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Transportation, Racial Inequalities, and Public Health in Washington, DC

November 2023

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Acknowledgments

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Executive summary

Greater Greater Washington conducted research to understand how lack of access to safe, convenient, and affordable public and active transportation creates structural health inequities among residents of Washington, DC. This report, funded by the Robert Wood Johnson Foundation "Data to Improve Community Conditions Shaped by Structural Racism" initiative, is a resource for public decision makers to understand how transportation intersects with public health outcomes in the District.

Negative public health impacts of exposure to emissions and traffic are not evenly distributed across DC. Overwhelmingly, neighborhoods where the median income is below $50,000, and where the majority of residents are Black or Hispanic, experience higher levels of health problems associated with pollution and traffic violence, such as asthma and traffic fatalities.

For example, communities in Wards 7 and 8 have the highest concentration of zero car households, but experience the highest levels of traffic injuries and deaths. Air pollution also has a disproportionate impact, with particulate matter affecting residents closer to areas with high traffic. As a result of these disproportionate impacts, Wards 7 and 8 have the highest rates of emergency room visits due to asthma, higher rates of mental distress, diabetes, and heart disease among others.

For health equity to become a reality in DC, a public health strategy to reduce the exposure of communities of color and low-income households to the harmful effects of single occupancy vehicles is needed, to be led by a multi-sectoral team of agencies and experts.

Grant deliverables

This report was produced with the generous support of the Robert Wood Johnson Foundation, and technical assistance from the Urban Institute. Throughout the grant period, GGWash complemented this research with additional deliverables, including:

- A webinar, held on Sept. 21, 2023, about how transportation decisions impact health outcomes, and the implicit influence that transportation has on structural racism and health equity, featuring Dr. Janet Phoenix and Rachel Clark; the recording can be found here.
- A briefing of findings to the Transportation Equity Network, a coalition managed by GGWash, on Sept. 29, 2023; the agenda can be found here, and the slide deck can be found here.
- An original qualitative analysis of the hypothetical impact of a 10 percent reduction in vehicle trips on public health, as represented by air quality and asthma rates, conducted by D. Taylor Reich for GGWash; a summary of that analysis begins on page 74.

Introduction

Social determinants of health

Access to safe, convenient, frequent, and comfortable transportation is a key factor in determining a person's overall health. A lack of these options is linked to a host of health inequities, which echo through generations. Many DC residents can access high-quality bus and rail services, and safe walking and biking routes. However, those who cannot do so are at much higher risk of worse health outcomes, which are closely correlated with race and income levels.

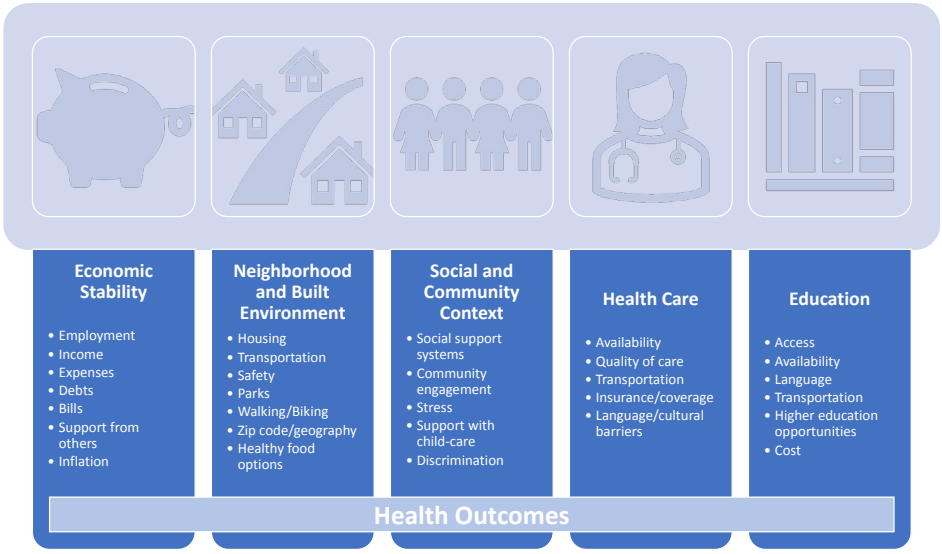


Figure 1: Social determinants of health, adapted from Centers for Disease Control and Prevention

The purpose of this report is to:

1. Examine transportation inequities in the District of Columbia, and
2. Highlight how these problems intersect with public health, and have important implications for racial and other dimensions of equity.

The information contained in the report is intended for use by elected officials, civic leaders, advocates, agency professionals, and residents, with the goal of establishing how investing in transportation equity– specifically public transit and active transportation like walking, biking and scooting– can help tackle long-term, often generational health inequities.

While gaps in transportation access across the District are relatively well-known, a less examined dimension of this problem is its intersection with public health. The purpose of this report is to examine inequity in transportation in the District of Columbia and show how this unequal distribution of resources can influence public health outcomes for underserved populations.

Social determinants of health are the aspects of daily life that determine health outcomes outside of medicine, according to the Centers for Disease Control and Prevention (CDC). These factors show up in many aspects of our lives, and the Office of Disease Prevention and Health Promotion explicitly names the Neighborhood and Built Environment category as one that has a major impact.

In line with this theme, the U.S. Department of Health and Human Services states that "communities that invest in mass transit can help reduce air pollution and prevent many serious health problems."

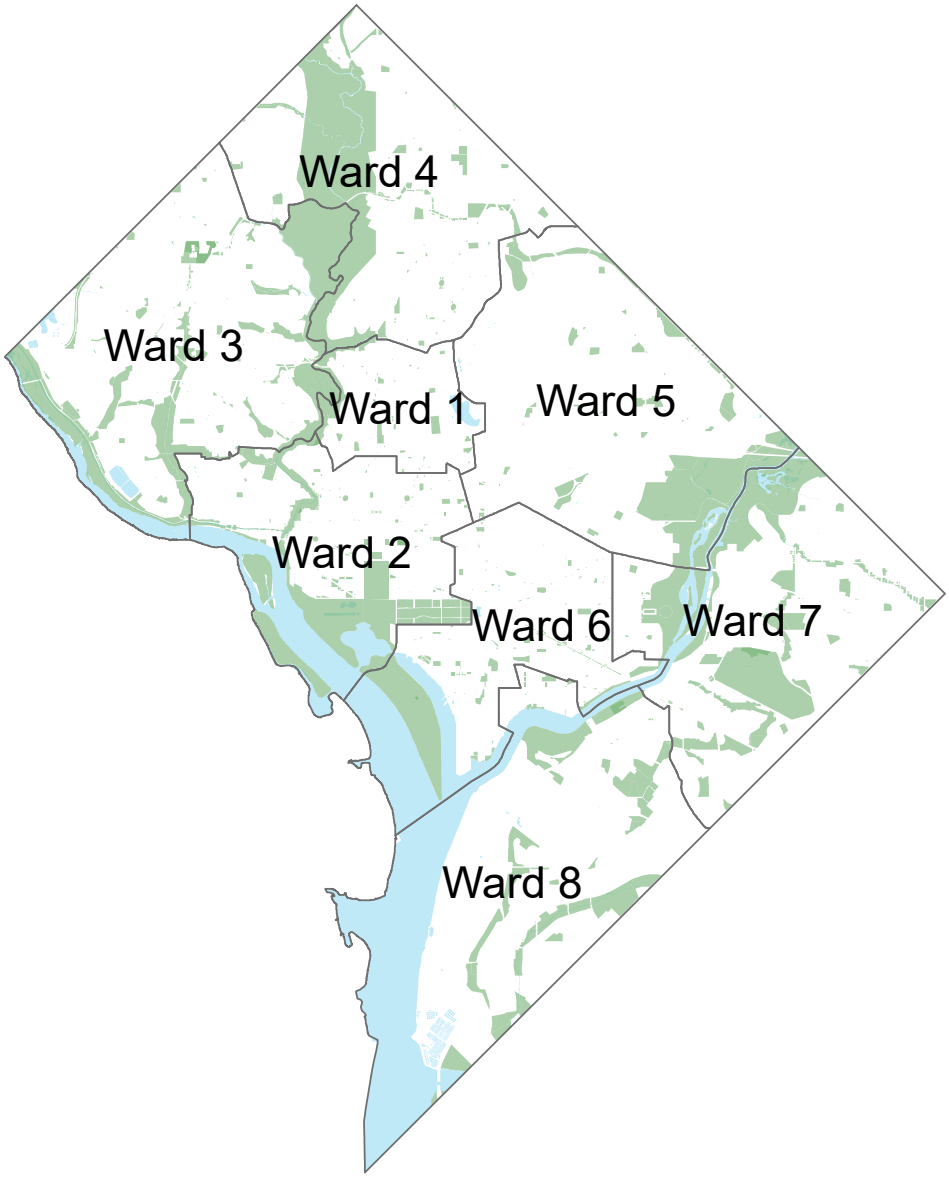
Housing and transportation are among the principal factors in a person's health. Residents living in areas with higher levels of traffic violence, heightened noise pollution, poor air quality, or limited infrastructure for walking and biking can experience adverse health outcomes related to these circumstances. The graphic above outlines an explanation of social determinants of healths' potential indicators of one's health.

Existing conditions

About the data

With the District's demographics as a foundation, the analysis section of this report will explore how access to adequate public transportation and public infrastructure differ across various groups. This report uses publicly available American Community Survey data from 2017-2021. The ACS is a yearly nationwide survey that collects information about the "social, economic, housing, and demographic characteristics" of the United States population. The ACS and its methods are used as the gold standard for planners (and Congress) as annual estimates look for data in "real time."

ACS data allows exploration of the demographics of District residents to be understood to explore where people live versus where health outliers and lack of infrastructure is occurring. One of the main drawbacks of this ACS dataset is that it only allows respondents to select one mode of transportation, even if they may use multiple modes throughout the week, which results in more emphasis on the mode they use most often.



Map 1: The District of Columbia is divided into eight wards, each home to approximately 75,000 residents.

Additional data components used in this report include: air pollution data provided by George Washington University, open data publicly available from the District of Columbia, high injury networks provided by District Department of Transportation (DDOT), health data publicly available from Centers for Disease Control and Prevention (CDC), and asthma data provided by Children's National Hospital.

Demographics

"The District has a higher level of income inequality than any state in the country, with households in the top 20 percent of income having 29 times more income than the bottom 20 percent. The bottom fifth of DC households had just two percent of total DC income in 2016, while the top fifth had a staggering 56 percent." *—DC Fiscal Policy Institute*

To understand where people live and how they move, it's important to understand the demographics of the District.

The figures below display demographic data across census tracts in the District of Columbia using ACS 2017-2021 data. This demographic data establishes important context for how DC's population changes based on ward, neighborhood, or even census tract. These maps also make it possible to highlight overlaps in infrastructure resource challenges compared to current neighborhood demographics, later in the report.

The following overview of District demographics showcases data on general population, housing, race, age, and gender.

An overview of the District can be seen in Figure 2 as well as Map 2 and Map 3. Portions of the District are denser in some locations compared to others. Map 2 displays where people are living throughout the District, and Map 3 showcases how many housing units are available. Importantly, areas with greater density of housing may not always look that way, because large apartment complexes may show up as a "housing unit" comparable to a single family home even though they contain more households.

Figure 2 displays DC's total population by race, while Map 4 and Map 5 display locations of Black and African-American populations and Hispanic and Latino populations, respectively.

Figure 2: District of Columbia American Community Survey fast facts (ACS 2017-2021 data)

Age

Understanding the age of residents throughout a community is vital to ensuring proper resource allocation. Map 6 and Map 7 show locations of the youngest and oldest age brackets in the District. Demographic data in Figure 5 shows the age of residents in the District of Columbia skews young, with the bulk of DC residents being under 40 years old.

Poverty

The District of Columbia "has one of the highest poverty rates in the country, when compared with states, behind only Mississippi, Louisiana, and New Mexico. At 18.6 percent, it is significantly higher than the national average of 12.7 percent" (DC Fiscal Policy Institute). The stark separation between wealthy and low-income households is evident in Map 8 showing census tracts where a high percent of its residents are in poverty.

Figure 3 illustrates the differences in median household income for Wards 7 and 8 compared to all other wards. The average median household income of Wards 1 through 6 is more than twice as much as the average median household income of Wards 7 and 8.

This extreme income gap illustrates that residents of lower-income wards have less surplus income to spend on transportation, such as taking a rideshare to work instead of more affordable but likely inconvenient public transit. The following analyses explore the relationship between race, income, and access to affordable and convenient public transportation.

Ward	Median Household Income
Ward 1	$126,433
Ward 2	$124,728
Ward 3	$157,057
Ward 4	$106,634
Ward 5	$102,744
Ward 6	$125,555
Ward 7	$49,509
Ward 8	$47,421

Figure 3: Median household income by ward (DC Health Matters)

Racial equity and distribution

Black and African-American residents are more likely to live in wards 5, 7, and 8. Hispanic and Latino residents are fairly scattered, with a concentration in Ward 4. Families in poverty are more likely to live in Wards 7 and 8. Older populations typically reside in Wards 3 and 4, and children are spread throughout the District.

In the analysis section of this report, we will show that resources are scattered and do not serve all populations the same as there are gaps in infrastructure making DC inequitable to typically underserved populations.

