx emissions decreased 55% from Illinois and 52% from Indiana during this timeframe. VOC emissions decreased 42% from Illinois and 34% from Indiana.

\textsuperscript{45} Data for 2014 is from https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei. Data from earlier years is from https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data.
Figure 5.7. Annual statewide emissions of (top) NOx and (bottom) VOCs from the three states in the Chicago nonattainment area. Data sources as cited in Figure 5.6.

Table 5.3. Comparison of 2011 and projected 2020 emissions of NOx and VOCs from the portions of each state in the Chicago nonattainment area. (Data were developed by each state for their 2016 redesignation requests for the Chicago nonattainment area.)

<table>
<thead>
<tr>
<th>State</th>
<th>NOx emissions</th>
<th>VOC emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2011</td>
<td>2020</td>
</tr>
<tr>
<td>IL</td>
<td>614.35</td>
<td>345.98</td>
</tr>
<tr>
<td>IN</td>
<td>151.80</td>
<td>102.32</td>
</tr>
<tr>
<td>WI</td>
<td>19.11</td>
<td>15.73</td>
</tr>
<tr>
<td>Total</td>
<td>785.25</td>
<td>464.01</td>
</tr>
<tr>
<td>WI % of Total</td>
<td>2.4%</td>
<td>3.4%</td>
</tr>
</tbody>
</table>
5.3.2. Trends in Ambient NOx Concentrations in Wisconsin

WDNR monitored ambient NOx concentrations in 2015 at two locations in the eastern part of the state (Figure 5.8), one urban (Milwaukee SER) and one rural (Manitowoc).\(^4\) None of these monitors are located within the eastern Kenosha County nonattainment area. However, trends at the existing monitors can provide insight into how ambient concentration along the lakeshore and in nearby inland counties have changed. Note that NOx may be transported significant but variable distances under the same meteorological conditions that transport ozone (discussed in Section 2.2). This means that concentrations measured at a given location may include NOx from both local and regional (upwind) sources.

Figure 5.8. Monitoring locations for ambient NOx and VOCs in Wisconsin. The eastern Kenosha County and Sheboygan County nonattainment areas are shaded in gray.

\(^4\) Monitoring NOx and VOC concentrations is relatively complicated, labor-intensive and expensive. Consequently, measurements of these pollutants in Wisconsin (and in most states) have been very limited, both spatially and temporally (i.e., many measurements are only made in the summer). It is also worth noting that there is only one location in the state at which both NOx and VOCs are measured (Milwaukee SER).
Average summer NOx concentrations were highest in all years at the urban (Milwaukee SER) monitor, followed by Manitowoc, which is located along the northern Lake Michigan shoreline (Figure 5.9). Average NOx concentrations at the Milwaukee SER monitor have decreased significantly since monitoring began in 2000. From 2000 to 2015, mean summer NOx concentrations decreased 54%, with the largest changes coming between 2003 and 2009 (Figure 5.9). NOx concentrations have continued to decrease, although the rate of decrease appears to have slowed. The 54% reduction in ambient NOx concentrations at Milwaukee SER (54% from 2000 to 2015) is similar in size to the reduction in NOx emissions from the entire state of Wisconsin (51% from 2002 to 2014; Figure 5.6) over a similar time period. The dip in concentrations in 2009 likely reflects the effect of the economic recession on economic activity.

NOx concentrations at Manitowoc increased slightly from 2007, when measurements began, until 2010 and have decreased fairly steadily since then. However, given the much lower concentration of NOx at Manitowoc, the magnitude of these changes is much smaller than at Milwaukee SER.

NOx concentrations in Kenosha County are likely heavily influenced by transport from the rest of the Chicago area. NOx concentrations are trending down at Illinois’s Chicago monitors (as shown in Appendix 10) at similar rates to the trends shown for Milwaukee. The finding that monitored concentrations at the downwind Manitowoc monitor are also decreasing suggests a linkage between upwind and downwind NOx trends. This all suggests that ambient NOx concentrations in Kenosha County are likely decreasing. However, the magnitude of the NOx concentrations and concentration decreases in Kenosha County are unknown due to the lack of NOx monitoring data in Kenosha County.

