



# RESEARCH BRIEF

Clean Wisconsin Environmental Health Initiative

## Hazardous Air Pollutants & Environmental Justice in Wisconsin

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**SUMMARY** – Hazardous Air Pollutants (HAPs) are air pollutants known to harm human health but for which there are no current air quality standards. HAPs include pollutants like benzene in vehicle exhaust and mercury and other heavy metals from coal-fired power plants. HAPs can cause serious health risks including cancer and damage to the immune, neurological, reproductive, or respiratory systems. Children, people with pre-existing health conditions, pregnant adults, and older adults are at a higher risk of experiencing negative health outcomes from exposure to HAPs. There are also environmental justice concerns in Wisconsin, with some communities experiencing a higher exposure risk to HAPs and subsequent increased risk of health complications. Despite these risks, there are no air quality standards for HAPs; instead, there are limits on emissions from facilities emitting HAPs, although this does not consider cumulative exposure from nearby sources. Although HAP concentrations in the air are not regularly monitored, the Environmental Protection Agency periodically estimates the health risks from HAP emissions using modeling techniques. In this brief, we explore what HAPs are and the associated modeled health risks in Wisconsin.

Key takeaways from this exploration include:

- Multiple sources can produce air toxics, or HAPs. The most common air toxics come from transportation sources (e.g., cars, trucks, buses), stationary sources (e.g., factories, refineries, power plants), and indoor sources (e.g., some building materials and cleaning solvents).
- Exposure to HAPs can come from breathing contaminated air, eating contaminated food products like fish from contaminated water, consuming water contaminated by toxic air pollutants, ingesting contaminated soil, and through skin contact with contaminated soil, dust, or water.
- Exposure to HAPs can have serious health consequences, including cancer, birth defects, impaired lung function, and harm to the cardiovascular system.
- Wisconsin has over 900 facilities emitting 3,800 tons of HAPs into the air every year.
- Lower-income and minority communities are more likely to live near sources of HAPs, reinforcing persistent environmental justice disparities.
- Roughly one third of Wisconsin's total population lives within one mile of a HAP facility, but minority and low-income populations are much more likely to live closer to HAP facilities than non-minority non-low-income populations.

- 50% of all minority residents live within one mile of a HAP facility. In contrast, only 30% of non-minority residents live within one mile of a HAP facility.
- This disparity extends to low-income populations as well: 44% of low-income residents live within one mile of a HAP facility compared to 30% of non-low-income residents.
- Block groups in Wisconsin with the most low-income or non-white residents are significantly closer to the nearest HAP facility and have significantly more HAP facilities within one mile than block groups with the least low-income or non-white residents.
- These disparities persist even when looking within urban areas where non-white populations and HAP facilities tend to be concentrated.
  - Within urban areas of Wisconsin, block groups with the most non-white residents are 0.8 miles from the nearest HAP facility while block groups with the fewest non-white residents are 1.5 miles from the nearest HAP facility
  - Similarly, urban area block groups with the most non-white residents are 0.9 miles from the nearest HAP facility while block groups with the fewest non-white residents are 1.4 miles from the nearest HAP facility.
  - Urban area block groups with the most non-white or low-income residents have on average nearly 2 HAP facilities within one mile, while block groups with the least non-white or low-income residents have on average less than one HAP facility within one mile.

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## Definitions

- **Hazardous Air Pollutant (HAP):** Pollutant known or suspected of causing cancer or other serious health effects, or adverse environmental effects (EPA 2024-a).
- **Environmental Justice:** The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies (EPA 2020-b).
- **Cancer Risk:** The chance or probability of developing cancer (CDC 2024).
- **Respiratory Hazard Index (RHI):** index that provides context around areas experiencing higher respiratory health risks. RHI value of 1 or less suggests that long-term exposure is unlikely to result in adverse health effects (Environmental Protection Agency 2022).
- **Risk-Screening Environmental Indicators (RSEI):** a model that integrates data from multiple sources to help provide context around toxic emissions that pose the greatest health risks from HAPs facilities (EPA 2025-g).
- **Census Block Group:** Geographical unit used by the United States Census Bureau, one level above census blocks and one level below census tracts. A Census Block Group consists of clusters of blocks within the same census tract, and typically contain between 600-3,000 people (United States Census Bureau 2011).

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## Introduction

Air pollution can affect nearly every organ in the body, leading to a wide range of health effects (World Health Organization n.d.). The Clean Air Act (CAA) requires the Environmental Protection Agency (EPA) to address air pollution across the United States by setting National Ambient Air Quality Standards (NAAQS) for specific pollutants, referred to as criteria air pollutants (Wisconsin Department of Natural Resources n.d.-a). These are common, widespread air pollutants with well-established health effects. Through these NAAQS, criteria air pollutants are regulated by setting limits on their concentration in the air based on their human health or environmental impacts (Environmental Protection Agency 2025-d). Six pollutants are classified as criteria air pollutants: carbon monoxide, ground-level ozone, lead, nitrogen dioxide, particulate matter (PM), and sulfur dioxide (Environmental Protection Agency 2025-d).

However, there are many more harmful air pollutants. These hazardous air pollutants (HAPs), also called air toxics, are not regulated through NAAQS. Instead, they are addressed through the National Emission Standards for Hazardous Air Pollutants (NESHAP)

(Wisconsin Department of Natural Resources n.d.-b). NESHAP is responsible for protecting public health and the environment by establishing mandates and emission limits of HAPs from industrial sources. While NESHAP sets limits on the amount of hazardous air pollution an individual facility can emit, it does not establish ambient air quality standards for these pollutants or consider cumulative exposure from nearby sources or other environmental stressors that impact public health (Environmental & Energy Law Program Harvard Law School 2021). Because pollutant concentrations in surrounding communities are often not monitored, it is difficult to measure the full extent of public health risks.

The CAA identifies 186 hazardous air pollutants that are considered toxic and originate from a variety of indoor and outdoor sources (Suh et al. 2000). Examples of HAPs that affect public health include benzene (found in gasoline), perchloroethylene (emitted from dry cleaning facilities), and methylene chloride (used as a solvent and paint stripper) (Environmental Protection Agency n.d.-b).

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## Human Health Impacts of HAPs

### Exposures

Exposure to HAPs primarily comes from inhaling pollutants near where people live or work. People living in urban areas are more likely to be exposed to HAPs because of human activities like heavy traffic, industrial plants, and construction projects, all of which produce a large amount of emissions (Morand 2004; Clean Air Fund 2025).

HAPs can also settle into the ground, resulting in contaminated soil and dust that people, particularly young children, incidentally ingest (Environmental Protection Agency 2024a). An example of this is lead from leaded gasoline contaminating soils near

roadways. HAPs can settle into waterways, streams, rivers and lakes where people can drink them in the water or eat them in fish caught from the water (American Lung Association n.d.).

### Vulnerable Populations

Children, people with pre-existing health conditions, pregnant adults, and older adults are at a higher risk of experiencing adverse health effects due to air pollution. People with preexisting health problems like asthma or lung and heart diseases are at a higher risk of experiencing negative health outcomes as a result of air pollution (Wisconsin Department of

Health Services 2025). Children face a significant risk because of their developing lungs. Children are also more often active outside when pollutants are high (Wisconsin Department of Health Services 2025). As a result, children are breathing in more toxic air compared to adults and are more likely to have adverse health consequences as compared to adults (Wisconsin Department of Health Services 2025).

## Health Outcomes

Exposure to HAPs is associated with a wide range of subclinical issues like headaches, dizziness, nausea, eyes and nose irritation, and respiratory issues (Environmental Protection Agency 2024b). Prolonged exposure to higher concentrations of HAPs can lead to more significant outcomes like cancer, significant harm to the nervous system and brain, birth defects, impaired lung function, fertility issues, and harm to the cardiovascular system (Kumar et al. 2024).

### **Cancer**

Approximately two-thirds of all listed HAPs are classified as known, probable, or possible human carcinogens (West Virginia Department of Environmental Protection n.d.). Formaldehyde, a hazardous air pollutant that is emitted from vehicle exhaust and industrial processes, is a known carcinogen that contributes to more than half of all cancer risks linked to HAPs in the U.S. (De Guzman et al. 2025). It leads to more cancer cases than any other airborne chemical (Lerner et al. 2024). Formaldehyde levels in outdoor air are expected to rise with climate change, as higher temperatures and humidity increase both direct emissions from vehicles and factories and the chemical reactions that form formaldehyde from other pollutants (Parthasarathy et al. 2011; Lerner et al. 2024).

### **Harm to the Central Nervous System and Brain**

HAPs also affect the nervous system and brain. Increased rates of diseases impacting the central nervous system (CNS), including stroke, Alzheimer's disease, Parkinson's disease, and

neurodevelopmental disorders have been associated with exposure to hazardous air (Genc et al. 2012).

Prenatal and early postnatal exposure to HAPs is particularly concerning due to the rapidly developing nervous system. Studies have found maternal exposure to polycyclic aromatic hydrocarbons, a class of HAPs, can lead to developmental delays and increase risk of behavioral effects like hyperactivity (Perera et al. 2012, 2014; Peterson et al. 2015)

### **Birth Defects**

Exposure to benzene during pregnancy has been linked to low birth weight, higher risks of childhood leukemia, and an increased risk of birth defects like spina bifida (Caron-Beaudoin 2017). Benzene is commonly used as a solvent in chemical and pharmaceutical industries and is produced by natural and man-made processes (National Cancer Institute n.d.). The main sources of benzene today are gas and oil production, and vehicle emissions (National Cancer Institute n.d.). Lupo et al. (2010) found that mothers living in areas with the highest benzene levels in Texas were more likely to give birth to children with spina bifida compared to women living in areas with the lowest levels.

### **Impaired Lung Function**

HAPs can affect the lungs, causing irritation and constriction of air passages, necrosis, edema, fibrosis, and cancer, causing anything from mild discomfort to death (Air & Waste Management 1996). Most of the effects from short-term exposure are reversible, but chronic exposure can lead to permanent damage (Air & Waste Management 1996).

### **Harm to the Cardiovascular System**

A recent literature review found that those who had been exposed to HAPs had a 13% higher risk of cardiovascular disease (CVD), and a 21% higher risk of CVD mortality (Adekoya et al. 2022). Additionally, the risk of stroke and cerebrovascular accidents, heart failure, and hypertension were statistically significant for those exposed to HAPs, contributing to the overall

finding that prolonged exposure to HAPs raises the risk of cardiovascular events (Adekoya et al. 2022).

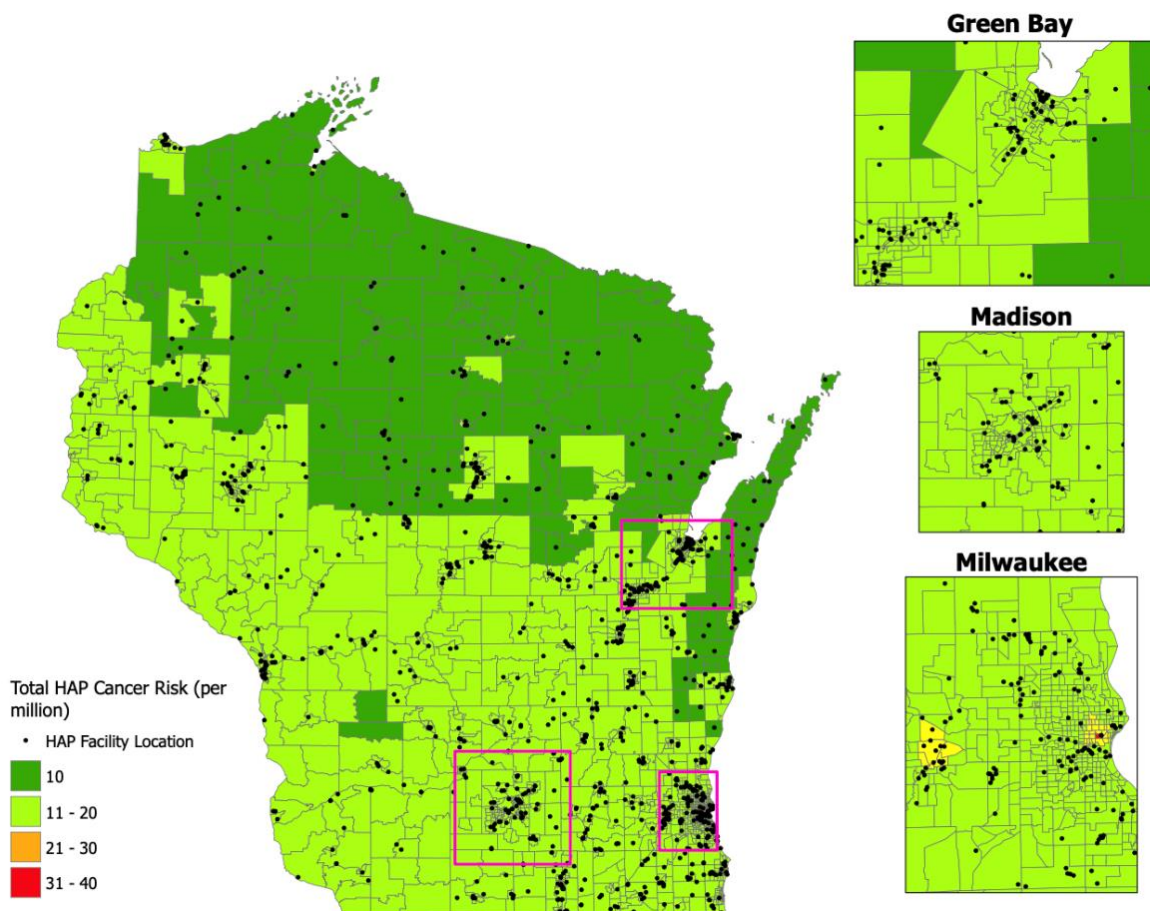
**Fertility Issues**

Animal and human epidemiological studies have shown that air pollutants can cause defects leading to

