2022 Fine Particles ($PM_{2.5}$) Data Summary Report

Indiana Department of Environmental Management (IDEM)
Office of Air Quality

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About This Report

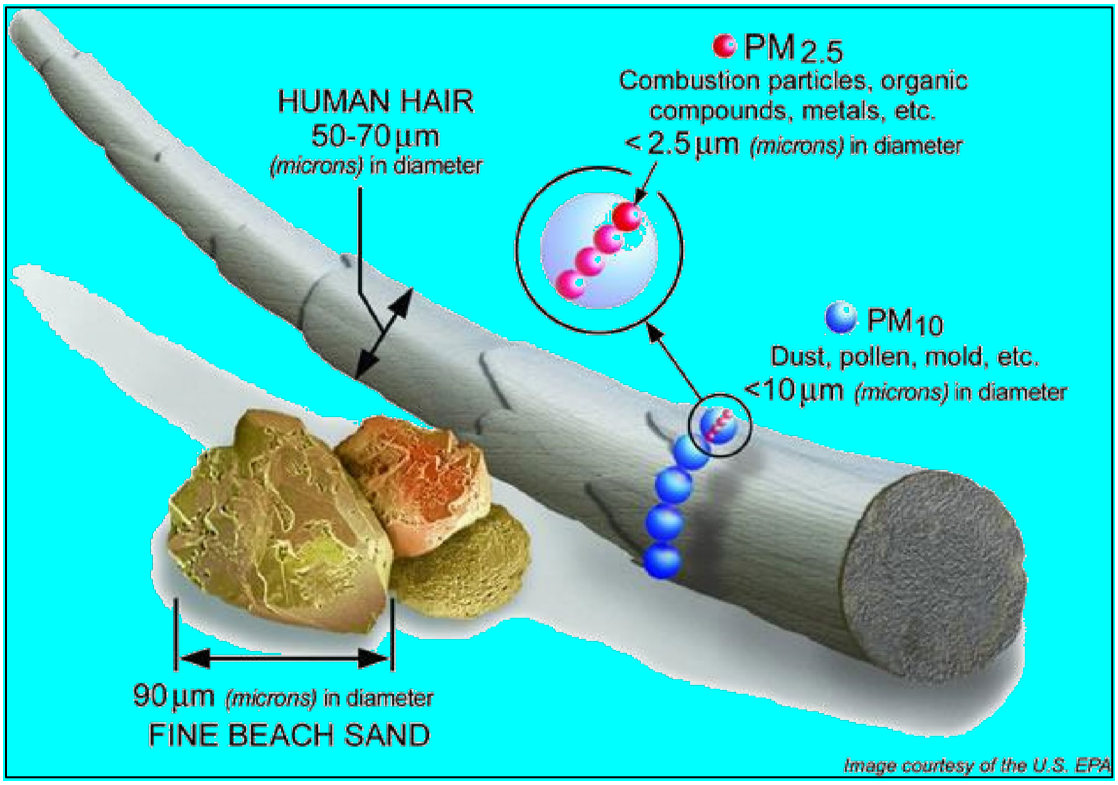
The Indiana Department of Environmental Management (IDEM) collects and analyzes air samples for regulated pollutants, including fine particles, which are referred to as $PM_{2.5}$. IDEM monitors for $PM_{2.5}$ year-round as mandated by United States Environmental Protection Agency (U.S. EPA), and the data is reported to U.S. EPA's Air Quality System (AQS). This ***2022 Fine Particles ($PM_{2.5}$) Data Summary Report*** provides an overview of $PM_{2.5}$ and its impacts, national air health standards, Indiana's $PM_{2.5}$ monitoring network, a summary of 2022 $PM_{2.5}$ monitoring data, air quality trends over the last 10 years, and the status of $PM_{2.5}$ designations in Indiana.

What Is Particulate Matter (PM)?

Particulate matter (PM) is a complex mixture of small particles found in the air, including dust, dirt, smoke, and liquid droplets. PM_{10} refers to extremely small particles that are 10 micrometers, or microns, in diameter or smaller. $PM_{2.5}$ refers to microscopic particles that are 2.5 microns in diameter or smaller.

Exposure to PM poses significant health concerns. As shown in Figure 1, PM_{10} is many times smaller than a fine grain of sand or a human hair. $PM_{2.5}$ is much smaller still. Because of their extremely small size, both PM_{10} and $PM_{2.5}$ can be inhaled deeply into the lungs and are very difficult to exhale.

Figure 1: Illustration of Fine Particles



PM also causes adverse environmental impacts. Airborne particles can settle on any surface, and depending on their composition, may adversely affect lakes, streams and soil, sensitive forests, crops, and ecosystems, and damage or stain buildings and monuments. $PM_{2.5}$ particles in the air cause haze and reduce visibility.

Where does PM come from? PM is generated by all types of combustion activities. Common sources include emissions from coal-fired power plants and industrial boilers, smoke from open burning activities, and motor exhaust. PM also includes dust from unpaved roads, fields, and construction sites.

What are the health effects of exposure to PM? PM is linked to adverse effects on the lungs and heart:

- Increased respiratory symptoms:
  - Irritation of the airways.
  - Coughing or difficulty breathing.
  - Decreased lung function.
  - Aggravated asthma.
  - Development of chronic bronchitis.
- Irregular heartbeats.
- Nonfatal heart attacks.
- Premature death in people with heart or lung disease.