**Figure 5.9. Trends in ambient NOx concentrations at Wisconsin monitors during the summer months (June-August).**
5.3.3. Trends in Ambient VOC Concentrations in Wisconsin

WDNR measured concentrations of 56 VOC compounds at one urban location (Milwaukee SER) and a smaller set of VOC compound measurements at two other locations, one urban (Milwaukee SER) and one rural (Horicon; Figure 5.8). None of these monitors is located within the current Kenosha County nonattainment area. However, as with NOx, trends at the existing monitors can provide insight about concentration changes in the region. The VOC compounds monitored at the Milwaukee SER site included 53 hydrocarbons and three carbonyls (formaldehyde, acetaldehyde and acetone). At the other two monitors, the compounds measured included the three carbonyls and a smaller subset of hydrocarbons. A complete listing of the VOCs measured at the different sites, along with their concentrations for a subset of years, is in Appendix 10. This document shows trends in the sums of compound classes, with VOCs separated into carbonyl and hydrocarbon classes. Because only a subset of hydrocarbons were measured at the Milwaukee Health Center and Horicon-Mayville sites, hydrocarbon sums are not shown here for those sites. Appendix 10 also shows trends in sub-classes of hydrocarbons (including n-alkanes, branched and cyclic hydrocarbons, unsaturated hydrocarbons, aromatic hydrocarbons and isoprene). VOCs were measured year-round at the Horicon-Mayville and Milwaukee Health Center sites but only monitored during the summer months (June-August) at the Milwaukee SER site.

Summer average concentrations of carbonyls were lowest at the rural Horicon-Mayville site and highest at the Milwaukee Health Center site in most years (Figure 5.10). There was a clear though uneven decrease in carbonyls at the Milwaukee SER and Horicon-Mayville sites. The trend at the Milwaukee Health Center site was more variable. However, concentrations at this monitor decreased fairly consistently from 2010 to 2015. Overall, carbonyl concentrations decreased by 12%-15% at the Milwaukee monitors and 2% at Horicon-Mayville over each site’s monitoring period (Figure 5.10). However, reductions from concentration peaks (around 2005-2006) were significantly greater.

47 The minimum in carbonyl VOCs in 2009 at both Milwaukee sites likely reflects decreased economic activity during the recession. Carbonyl concentrations appeared especially low in 2004, the first year of measurement at both the Milwaukee SER and Horicon-Mayville sites. This may be because the summer of 2004 was very cool, which can affect formation of secondary VOCs like formaldehyde and acetaldehyde.

48 The larger amount of variability at the Milwaukee Health Center site likely results because these samples are only collected once every 12 days (as opposed to every 6 days at Milwaukee SER currently), so that fewer measurements are averaged together for each summer. As a result, one unusual measurement can have a greater influence on the average.
Figure 5.10. Trends in summer (June-August) mean concentrations of two different classes of VOCs: (left) carbonyls and (right) hydrocarbons. Hydrocarbons are not shown for the Milwaukee Health Center or Horicon-Mayville monitors because only a few compounds were measured at these sites.

Summer average total hydrocarbons at the Milwaukee SER site showed a large (45%) but variable decrease between 2000 and 2015 (Figure 5.10). This is similar in magnitude to the reduction in VOC emissions from the entire state over a similar time period (50% from 2002 to 2014; Figure 5.6). Concentrations of all of the sub-classes of anthropogenic hydrocarbons also decreased during this time period (Appendix 10). As discussed for NOx, the minimum in 2009, and likely the lower concentrations in 2008 and 2010, probably reflect decreased emissions due to lower economic activity because of the recession. 2008 and 2009 also reflected summers with lower peak and average temperatures, conditions that would reduce seasonal average rates of evaporative fuel and uncontrolled solvent emissions of VOCs. Appendix 10 shows graphical trends in these hydrocarbon compound class averages, as well as showing the concentrations and percent changes in concentrations of individual VOC compounds.

VOC concentrations in Kenosha County are likely also decreasing, as found for the nearby Milwaukee monitors, as well as the inland rural monitor at Horicon. However, the magnitude of the concentrations and concentration decreases in Kenosha County is unknown due to the lack of VOC monitoring in the county.