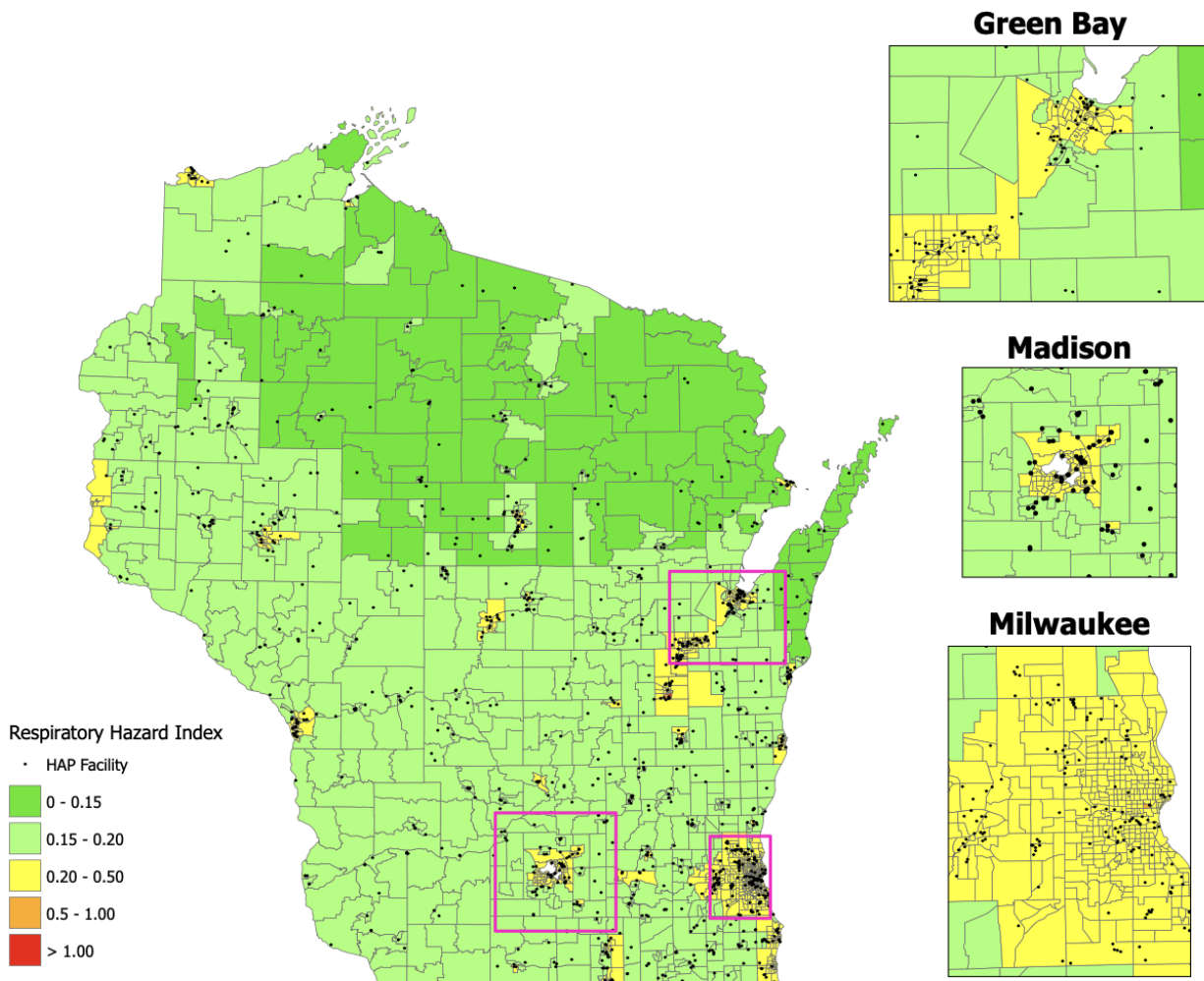
a decrease in reproductive functioning in exposed populations (Carre et al. 2017). In vitro and vivo studies suggest that air pollutants may act as endocrine disruptors, promote oxidative stress and damage genetic material like DNA (Conforti et al. 2018).

**Prevalence Across Wisconsin**

In the EPA’s most recent air toxics assessment, 940 HAP facilities were identified, emitting 3,800 tons (or 7.6 million pounds) of HAPs annually (Environmental Protection Agency 2025-f). Across Wisconsin, modeled cancer risk from air toxics is generally less than 10 cases per million people in the northern part of the state and less than 20 cases per million people in the southern part of the state (Figure 1). This is lower than the national average of 30 cases per million due to air toxics. However, there are small pockets of areas with elevated cancer risks in Milwaukee and Waukesha.

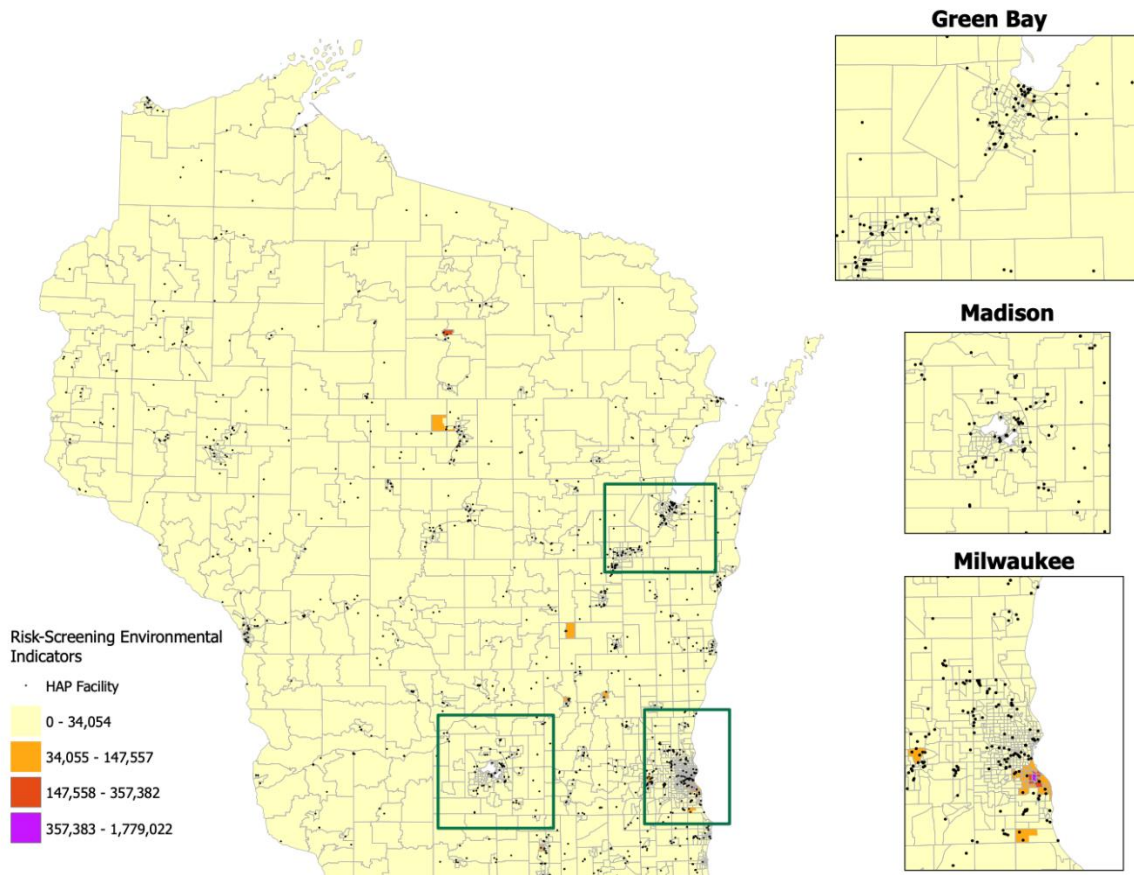


**Figure 1.** Map of the total cancer risk (per million) from hazardous air pollution (HAP) for each census tract in Wisconsin. Most of the state has low levels of cancer risk due to HAP exposure. The highest cancer risk is found in the densest urban areas around Milwaukee.



**Figure 2.** Map of the Respiratory Hazard Index (RHI), which provides context around areas experiencing higher respiratory health risks. An RHI value of 1 or less suggests that long-term exposure is unlikely to result in adverse health effects (Environmental Protection Agency 2022).

Figure 2 shows that elevated RHI risks are found across all urban areas in Wisconsin. These tracts tend to have higher RHI values compared to rural areas due to the higher concentration of industrial activity and traffic-related emissions. Only one census tract, located in Oshkosh, has an RHI at or above 1.0 (1.14). Five urban census tracts exceed 0.5, indicating a small subset of areas face elevated respiratory health risks.

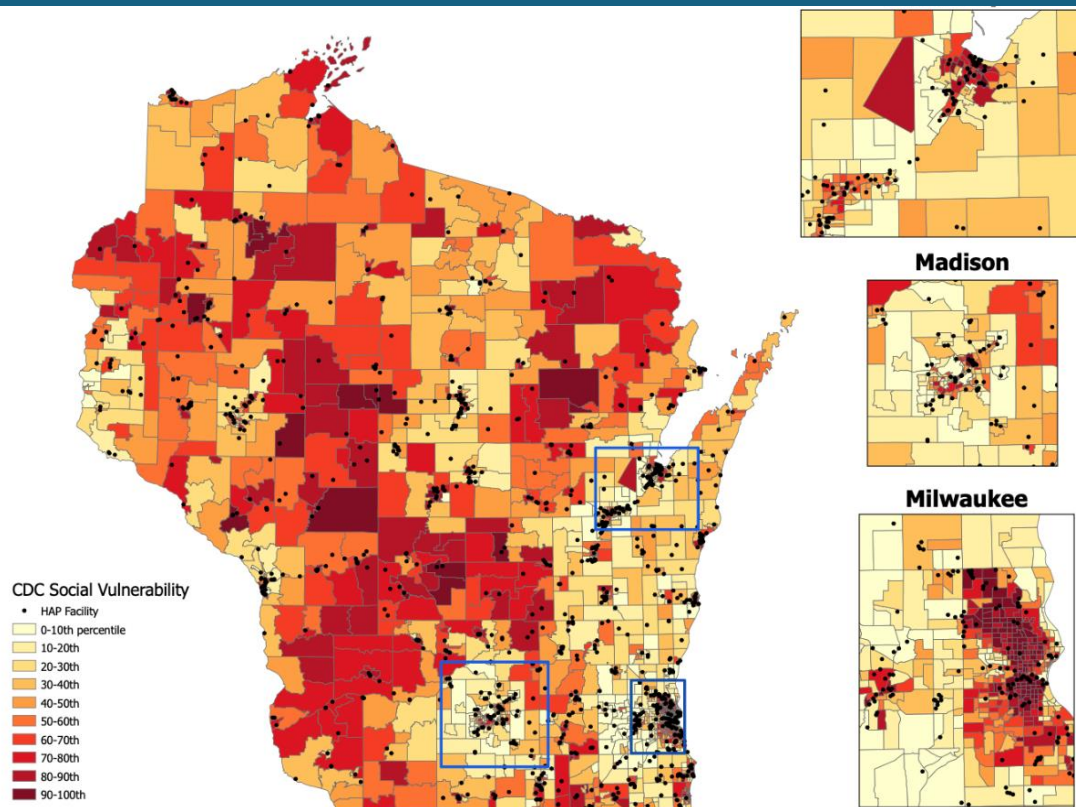


**Figure 3.** Map of the Risk-Screening Environmental Indicators (RSEI) model, which integrates data from multiple sources to help provide context around toxic emissions that pose the greatest health risks from HAPs facilities. RSEI scores are relative and do not have a fixed threshold. Instead, they help flag areas or facilities that may pose greater potential health risks based on a combination of chemical toxicity, exposure pathways, and nearby population (Environmental Protection Agency n.d.-c). A score that is significantly higher, such as 10 times greater than others, suggests a much higher potential impact (Environmental Protection Agency n.d.-c). Facilities or areas in the top 10% of RSEI scores are often considered priorities for closer review or further analysis (Environmental Protection Agency n.d.-c).