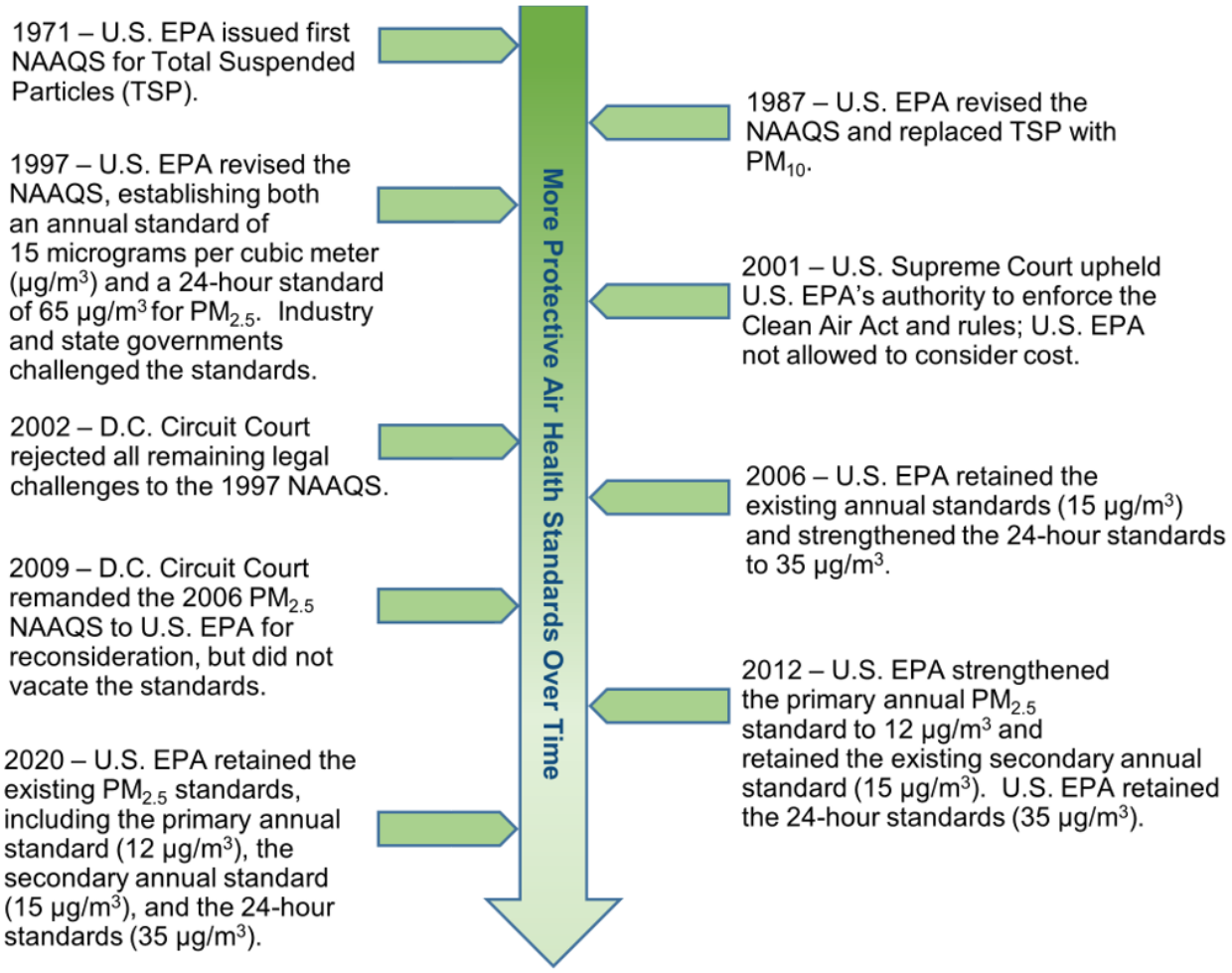
National Ambient Air Quality Standards (NAAQS) for $PM_{2.5}$

The federal Clean Air Act (CAA) requires U.S. EPA to establish National Ambient Air Quality Standards (NAAQS) for common outdoor air pollutants, including $PM_{2.5}$. NAAQS, which are also known as air health standards, include:

- Primary standards for public health, which set pollutant limits to protect the most vulnerable groups such as young children, the elderly, and individuals with respiratory illnesses.
- Secondary standards for public welfare, which set limits to protect visibility and prevent damage to animals, crops, vegetation, and buildings.

Primary and secondary NAAQS established in 1971 set the first limits for total suspended particles (TSP). Reviews and revisions have occurred over the years. Standards for PM_{10} were first established in 1987. Standards for $PM_{2.5}$ were first established in 1997. Figure 2 notes milestones in the history of the $PM_{2.5}$ NAAQS.

Figure 2: History of the $PM_{2.5}$ NAAQS



Attaining the $PM_{2.5}$ Standards

Air quality must meet both the annual and the 24-hour, or daily, standards for $PM_{2.5}$. Three complete, consecutive years of monitoring data is used to make a determination about a given area. For example, an evaluation in 2024 will be based on data from 2021 to 2023.

How does an area attain the current annual $PM_{2.5}$ NAAQS? For the annual standards, measured concentrations are averaged on an annual rolling basis. Air quality meets the primary annual standard when the annual arithmetic mean of the daily values averaged over three years does not exceed 12 micrograms per cubic meter (µg/m³). The secondary annual standard is achieved when the annual arithmetic mean averaged over three years does not exceed 15 µg/m³. The data from each monitor is evaluated.

How does an area attain the current 24-hour $PM_{2.5}$ NAAQS? For the daily standards, measured concentrations are averaged on a 24-hour rolling basis. Air quality meets the primary and secondary daily standards, which are set at the same level, when the three-year average of the 98th percentile of measured concentrations does not exceed 35 µg/m^3. The data from each monitor is evaluated.

What is a design value? The three-year average is referred to as the **design value**. The annual design value is the three-year average of the weighted annual mean $PM_{2.5}$ concentrations. The 24-hour design value is the three-year average of the 98th percentile of 24-hour concentrations.

Monitor design values are calculated at the end of the year once all the data has been quality assured. Where two or more monitors are located within the same area, the monitor with the highest design value is used for the air quality designation.

What is the difference between an exceedance and a violation? When a monitor records a concentration above the limit established by the NAAQS, it is referred to as an **exceedance**. A monitor can have an exceedance without being in **violation** of the standard. If a monitor's three-year design value exceeds the NAAQS, the monitor is in violation.