	Population
Total:	**689,545**
Population of one race:	**633,468**
White alone	273,194
Black or African American alone	285,810
American Indian and Alaska Native alone	3,193
Asian alone	33,545
Native Hawaiian and Other Pacific Islander alone	432
Some Other Race alone	37,294
Population of two races:	**51,147**
White; Black or African American	7,543
White; American Indian and Alaska Native	2,212
White; Asian	8,646
White; Native Hawaiian and Other Pacific Islander	247
White; Some Other Race	23,425
Black or African American; American Indian and Alaska Native	2,334
Black or African American; Asian	1,340
Black or African American; Native Hawaiian and Other Pacific Islander	112

Figure 4: Racial demographics of DC (ACS 2017-2021 data)

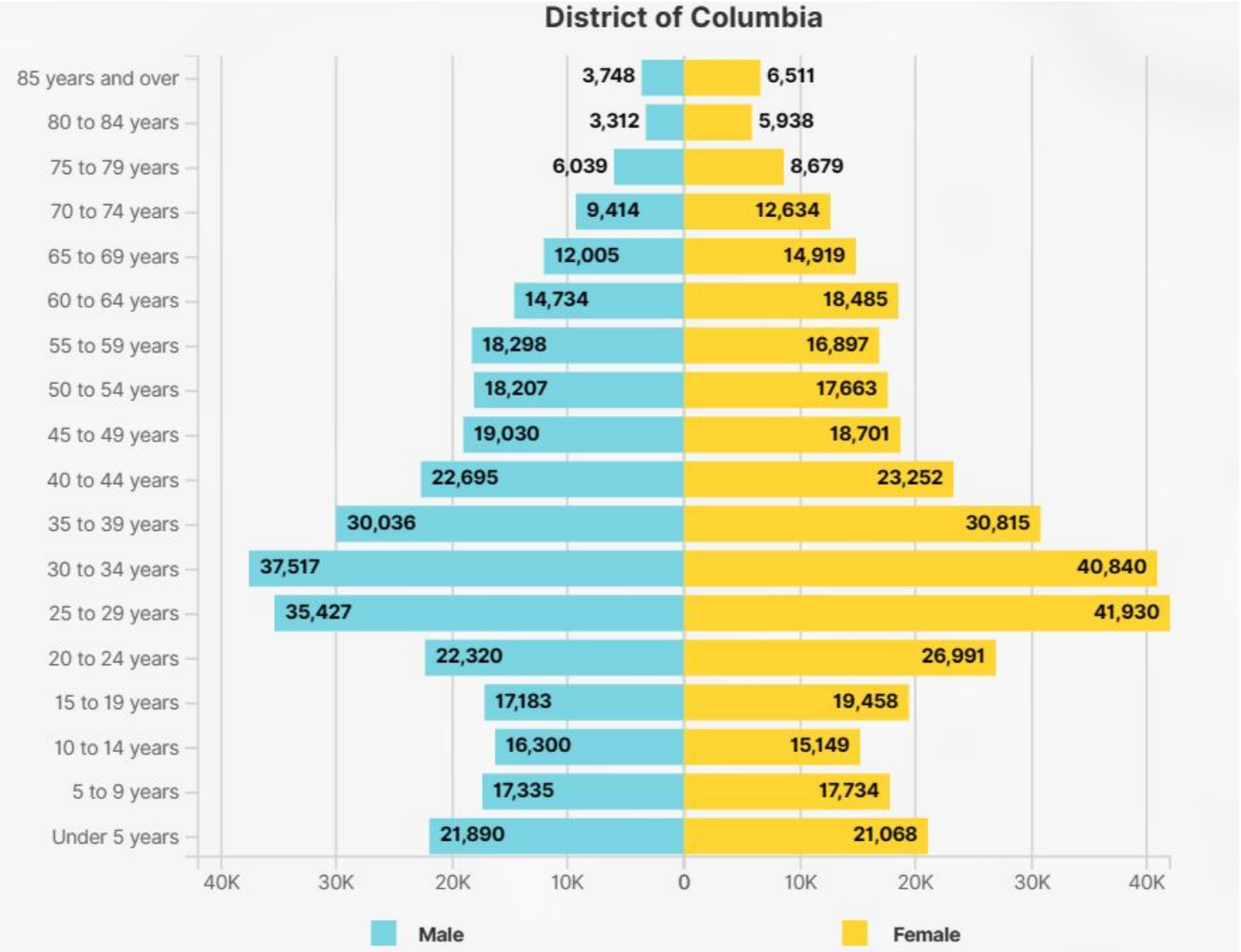
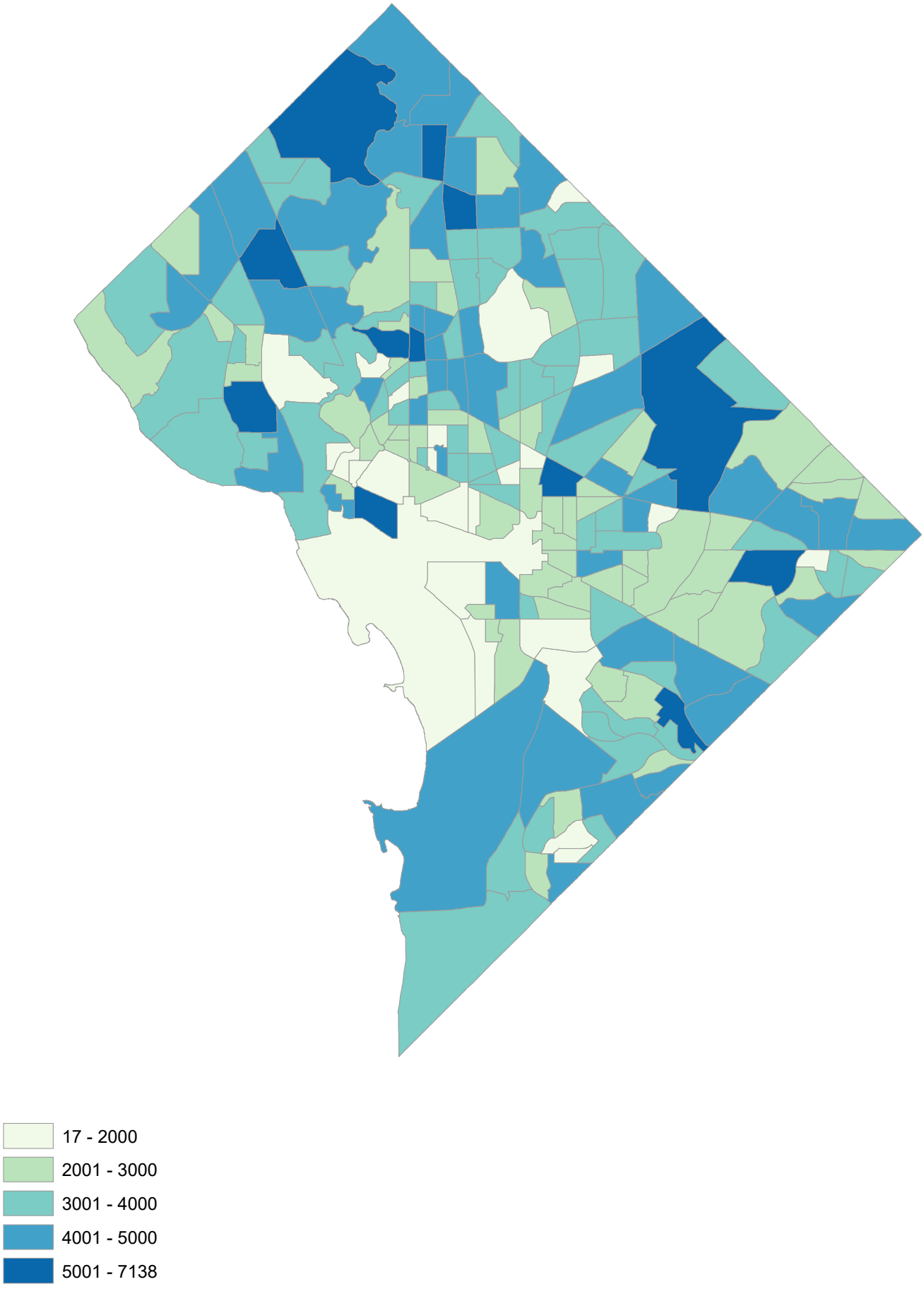
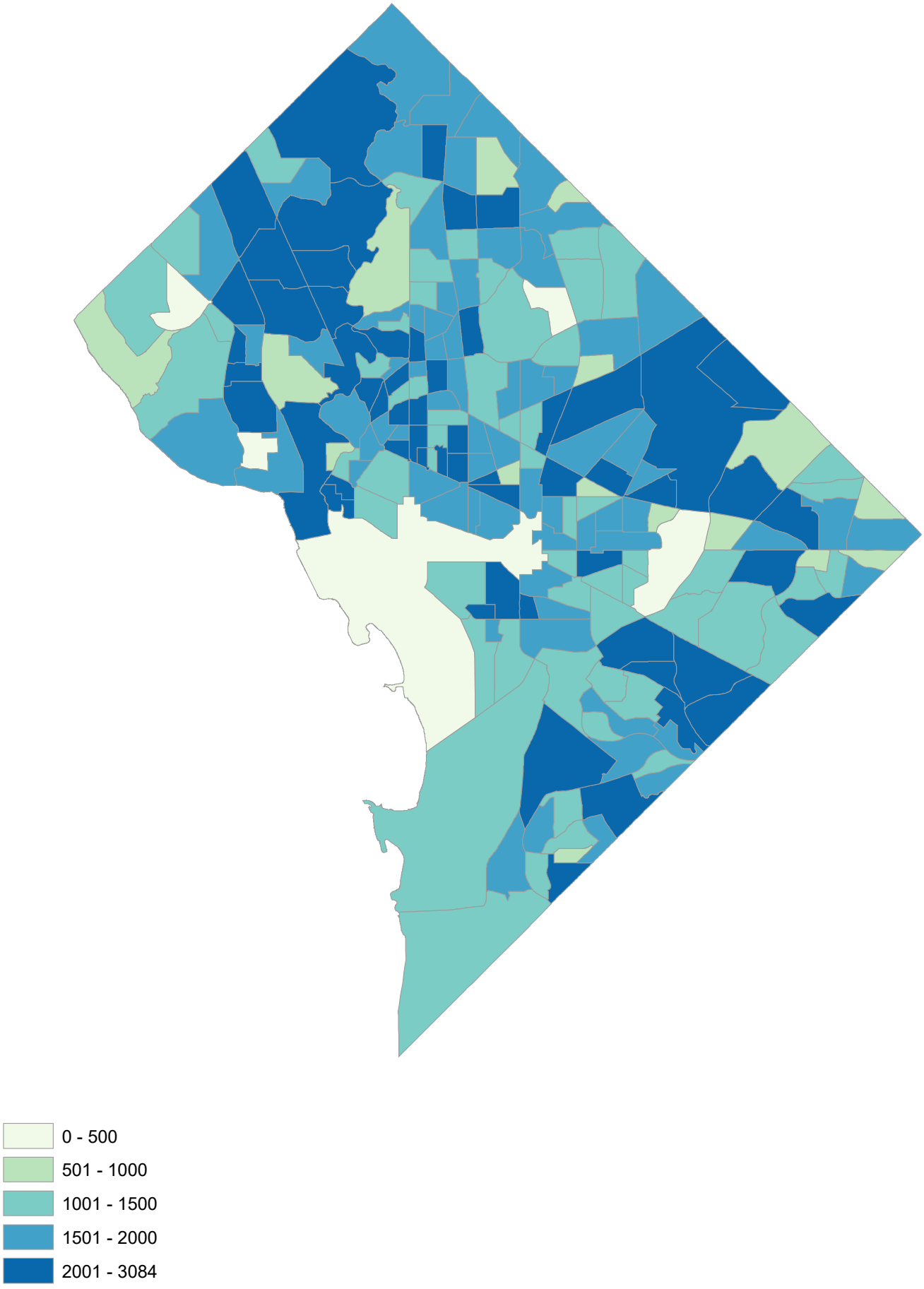


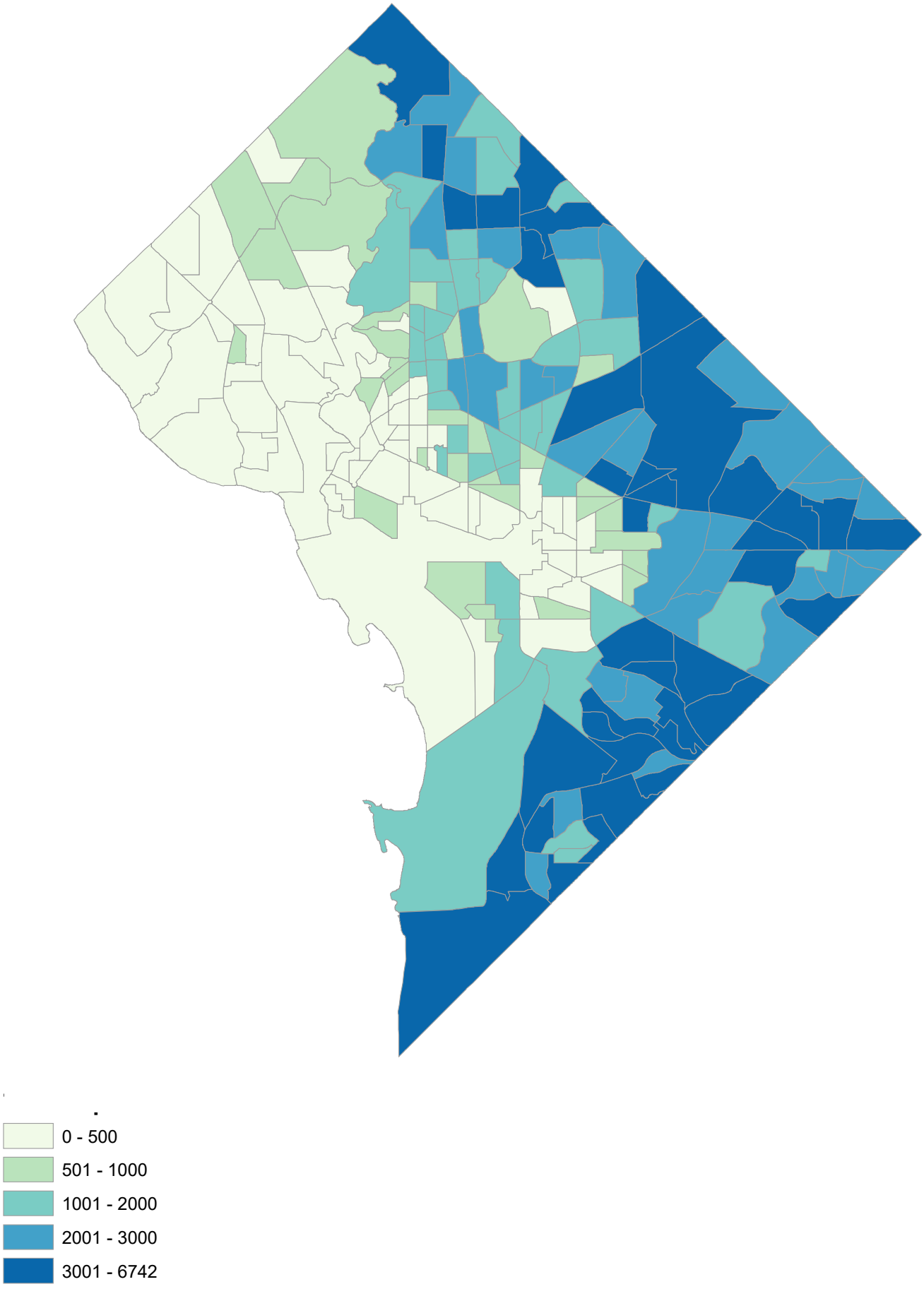
Figure 5: District of Columbia residents by age and sex (ACS 2017-2021 data)