Wisconsin ranks 16<sup>th</sup> out of 51 states and districts in the U.S. in terms of RSEI scores, indicating a relatively higher potential for health risks from industrial toxic air emissions (Environmental Defense Fund, n.d.). This ranking reflects the combined effect of pollutant toxicity, exposure potential, and population proximity to emission sources (Environmental Protection Agency, n.d.-c). Figure 3 highlights several hotspots, with the highest scores clustered around Milwaukee. Additional isolated hotspots appear in the central and north-central parts of the state, likely tied to individual facilities such as the 3M plant in Wausau or paper mills. Compared to the RHI patterns in Figure 2, both maps show higher health risk indicators in urban areas. However, the RSEI map pinpoints where the largest modeled toxic emissions come from, making certain industrial hubs and single high-emission facilities stand out more clearly. The RHI measure, by contrast, reflects a broader set of pollution sources and exposure factors.

## HAPs and Environmental Justice

Air pollution exposure correlates with racial, ethnic, and income disparities across the United States, including in Wisconsin. Longstanding environmental injustices and systemic racism have led to a higher number of low-income and minority residents living near sources of air pollution. This prolonged exposure to unhealthy air leads to negative health outcomes, especially when compared to non-low-income, white communities (Wisconsin Department of Health Services 2025). As a result, low-income and minority communities can experience higher levels of heart and lung disease (Wisconsin Department of Health Services 2025).



**Figure 4.** Map of the CDC Social Vulnerability percentiles, which integrates data from multiple sources to help provide context around HAPs facility locations (black dots) and quantifies communities experiencing social vulnerability. Low social vulnerability risks are defined as being within the 0-10<sup>th</sup> percentile, and high social vulnerability risks scale upward.

The SVI index shows that areas around Milwaukee and Green Bay are more vulnerable to health and environmental harms based on factors like poverty, race, age, language, housing, and access to transportation. These socially vulnerable neighborhoods often face higher exposure to environmental hazards due to how the built environment is shaped. Industrial facilities and major transportation corridors are more likely to be sited near communities with less political power and fewer economic resources (Morello-Frosch et al. 2011). As a result, these areas experience a greater pollution burden, reinforcing existing health disparities and limiting access to clean air and other basic environmental protections (Morello-Frosch et al. 2011).

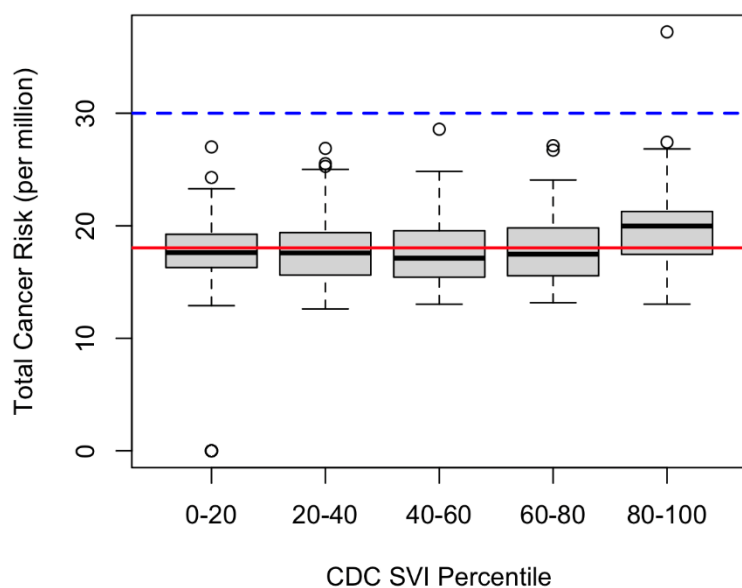
### Cancer Risk & Respiratory Health Index Disparities by Social Vulnerability & Race/Ethnicity

Wisconsin's estimated cancer risk from HAPs is lower than the national average, with a statewide average of 18 cancer cases per one million people from HAPs compared to 30 cases per million nationally. Much of the state, particularly northern Wisconsin, falls below the national average (Figure 1).

However, elevated risks are concentrated in urban and industrialized areas. Milwaukee and Waukesha counties show significantly higher cancer risk levels, likely due to a higher concentration of HAP-emitting facilities (Figure 1).

These risks are not distributed equally across populations. In Wisconsin, census blocks in the 80<sup>th</sup> to 100<sup>th</sup> percentile of the CDC's Social Vulnerability Index (SVI) experience elevated cancer risks from HAPs (Figure 5).

**Total Cancer Risk by SVI Group**

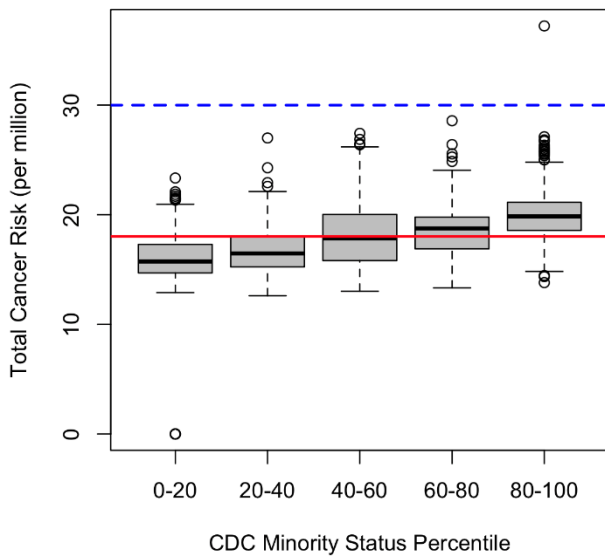


**Figure 5.** Estimated cancer risk from all HAP sources, expressed in cases per million people, by CDC Social Vulnerability Index (SVI) percentile group. A higher percentile indicates more vulnerability. The red line represents the Wisconsin average cancer risk, and the blue dashed line represents the national average cancer risk.

This pattern reflects broader evidence linking environmental exposure to systemic inequities. Individuals in disadvantaged or marginalized communities face higher risks of developing cancer from hazardous air pollution compared to wealthier and less vulnerable populations. (Pratt et al. 2015). Prior research has shown that cancer risk from HAPs is twice as high for neighborhoods in the 95<sup>th</sup> percentile of socioeconomic disadvantage compared to those in the 80<sup>th</sup> percentile, and 2.6 times higher at the 99<sup>th</sup> percentile (Pratt et al. 2022).

A clearer trend emerges when looking at race and ethnicity, showing that cancer risk increases with minority population concentration (Figure 6). Census tracts in the 80-100<sup>th</sup> percentile of the CDC Minority Status SVI have median cancer risks about 30% higher than those in the 0-20<sup>th</sup> percentile group. This highlights how minority (non-white) communities face disproportionate HAP exposure risk in Wisconsin.

### Total Cancer Risk by Minority Status SVI Group

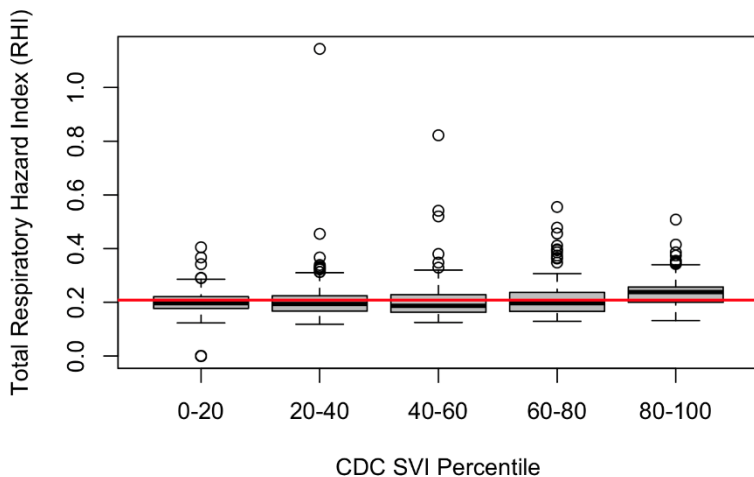


**Figure 6.** Estimated cancer risk from all sources of HAPs, expressed in cases per million people, by CDC Social Vulnerability Index (SVI) percentile and minority population status. A higher percentile indicates more vulnerability. The red line represents the Wisconsin average cancer risk, and the blue dashed line represents the national average cancer risk.

These findings show that low-income and minority communities continue to bear the greatest environmental health burdens. Many of the most impacted blocks are located in or around Milwaukee, where industrial density correlates with historical patterns of racial segregation and disinvestment (Kodros et al. 2024).

In addition to cancer risk, we examined respiratory health risks from HAP exposure using the RHI. Figure 7 shows the distribution of Respiratory Hazard Index (RHI) values across CDC SVI percentile groups in Wisconsin. Tracts in the 80<sup>th</sup>-100<sup>th</sup> percentile of SVI had the highest median RHI, suggesting that the most disadvantaged populations may face disproportionately higher respiratory risks from HAPs.

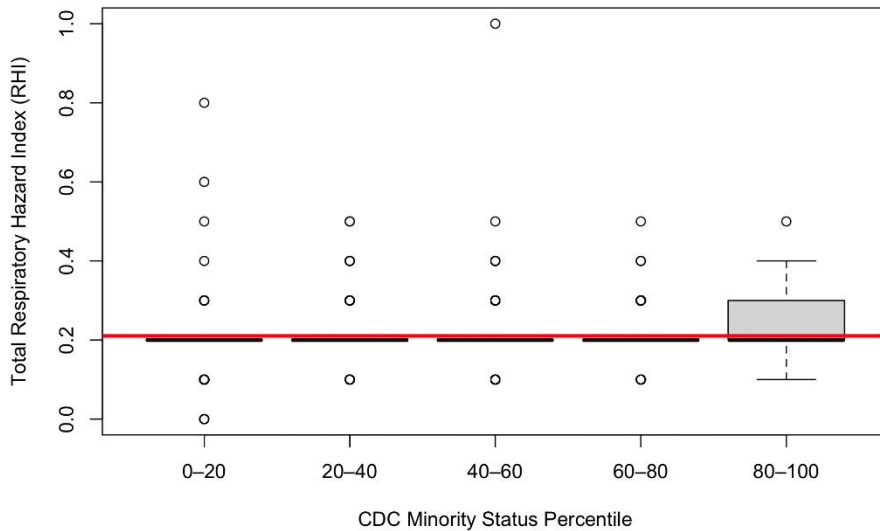
### Total Respiratory Hazard Index (RHI) by SVI Group



**Figure 7.** Cumulative Respiratory Hazard Index from all hazardous air pollution sources, organized by CDC Social Vulnerability Index (SVI) percentile groups. A higher percentile indicates more vulnerability. The red line represents the Wisconsin average RHI.

When examining RHI values by race and ethnicity, census tracts in the 80-100<sup>th</sup> percentile had greater variability compared to tracts in lower minority status percentiles (Figure 8). This suggests that communities with higher proportions of minority residents may face disproportionate respiratory health risks from HAPs, similar to the disparities seen around cancer risk.

**Total Respiratory Hazard Index (RHI) by Minority Status SVI Group**



**Figure 8:** Estimated Respiratory Hazard Index from all HAP sources by CDC Social Vulnerability Index (SVI) percentile group. A higher percentile indicates more vulnerability. The red line represents the Wisconsin average RHI.