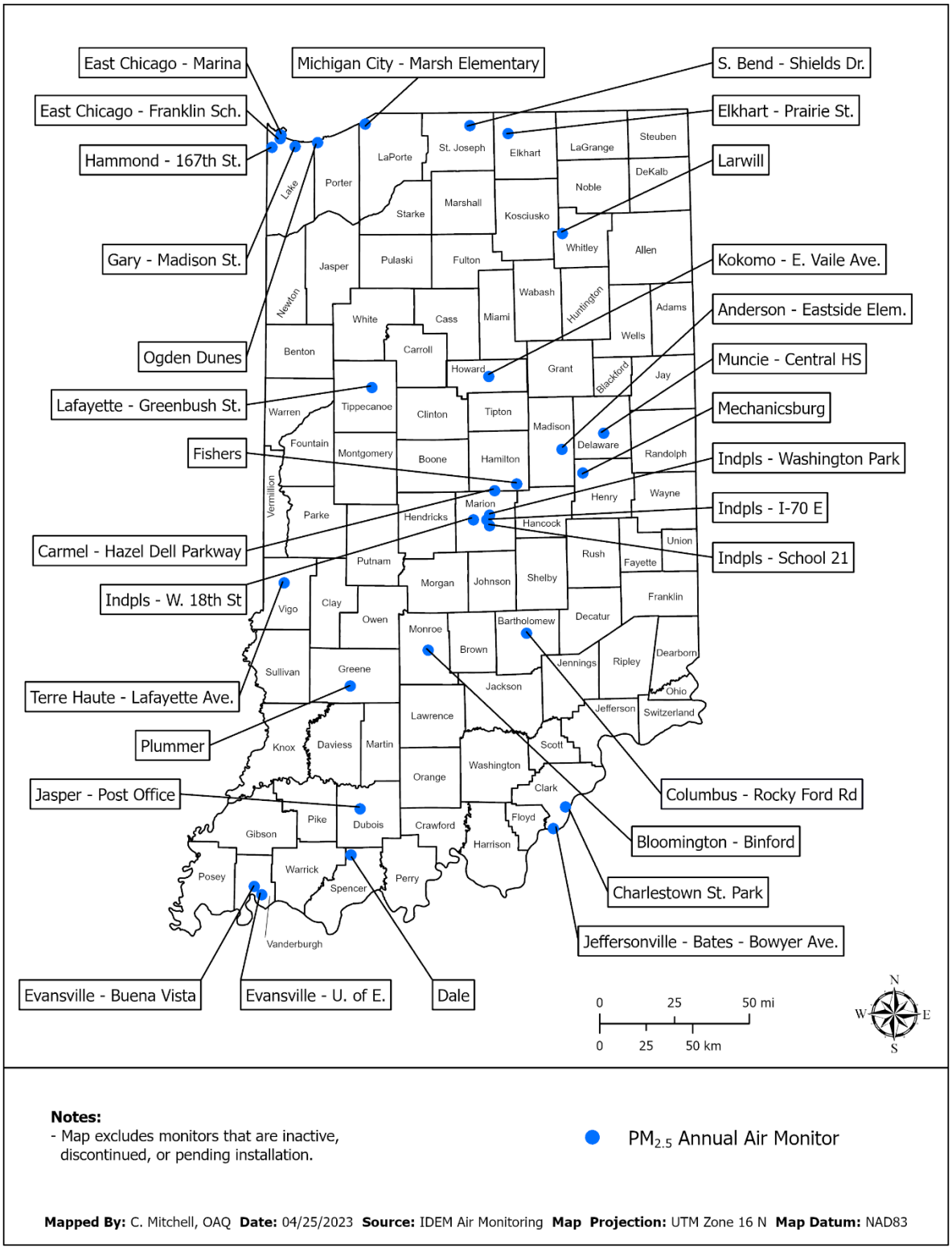
2022 $PM_{2.5}$ Monitoring Network

$PM_{2.5}$ monitors are placed in locations across Indiana according to U.S. EPA guidance on factors including population and manufacturing levels. The annual and 24-hour $PM_{2.5}$ monitoring network consists of 33 monitoring sites in 21 counties (three locations reflect air quality in a relatively small area, are directly influenced by a specific source, and are intended to be used for determining attainment status under the 24-hour standard only).

IDEM conducts annual reviews of the monitoring network, which are published each year in the *Indiana Annual Ambient Air Monitoring Network Plan* and can be viewed on Indiana's Ambient Air Monitoring Network web page at: https://www.in.gov/idem/airmonitoring/indianas-ambient-air-monitoring-network/.

Figure 3 shows annual $PM_{2.5}$ monitor locations and Figure 4 shows 24-hour $PM_{2.5}$ monitor locations for 2022.

Figure 3: Annual $PM_{2.5}$ Monitoring Network for 2022

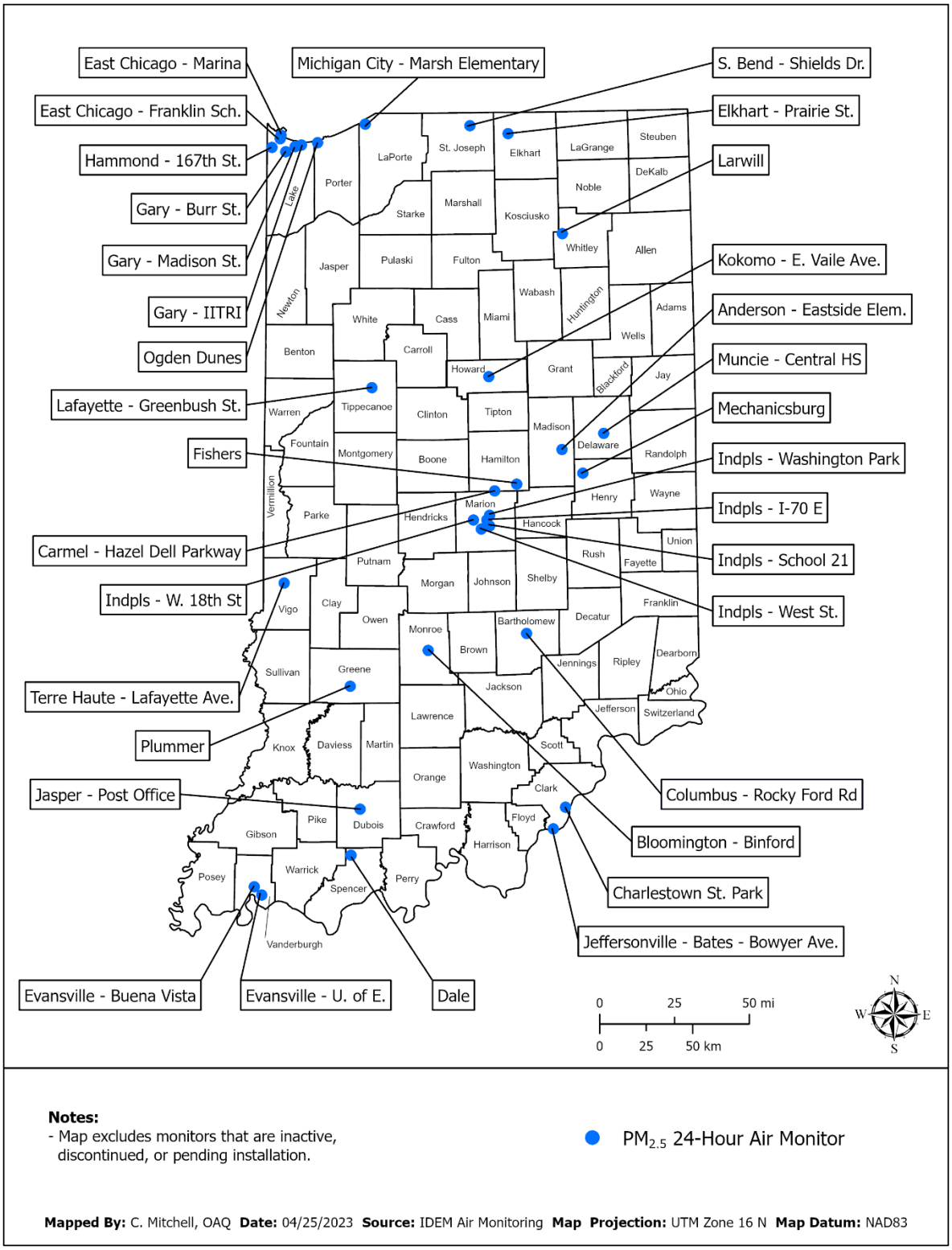


Notes:
- Map excludes monitors that are inactive, discontinued, or pending installation.

● $PM_{2.5}$ Annual Air Monitor

Mapped By: C. Mitchell, OAQ **Date:** 04/25/2023 **Source:** IDEM Air Monitoring **Map Projection:** UTM Zone 16 N **Map Datum:** NAD83

Figure 4: 24-Hour $PM_{2.5}$ Monitoring Network for 2022



Notes:
- Map excludes monitors that are inactive, discontinued, or pending installation.