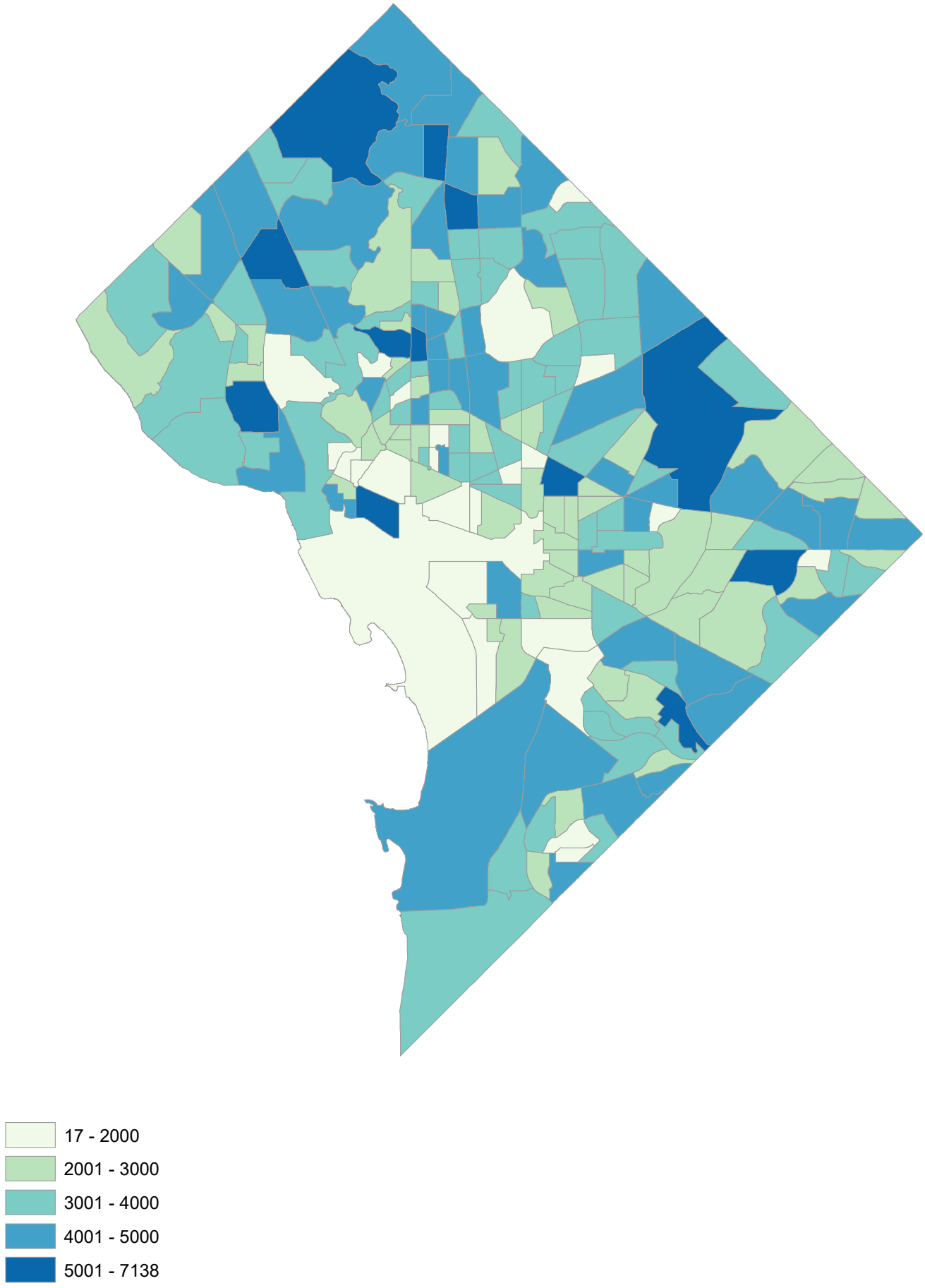
Map 2: Total population by Census tract (ACS 2017-2021 data)



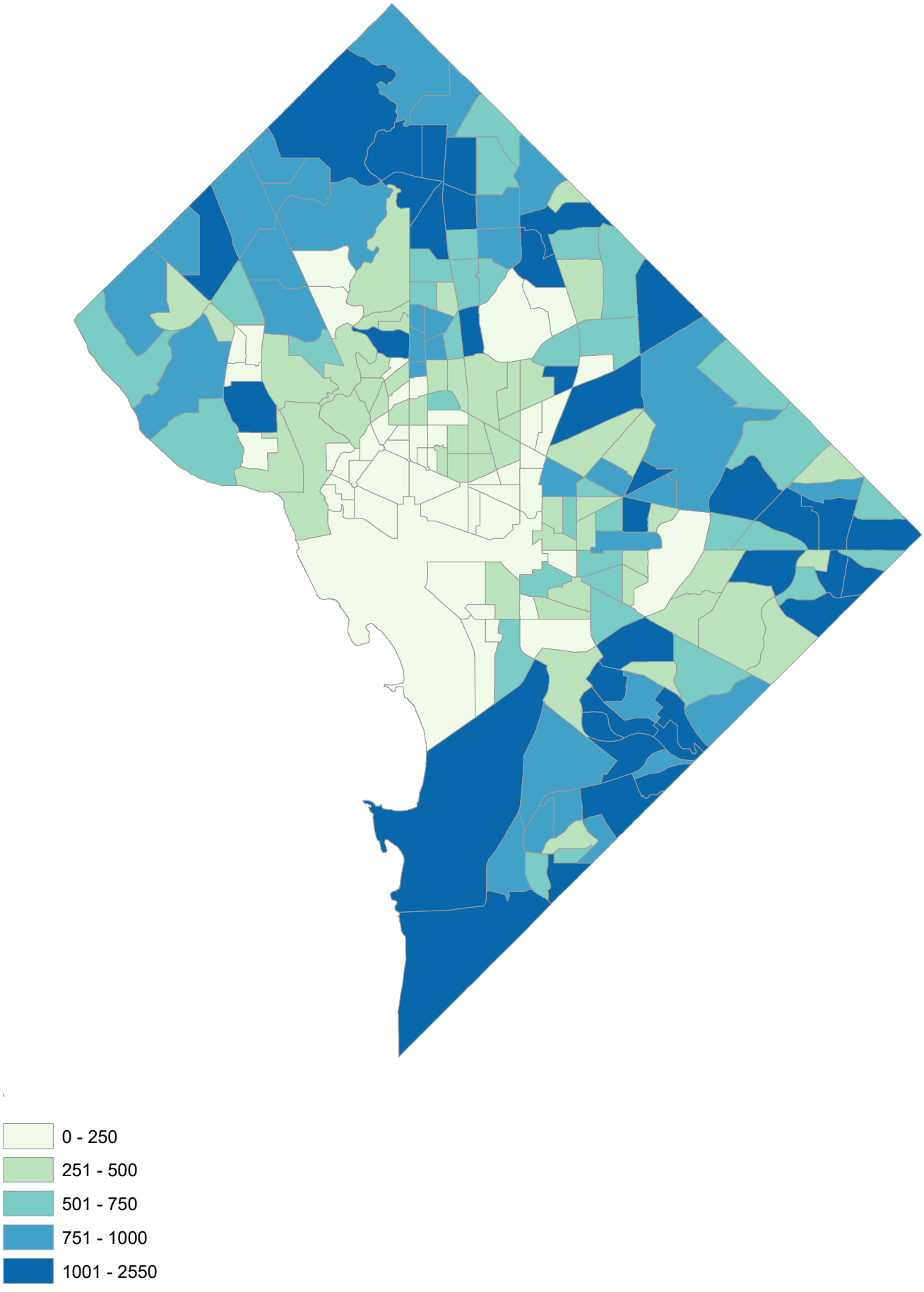
Map 3: Total housing units by Census tract (ACS 2017-2021 data)



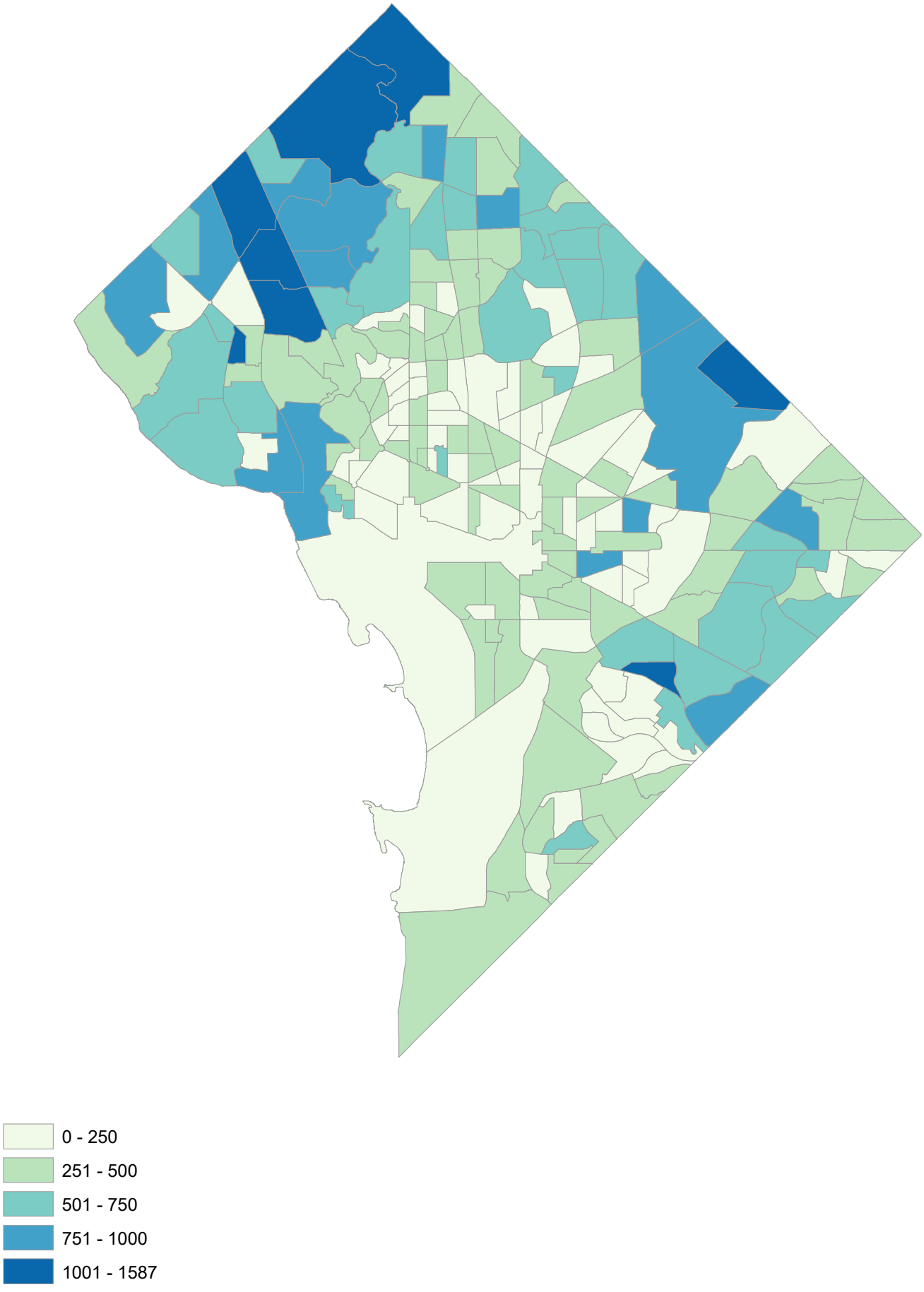
Map 4: Black and African-American residents by Census tract (ACS 2017-2021 data)



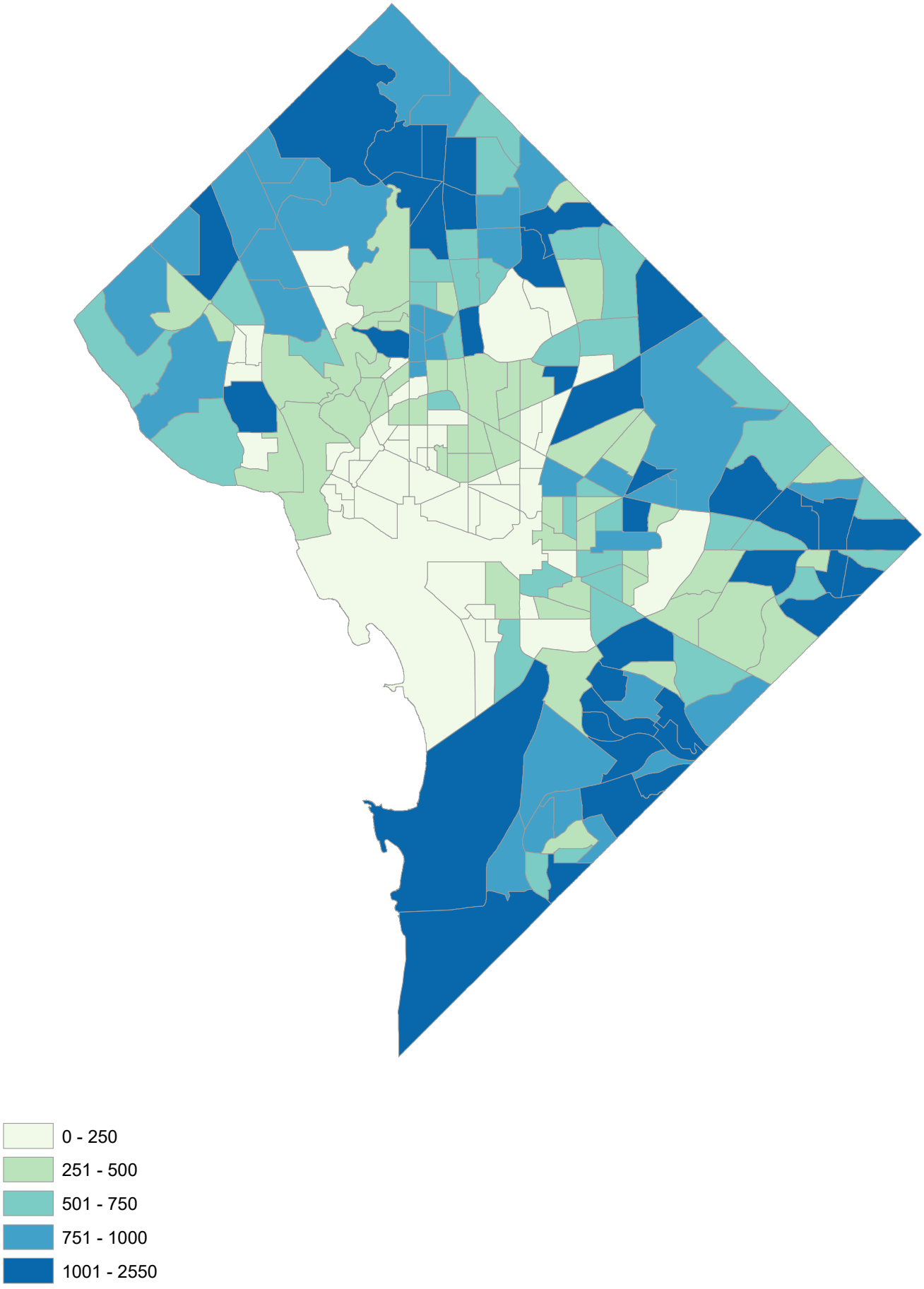
Map 5: Hispanic and Latino residents by Census tract (ACS 2017-2021 data)



Map 6: Residents under 18 years old by Census tract (ACS 2017-2021 data)



Map 7: Residents 65 years old and older by Census tract (ACS 2017-2021 Data)



Map 8: Families in poverty by Census tract (ACS 2017-2021 data)

Analysis: Transportation and public health

Commute

When completing the American Community Survey, respondents are asked to select their primary mode of travel for commuting to work. For example, if a person commutes by car three days a week but by transit for two, they would indicate that driving is their primary mode of travel. Although ACS data indicated that DC was the top city for remote work in the United States in 2021, the Biden administration is now urging federal agencies to cut back on remote work policies. As of late 2023, DC's traffic has returned to pre-pandemic levels, and we can expect greater increases as federal workers gradually return to the office.

Additionally, the pandemic had less of an effect on many low-income residents' commute patterns than it did on high-income earners. A study by the Journal of Transport Geography showed a statistically significant difference in rates of remote work among low-income earners versus higher income earners, reflecting that many low-income workers are required by their employers to work in person.