5.3.4. Comparison of Trends in Emissions and Monitored Concentrations

Figure 5.11 compares trends in emissions and monitored concentrations of ozone precursors, as well as monitored ozone concentrations. All trends are normalized to their value in 2008 in order to directly compare the different parameters. This comparison shows that monitored NOx concentrations in Milwaukee tracked inventoried statewide NOx emissions relatively well (Figure 5.11). NOx emissions and concentrations in Milwaukee were both 1.5-1.7 times higher in 2002 relative to 2008. NOx emissions and Milwaukee concentrations in 2014 decreased by similar amounts from their 2008 values. NOx concentrations at the downwind, rural Manitowoc monitor were much lower than those in Milwaukee and were more decoupled from statewide emissions, although they showed similar reductions in 2014 relative to 2008.
Figure 5.11. Trends in (top) NOx and (bottom) VOC statewide emissions and monitored concentrations in Wisconsin, along with ozone design values at the Chiwaukee Prairie (CP) and Kohler Andrae (KA, in Sheboygan County) monitors. All values were normalized to their value in 2008 to allow comparisons of relative reductions over time. HC = hydrocarbon VOCs, and carbonyls are a class of VOCs including formaldehyde, acetaldehyde and acetone. Emissions data is from EPA (https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data).
Similarly, trends in hydrocarbon VOCs at the Milwaukee SER monitor tracked statewide VOC emissions fairly well, although monitored concentrations were more variable than emissions (Figure 5.11). Emissions and monitored hydrocarbon concentrations both decreased from 1.3-1.5 times 2008 levels in 2002 to 0.8 times 2008 levels in 2014. Monitored concentrations of carbonyl VOCs were more variable than were hydrocarbons but also roughly follow the emission trends. In particular, urban carbonyl concentrations have seemed to track emissions since roughly 2006. Most hydrocarbon VOCs are directly emitted from sources, whereas carbonyls can be formed from reactions in the atmosphere, so it is unsurprising that these two types of VOCs have somewhat different trends. However, overall, monitored VOC concentrations have decreased as VOC emissions have decreased.

While monitored ozone concentrations have decreased during this time period, the magnitude of this decrease has not tracked NOx or VOC emission or concentration trends very closely (Figure 5.11). Ozone concentrations have decreased at a much slower rate than have either precursor emissions or monitored precursor concentrations. This slower rate of reductions likely results from a variety of factors that affect ozone formation and cause its concentrations to be nonlinear with the concentrations of ozone precursor concentrations. These factors include:

- Meteorological variability between years.
- The nonlinearity of ozone chemistry.
- The influence of ozone transported from upwind regions in the U.S. and from other countries.

The role of these different factors in contributing to ozone formation and trends are discussed in more detail in Sections 5.2 and 5.4.

5.4. Influence of Transport and Chemistry on Ozone Trends

Ozone concentrations can be influenced by several other factors besides the local concentration of ozone precursors and meteorology. These factors include transport from upwind areas and ozone formation chemistry. This part of the document examines the role of each of these factors in driving ozone concentrations in Kenosha County. These analyses highlight the importance of interstate transport in delivering ozone to the Chiwaukee Prairie monitor and underscore the need for more information on current ozone chemistry in this region.

5.4.1. Influence of Transport on Ozone, NOx and VOC Concentrations

One of the most important factors driving high ozone concentrations in Wisconsin’s ozone nonattainment areas is transport of ozone and ozone precursors from upwind areas. Recent source apportionment modeling from LADCO found that out-of-state emissions were responsible for approximately 89% of the measured ozone concentrations at the Chiwaukee Prairie monitor; in contrast, Wisconsin sources contributed less than 11% (Figure 5.12). Six nearby states together contributed 47% of the measured ozone. In particular, Illinois and Indiana contributed 33% and 6% of the measured ozone, respectively. Contributions from outside the U.S. (“boundary conditions”) and from natural sources (“biogenics”) contributed 28%. This modeling similarly showed that out-of-state contributions dominate measured ozone concentrations at the state’s other ozone nonattainment area, Sheboygan County. The transport of such large amounts
of ozone and ozone precursors from areas outside Wisconsin significantly limits the state’s ability to reduce high ozone concentrations within its borders.