● $PM_{2.5}$ 24-Hour Air Monitor

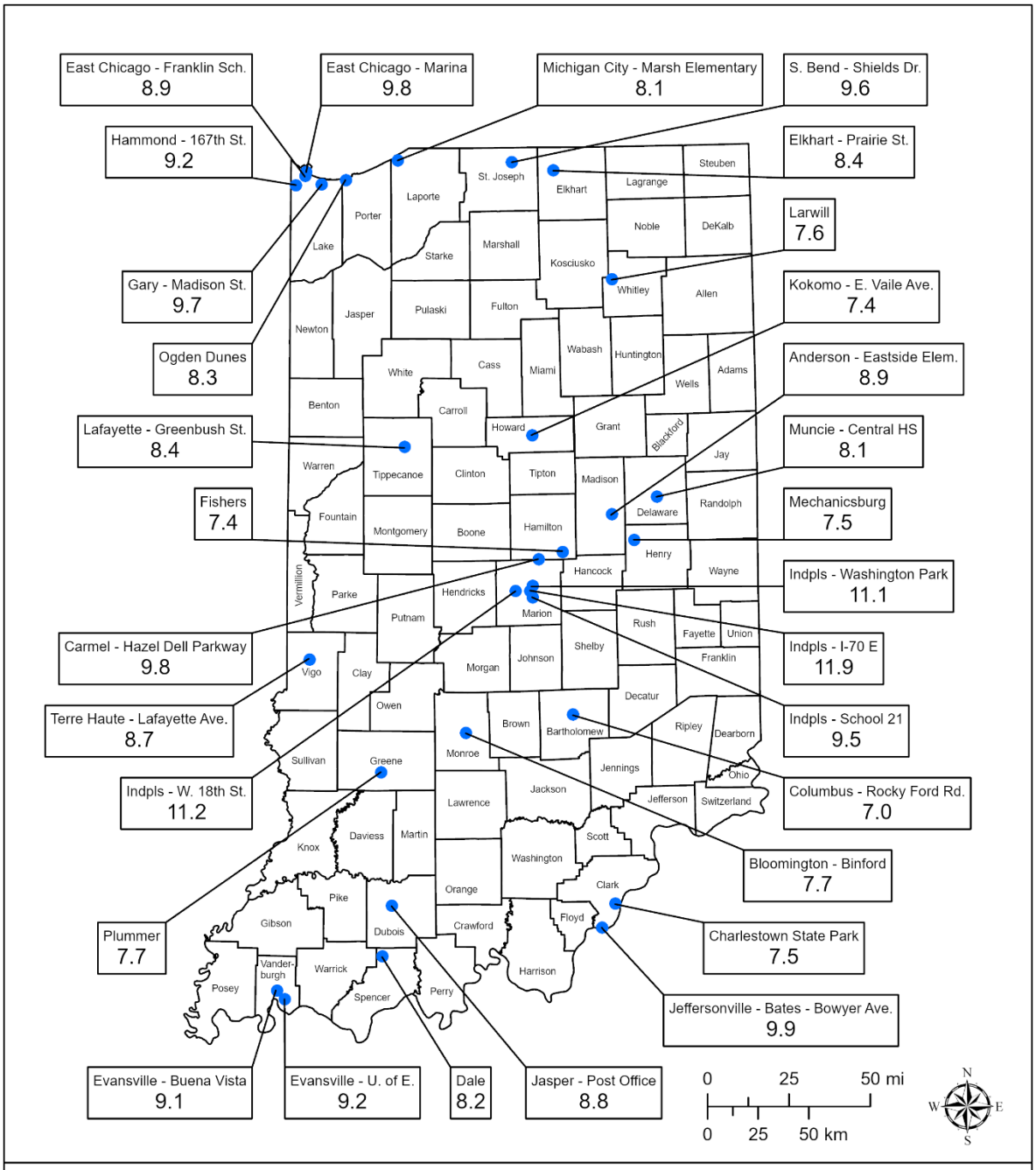
Mapped By: C. Mitchell, OAQ **Date:** 04/25/2023 **Source:** IDEM Air Monitoring **Map Projection:** UTM Zone 16 N **Map Datum:** NAD83

2022 $PM_{2.5}$ Monitoring Data Summary

$PM_{2.5}$ monitoring data has been quality assured for 2022.

Annual Monitoring Data: One monitor in Central Indiana had annual mean $PM_{2.5}$ concentrations above the primary annual standard of 12 µg/m^3 in 2022 (Indpls – I-70E at 12.20 µg/m^3). All annual monitor design values were equal to or less than the primary annual standard of 12 µg/m^3 for 2020-2022, as shown in Figure 5.

Figure 5: Annual $PM_{2.5}$ Design Values for 2020-2022



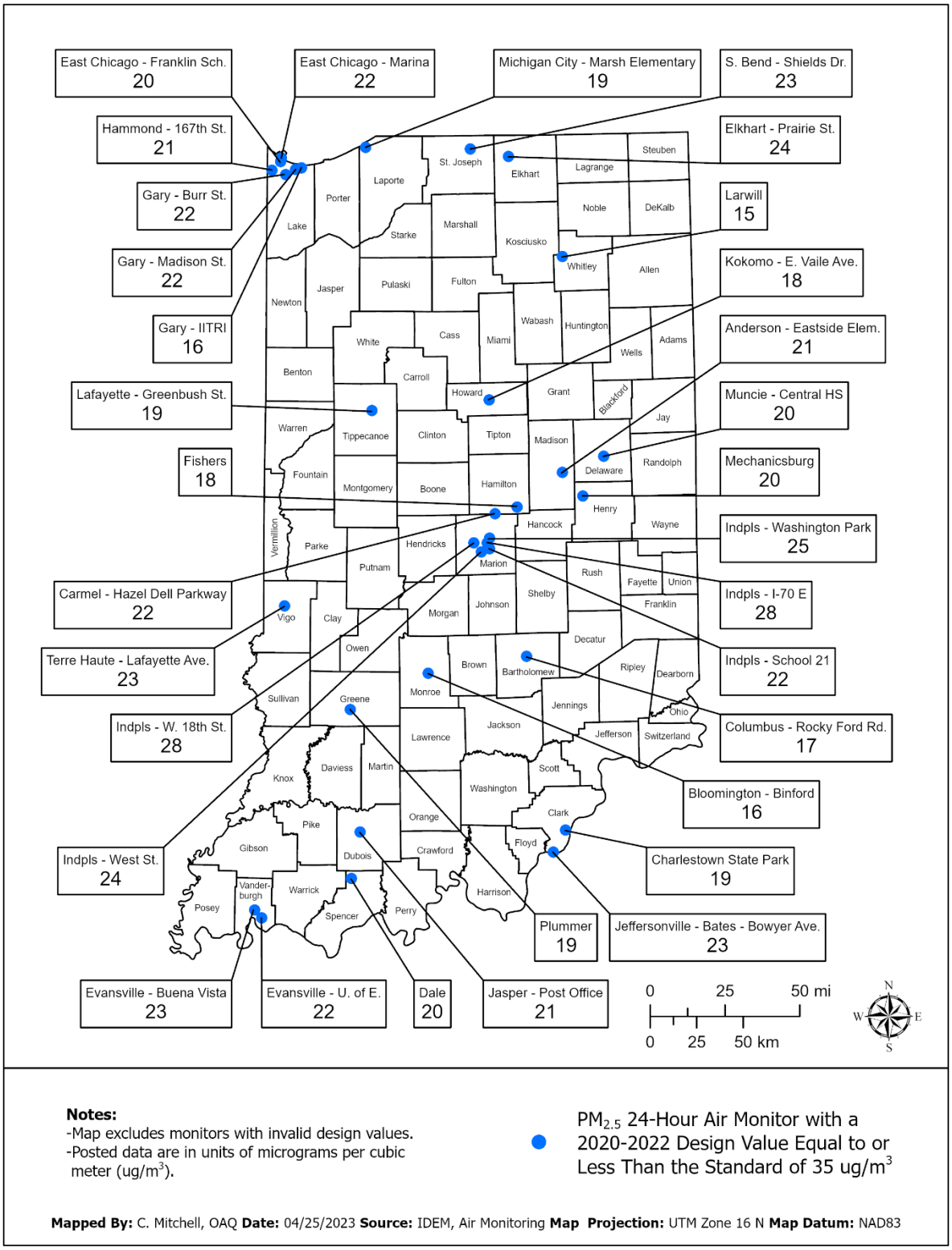
Notes:
-Map excludes monitors with invalid design values.
-Posted data are in units of micrograms per cubic meter (ug/m^3).