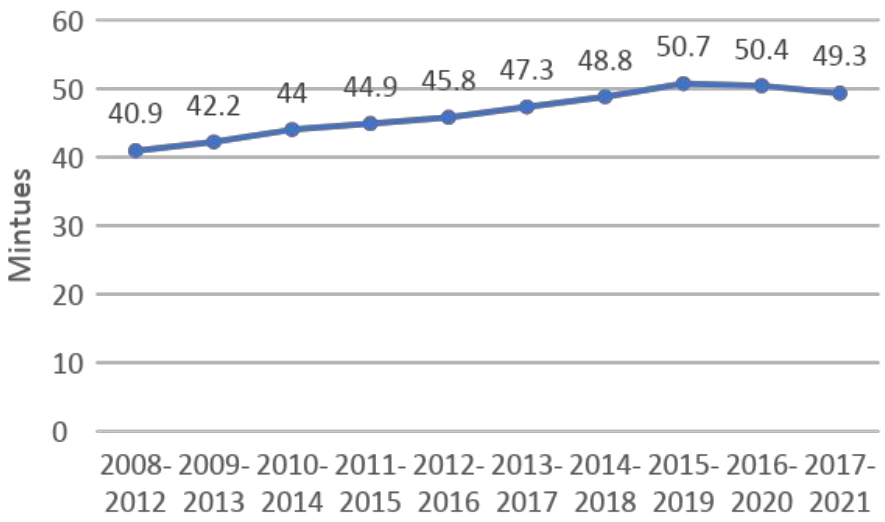


Figure 6: Solo drivers with a long commute, 2008–2021 (DC Health Matters / ACS)

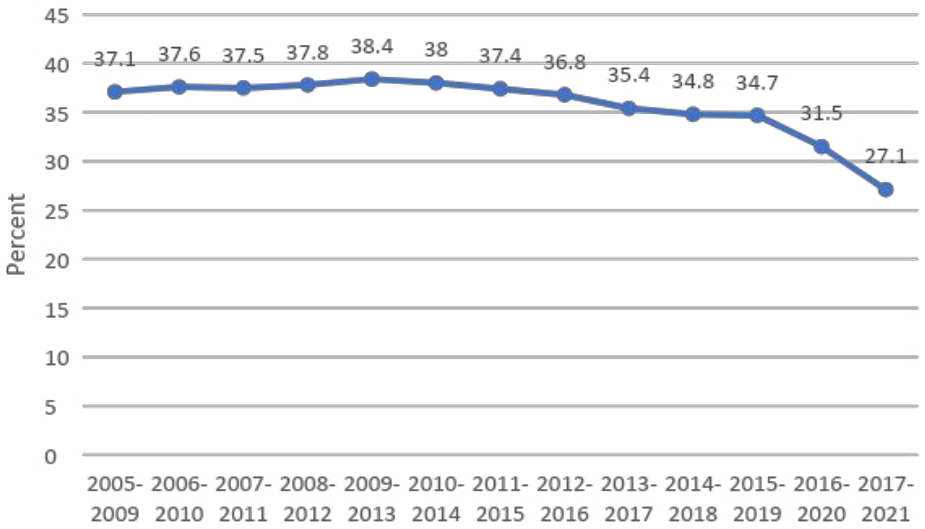


Figure 7: Workers commuting by public transportation (DC Health Matters / ACS)

An unreleased report on road pricing, commissioned by the District government in 2019, managed by the DC Sustainable Transportation Coalition, and updated in 2021 finds, "Census data indicates that very few low-income earning workers commute to downtown DC by automobile, while WMATA ridership data points to stronger dependence on the bus network than rail. The bus system is a critical means of access to local services and essential jobs. Because buses share roadways with private automobiles and other vehicles, bus transit service is impacted by roadway congestion. By reducing this congestion, congestion pricing can help create a more equitable transportation system."

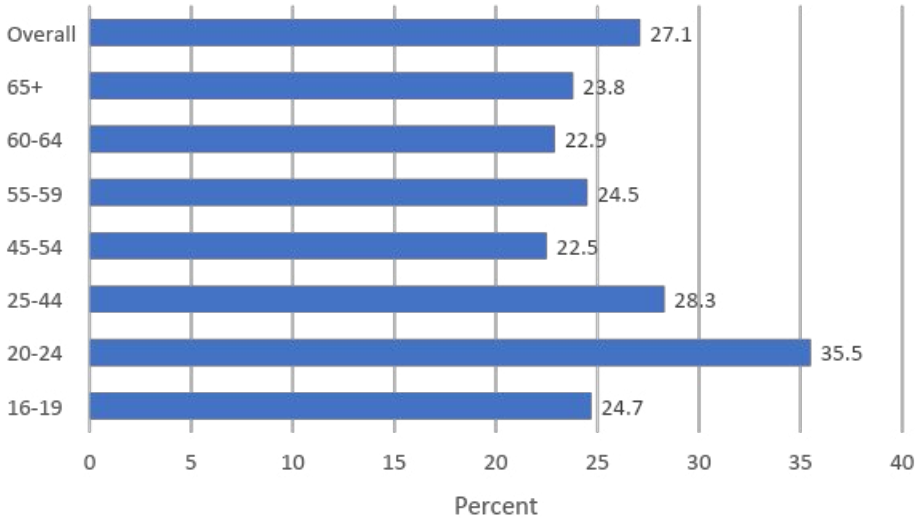


Figure 8: Workers commuting by public transportation by age ([DC Health Matters](#) / ACS)

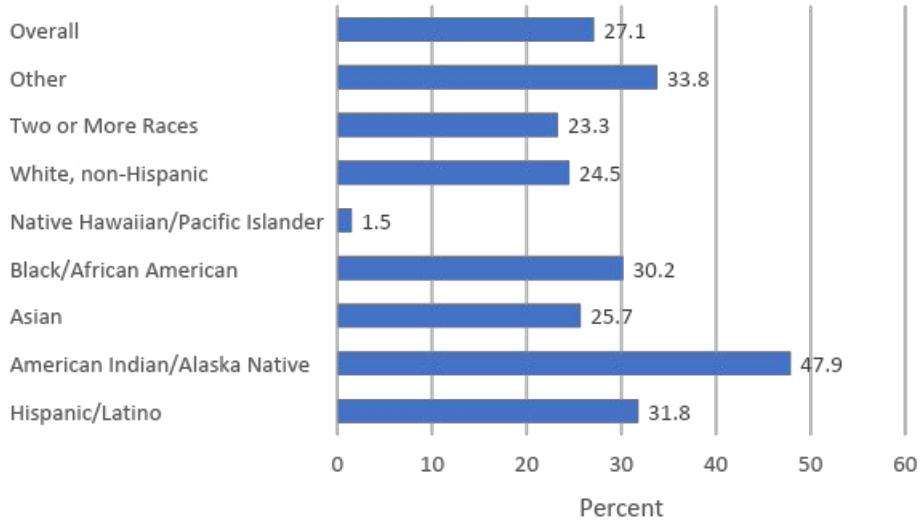


Figure 9: Workers commuting by public transportation by race ([DC Health Matters](#) / ACS)

An analysis of ACS commute data reveals a trend in which fewer people are using public transportation to travel to work; it also reveals demographic differences in usage. While there has been a small dip in recent years, the amount of solo drivers with a long commute has increased over the last 10 years. A decline in the number of people taking public transportation to work had been occurring in the District some time before the COVID-19 pandemic in 2020. Workers commuting via public transportation peaked, according to ACS data, from 2009 - 2013, when 38.4 percent of residents reported that their primary mode of travel was public transportation. From 2017-2021, only 27.1 percent of people reported traveling to work via public transportation.

Commuters using public transportation skew young. This is consistent with the demographic analysis above, which shows that the majority of DC's residents are under 40 years old. The majority of public transportation commuters in DC are between ages 20 and 44.

The Census tracts with the highest public transit ridership are in locations with easy access to the Metro system, as highlighted in Maps 10 and 11.

Map 9 demonstrates that census tracts with the highest level of public transit ridership are located in areas with easy access to Metro lines, and are also often (though not always) co-located with higher incomes.

From the to-be-released report on road pricing, data gathered during the pandemic highlights two major inequities in DC's current public transportation service network. Essential workers 1) often don't have access to cars or other alternate modes of transportation, and 2) live in areas with limited Metro access and tend to ride the bus more. Map 10 below displays that DC's bus lines cover a much wider range of the District than Metro lines.

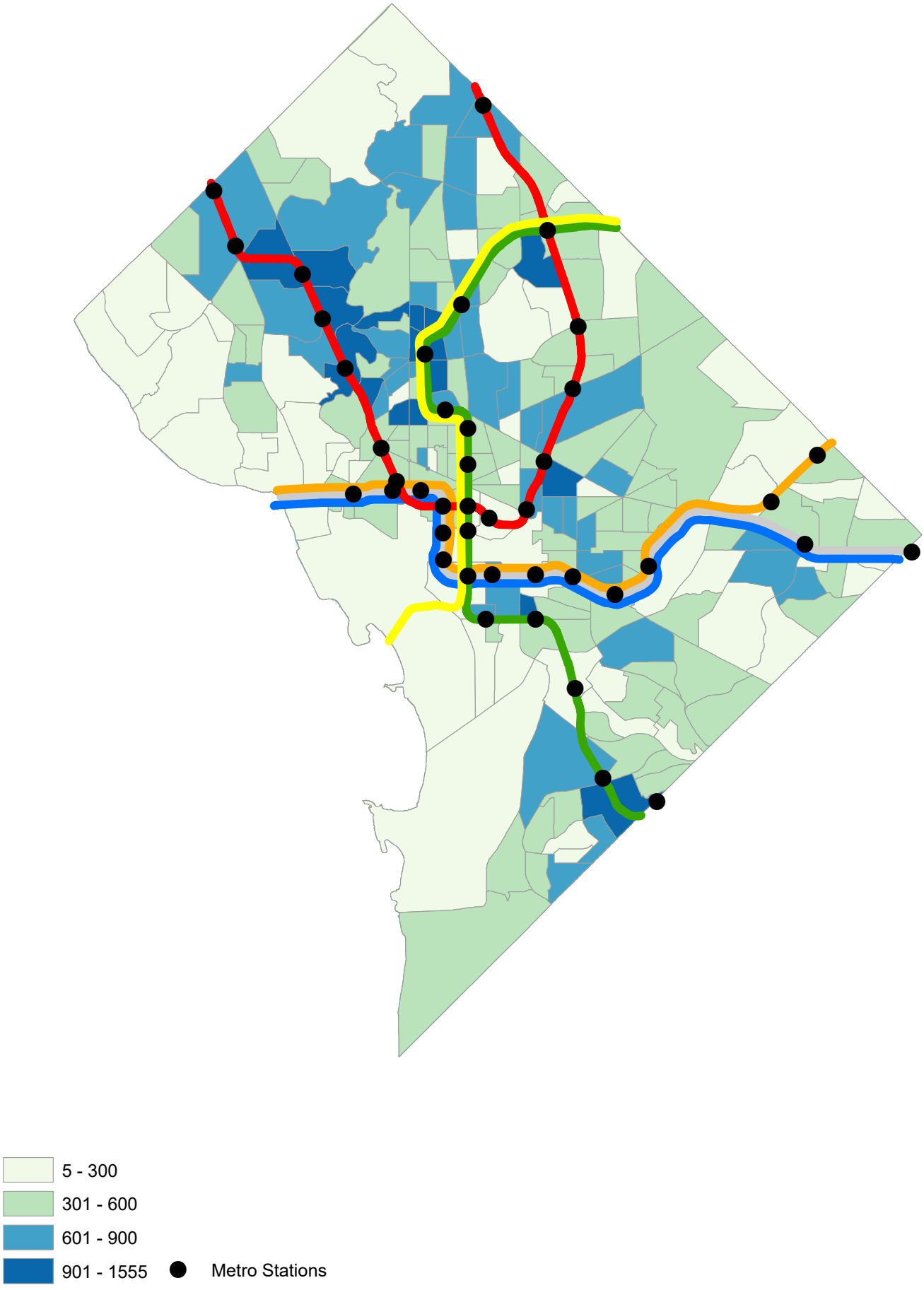
The largest concentrations of residents who primarily walk to work are in downtown DC, Georgetown, and Capitol Hill neighborhoods. Many residents' jobs have been historically located downtown, and the infrastructure near downtown, Georgetown and the Capitol supports an easier and safer commute by walking than in other areas of the District. This data suggests that most residents outside of downtown drive, take public transit or bike to work.

This data is not only important when considering the level of access to public transit options in these areas, but also for the overall health of residents. Those who can factor in a daily walk to work (or other activities) will reap more health benefits than those who cannot. A regular brisk walk can help prevent several medical conditions such as heart disease, stroke, cancer, and diabetes.

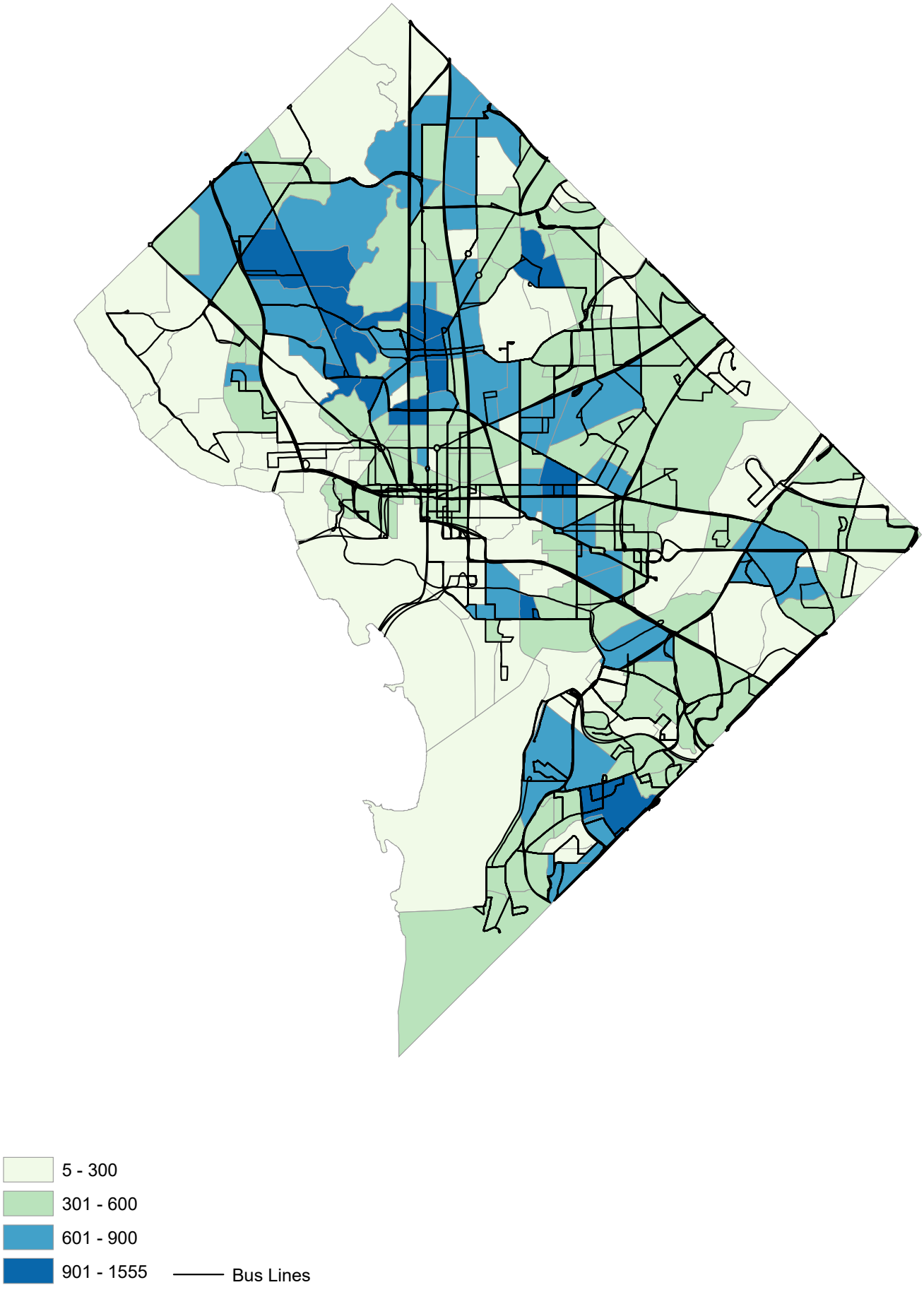
Regular exercise is also associated with better overall physical and mental health. Policies that encourage or facilitate walking as a travel mode can help people incorporate these benefits without them having to actively seek out additional time for exercise, which can be even harder for low-income or otherwise marginalized groups with limited resources.