Figure 5.12. Ozone source apportionment modeling from LADCO for Kenosha. Colors correspond to emission source categories, as discussed in Chapter 3.49

To further examine the role of transport on ozone at any given site, it is informative to investigate how pollutant concentrations vary with wind direction. Winds from different directions transport pollutants from different upwind origins. The coastline around the Chiwaukee Prairie monitor is oriented more or less in a straight north-south direction (Figure 1.1). Figure 5.13 shows one-hour ozone concentrations and wind data at this monitor for hours when ozone concentrations exceeded the standard. This analysis showed that high ozone concentrations almost always occurred when winds were from the south-southeast (Figure 5.13). Roughly 64% of ozone came to the Chiwaukee Prairie monitor from 146°-185° during high-ozone hours. Winds from these directions include lake breeze transport and direct transport from the south over Lake Michigan. Another 19% of the high ozone concentrations came from the south over land, from 186°-265°. This ozone presumably originated from sources to the south but was not carried over Lake Michigan. Only 7% of the ozone came with winds from the north, and only 1% came from over land to the north (e.g., from over Wisconsin’s land mass). This analysis indicates that high ozone concentrations almost never occurred when winds came from directly over Wisconsin.

49 The Central region includes MN, IA, NE, KS, OK, TX, AR and LA. The Southeast region includes MS, AL, GA, FL, TN, VA, NC and SC. The West region includes WA, OR, CA, NV, ID, MT, WY, UT, CO, AZ, NM, ND and SD. The Northeast region includes ME, NH, VT, MA, RI, CT, NY, NJ, PA, DE, MD, and WV. BC is boundary conditions, which are contributions from outside the U.S. Bio and Biog are biogenics.
Figure 5.13. (left) One-hour ozone concentrations above 75 ppb plotted by wind direction and (right) percent contributions of ozone above 75 ppb from different wind directions for the Chiwaukee Prairie monitor. The length of the paddle in the pollution rose (left) indicates the frequency of that concentration-wind direction combination, and the color indicates the concentration (in ppb). Data are for 2000-2015, as available.

These findings confirm that ozone concentrations in the nonattainment area are dominated by ozone transported into the area. Transport from the south, primarily over Lake Michigan but also over land, is the primary cause of the high concentrations of ozone measured at this location. This transport most often occurs during a lake breeze event but may also occur with synoptic southerly winds (see Chapter 2).

5.4.2. Influence of Ozone Formation Chemistry on Ozone Concentrations

As discussed in Section 5.3.1, ozone formation is known to be nonlinear with concentrations of NOx and VOCs, and at some points may be sensitive to changes in NOx concentrations and at others sensitive to changes in VOC concentrations. Under other circumstances, primarily in heavily polluted urban centers, high NOx concentrations may react with ozone, lowering its concentration locally via “titration”. However, this ozone generally reforms downwind. Precursor concentrations can also affect the rates at which ozone is formed via complex chemical processes. Overall, the chemistry of ozone formation is extremely complicated.

Understanding of ozone chemistry in the region is not current. The large changes in NOx and VOC concentrations have likely changed the susceptibility of ozone formation to changes in precursor concentrations, as well as to other factors (as shown for meteorology in the Section 5.2.3). However, the last major field study to make direct measurements of ozone chemistry in the Lake Michigan region ended in 2003. At that time, NOx and VOC concentrations were 1.5

50 Several field campaigns have been conducted to study ozone over Lake Michigan, most notably the Lake Michigan Ozone Study (LMOS) in 1991 and the LADCO Airplane Project from 1994-2003. A field campaign to help better understand current regional ozone chemistry, the Lake Michigan Ozone Study 2017, is scheduled for
to 2 times higher than today (Figures 5.9 and 5.10), and ozone design values were more than 20 ppb (roughly 30%) higher in Kenosha (Figure 5.1).

Examination of the changes in the weekday/weekend effect on ozone formation demonstrate that ozone chemistry in the region has in fact changed over time. Studies of this effect have been used to gain insight into the sensitivity of ozone concentrations to reductions in NOx emissions. Such studies take advantage of the fact that NOx emissions and concentrations tend to be lower on weekends than during the week (Figure 5.14), primarily due to decreased heavy vehicle traffic. As has been found in other studies in this and other regions, average ozone concentrations at the Chiwaukee Prairie monitor in 2001-2005 increased over the weekend, reaching a maximum on Sunday, when NOx concentrations are at their lowest (Figure 5.14). This effect has been attributed to reducted titration of ozone by high NOx concentrations on weekdays and other related effects. Similar findings in the region have been interpreted as suggesting that controlling urban NOx emissions might not be an effective local pollution control strategy.

**Figure 5.14.** Average (left) NOx concentrations for the Milwaukee SER monitor and (right) 95th percentile maximum daily 8-hour average (MDA8) ozone for the Chiwaukee Prairie monitor for each day of the week, grouped into five- or six-year groups.