● $PM_{2.5}$ Annual Air Monitor with a 2020-2022 Design Value Equal to or Less Than the Standard of 12 ug/m^3

Mapped By: C. Mitchell, OAQ **Date:** 04/24/2023 **Source:** IDEM, Air Monitoring **Map Projection:** UTM Zone 16 N **Map Datum:** NAD83

<u>24-Hour Monitoring Data</u>: There was not any monitor with a daily 98th percentile of 24-hour $PM_{2.5}$ concentrations above the primary 24-hour standard of 35 µg/m^3 in 2022. All 24-hour monitor design values were less than the primary 24-hour standard of 35 µg/m^3 for 2020-2022, as shown in Figure 6.

Figure 6: 24-Hour $PM_{2.5}$ Design Values for 2020-2022



Notes:
-Map excludes monitors with invalid design values.
-Posted data are in units of micrograms per cubic meter (ug/m^3).

● $PM_{2.5}$ 24-Hour Air Monitor with a 2020-2022 Design Value Equal to or Less Than the Standard of 35 ug/m^3

Mapped By: C. Mitchell, OAQ **Date:** 04/25/2023 **Source:** IDEM, Air Monitoring **Map Projection:** UTM Zone 16 N **Map Datum:** NAD83

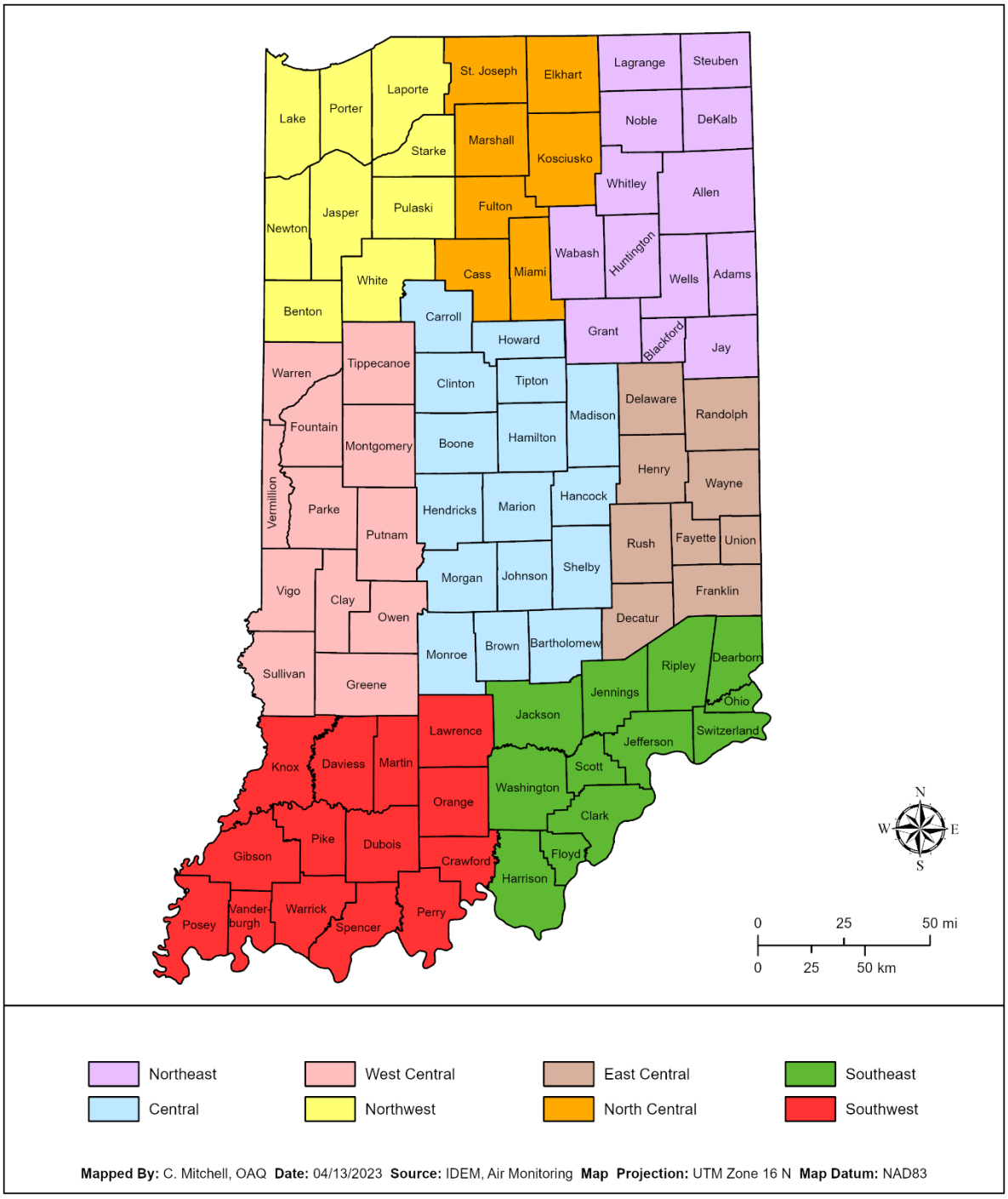
Exceedances: Exceedances of the 24-hour $PM_{2.5}$ standards were recorded on seven days in 2022.

Air Quality Action Days: IDEM works to analyze continuous monitoring data and issue year-round air quality forecasts in coordination with local, state, and regional partners. Public alerts called **Air Quality Action Days** (AQADs) are issued when unhealthy air pollution is predicted. Three AQADs were issued for $PM_{2.5}$ in 2022. The public can find daily air quality forecasts and sign up to receive email or text alerts on IDEM's SmogWatch website at: https://apps.idem.in.gov/smogwatch/Current.aspx.