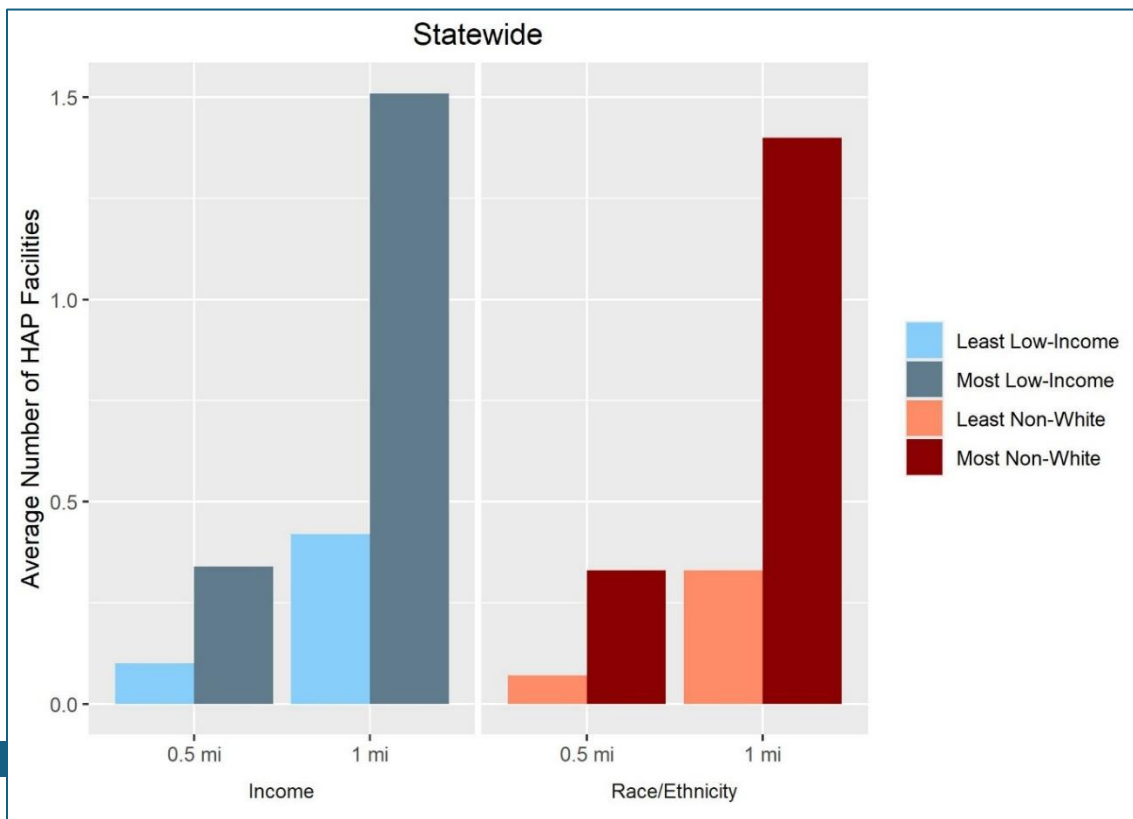
These findings mirror national trends. Prior studies have shown that low-income communities in the U.S. face higher exposure to air pollutants, an increased susceptibility to poor health, and health disparities as a result of environmental factors (Hajat et al. 2015). This is also consistent with a study examining Milwaukee County that identified spatial hot spots of populations most exposed to environmental pollution, including air toxics, revealing clear environmental exposure disparities across socioeconomic and racial lines (Kodros et al. 2024). Urban areas characterized by low socioeconomic status and an overrepresentation of the non-Hispanic Black population relative to Milwaukee County as a whole saw average pollutant concentrations equivalent to the 78<sup>th</sup> percentile in county-level air toxics (Kodros et al. 2024).

### Proximity Analyses

To find whether minority (non-white) or low-income residents in Wisconsin live closer to HAP facilities, we calculated the average number of HAP facilities located within 1/2 and 1 mile of block groups in the highest (>75<sup>th</sup> percentile) and lowest (<25<sup>th</sup> percentile) demographic categories for each group.

Statewide, block groups with the most low-income residents had on average 0.3 HAP facilities within a half-mile, significantly more than 0.1 facilities for block groups with the least low-income residents (Mann-Whitney U Test,  $W = 127656$ ,  $p < 0.001$ ) (Figure 9). Within one mile, block groups with the most low-income residents had 1.5 facilities, significantly more than the 0.4 facilities for block groups with the least low-income residents ( $W = 63805$ ,  $p < 0.001$ ).

For minority status, block groups with the most non-white residents averaged 0.3 facilities within a half-mile, significantly more than the 0.1 facilities for block groups with the least non-white residents ( $W = 575172$ ,  $p < 0.001$ ). Block groups with the most non-white residents averaged 1.4 facilities within one mile, significantly more than the 0.3 facilities for block groups with the least non-white residents ( $W = 395180$ ,  $p < 0.001$ ).

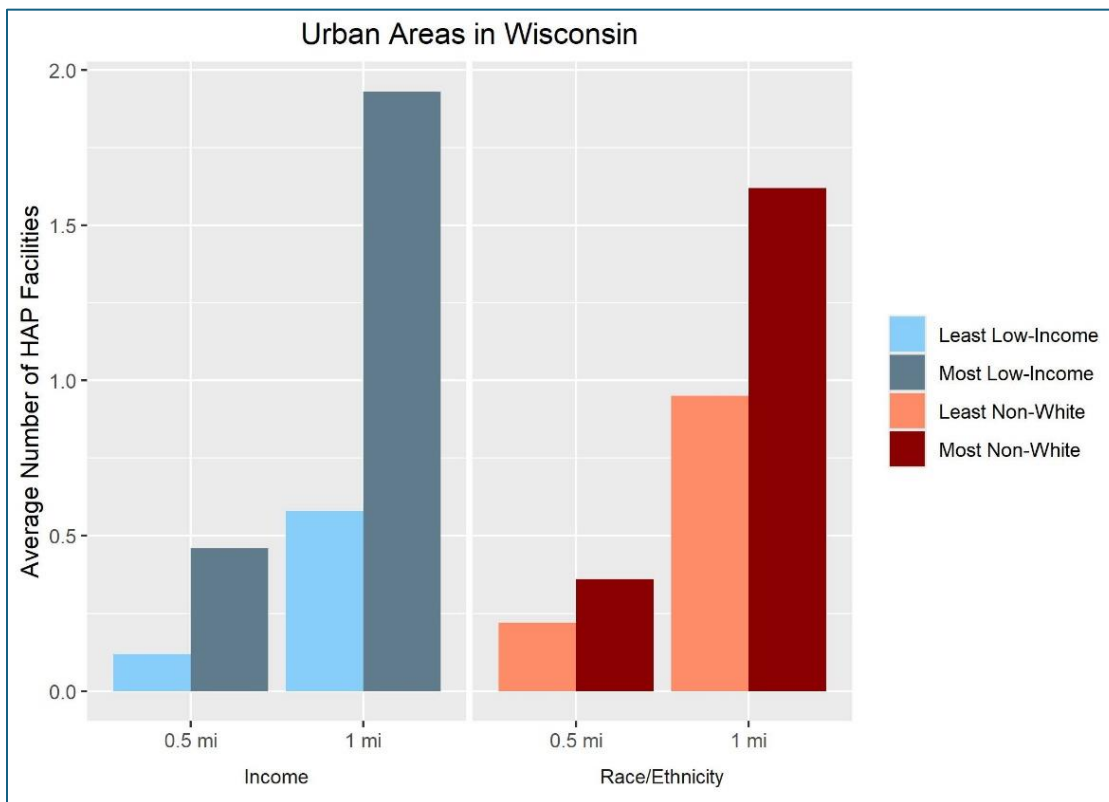


**Figure 9.** Average number of HAP facilities within 0.5 and 1 mile of census block groups in Wisconsin, comparing areas with the least (<25<sup>th</sup> percentile) and most (>75<sup>th</sup> percentile) minority and low-income residents. Communities with higher concentrations of disadvantaged populations have, on average, more HAP facilities nearby.

Recognizing that Wisconsin’s non-white population is largely concentrated in the urban areas, where HAP sources are also more likely to be found, we also limited our analysis to the state’s urban areas (figure 10). We found that that the same disparities exist, even within urban areas.

Urban area block groups with the most low-income residents had on average 0.5 HAP facilities within a half-mile, significantly more than 0.1 facilities for block group with the least low-income residents ( $W=68145$ ,  $p<0.001$ ). Within one mile, block groups with the most low-income residents had 1.9 facilities, significantly more than the 0.6 facilities for block groups with the least low-income residents ( $W=43284$ ,  $p<0.001$ ).

Urban area block groups with the most non-white residents averaged 0.4 facilities within a half-mile, significantly more than the 0.2 facilities for block groups with the least non-white residents ( $W = 210359$ ,  $p<0.001$ ). Within a mile, block groups with the most non-white residents had 1.6 facilities, significantly more than the 1.0 facilities for the block groups with the least non-white residents ( $W=174233$ ,  $p<0.001$ ).

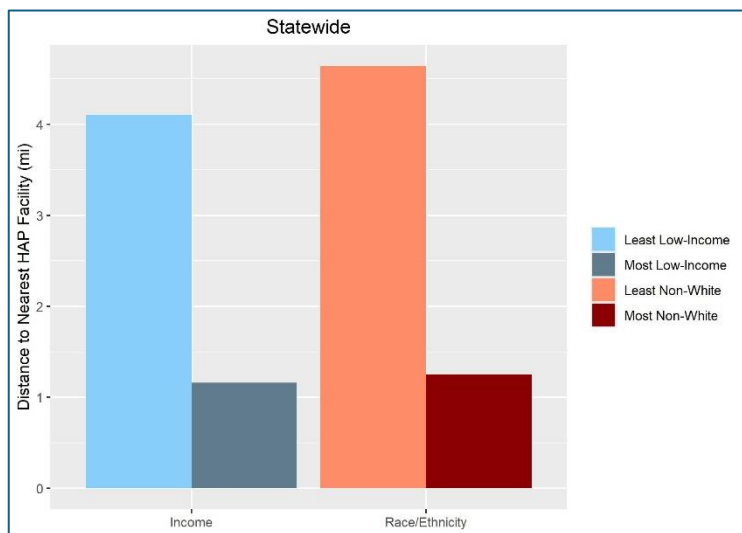


**Figure 10.** Average number of HAP facilities within 0.5 and 1 mile of census block groups in urban areas in Wisconsin, comparing areas with the least (<25<sup>th</sup> percentile) and most (>75<sup>th</sup> percentile) minority and low-income residents. Communities with higher concentrations of disadvantaged populations have, on average, more HAP facilities nearby.

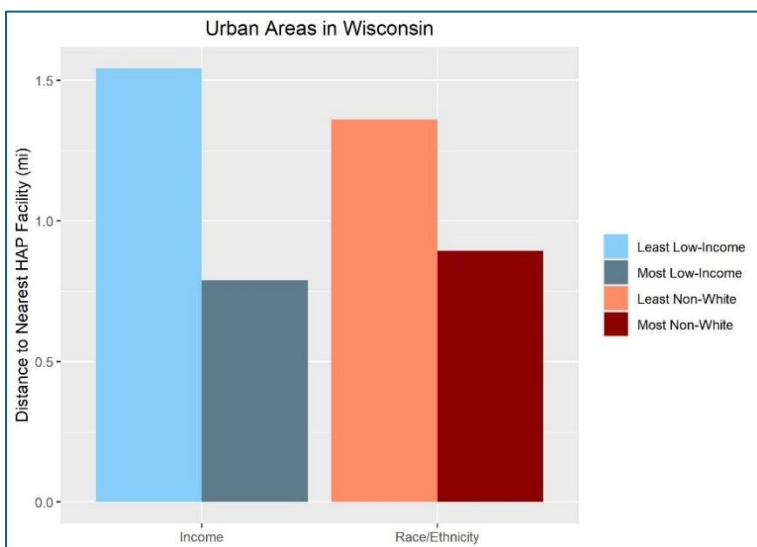
Similarly, we calculated the distance to the nearest HAP facility from block groups with the most non-white or low-income residents (>75<sup>th</sup> percentile) compared to block groups with the least non-white or low-income residents (<25<sup>th</sup> percentile).