![Figure 5.14](image)

Figure 5.14 shows that the weekday/weekend effect decreased dramatically in 2006-2010. For the most recent time period examined, 2011-2016, average ozone concentrations remained virtually constant between the different days of the week for this site. The same results were found for all sites along Wisconsin’s and Illinois’s Lake Michigan lakeshore (not shown), as well as in other parts of the country. This updated analysis suggests that ozone formation chemistry has changed over the last 15 years, and any disbenefit to NOx reductions that may have existed during May-June 2017. The results of this field campaign should allow better understanding of ozone chemistry and more accurate evaluation of control strategies for future attainment demonstrations, if needed.


53 These effects may, however, be complicated by the relatively long lifetimes of ozone and ozone precursors, such that ozone formed on one day might affect a site a day or two later.

in the early 2000s appears to be gone. However, other lines of evidence suggest that a NOx
disbenefit may continue in urban centers, and more work is required to fully evaluate the current
chemistry of ozone formation in this region.

5.5. Conclusion

These weight of evidence analyses support the modeled projection of attainment in eastern
Kenosha County. As shown above, monitored ozone concentrations have decreased since 2000.
When adjusted to account for meteorological variability, ozone concentrations for equivalent
conditions also show a decrease. Emissions of NOx and VOCs from Wisconsin have decreased
over each three-year period from 2002 through 2014, as reflected in the periodic annual
inventories (NEI) and inclusive of the economic recession in 2008-2010. Similar reductions
occurred in Illinois and Indiana emissions. Over this same period, monitored NOx and VOC
concentrations along Wisconsin’s Lake Michigan shoreline also decreased, following a similar
pattern.

These analyses show that a majority of the ozone measured at the Chiwaukee Prairie monitor
was delivered via transport from upwind states, with very little originating from sources in
Wisconsin. This demonstrates that controls on sources in upwind states have been essential to
reducing ozone concentrations in eastern Kenosha County to date. Such upwind controls will
continue to be important for ongoing attainment and maintenance of the 2008 ozone NAAQS in
the Wisconsin portion of the Chicago nonattainment area.
6. OTHER MODERATE AREA SIP REQUIREMENTS

6.1. Transportation Conformity

Transportation conformity is required under CAA section 176 (c) (42 U.S.C 7506(c)) to ensure that federally funded or approved highway and transit activities are consistent with (“conform to”) the purpose of the SIP. “Conform to” the purpose of the SIP means that transportation activities will not cause or contribute to new air quality violations, worsen existing violations, or delay timely attainment of the relevant NAAQS or any interim milestones. Transportation conformity applies to designated nonattainment and maintenance areas for transportation-related criteria pollutants: ozone, fine particles (PM\textsubscript{2.5}), coarse particles (PM\textsubscript{10}), carbon monoxide, and nitrogen dioxide. EPA’s transportation conformity rule (40 CFR Parts 51 and 93) establishes the criteria and procedures for determining whether metropolitan transportation plans, metropolitan transportation improvement programs, federally supported highways projects, and federally supported transit projects conform to the SIP.

The eastern Kenosha County nonattainment area currently demonstrates transportation conformity using the “Motor Vehicle Emissions Budget (MVEB) Test” (40 CFR 93.119). WDNR submitted an early progress SIP with updated MVEBs for the eastern Kenosha County nonattainment area on January 16, 2015. On April 1, 2015, EPA found the MVEBs for Wisconsin’s 8-hour ozone nonattainment area were adequate for use in transportation conformity determinations (80 FR 17428).

EPA requirements outlined in 40 CFR 93.118(e) (4) stipulate that MVEBs for NOx and VOC are established as part of a control strategy implementation plan revision or maintenance plan. MVEBs are necessary to demonstrate conformance of transportation plans and improvement programs with the SIP.