$PM_{2.5}$ Air Quality Trends

$PM_{2.5}$ monitoring data in charts 1 through 4 below are divided into regions as shown in Figure 7.

Figure 7: Indiana Regions



<u>Annual $PM_{2.5}$ Trends</u>: Annual $PM_{2.5}$ trends are shown in charts 1 and 2. Chart 1 plots the highest annual arithmetic mean concentration values in each region for 2013-2022. Chart 2 plots highest annual design values for 2013-2015 through 2020-2022. Charts 1 and 2 include the 2012 primary annual $PM_{2.5}$ standard (12 µg/m^3) for comparison.

Chart 1: $PM_{2.5}$ Primary Annual Mean Trends for 2013-2022

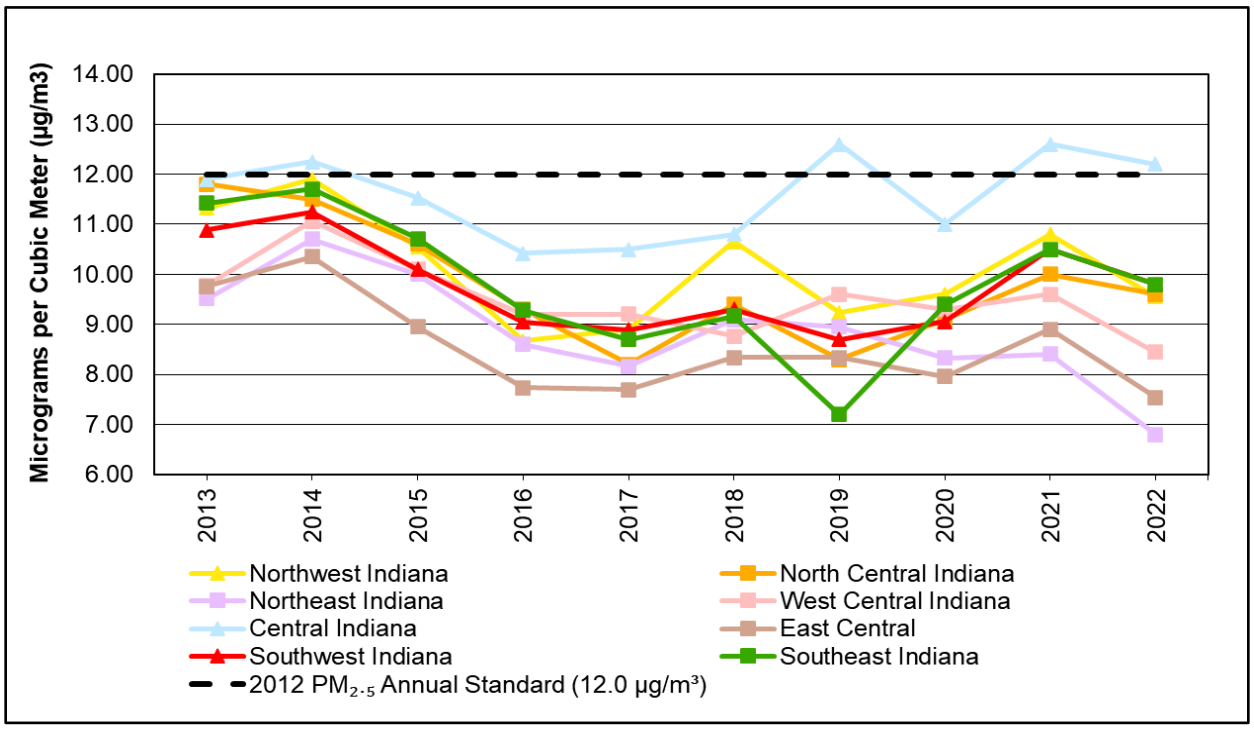


*Chart excludes monitors with incomplete data.

Chart 2: $PM_{2.5}$ Primary Annual Design Value Trends for 2013-2015 through 2020-2022

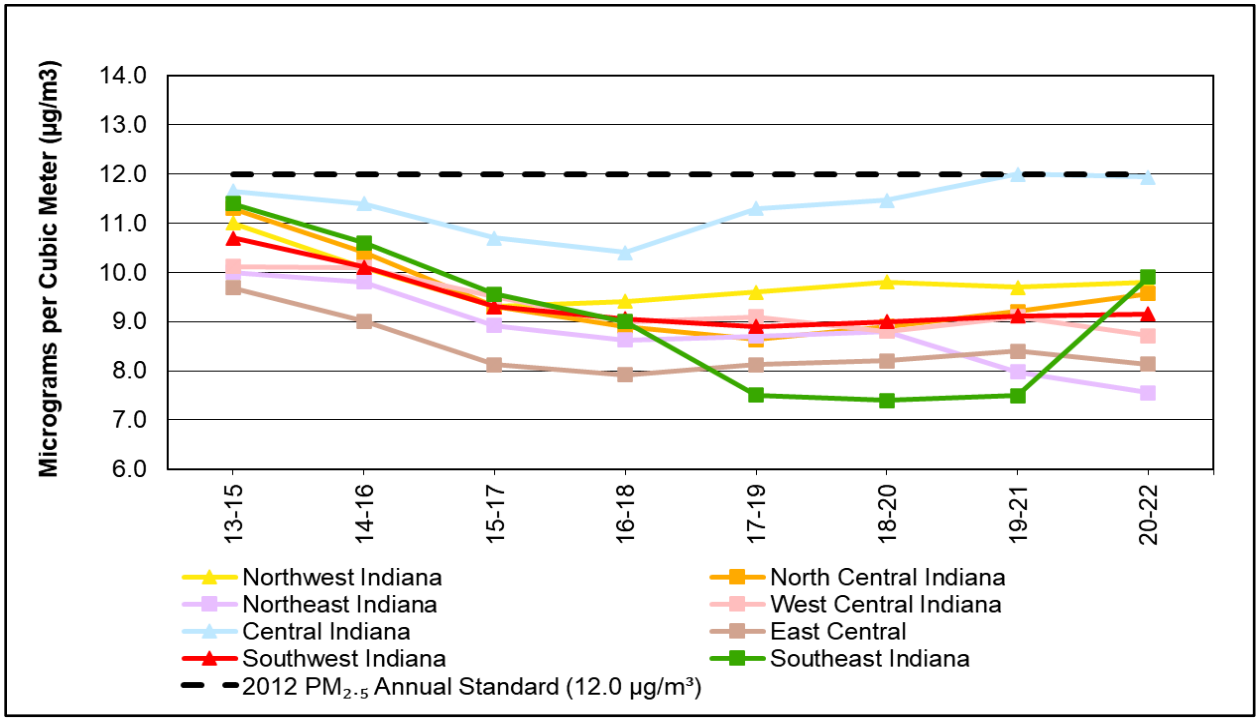


*Chart excludes monitors with incomplete data and/or less than three years of monitoring data.