Our analysis suggests that residents who live downtown or in Northwest DC are more likely to have a commute under 30 minutes. Most census tracts with a majority of residents who have a commute longer than 30 minutes are in Wards 4, 5, 7, and 8, and are often near interstates and other major roads. Proximity to major roads can increase exposure to pollutants, noise, and traffic violence, issues this report will address later on. Areas of the city farther from downtown often have longer commutes to work. This is also shown by the number of major roads (categorized as arterial and above) that are needed to meet demand of commuters driving into downtown.

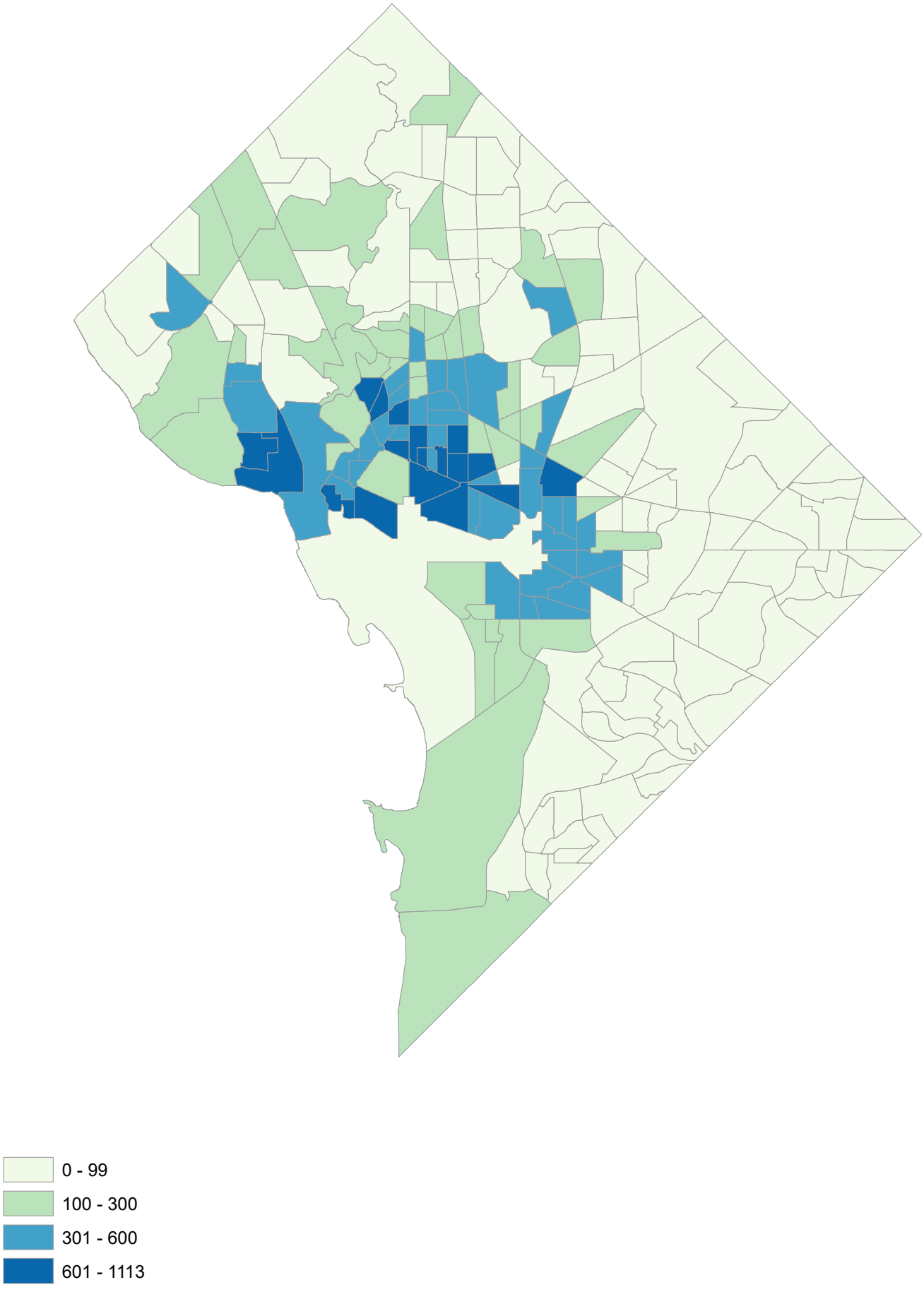
An analysis of households that don't have cars reveals more information about how residents travel. The areas with residents who have the longest commutes, the least opportunities to walk to work, and less access to Metro lines are also areas where 45-80 percent of residents do not own cars. As a result, these zero-car households rely on public transportation more than on any other mode of travel. Residents without a car are more likely to live in areas with better access to public transit, but certain neighborhoods in wards 7 and 8 have limited access to Metro lines and infrequent buses that don't benefit from the speed and reliability efficiencies of bus lanes. These residents stand to benefit the most from expansion of Metro lines, as well as sidewalks and bicycle lanes that serve health-promoting transportation choices.



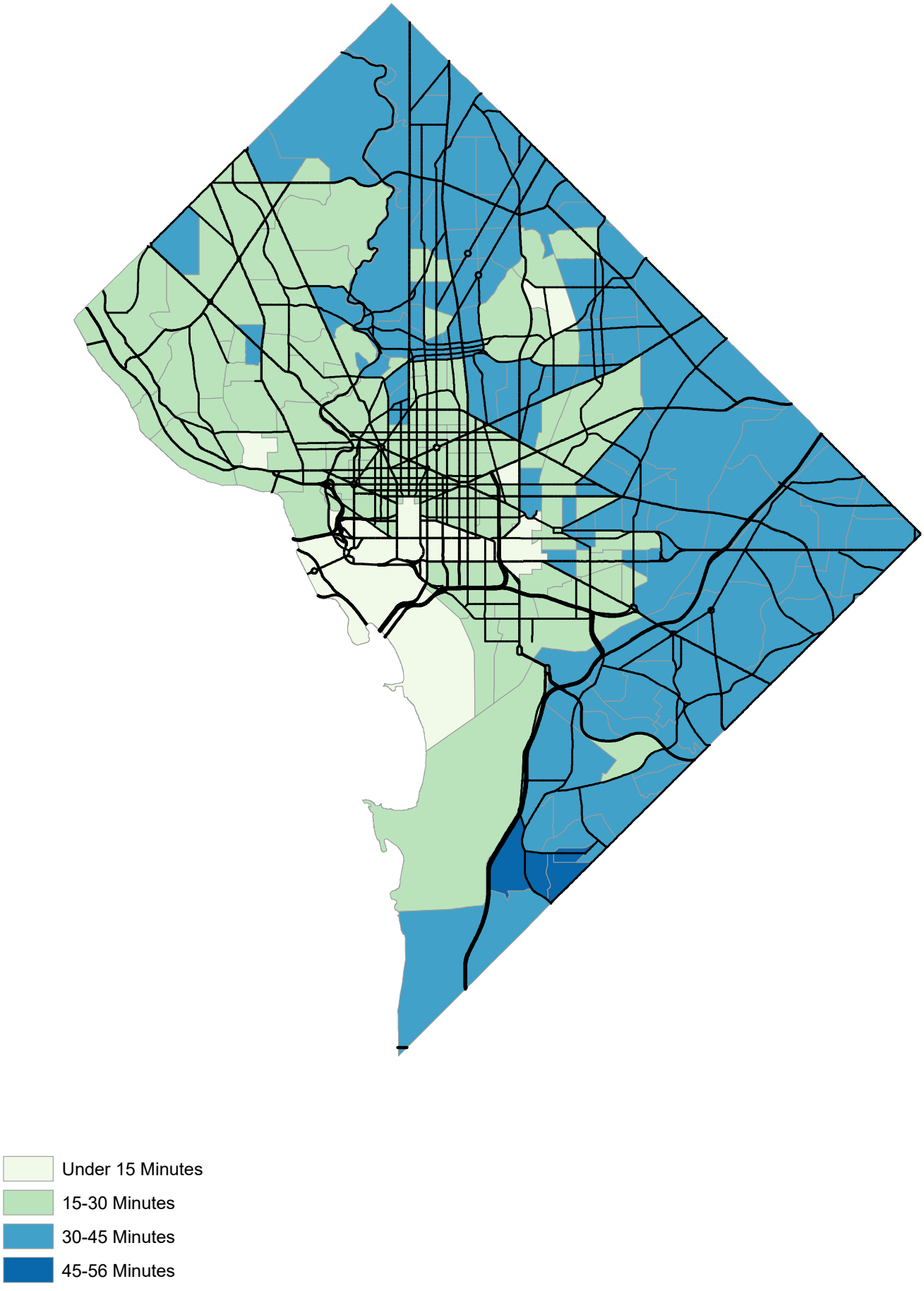
Map 9: Commute by public transit with Metrorail map



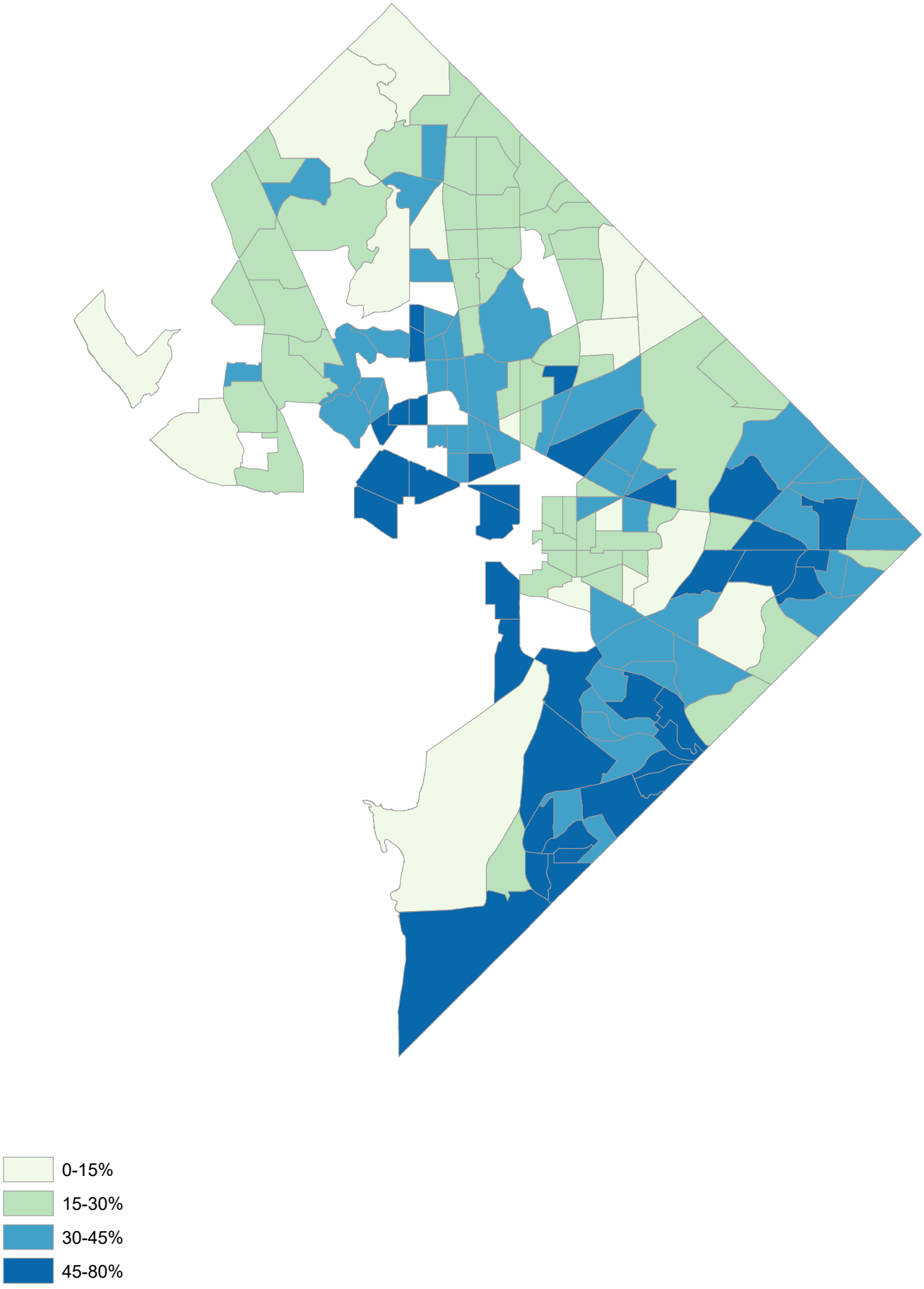
Map 10: Commute by public transit with bus map