6.1.1. Motor Vehicle Emissions Model

The EPA’s MOVES2014a model is used to derive estimates of hot summer day emissions for ozone precursors of NOx and VOCs. Numerous variables can affect these emissions, especially the size of the vehicle fleet (the number of vehicles on the road), the fleet’s age, the distribution of vehicle types, and the VMT. The transportation information is derived from a travel demand model. Appendix 5 contains key data used to develop inputs to MOVES2014a.\textsuperscript{55}

6.1.2. Motor Vehicle Emissions Budgets (MVEBs)

Table 6.1 contains the MVEBs for the eastern Kenosha County nonattainment area for the years 2017 and 2018. Since assumptions change over time, it is necessary to have a margin of safety that will accommodate the impact of refined assumptions in the process. 40 CFR 93.101 defines safety margin as the amount by which the total projected emissions from all sources of a given pollutant are less than the total emissions that would satisfy the applicable requirement for RFP, attainment, or maintenance. WDNR increased the on-road mobile source portions of the 2017 and 2018 projected emissions inventories by 7.5% for eastern Kenosha County to account for

\textsuperscript{55} The complete set of inputs to MOVES2014a is too lengthy to include in this document. However, electronic copies of the inputs can be obtained from WDNR by sending an email to christopher.bovee@wisconsin.gov or by phone at (608) 266-5542.
uncertainties in future mobile source emissions. Even with this emissions buffer in the modeled demonstration, eastern Kenosha County is forecast to attain the 2008 ozone standard.

For the eastern Kenosha County nonattainment area, transportation conformity will be based on the submitted MVEBs after EPA determines that the budgets meet the adequacy criteria of the transportation conformity rule. Once these budgets are found adequate by EPA, they will replace the MVEBs established for the 2008 ozone early progress plan (80 FR 17428). Table 6.1 identifies the 2017 and 2018 MVEBs for the Wisconsin 2008 ozone attainment plan for use in transportation conformity analyses.

**Table 6.1. Motor vehicle emissions budgets (MVEBs) for eastern Kenosha County for 2017 and 2018.**

<table>
<thead>
<tr>
<th>Year</th>
<th>Emissions (tons per hot summer day)</th>
<th>VOC</th>
<th>NOx</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td></td>
<td>1.56</td>
<td>3.05</td>
</tr>
<tr>
<td>2018</td>
<td></td>
<td>1.44</td>
<td>2.75</td>
</tr>
</tbody>
</table>

### 6.2. Reasonably Available Control Technology (RACT) Program for NOx

Wisconsin’s NOx RACT program was first adopted by the state in July 2007 as codified under s. NR 428.20 to 428.26, Wis. Adm. Code. The program was approved by EPA into the SIP in October 2009 (75 FR 64155). This program was established to fulfill NOx RACT requirements for southeast Wisconsin counties, including eastern Kenosha County, that were designated moderate nonattainment under the 1997 ozone NAAQS.

WDNR has determined that Wisconsin’s current NOx RACT program fulfills RACT requirements under the 2008 ozone NAAQS. The basis for this determination is:

1) Wisconsin’s existing NOx RACT program applies to major sources with a potential-to-emit of 100 tons per year and thus meets the necessary applicability requirements.

2) A review of control technology indicates that a new assessment of control technology conducted for the 2008 ozone NAAQS would not change the determination of RACT under Wisconsin’s existing program.

#### 6.2.1. Major Source Applicability

EPA set applicability of RACT for non-CTG facilities at an emissions threshold of 100 tons per year (TPY) or more based on a facility’s PTE. Wisconsin applied this threshold in setting emission limitations for the current RACT program, which was originally promulgated to fulfill requirements for moderate nonattainment counties. Since EPA has already approved Wisconsin’s RACT program for moderate nonattainment areas, this existing program likewise satisfies RACT applicability for Kenosha’s moderate nonattainment designation under the 2008 ozone NAAQS.

6.2.2. Control Technology

The 2008 ozone implementation rule provides that states can show that existing NOx RACT programs fulfill requirements for the 2008 NAAQS\textsuperscript{57}. EPA states this demonstration should be based on a review of RACT control technologies for conditions in 2008. If this review indicates there would be no incremental difference in control technologies between the existing program and the updated assessment, the existing program can be certified as meeting RACT under the 2008 NAAQS. Even in the case that an updated RACT could result in additional emission reductions, EPA indicates that such an action would likely not be cost-effective. EPA states:

“In cases where controls were applied due to the 1-hour or 1997 NAAQS ozone RACT requirement, we expect any incremental emissions reductions from the application of a second round of RACT controls may be small and, therefore, the cost for advancing that small additional increment of reduction may not be reasonable.”

Wisconsin’s NOx RACT program was first implemented in 2007 based on an assessment of the control technologies and cost information available at that time. As a result, WDNR expects little, if any, change in the assessment of RACT control technology between 2007 and 2008, as required under the implementation rule. The RACT assessments would be based on essentially the same information.