Statewide, block groups with the most low-income residents were significantly closer (1.2 miles) to the nearest HAP facility compared than block groups with the least low-income residents (4.1 miles) (W=295589, p<0.001). Block groups with the most non-white residents were also significantly closer (1.3 miles) to the nearest HAP facility compared than block groups with the least non-white residents (4.6 miles) (W=1126127, p<0.001).

The disparities persist even when looking only within urban areas. Block groups with the most low-income residents were significantly closer (0.8 miles) to the nearest HAP facility compared than block groups with the least low-income residents (1.5 miles) (W=127457, p<0.001). Block groups with the most non-white residents were significantly closer (0.9 miles) to the nearest HAP facility compared than block groups with the least non-white residents (1.4 miles) (W=283961, p<0.001).



**Figure 11.** Average average distance to the nearest hazardous air pollutant facility from census block groups in Wisconsin (top) and urban areas in Wisconsin (bottom), comparing areas with the least (<25<sup>th</sup> percentile) and most (>75<sup>th</sup> percentile) minority and low-income residents. In both cases, communities with higher concentrations of disadvantaged populations are, on average, closer to HAP facilities.

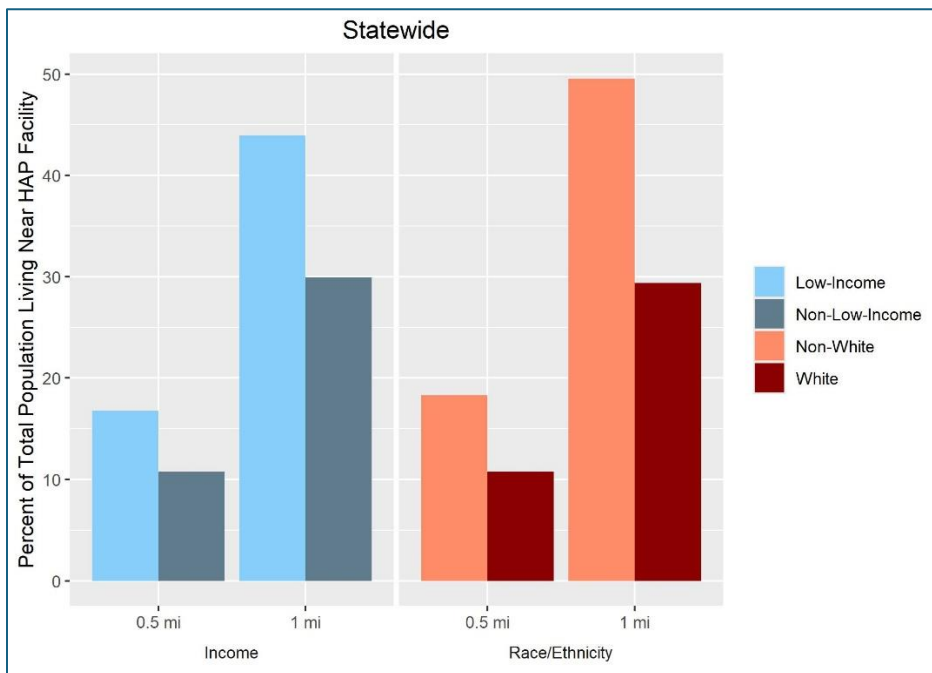


### Proximity (Buffer) Analysis

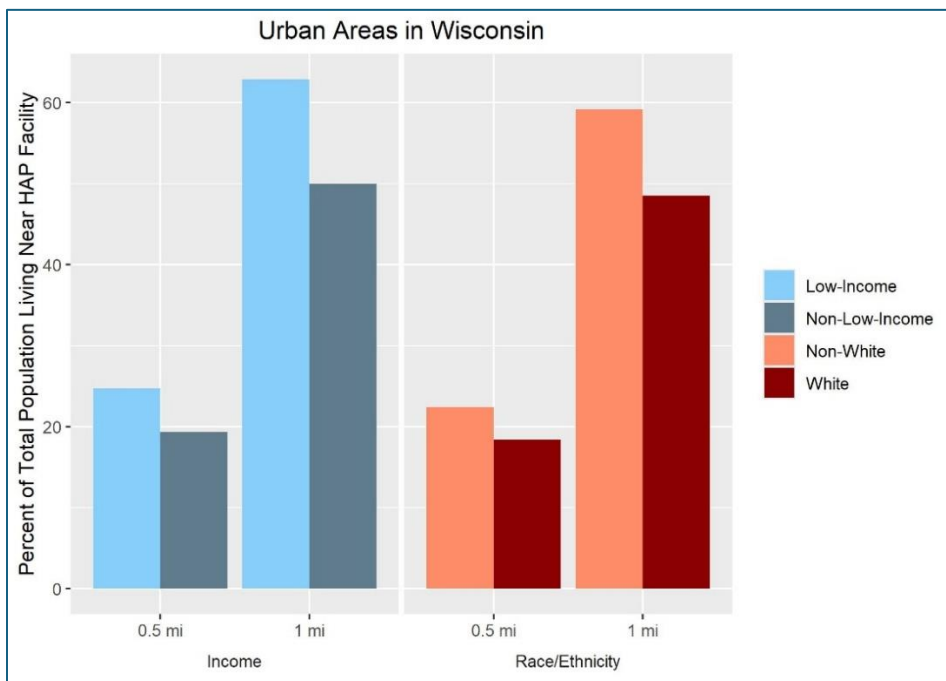
Here we looked at the total non-white and low-income population living in close proximity to a HAP facility compared to the total white and non-low-income population living in close proximity to a HAP facility. Statewide, 17% of the total low-income population and 18% of the total non-white population lived within a half-mile of a HAP facility. In contrast, 11% of both the total non-low-income and white population lived within a half-mile of a HAP facility. These disparities are even greater using a one-mile buffer: 50% of the total non-white population and 44% of the low-income population lives within one mile of a HAP facility compared to 29% of the non-minority population and 30% of the non-low-income population (Figure 12).

Limiting the analysis to only urban areas shows that disparities persist: 59% of the total non-white population and 63% of the low-income population lives within half-mile of a HAP facility compared to 50% of the non-minority population and 49% of the non-low-income population (Figures 13).

While the absolute number of facilities within each buffer can vary, the population-based buffer analysis shows that higher shares of minority and low-income residents live within close proximity to these sources compared to non-minority and non-low-income populations. This underscores the need to evaluate exposure through a cumulative impact framework.



**Figure 12.** The percentage of the total minority, non-minority, low-income and non-low income populations that live within 0.5 and 1 mile of a HAP facility statewide. The proportion of non-white and low-income populations that live within close proximity of a HAP facility is higher than the proportion of white and non-low-income populations living in close proximity statewide.



**Figure 13.** The percentage of the total minority, non-minority, low-income and non-low income populations that live within 0.5 and 1 mile of a HAP facility within **urban areas**. The proportion of non-white and low-income populations living within close proximity of a HAP facility is higher than the proportion of white and non-low-income population living in close proximity within urban areas.

A detailed methods used can be found in Appendix A. Additional analyses looking at major areas (Milwaukee, Madison, Beloit/Janesville, Appleton/Green Bay/Oshkosh) can be found in Appendix B.

## Policy Implications

### Examples of HAP-Specific Responses

Some communities have addressed HAP overburdens through targeted emissions reductions and permitting changes. In Kentucky, Louisville introduced the STAR Program (Strategic Toxic Air Reduction Program) in 2005 to reduce emissions of toxic chemicals in industries below the federal requirement (ArcGIS 2023). In 2023, Louisville’s Air Pollution Control District (APCD) released a report stating that since STAR was enacted, emissions of all toxic air pollution dropped nearly 80% and emissions from Category 1

Toxics Air Contaminants (TACs), which produce the greatest cancer and noncancer risk, had dropped by almost 96% (Louisville Metro Government 2023). Cities across Wisconsin could implement a similar framework by requiring industrial facilities that emit air toxics to meet health-based standards that are more stringent than federal limits. This could entail mandating public disclosures of toxic emissions data and involving affected residents in the permit decision-making process. Implementing these measures could help regulators address HAP hot spots more proactively to improve public health outcomes in the most impacted neighborhoods.

In California, the Air Toxics “Hot Spots” Information and Assessment Act (AB 2588, 1987, Connelly) was enacted in 1987 and requires stationary sources to disclose the type and quantities of substances regularly emitted into the air (California Air Resources Board n.d.-a). Facilities covered under the program must submit air toxics emission inventory plans which are reviewed to determine whether a health risk assessment is required (California Air Resources Board n.d.-b). To support the cost of running the program, the state can charge annual regulatory fees for facilities that are covered under the program (California Air Resources Board n.d.-c). The fees fund state and local activities such as developing emissions inventory guidelines, maintaining a statewide database of toxic air emissions, and providing guidance on risk reduction mitigation (California Air Resources Board n.d.-b). Wisconsin could adopt a similar model by requiring high-emitting facilities to submit risk assessments that are publicly available. Similar to California, Wisconsin could fund this through annual regulatory fees and in turn provide improved emissions tracking and targeted risk reduction to overburdened communities across the state.

### Why a Policy Response is Needed

The results from Wisconsin’s cancer, respiratory risk, and social vulnerability analyses highlight clear environmental justice concerns. Although the state’s average cancer and respiratory hazard risks are lower than the national average, the burden is not evenly distributed. Low-income and minority communities disproportionately face higher exposure to HAPs, reflecting broader patterns of discriminatory policies. Redlining, exclusionary zoning, and targeted siting of hazardous facilities have created an environment where overburdened communities experience higher levels of exposure to pollution. These findings point to the need for policy interventions that account for cumulative impacts and address the root causes of exposure disparities.

### Historic Policy Legacies and the Need for Cumulative Impact Policies

Redlining was a discriminatory federal housing policy that denied Black families and other communities of color access to home loans, while simultaneously subsidizing homeownership for white households through government-backed mortgages (Gerken et al. 2023). This intentional exclusion contributed to racial segregation in cities across the U.S., including Madison and Milwaukee (Gerken et al. 2023). As a result of these policies, Wisconsin had the third-lowest Black homeownership rate in the country as of 2020, with only 23% of Black residents owning homes (Dabruzzi 2020).

The legacy of redlining continues to shape health outcomes. A 2021 study on the lasting effects of redlining found that neighborhoods historically marked for disinvestment experience significantly poorer physical and mental health outcomes than areas that received high investment (Lynch et al. 2021). Milwaukee County consistently ranks among the lowest counties in Wisconsin for overall health outcomes, with white residents living an average of 14 years longer than Black residents (City of Milwaukee 2023). The infant mortality rate is also three times higher than that of white infants in Milwaukee (City of Milwaukee 2023).

Many public health experts emphasize the importance of adopting cumulative impact policies that reflect the full range of challenges communities face, including both environmental exposures and underlying social stressors (Union of Concerned Scientists 2024). These approaches recognize how multiple sources of pollution, combined with poverty rates, housing discrimination, and limited access to healthcare can collectively harm community health (Union of Concerned Scientists 2024). Centering cumulative impacts in policy design is crucial for reducing health disparities and advancing environmental justice in historically marginalized areas (Union of Concerned Scientists 2024).

## State and Federal-Level Models

As Wisconsin faces environmental and public health consequences of HAP exposure, state-level strategies can offer a path forward. While no single policy can address the full extent of historic and ongoing disparities, several states have taken steps to advance environmental justice by adopting cumulative impact frameworks. These efforts show how state and local policy measures can begin to reduce environmental burdens and address long-state inequities.

- **Cumulative Impact Frameworks:** In 2023, Assembly Bill 796 was proposed in Wisconsin state legislature that would establish cumulative impact requirements for facilities seeking permits in vulnerable communities in Wisconsin. This bill would have prohibited the DNR from issuing permits for certain facilities located wholly or partially within a vulnerable community, unless applicants prepared an environmental impact report and provide it to the DNR, the local municipality, make it publicly available, and conduct a public hearing. This bill did not advance to the legislative session.

Other states such as California, Colorado, Connecticut, Minnesota, New Jersey, New York, Washington, and Vermont have implemented cumulative impact policies or initiatives to proactively address environmental injustice (Livingston 2023). More details on the following laws or policies can be [found here](#), created and updated by the [Tishman Environmental and Design Center](#) (TEDC).