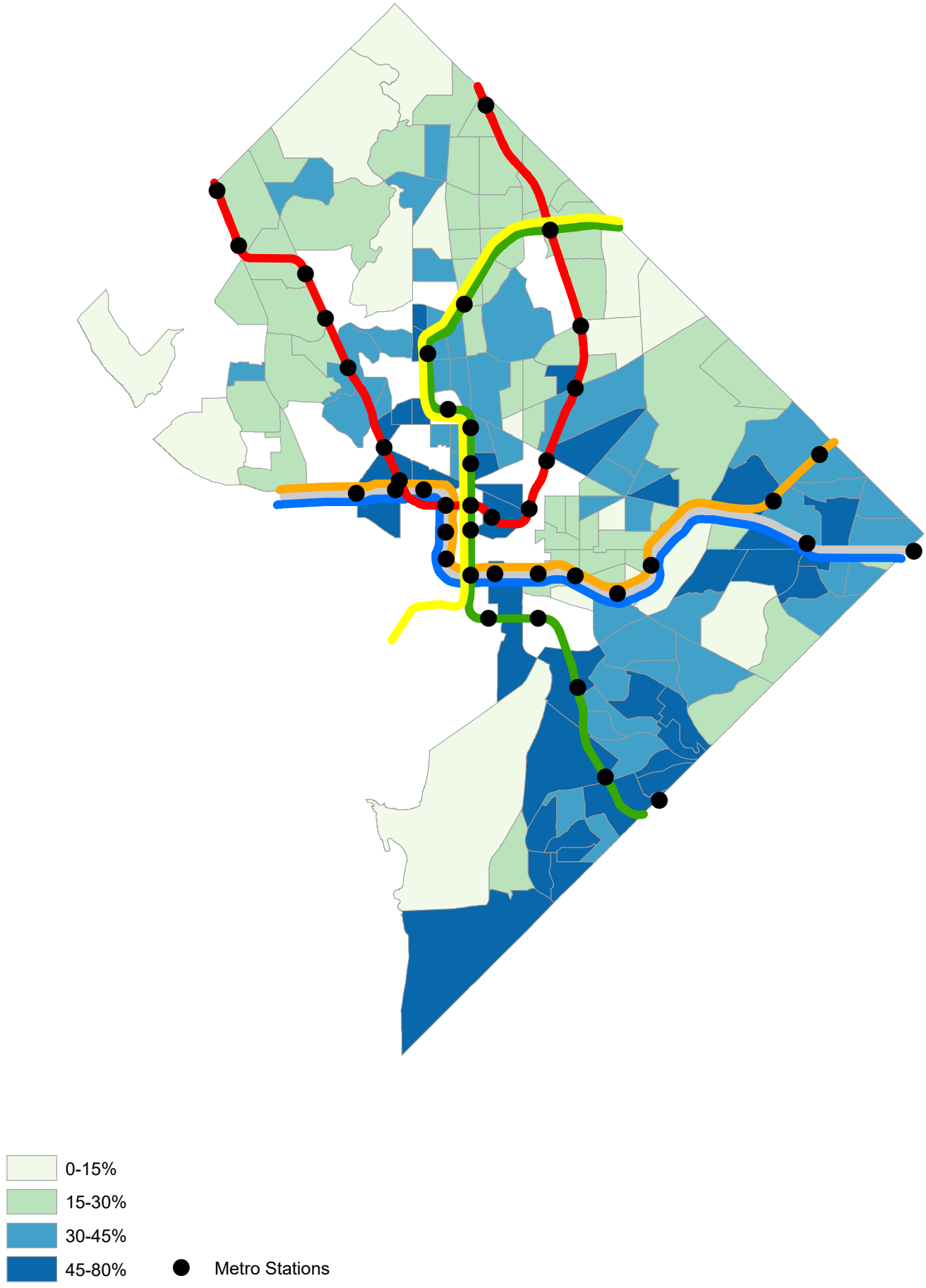
Map 11: Commute by walking



Map 12: Commute time to work and major roads



Map 13: Zero-car households in the District of Columbia, 2014-2018. Data for some census tracts was unavailable (Urban Institute).



Map 14: Zero-car households in the District of Columbia with Metrorail map, 2014-2018. Data from some census tracts was unavailable (Urban Institute).

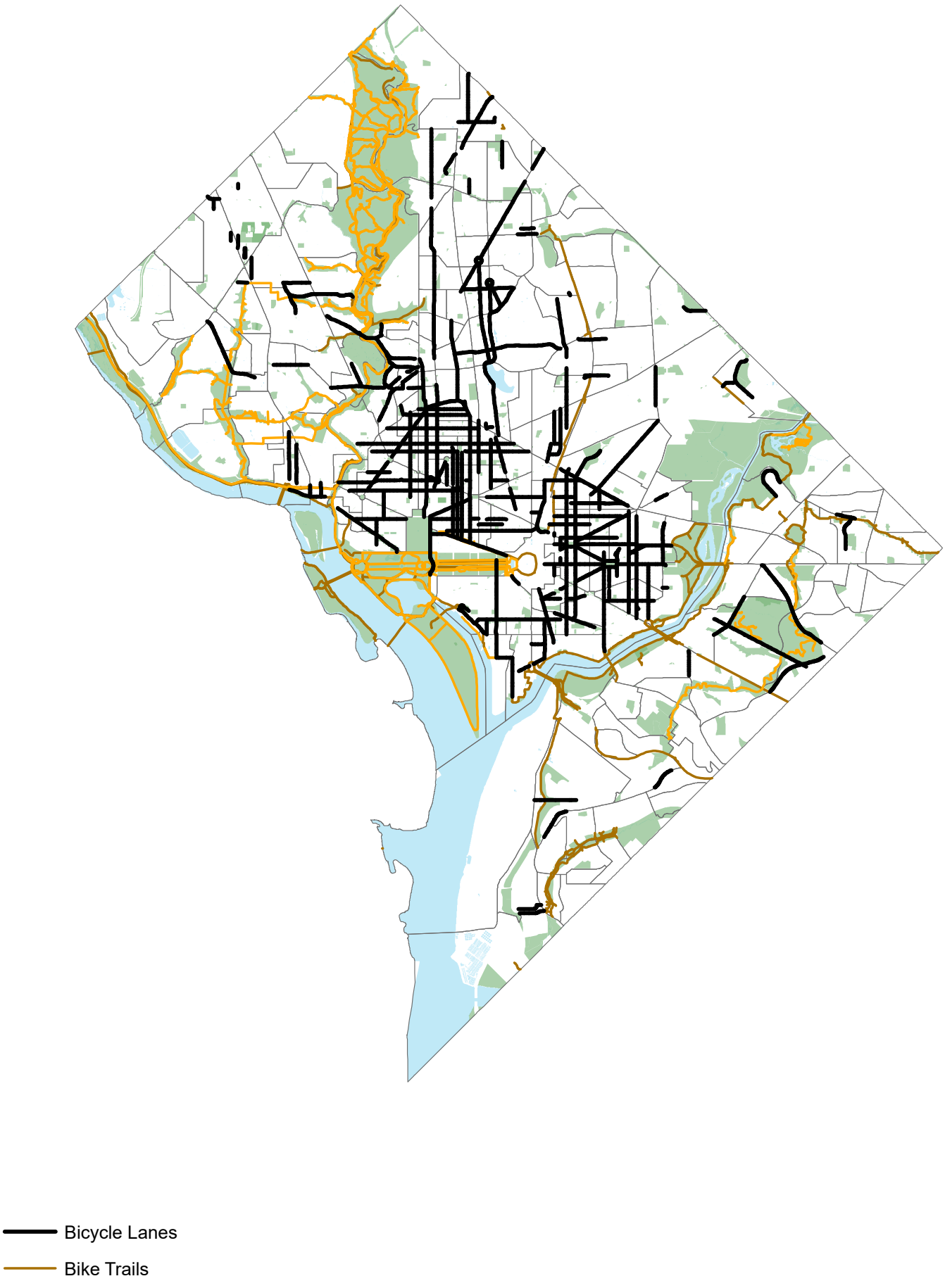
Infrastructure

When evaluating commute and travel patterns of residents, it is important to consider where the infrastructure is that enables these patterns. How does the placement of major roadways, Metro lines and stops, bus stops, and bike paths affect how people navigate the District? Is the infrastructure adequate for demand and safe for users?

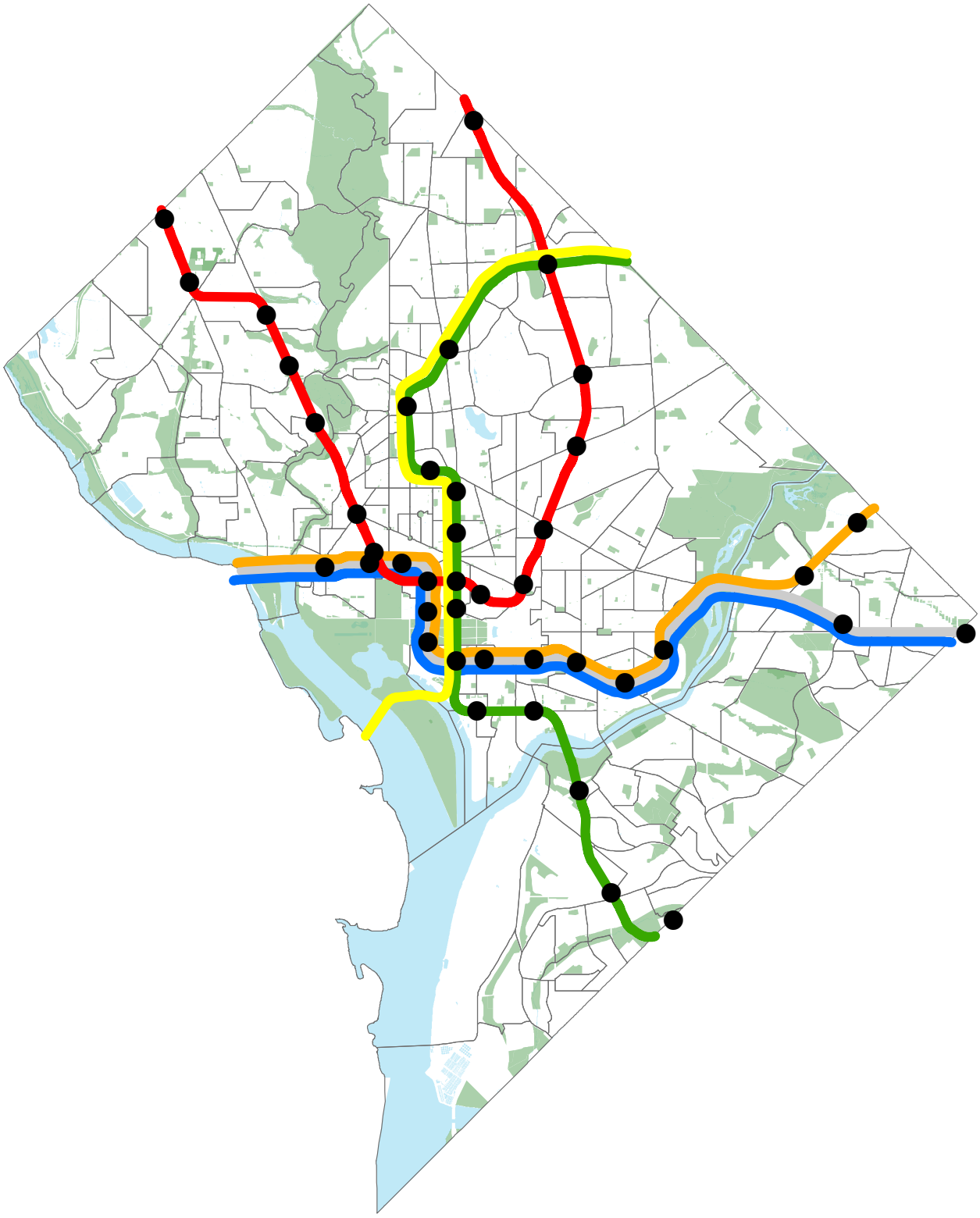
Using DC open data, maps and tables were created to understand the current state of this infrastructure in the District. The following display, respectively, the locations of bicycle, Metrorail, Metrobus, and highway infrastructure.

In addition to the infrastructure displayed in the following maps, sidewalks are an important resource for transportation. Sidewalks allow opportunity for people to have a safe place to walk, for transportation purposes as well as physical activity. Sidewalks are difficult to display in a singular map as there can be gaps that are not visibly displayed well due to the large study area.

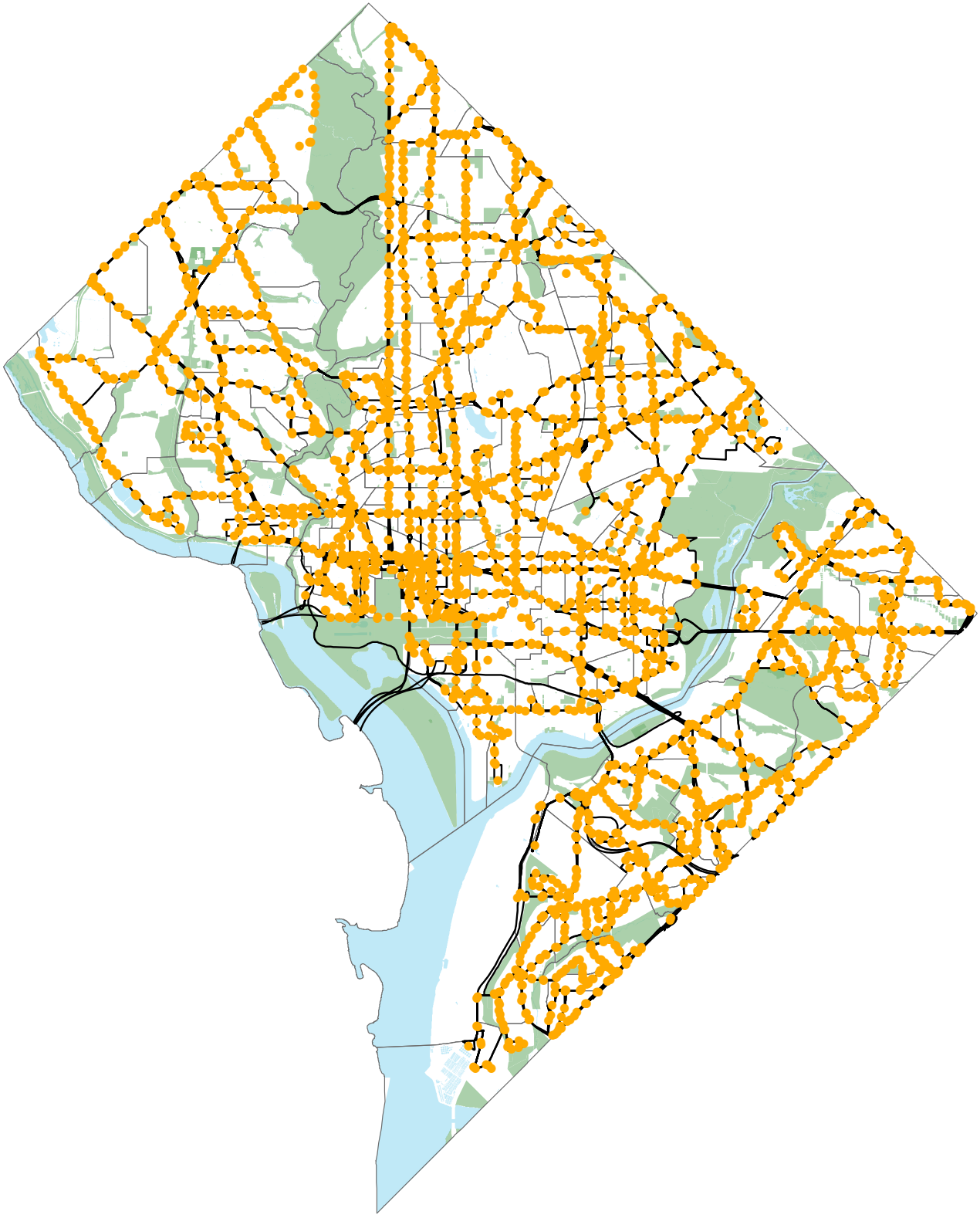
This interactive map shows the width of sidewalks across the District for specifics on neighborhoods. It is important to not only consider sidewalks locations, but also their condition. If a sidewalk is narrow, has cracks or is blocked by increasingly large vehicles parked in driveways, it won't be accessible to all residents, particularly those with physical impairments or limited vision.