However, to ensure this conclusion is correct, WDNR reviewed the current Wisconsin RACT requirements that could apply for emission units operating in eastern Kenosha County in 2008. The RACT source categories and control technologies found applicable are presented in Table 6.2. WDNR’s review showed that two coal-fired boilers operated at the Pleasant Prairie power plant fall in the RACT source category of coal-fired boilers greater than 1,000 mmBtu per hour. These two boilers accounted for approximately 95% of 2008 NO\textsubscript{x} emissions. WDNR also identified other emission units that could potentially be subject to RACT emission limits if they were larger or operated more frequently regardless of facility PTE. This exercise provided insight into other types of sources that could potentially be subject to RACT in the future in eastern Kenosha County. After reviewing the identified source categories and applicable control technologies, WDNR has concluded there would be no change in RACT if an updated assessment of control technology were performed based on 2008, or even 2015, information.

\textsuperscript{57} EPA, 2015, Implementation of the 2008 National Ambient Air Quality Standards for Ozone: Requirements for State Implementation Plans, 80 FR 12279, March 6, 2015.
Table 6.2. RACT control technology required for different source categories under Wisconsin’s NOx RACT program.

<table>
<thead>
<tr>
<th>Source Category</th>
<th>RACT Control Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal-fired boilers &gt; 1000 mmBtu/hr</td>
<td>SCR</td>
</tr>
<tr>
<td>IC engine emergency generators</td>
<td>Exempt</td>
</tr>
<tr>
<td>Natural gas-fired boiler &gt; 100 mmBtu/hr*</td>
<td>LNB/OFA/GR</td>
</tr>
<tr>
<td>Natural gas-fired process heaters &gt; 100 mmBtu/hr*</td>
<td>Low NOx Burners</td>
</tr>
<tr>
<td>Asphalt plants &gt; 65 mmBtu/hr*</td>
<td>Low NOx Burners</td>
</tr>
<tr>
<td>IC engines &gt; 500 hp*</td>
<td>80 – 90% Control (various technologies)</td>
</tr>
</tbody>
</table>

*The WDNR found that these types of emission sources operate in the eastern Kenosha nonattainment area. However, the sources are not above thresholds for applicability of RACT emission limitations.

Thus, based on equivalency in major source applicability and RACT control technology, the WDNR concludes that Wisconsin’s current NOx RACT program under ss. NR 428.20 to 25 fulfills RACT requirements for the 2008 ozone NAAQS.

6.3. Reasonably Available Control Technology (RACT) Program for VOCs

Section 182(b)(2) of the CAA requires states with moderate nonattainment areas to implement RACT under section 172(c)(1) with respect to each of the following:

- Each category of VOC sources in the nonattainment area covered by an EPA control technique guideline (CTG) document issued between the date of the enactment of the 1990 CAA and the date of attainment.
- All VOC sources in the area covered by any CTG issued before the enactment date of the 1990 CAA.
- All other major stationary VOC sources that are located in ozone nonattainment areas.

As a part of its SIP, the WDNR has adopted and implemented administrative rules requiring all existing major stationary sources of VOCs in ozone nonattainment areas to meet VOC RACT. These rules apply to all of Kenosha County because of its nonattainment status under the 1997 ozone NAAQS. These VOC RACT/CTG requirements are codified under chapters NR 419 through 424, Wis. Adm. Code. The list of the CTGs in place in Wisconsin is provided in Appendix 8. All of these CTG requirements were implemented and effective prior to the 2011 base year. Also in Appendix 8, Wisconsin is making a negative declaration for the listed CTG source categories where Wisconsin has determined that there are no identified sources in the eastern Kenosha 2008 ozone NAAQS nonattainment area meeting the applicability criteria recommended in the specified CTG documents. In addition, Wisconsin has adopted MACT rules further controlling air toxics, which include many VOCs, from major sources throughout the state.

All of the above-listed Wisconsin administrative rules and federal regulations collectively comprise a comprehensive VOC emissions control program covering all high-emitting stationary...
sources of VOCs in the eastern Kenosha County nonattainment area. Consequently, the WDNR has determined that these VOC RACT requirements meet the VOC RACT mandate of Subpart 2 of the federal CAA.