- **Minnesota:** Frontline Communities Protection Act was signed into law in 2023. This law incorporates provisions that establish cumulative impacts analysis requirements for permits in or near EJ designated areas (TEDC 2025). This law directs the Minnesota Pollution Control Agency to require or allow a cumulative impact analysis under specified conditions and to issue or deny permits depending on the substantial adverse impacts to nearby communities (TEDC 2025). The act also requires the applicants to hold two public meetings within the impacted community or EJ area – one before the analysis and one after (TEDC 2025). These provisions do not define a fixed list of facility types but are rather based on geographic criteria (Minn. Stat. § 116.065, 2023).
- **New Jersey:** New Jersey’s Environmental Justice Law, enacted in 2020, authorizes the Department of Environmental Protection to deny permits for new or expanded facilities if they are expected to lead to additional environmental public health burdens in already overburdened communities (N.J. Stat. Ann. § 13:1D-157, 2020). The law also emphasizes the importance of community engagement by requiring applicants to host public hearings and consider community input as part of the decision-making process (Livingston 2023).
- **New York:** In 2023, New York enacted “an Act to Amend and Clarify Environmental Facility Siting Provisions Addressing Disproportionate Impacts on Disadvantaged Communities”. This law requires consideration of cumulative and disproportionate impacts in state environmental review and permitting (TEDC 2025). The law also requires applicants to prepare an existing burden report (EBR) for new projects and for some renewals, as well as allowing a public comment period that includes comments from the disadvantaged community (TEDC 2025). Under this act, the Department of Conservation must consult with the Department of Health to develop the scope of the EBR that adapts the requirements for new, modified, or renewal permits (TEDC 2025). The EBR must include

baseline community data, existing stressors, projected contributions of the proposed action/permit, and potential community benefits (TEDC 2025).

- **Vermont:** The state passed Senate Bill 148 Act 154, “an act relating to environmental justice in Vermont” in 2022. This law establishes a statewide framework for advancing environmental justice and equitable decision-making (TEDC 2025). This law not only defines environmental justice, environmental populations and benefits, and cumulative environmental burdens, but also directs ten state agencies to develop community engagement plans and consider cumulative environmental impacts in decision-making (TEDC 2025). This act also mandated the development of a state environmental justice mapping tool to identify environmentally overburdened communities and environmental health disparities (VT. Act. No. 154, 2022).
- **Washington:** Passed in 2021, the state’s Healthy Environment for All (HEAL) Act implemented multiple recommendations from Washington’s Environmental Justice Task Force (Zapata & Noll 2022). This act requires state agencies to “create and adopt equitable community engagement plans to facilitate and support the meaningful and direct involvement of vulnerable populations and overburdened communities and must conduct an ‘environmental justice assessment’ for a significant agency action, which may require the use of cumulative impact analyses” (Wash. Rev. Code § 70A.02.100, 2021).
- **Federal Models:** As part of the Biden Administration, the Justice40 Initiative was a strategy to address environmental injustice. The initiative aimed to ensure that at least 40% of the benefits from specific federal investments flow to communities that are marginalized, underserved, or overburdened by pollution (Walls et al. 2024). These investments span a wide range of programs including clean energy, transportation, workforce development, and the remediation of legacy pollutions (National Archives and Records Administration n.d.). As part of EJ40, the federal government developed the Climate and Economic Justice Screening Tool (CEJST), which was intended to guide the equitable distribution of federal resources to help agencies prioritize community needs in funding and program designs (National Archives and Records Administration n.d.). Although this initiative was rolled back by the current administration, the Justice40 initiative is one example of worthy efforts that should continue to be prioritized and reinstated.
- **Community Partnerships:** In addition to state and federal efforts, community-led organizations play an important role in advancing environmental justice. For example, Milwaukee Environmental Justice Alliance (MEJA) brings together residents, grassroots organizations, and advocates to address environmental racism and push for systemic change in historically overburdened communities (MEJA n.d.). Organizations like these are already well-positioned to guide equitable implementation of cumulative impact policies by providing community engagement and data from lived experiences. Any statewide policy response should incorporate partnerships with community organizations to ensure inclusive solutions.

Together, these policy frameworks demonstrate how cumulative impacts can be operationalized through policy actions. Wisconsin can build on these initiatives by developing its own cumulative impact policies, investing in transparent screening tools, and prioritizing historically overburdened communities in permitting and enforcement decisions. Aligning environmental policy with cumulative impact principles is a necessary step toward reducing exposure disparities to HAPs and advancing environmental justice across the state.

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## Appendix A

### Methods

To evaluate disparities in estimated health burdens from HAPs exposure, we analyzed cancer risk levels, the Respiratory Hazard Index (RHI) and risk screening environmental indicator (RSEI) at the census tract level as a function of Social Vulnerability Index (SVI) at the census tract level. RHI and RSEI both assess health risks from exposure to air toxics, but they use different approaches. RHI estimates the potential for non-cancer chronic health effects from inhaling hazardous pollutants over a lifetime (Environmental Protection Agency 2020). In contrast, RSEI is a screening-level prioritization tool that is used to compare relative risk across facilities and regions by combining chemical toxicity, release amounts, exposure potential, and population proximity into a single score, called the RSEI Hazard (Environmental Protection Agency 2020).

To measure disparities in potential exposure to HAP emissions, we analyzed Wisconsin block group data to assess how close different racial and socioeconomic groups live to HAP facilities. For each block group, we assigned a percentile rank for both non-white and low-income residents for each block group. Block groups in the 75<sup>th</sup> percentile or higher were collectively identified as areas with the most non-white or low-income residents. Block groups in the 25<sup>th</sup> percentile or lower were collectively identified as areas with the least non-white or low-income residents. These thresholds reflect the most and least racially and economically marginalized urban areas in Wisconsin. Using these groupings, we conducted two proximity analyses:

1. The average number of facilities within 0.5 and 1 mile of the geographic center point of the most and least non-white or low-income block groups.

2. The distance from the geographic center point of the most and least non-white or low-income block groups to the nearest HAP facility.

Statistical differences between the most and least non-white or low-income block groups were evaluated with a Mann-Whitney U test using R software.

Additionally, we calculated the percent of each demographic group's total population living within 0.5 and 1 mile of a HAP facility.

Distances from block group center points to the nearest HAP facility and the number of facilities within 0.5 and 1 mile of HAP were calculated in ArcGIS Pro 3.3.

The proximity analyses were conducted at multiple geographic scales: all census block groups in the state; all census block groups in urban areas of the state, with urban areas as defined by the 2020 US Census; and within four of the most populous urban areas individually: Milwaukee, Madison, Beloit/Janesville, and Appleton/Green Bay/Oshkosh.

### Data Sources

HAP facility location information, cancer risk and RHI data were obtained from the U.S. EPA's 2019 Air Toxics Screening Assessment (Environmental Protection Agency 2025-f). Air toxics RSEI data were obtained from the 2024 EJScreen dataset<sup>1</sup>.

Demographics and social vulnerability data came from the CDC's Social Vulnerability Index database (Agency for Toxic Substances and Disease Registry n.d.) and the EJScreen dataset.

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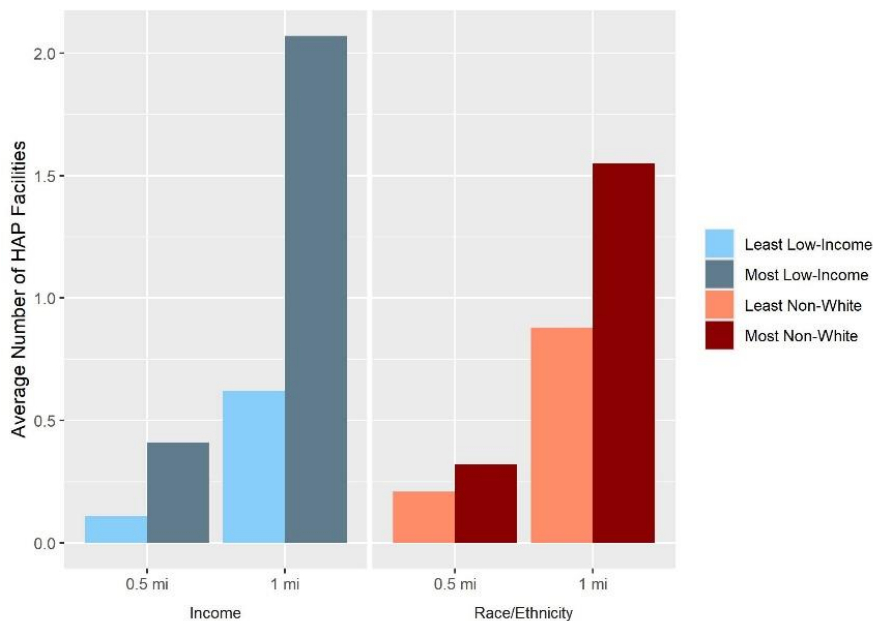
<sup>1</sup> This dataset has been removed from the EPA website as of February 2025.

## Appendix B

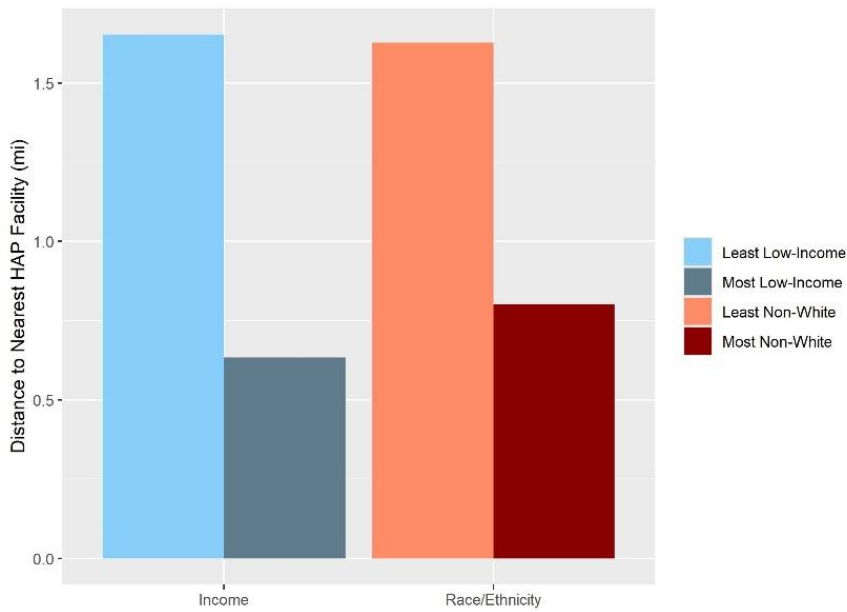
### Regional Patterns

#### Milwaukee Analysis

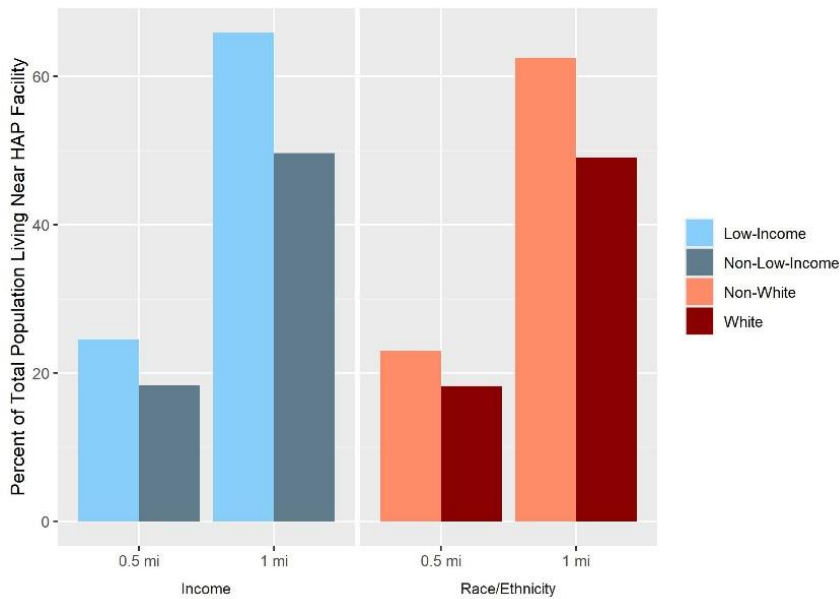
- Looking at Milwaukee, block groups with the most minority residents have significantly more HAP facilities nearby compared to those with least minority residents: 0.3 vs. 0.2 within a half-mile (W=34853, p=0.02), and 1.6 vs. 0.9 within one mile (W=27960, p<0.001) (Figure B1).
  - The same pattern holds for income. Block groups with the most low-income residents have over three times the number facilities compared to those with the least low-income residents: 0.4 vs. 0.1 within a half-mile (W=30778, p<0.001), and 2.1 vs. 0.6 within one mile (W=58451, p<0.001).
- Block groups with the most minority residents are twice as close on average to the nearest HAP facility (0.8 mi) than block groups with the least minority residents (1.6 mi) (W=49377, p<0.001; Figure B2).
  - Block groups with the most low-income residents are over twice as close on average to the nearest HAP facility (0.6 miles) than block groups with the least low-income residents (1.7 mi) (W= 58451, p<0.001).
- Similar to the statewide analysis results, in Milwaukee, a greater percentage of minority (62% within a half-mile) and low-income (66% within a half mile) populations live within close proximity to HAP facilities compared to non-minority (49% within a half-mile) and higher-income (49% within a half-mile) populations (Figure B3).