<u>24-Hour $PM_{2.5}$ Trends</u>: Daily, or 24-hour, trends are shown in charts 3 and 4. Chart 3 plots the highest 24-hour 98th percentile values in each region for 2013-2022. Chart 4 plots the highest 24-hour design values for 2013-2015 through 2020-2022. Both charts include the 2006 24-hour $PM_{2.5}$ standards (35 µg/m^3) for comparison.

Chart 3: $PM_{2.5}$ 24-Hour Standard 98th Percentile Value Trends for 2013-2022

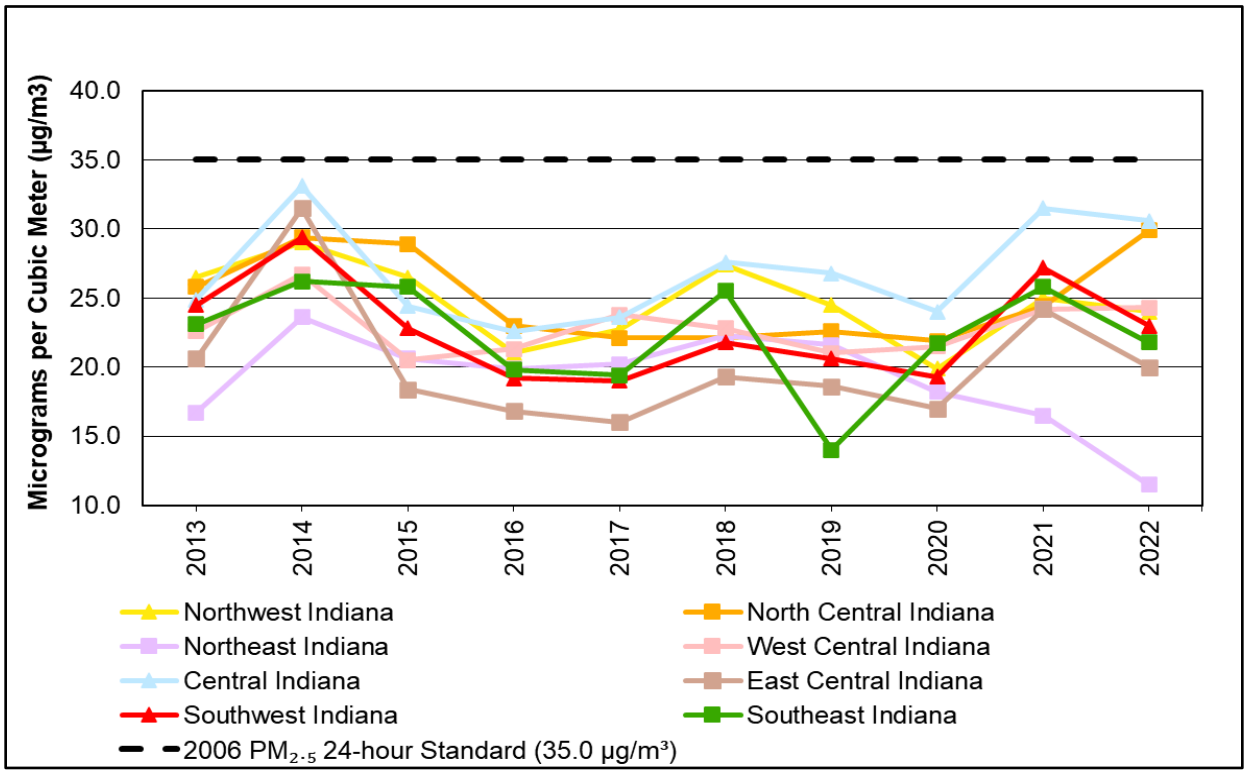


*Chart excludes monitors with incomplete data.

Chart 4: $PM_{2.5}$ 24-Hour Design Value Trends for 2013-2015 through 2020-2022

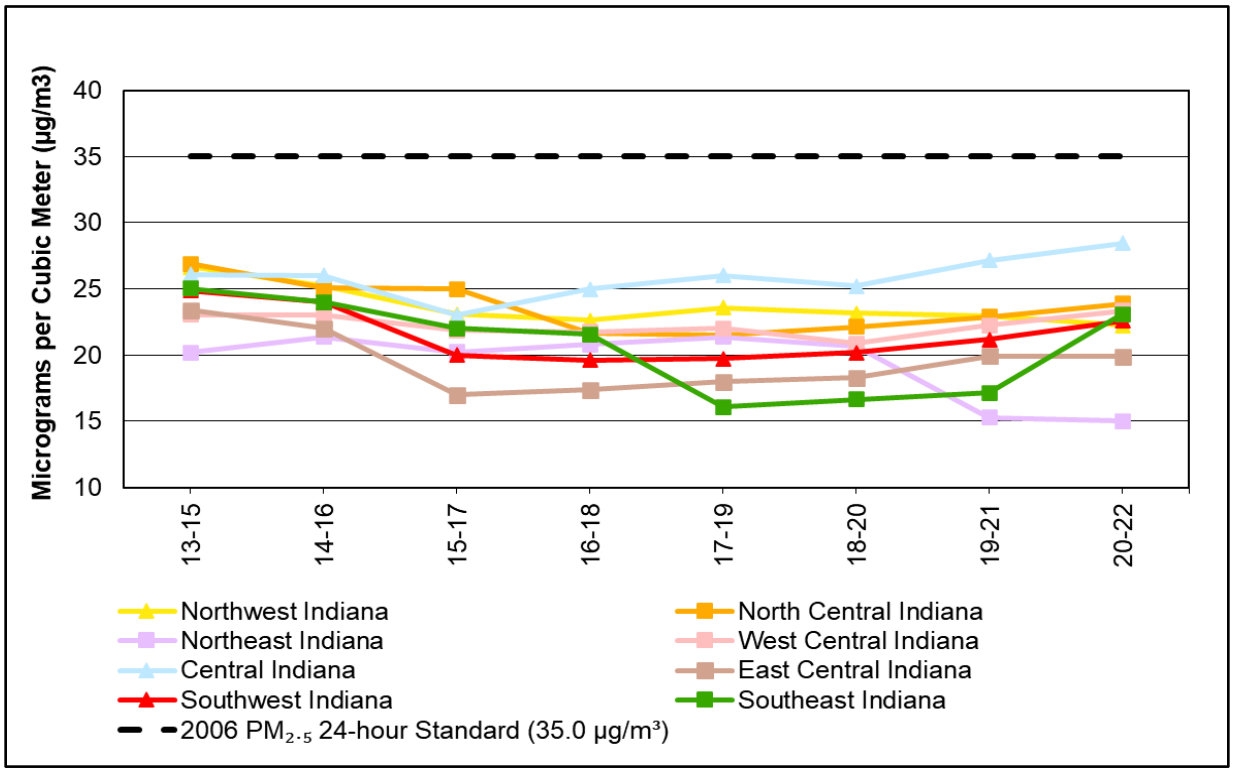


*Chart excludes monitors with incomplete data and/or less than three years of monitoring data.