6.4. Evaluation of Reasonably Available Control Measures (RACM)

CAA Section 172(c)(1) requires that states implement any reasonably available control measures necessary for attainment of the NAAQS. As detailed in 40 CFR 51.1108(d), any control measures needed for attainment must be implemented by the beginning of the attainment year ozone season, April 15, 2017. With this submittal, Wisconsin is demonstrating that attainment is achieved and therefore no additional control measures are required for that purpose.

However, additional control measures are required if it can advance the attainment date by a year or more. This means that any measures advancing the attainment date by a year would have needed to be in place by April 15, 2016. Since this date has already passed, the WDNR has concluded there is no possibility of implementing any level of additional control prior to this date. Accordingly, no additional controls or emission reductions requirements in Kenosha County are applicable for RACM under the 2008 ozone NAAQS.

6.5. Motor Vehicle I/M Program

The general purpose of motor vehicle I/M programs is to reduce emissions from in-use motor vehicles in need of repairs and thereby contribute to state and local efforts to improve air quality and to attain the NAAQS. Wisconsin’s I/M program has been in operation since 1984. It was originally implemented in accordance with the 1977 CAA Amendments and operated in the six counties of Kenosha, Milwaukee, Ozaukee, Racine, Washington and Waukesha. Sheboygan County was added to the program in July 1993, resulting in a seven-county program area that has remained to the present. Vehicles were originally tested by measuring tailpipe emissions using a steady-state idle test. Tampering inspections were added in 1989. The I/M program is jointly administered by WDNR and the Wisconsin Department of Transportation.

The 1990 CAA Amendments set additional requirements for I/M programs. For moderate areas, a “basic” program was required under section 182(b)(4). For serious or worse areas (which included Kenosha County at that time), an “enhanced” program was required under section 182(c)(3). EPA’s requirements for basic and enhanced I/M programs are found in 40 CFR part 51, subpart S.

Wisconsin’s I/M program transitioned to an enhanced program in December 1995. The major enhancement involved adding new test procedures to more effectively identify high-emitting vehicles. These new test procedures included a transient emissions test in which tailpipe emissions were measured while the vehicle was driven on a dynamometer (a treadmill-type device). Improving repairs and public convenience were also major focuses of the enhancement effort.

Since July of 2001, all model year (MY) 1996 and later cars and light trucks have been inspected by scanning the vehicle's computerized second generation on-board diagnostic (OBDII) system instead of measuring tailpipe emissions. As of July 2008, the program dropped tailpipe testing entirely and has inspected all vehicles by scanning the OBDII system. This change was the result
of statutory changes in the State's 2007-2009 biennial budget which exempted model years of vehicles not federally-required to be equipped with the OBDII technology (MY 1995 and earlier cars and light trucks and MY 2006 and earlier heavy trucks). To help offset the emissions reductions lost from exempting the pre-OBDII vehicles, the program increased the testable fleet for MYs 2007 and later by adding gasoline-powered vehicles between 10,001 to 14,000 pounds gross vehicle weight rating (GVWR) and diesel-powered vehicles of all weights up to 14,000 pounds GVWR.

EPA fully approved Wisconsin's I/M program on August 16, 2001 (66 FR 42949), including the program's legal authority and administrative requirements in the Wisconsin Statutes and Wisconsin Administrative Code. On June 7, 2012, WDNR submitted a SIP revision to EPA covering all the changes to the program since EPA fully approved the program in 2001. This submittal included a demonstration under section 110(l) of the CAA addressing lost emission reductions associated with the program changes. The EPA approved this SIP revision on September 19, 2013 (78 FR 57501).

Legal authority and administrative requirements for the Wisconsin I/M program are found in sections 110.20 and 285.30 of the Wisconsin Statutes and Chapters NR 485 and Trans 131 of the Wisconsin Administrative Code.
7. PUBLIC PARTICIPATION

This section will be completed after the public review process is completed.
8. CONCLUSION

In submitting this attainment plan, Wisconsin is fulfilling its CAA SIP requirements for the eastern Kenosha County moderate nonattainment area for the 2008 ozone NAAQS. Air quality modeling projects that eastern Kenosha County will attain the 2008 ozone NAAQS by the July 20, 2018 moderate area attainment date, as will the rest of the Chicago nonattainment area. Additional air quality monitoring data confirms that concentrations of ozone (when adjusted for meteorology) and ozone precursors have decreased dramatically over the last 15 years in the nonattainment area. Wisconsin has met the required RFP emission reductions due to an array of permanent and enforceable measures. The state has also met all other obligations required of moderate nonattainment areas.