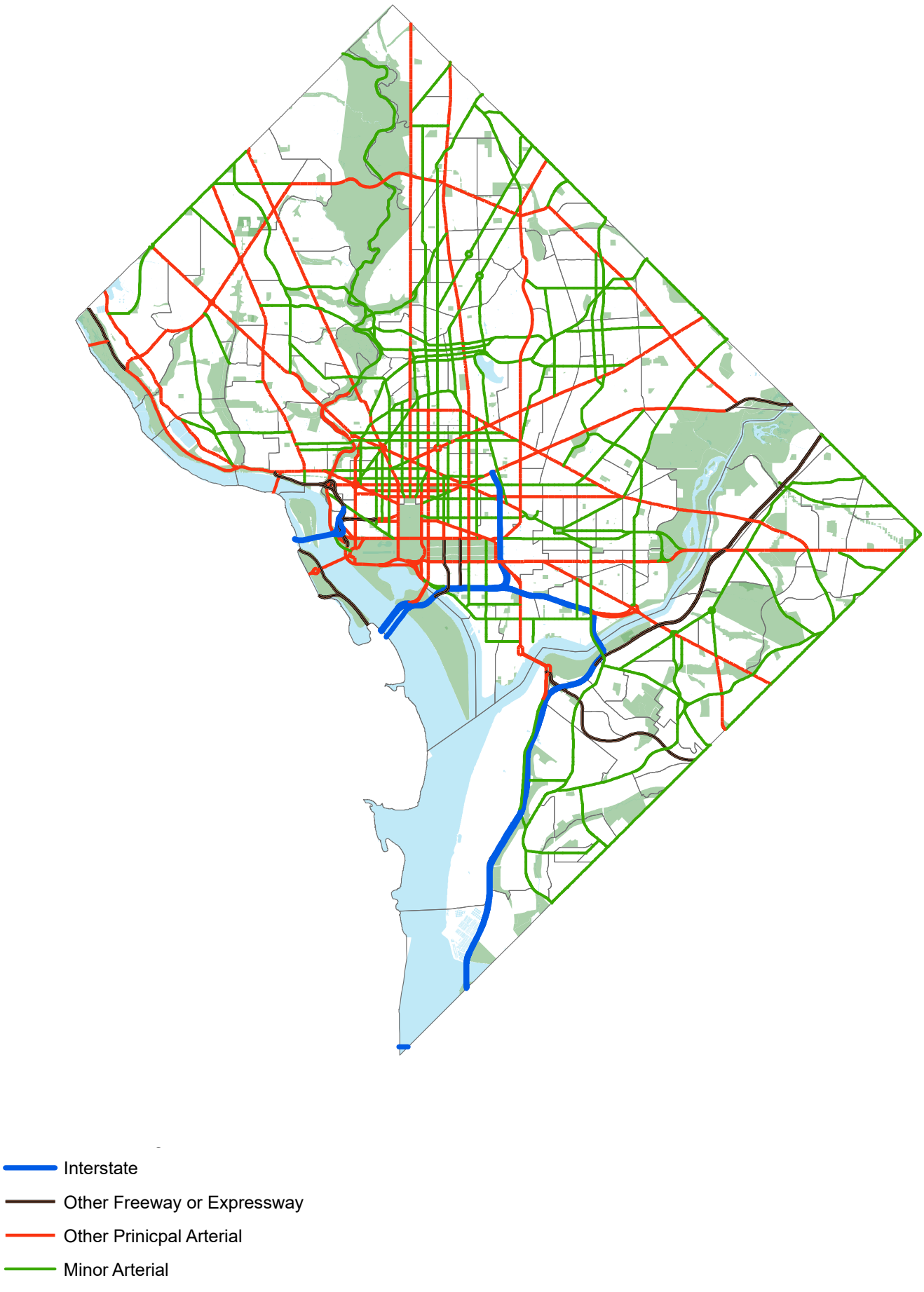
Map 15: Bicycle lanes



Map 16: Metrorail lines and stops



Map 17: Metrobus lines and stops



Map 18: District of Columbia highways

Environmental factors

Air pollution is associated with an estimated 100,000 to 200,000 deaths annually in the United States. —*National Academy of Sciences*

When air is contaminated by pollutants, long term health effects, including death, can occur. These pollutants are often due to particles commonly emitted into the air by motor vehicles, industrial facilities, and fires (Healthy People 2030). The lifetime of pollutants assists the spread of said pollutants. The longer a particle is in the atmosphere before being eliminated, the further it can spread. This leads to three types of pollution - ground-level ozone, regional (PM2.5) and localized (NO2) discussed below.

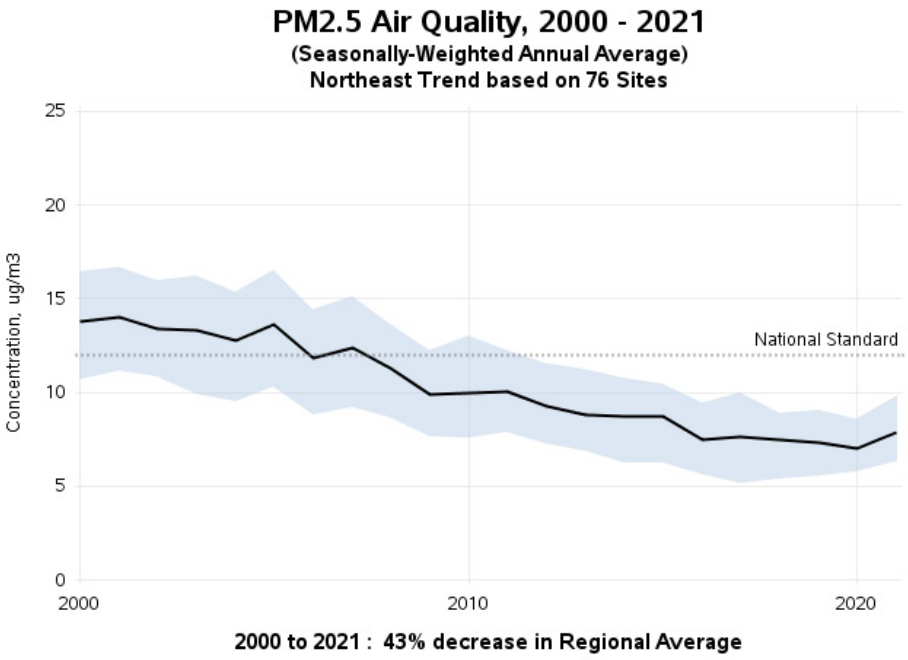


Figure 10: Northeast PM2.5 air quality, 2020-2021 (Environmental Protection Agency)

O3: Ground-level ozone

Ground-level ozone is a pollutant that primarily comes from "cars, power plants, industrial boilers, refineries, and chemical plants" (US Air Quality Index). Ozone levels therefore tend to be higher in urban areas. According to the Department of Energy and Environment (DOEE), "ozone has been found to...aggravate lung diseases such as asthma, emphysema, and chronic bronchitis among others."

According to the District of Columbia's Department of Energy and the Environment's Exceptional Event Demonstration for 2020 Ozone Levels, "A regional analysis using BenMap found that between 2015 and 2019 excess mortality would have been reduced by 10 persons, there would have been 20 fewer hospital admissions, and there would have been 26,000 fewer asthma exacerbations," with a decrease in observed ozone levels to the recommended range of the Clean Air Scientific Advisory Committee.

PM2.5: Regional

Particulate Matter (PM2.5), or surface-level fine particulate matter, comes from a variety of sources, both natural (such as sea salt or dust) and human-made (such as car exhaust, fires, or construction sites). PM2.5 levels have declined due to increased federal regulation (such as the Clean Air Act passed in 1970) and increased demand for regulation over the past 20 years. A 2021 study, "Inequities in PM2.5-Attributable Health Impacts in the District of Columbia," found that:

- "Fine particulate matter-attributable health risks are unevenly and inequitably distributed across Washington, DC," and,
- Higher PM2.5-attributable disease burdens are found in neighborhoods with larger proportions of people of color in Washington, DC."

Highlighted in Figure 10, according to the Environmental Protection Agency (EPA), a 43 percent decrease has occurred in the Northeast region over the past 20 years due to federal regulations limiting the pollutant. Much of this reduction is due to work the EPA is conducting nationally and regionally. But PM2.5 is still present at levels high enough to negatively and disproportionately affect the health of DC residents. Wider uptake of electric vehicles will likely disappoint leaders hoping for significant health improvements, as more particulate matter comes from car tires than emissions.

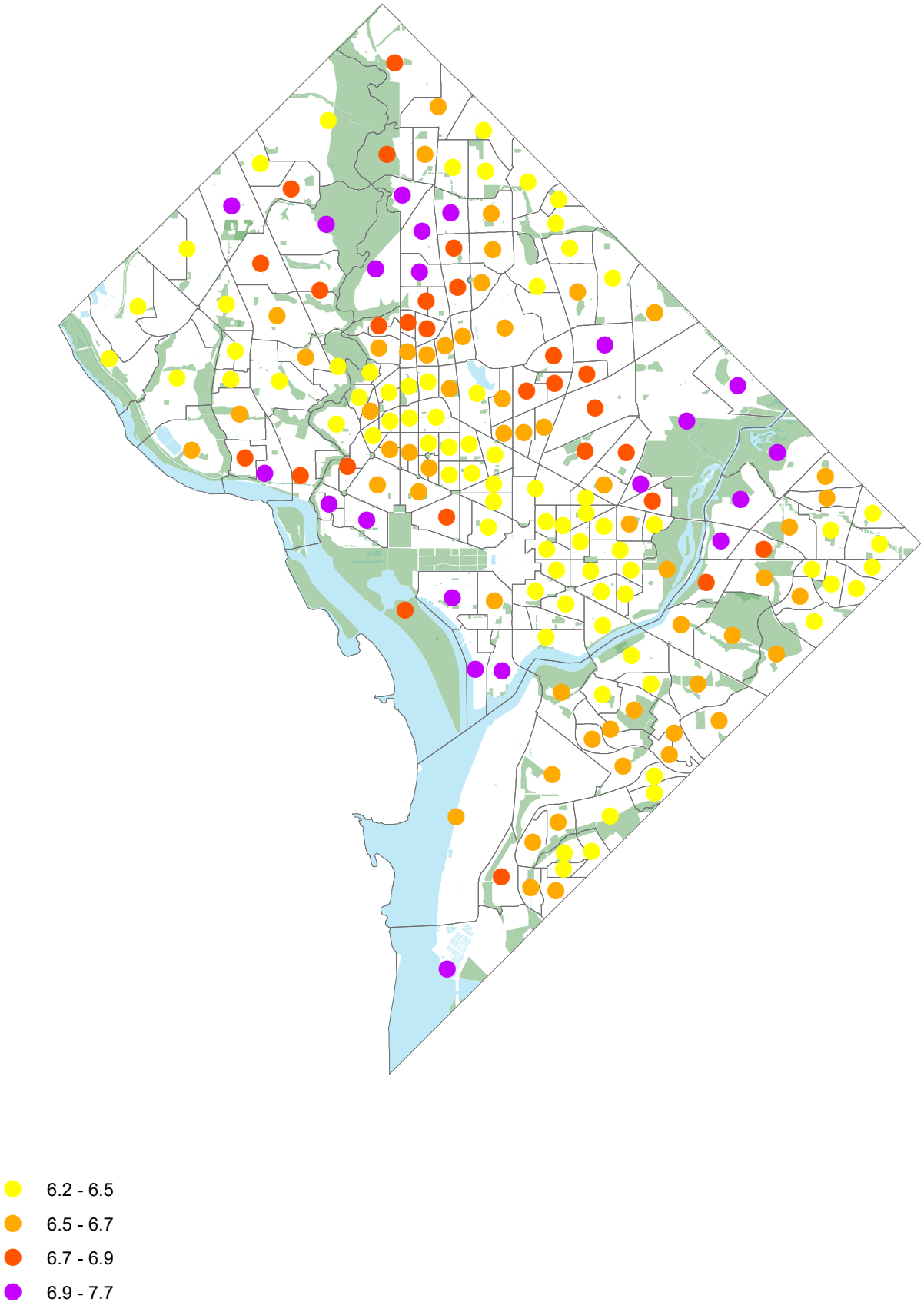
The highest, and most contiguous, concentrations of PM2.5 are in wards 4 and 5, which have the second-lowest median incomes in the District."

NO2: Localized

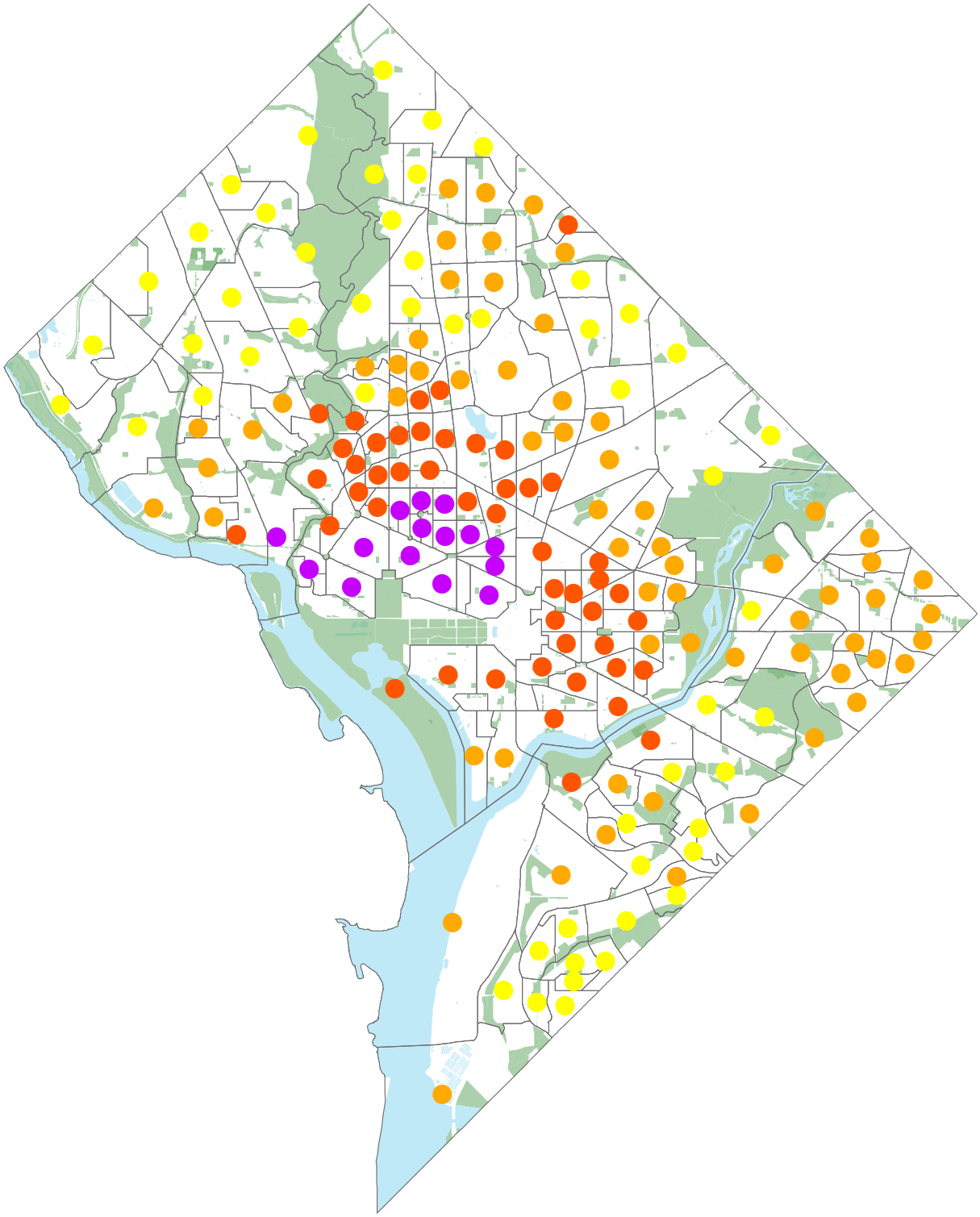
Nitrogen dioxide (NO2) does not remain in the air as long as PM2.5, which means that NO2 tends to produce spiky data with sudden highs that disappear quickly along with the causal event. While PM2.5 is helpful in understanding long-term pollution trends, NO2 is more useful for analyzing short-term local events that have an effect on air quality and pollution.