Status of $PM_{2.5}$ Designations

When a NAAQS is issued, the implementation process begins. The first step is for U.S. EPA to designate air quality for all areas of the country. Areas that are not attaining the new standard, and areas that are contributing to areas that are not attaining the standard, are designated as nonattainment. When a nonattainment area attains the standard, IDEM submits a request to U.S. EPA for the area's redesignation to attainment status. This formal action ensures the area is recognized for its compliance.

No areas of Indiana are designated as nonattainment under any of the $PM_{2.5}$ standards. Following are details concerning designations under each $PM_{2.5}$ NAAQS.

1997 Primary Annual $PM_{2.5}$ Standard: On July 18, 1997, U.S. EPA established health-based (primary) annual standards for $PM_{2.5}$ (62 FR 38652). Following the resolution of legal challenges to the new standards, designations were completed several years later, on January 5, and April 14, 2005, effective April 5, 2005 (70 FR 944 and 70 FR 19844).[1] Although most areas of the state were meeting the standard, 12 Indiana counties and five townships were initially designated nonattainment. All of these areas were later redesignated to attainment based on subsequent monitoring data showing compliance, as shown in Table 1.

[1] Federal Register (FR) notices (cited by volume and page number) can be viewed at https://www.federalregister.gov/.

Table 1: Designations Under the 1997 Primary Annual $PM_{2.5}$ NAAQS

Area	County / Township(s)	Status
Chicago-Gary-Lake County, IL-IN	Lake (All)	Attainment, effective February 6, 2012 (76 FR 76302)
	Porter County (All)	
Cincinnati-Hamilton, OH-KY-IN	Dearborn County, Lawrenceburg Township	Attainment, effective September 1, 2017 (82 FR 41527)
Evansville, IN	Dubois County (All)	Attainment, effective October 27, 2011 (76 FR 59527)
	Gibson County, Montgomery Township	
	Pike County, Washington Township	
	Spencer County, Ohio Township	
	Vanderburgh County (All)	
	Warrick County (All)	
Indianapolis, IN	Hamilton County (All)	Attainment, effective July 11, 2013 (78 FR 41698)
	Hendricks County (All)	
	Johnson County (All)	
	Marion County (All)	
	Morgan County (All)	
Louisville, KY-IN	Clark County (All)	Attainment, effective September 9, 2016 (81 FR 62390)
	Floyd County (All)	
	Jefferson County, Madison Township	
All Other Counties		Unclassifiable/Attainment, effective April 5, 2005 (70 FR 944 and 70 FR 19844)

The 1997 primary annual standard was retained following a review in 2006, and later revoked when the 2012 primary annual standard was implemented.

2012 Primary Annual $PM_{2.5}$ Standard: U.S. EPA's most recent revision to the primary annual $PM_{2.5}$ NAAQS occurred on January 15, 2013, following the completion of a review in 2012. In that action, the standard was strengthened from 15 $\mu g/m^3$ to 12 $\mu g/m^3$ (78 FR 3085). Following a review in 2019, U.S. EPA retained the 2012 primary annual standard on December 18, 2020 (85 FR 82684).

All Indiana counties are designated as unclassifiable/attainment under the 2012 primary annual $PM_{2.5}$ standard. Most areas received the designation on January 15, 2015, effective April 15, 2015 (80 FR 2205). However, Clark, Floyd, Lake, and Porter counties required additional review prior to their unclassifiable/attainment designation on December 27, 2018, effective January 28, 2019 (83 FR 66631). Following are details:

- Clark and Floyd counties – These counties were designated on January 15, 2015, as part of the Louisville, KY-IN nonattainment area based on 2011-2013

data showing that one monitor in the area was slightly above the standard. U.S. EPA changed the designation to unclassifiable on April 7, 2015, based on quality assured, certified 2012-2014 data submitted by Indiana showing Clark and Floyd counties to be in attainment (80 FR 18535). However, a determination could not be made at that time due to invalid data from other monitors in the area. The December 27, 2018, unclassifiable/attainment designation was issued based on complete, quality-assured 2015-2017 data showing all area monitors to be in attainment.

- Lake and Porter counties – These counties were initially designated as part of the Chicago, IL-IN unclassifiable area on January 15, 2015. Although monitoring data for Lake and Porter counties did not indicate a violation, a determination could not be made at that time due to invalid monitoring data from other monitors in the area. The December 27, 2018, unclassifiable/attainment designation was issued based on complete, quality-assured 2015-2017 data showing all area monitors to be in attainment.

Table 2 provides a summary of designations under the 2012 primary annual $PM_{2.5}$ NAAQS.

Table 2: Designations Under the 2012 Primary Annual $PM_{2.5}$ NAAQS

Area	County / Township(s)	Status
Chicago, IL-IN	Lake (All)	Unclassifiable/Attainment, effective January 28, 2019 (83 FR 66631)
	Porter County (All)	
Louisville, KY-IN	Clark County (All)	Unclassifiable/Attainment, effective January 28, 2019 (83 FR 66631)
	Floyd County (All)	
All Other Counties		Unclassifiable/Attainment, effective April 15, 2015 (80 FR 2205)

<u>24-Hour $PM_{2.5}$ Standards</u>: U.S. EPA established primary and secondary 24-hour standards at a level of 65 $\mu g/m^3$ on July 18, 1997 (62 FR 38652). The standards were revised to a more protective level of 35 $\mu g/m^3$ on October 17, 2006 (71 FR 61144). U.S. EPA retained the 2006 24-hour standards following reviews in 2012 (78 FR 3085, January 15, 2013) and 2019 (85 FR 82684, December 18, 2020).

U.S. EPA issued designations for the 2006 24-hour $PM_{2.5}$ standards on November 13, 2009, effective December 14, 2009 (74 FR 58688). Indiana has never had any nonattainment areas for the 24-hour $PM_{2.5}$ standards, as shown in Table 3.

Table 3: Designations Under the 24-Hour $PM_{2.5}$ NAAQS

Area/County	Current Status
All Areas/Counties	Unclassifiable/Attainment, effective December 14, 2009 (74 FR 58688)

Additional Information

- For near real-time continuous monitoring data, data summaries, and air quality reports, visit IDEM's Air Quality Data Web page at: https://www.in.gov/idem/airmonitoring/air-quality-data/.
- For air quality designations, attainment demonstrations, requests for redesignation and maintenance plans, visit IDEM's State Implementations Plan website at: https://www.in.gov/idem/sips/.
- To learn about voluntary projects for the advancement of cleaner fuels, technology, and reduced idling, visit the DieselWise Indiana website at: https://www.in.gov/idem/airquality/dieselwise/.
- For information about $PM_{2.5}$ and NAAQS implementation, visit U.S. EPA's NAAQS website at: https://www.epa.gov/naaqs.
- Learn about U.S. EPA's Air Quality System (AQS) at: https://www.epa.gov/aqs.

Contact IDEM's Office of Air Quality

Please feel free to direct questions or comments to Michele Boner, environmental manager with IDEM's Office of Air Quality, at (800) 451-6027 Option 4 (*toll free*), (317) 233-6844 (*direct*), or mboner@idem.in.gov (*email*).