**Figure B1.** Average number of HAP facilities within 0.5 and 1 mile of census block groups in Milwaukee, comparing areas with the least (<25<sup>th</sup> percentile) and most (>75<sup>th</sup> percentile) minority and low-income residents.



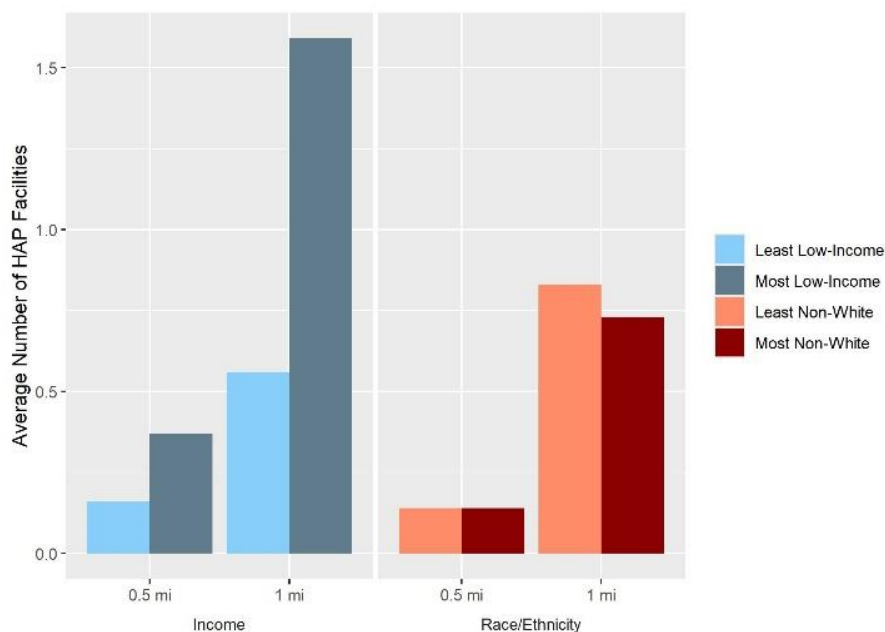
**Figure B2.** Distance to the nearest HAP facility in Milwaukee, comparing block groups with the least (<25<sup>th</sup> percentile) and most (>75<sup>th</sup> percentile) minority and low-income residents.



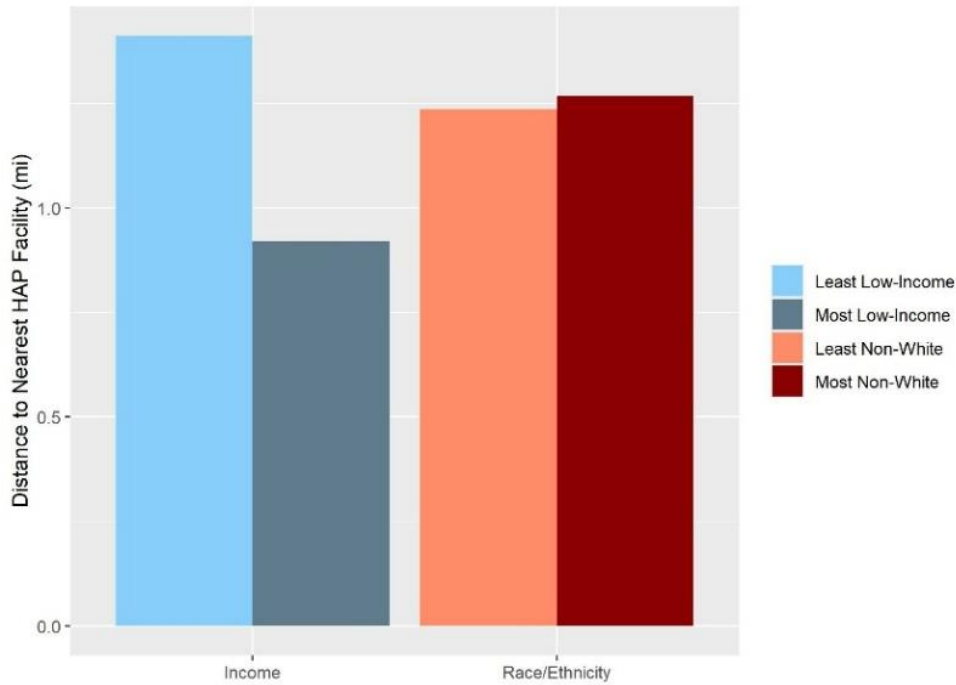
**Figure B3.** The percentage of the total minority, non-minority, low-income and non-low-income populations that live within 0.5 and 1 mile of a HAP facility in Milwaukee.

**Madison Analysis**

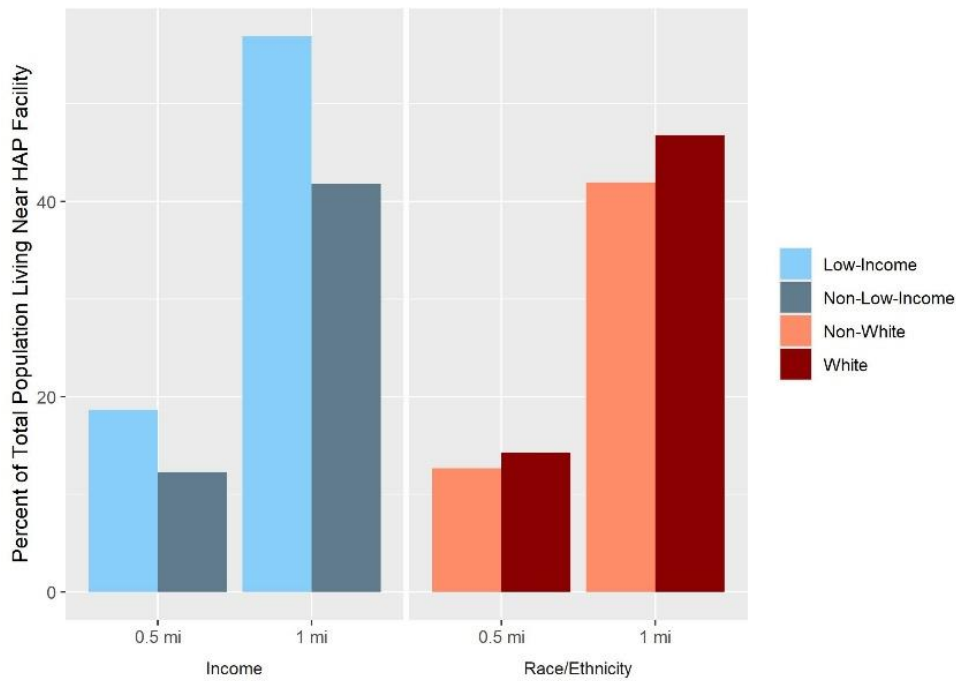
- Looking at Madison, block groups with the most and least minority residents have a similar number of HAP facilities nearby: 0.1 for both within a half-mile (W=1986, p=0.78), and 0.7 vs. 0.8 within one mile (W=2073, p=0.76) (Figure B4).
  - Block groups with the most low-income residents have significantly more nearby facilities compared to those with the least low-income residents: 0.4 vs. 0.2 within a half-mile (W=1701, p=0.02), and 1.6 vs. 0.6 within one mile (W=2883, p<0.001).
- Block groups with the most and least minority residents are a similar distance to the nearest HAP facility (W=1958, p=0.78) (Figure B5).
  - Block groups with the most low-income residents are significantly closer on average to the nearest HAP facility (0.9 miles) than block groups with the fewest low-income residents (1.4 mi) (W=2883, p<0.001).
- In Madison, a similar percentage of the minority population (13% within a half-mile) lives within close proximity to HAP facility compared to non-minority populations (14% within a half-mile) (Figure B6). A higher percentage of the low-income population (19% within a half-mile) lives within close proximity to a HAP facility compared to the non-low-income population (12% within a half-mile).



**Figure B4.** Average number of HAP facilities within 0.5 and 1 mile of census block groups in Madison, comparing areas with the least (<25<sup>th</sup> percentile) and most (>75<sup>th</sup> percentile) minority and low-income residents.



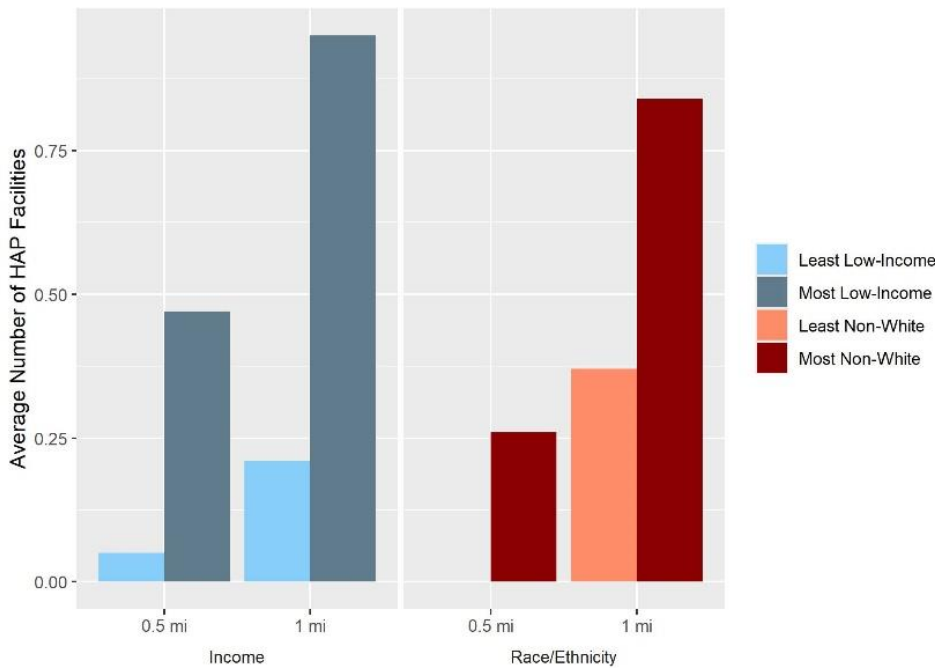
**Figure B5.** Distance to the nearest HAP facility in Madison, comparing block groups with the least (<25<sup>th</sup> percentile) and most (>75<sup>th</sup> percentile) minority and low-income residents.



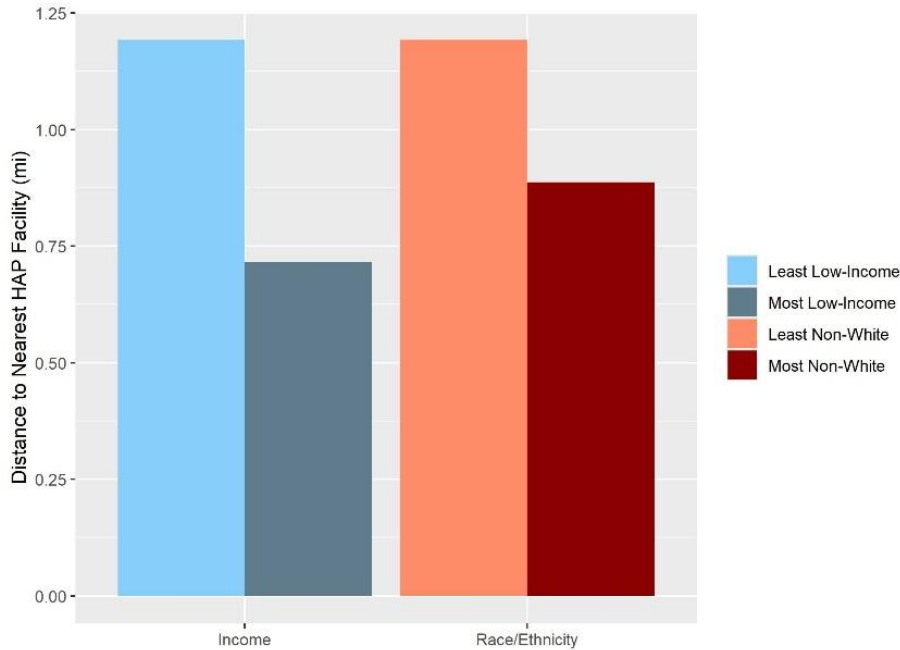
**B6.** The percentage of the total low-income and non-low-income populations that live within 0.5 and 1 mile of a HAP facility in Madison.

**Beloit and Janesville Analysis**

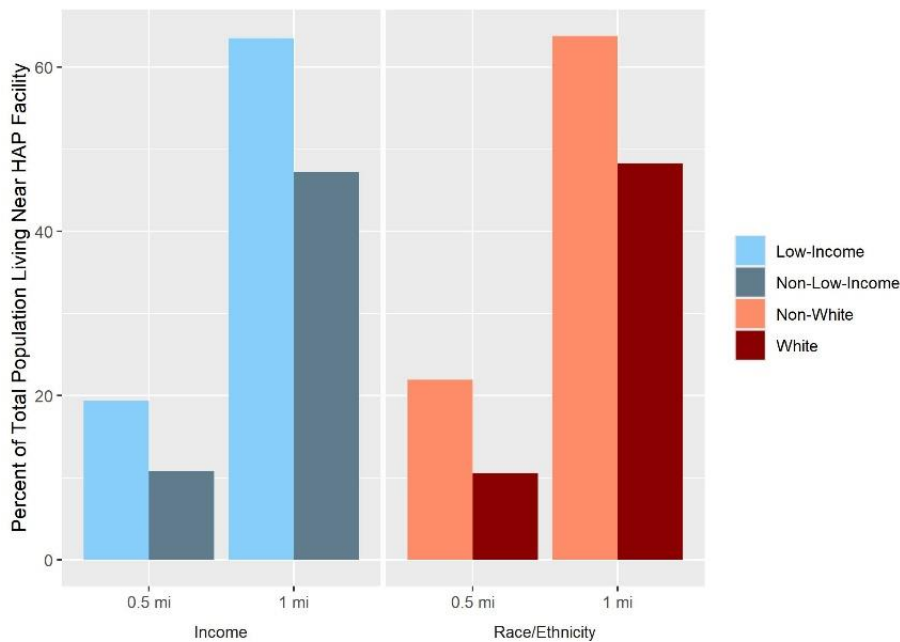
- Looking at Beloit and Janesville, block groups with the least minority residents have significantly more HAP facilities nearby compared to those with least minority residents: 0.3 vs 0.0 within a half-mile ( $W=114$ ,  $p=0.009$ ), and 0.8 vs. 0.4 within one mile ( $W=78$ ,  $p<0.001$ ) (Figure B7).
  - The pattern is the same for income. Block groups with the most low-income residents have significantly more nearby facilities compared to those with the least low-income residents: 0.5 vs. 0.1 within a half-mile ( $W=133$ ,  $p=0.02$ ), and 1.0 vs. 0.2 within one mile ( $W=258$ ,  $p=0.02$ ).
- Block groups with the most minority residents are significantly closer on average to the nearest HAP facility (0.9 mi) than block groups with the least minority residents (1.2 mi) ( $W = 258$ ,  $p=0.02$ ; Figure B8).
  - Block groups with the most low-income residents are significantly closer on average to the nearest HAP facility (0.7 miles) than block groups with the fewest low-income residents (1.2 mi) ( $W=281$ ,  $p=0.003$ ).
- A higher percentage of the minority population (22% within a half-mile) lives within close proximity to HAP facility compared to non-minority populations (11% within a half-mile) (Figure B9). A higher percentage of the low-income population (19% within a half-mile) lives within close proximity to HAP facility compared to the non-low-income population (11% within a half-mile).



**Figure B7.** Average number of HAP facilities within 0.5 and 1 mile of census block groups in Beloit and Janesville, comparing areas with the least (<25<sup>th</sup> percentile) and most (>75<sup>th</sup> percentile) minority and low-income residents.



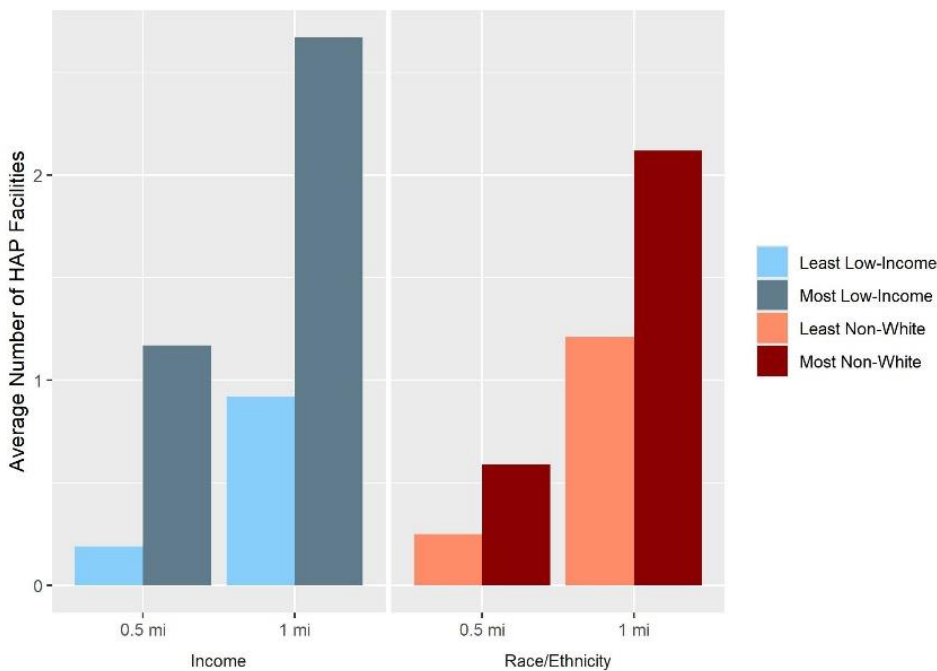
**Figure B8.** Distance to the nearest HAP facility in Beloit and Janesville, comparing block groups with the least (<25<sup>th</sup> percentile) and most (>75<sup>th</sup> percentile) minority and low-income residents.



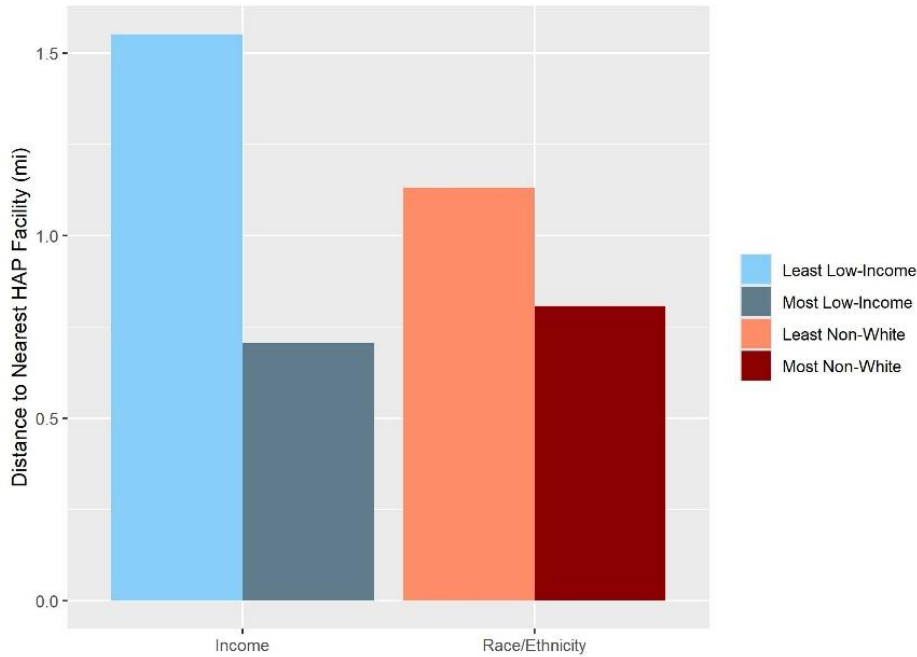
**B9.** The percentage of the total low-income and non-low-income populations that live within 0.5 and 1 mile of a HAP facility in Beloit and Janesville.

**Appleton, Green Bay, and Oshkosh Analysis**

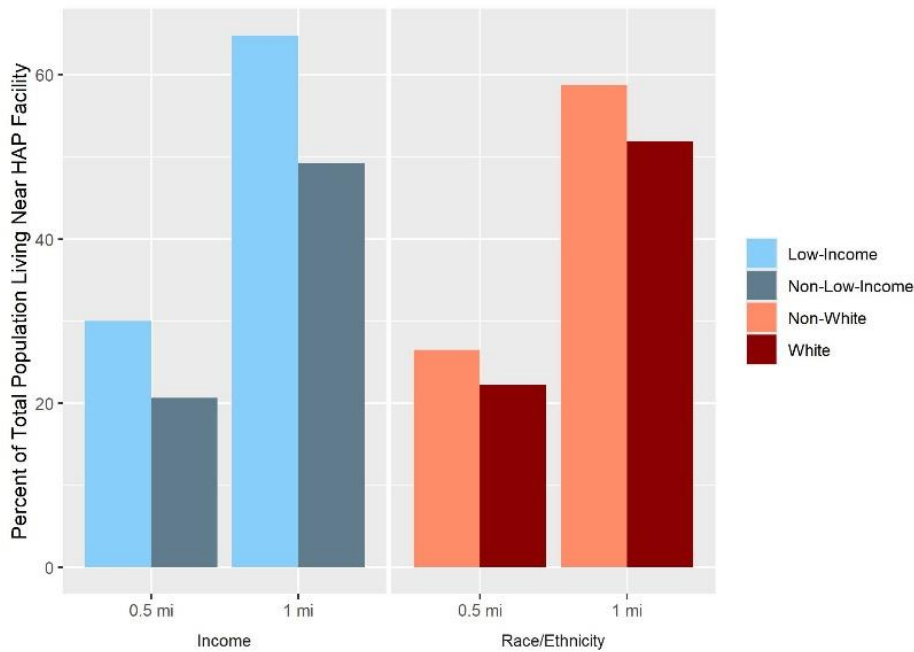
- Looking at the Fox Valley region, block groups with the least minority residents have significantly more HAP facilities nearby compared to those with least minority residents: 0.6 vs 0.3 within a half-mile (W=3420, p=0.008), and 2.1 vs. 1.2 within one mile (W=5212, p=0.003 ) (Figure B10).
  - The pattern is the same for income. Block groups with the most low-income residents have significantly more nearby facilities compared to those with the least low-income residents: 1.2 vs. 0.2 within a half-mile (W=2679, p<0.001), and 2.7 vs. 0.9 within one mile (W=1979, p<0.001).
- Block groups with the most minority residents are significantly closer on average to the nearest HAP facility (0.8 mi) than block groups with the least minority residents (1.1 mi) (W=5212, p=0.003; Figure B11).
  - Block groups with the most low-income residents are also significantly closer on average to the nearest HAP facility (0.7 miles) than block groups with the fewest low-income residents (1.6 mi) (W=6780, p<0.001).
- A higher percentage of the minority population (26% within a half-mile) lives within close proximity to HAP facility compared to non-minority populations (22% within a half-mile) (Figure B12). A higher percentage of the low-income population (30% within a half-mile) lives within close proximity to HAP facility compared to the non-low-income population (21% within a half-mile).



**Figure B10.** Average number of HAP facilities within 0.5 and 1 mile of census block groups in Green Bay, Appleton and Oshkosh, comparing areas with the least (<25<sup>th</sup> percentile) and most (>75<sup>th</sup> percentile) minority and low-income residents.



**Figure B11.** Distance to the nearest HAP facility in Green Bay, Appleton and Oshkosh, comparing block groups with the least (<25<sup>th</sup> percentile) and most (>75<sup>th</sup> percentile) minority and low-income residents.



**Figure B12.** The percentage of the total low-income and non-low-income populations that live within 0.5 and 1 mile of a HAP facility in Green Bay, Appleton and Oshkosh.