For example, one study discussed NO2 "hotspots" on roads where vehicles accelerated or stalled for long periods of time. These hotspots occur throughout neighborhoods close to pollution producers (cars, power plants, construction equipment), making NO2 a good marker for pollution. NO2 particles, or surface-level estimated nitrogen dioxide, contribute to health impacts, such as asthma.

While Map 19 displays PM2.5 concentrations of particles west of both the Potomac and Anacostia rivers, Map 17 displays a high concentration of NO2 particles in downtown areas. This can be at least plausibly attributed in part to traffic, with standing cars and high concentrations of vehicles contributing factors.



Map 19: Levels of PM2.5



Map 20: Levels of NO2

Traffic violence

The publicly available District of Columbia Vision Zero Traffic Fatalities and Injury Crashes Dashboard showcases data relating to crashes involving injuries and fatalities in the District of Columbia. Figure 11 displays District data by ward for the fatal crashes over the 5 year period of 2017-2021, broken out by crash type.

From 2017-2021, there were 167 roadway fatalities in the District of Columbia. Wards 5, 7, and 8 had a disproportionately higher number of fatal crashes than Ward 1 and Ward 3.

According to the United States Department of Transportation (USDOT), 19 percent of fatalities on roadways are deaths of pedestrians and bicyclists. Pedestrian deaths in the United States have risen by 54 percent in the past decade while other traffic deaths have only increased by 13 percent. Low-income communities and communities of color have had a disproportionate number of pedestrian injuries and fatalities. These groups are also more vulnerable to instances of traffic violence as more frequent public transportation users. Figure 12 shows the number of pedestrian fatalities by ward.

Wards 2 and 8 each had 14 pedestrian deaths across the five years of data. Ward 3 had 0 pedestrian deaths.
Crashes are devastating to a person's life, physically,

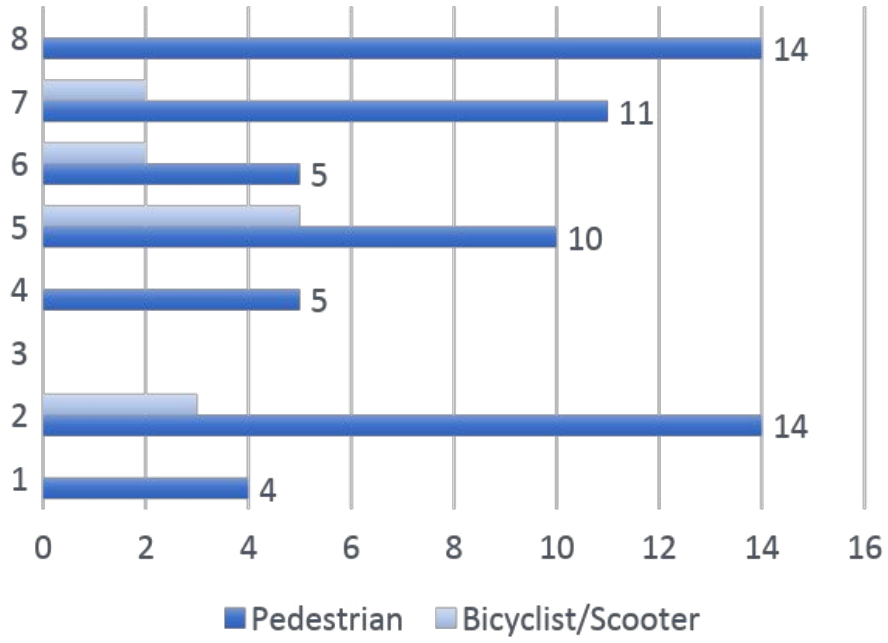


Figure 11: Fatal crashes by ward (District of Columbia Vision Zero Traffic Fatalities and Injury Crashes Dashboard)

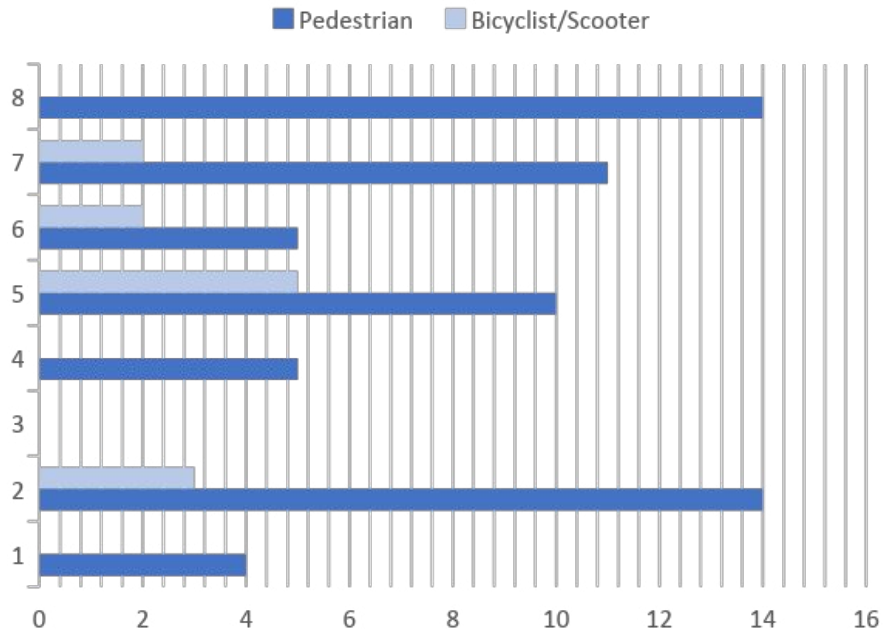


Figure 12: Pedestrian fatal crashes by ward (District of Columbia Vision Zero Traffic Fatalities and Injury Crashes Dashboard)

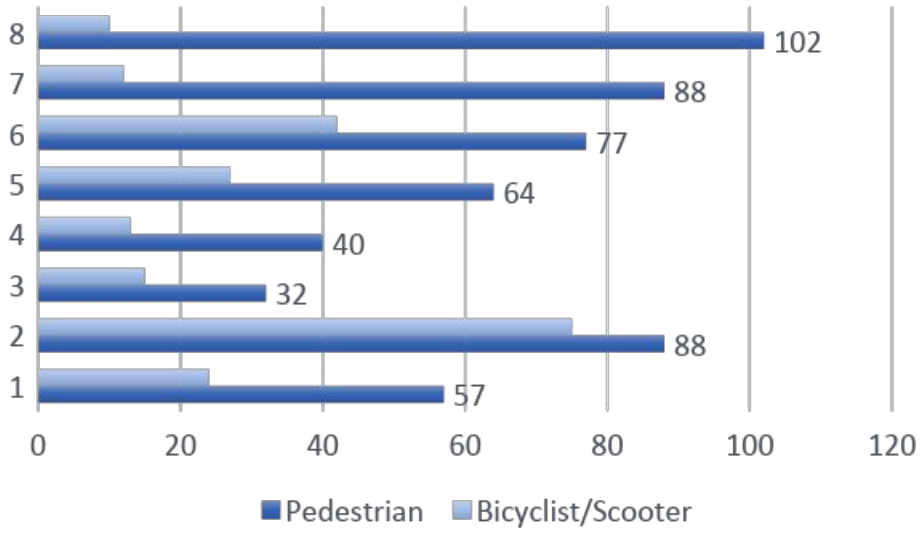


Figure 13: Severe injury crashes by ward (District of Columbia Vision Zero Traffic Fatalities and Injury Crashes Dashboard)

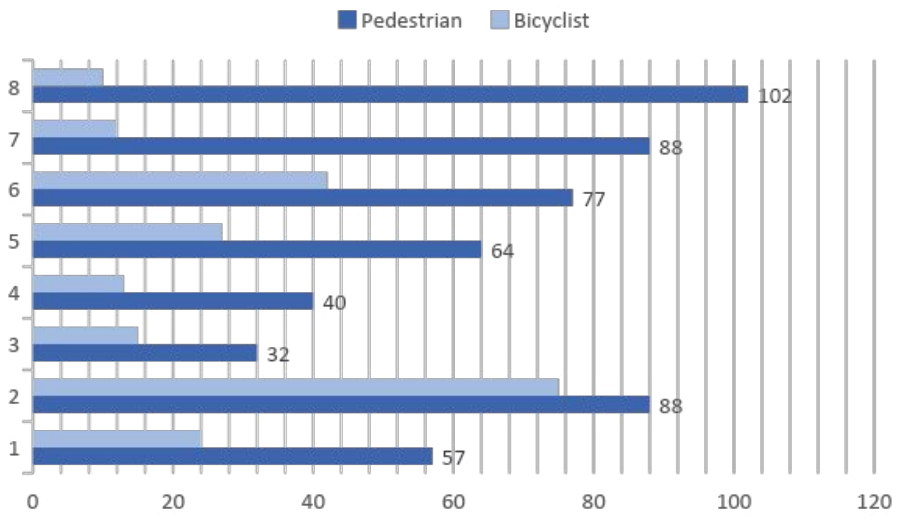


Figure 14: Pedestrian serious injury crashes by ward (District of Columbia Vision Zero Traffic Fatalities and Injury Crashes Dashboard)

emotionally, and financially, and while very difficult for many on a personal level, the cost extends beyond the affected individual and their household. According to the National Safety Council, nation-wide, "medically consulted injuries in motor-vehicle incidents totaled 5.4 million in 2021, and total motor-vehicle injury costs were estimated at $498.3 billion. Costs include wage and productivity losses, medical expenses, administrative expenses, motor-vehicle property damage, and employer costs." The DC Vision Zero Dashboard also provides data on crashes resulting in serious injuries.

Injuries help us understand the depth of the traffic violence problem, as opposed to deaths alone. From 2017-2021, there were 2,135 serious injury crashes in the District of Columbia. Significantly more injury crashes occurred in Ward 7 and Ward 8 than in Ward 1 and Ward 3.

Figure 14 displays locations of pedestrian serious injury crashes across the District's wards.

Ward 2 and Ward 8 had a disproportionately higher number of fatal crashes (88 injuries and 102 injuries, respectively) than Ward 3 and Ward 4 (32 injuries and 40 injuries, respectively). This disparity could be due to increased frequency of walking, especially in ward 2, or less infrastructure for pedestrian safety especially in Ward 8.

The Governors Highway Safety Association released a study showing American Indian/ Alaska Native and Black populations have a significantly higher chance of dying on American roadways than any other population.

High Injury Network

The District Department of Transportation's 2022 update to the Vision Zero for DC features a High Injury Network map, which shows the roadways with the most deaths and injuries. Map 18 incorporates DC's high-injury corridors, which are high priority for safety interventions. It also shows high-injury corridors from 2015. These corridors are displayed overlaid on non-local roads (higher than arterial) in the District.

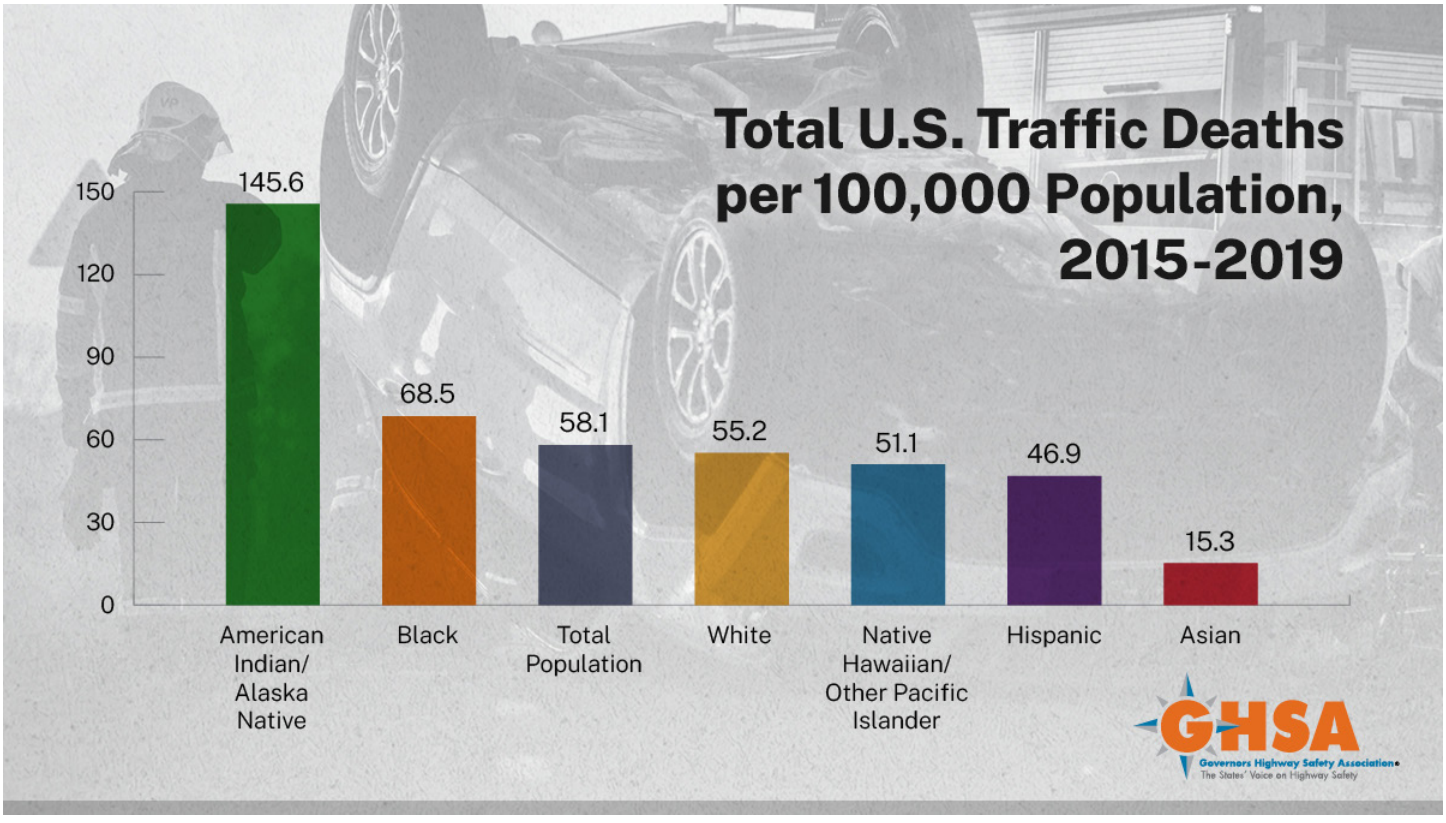
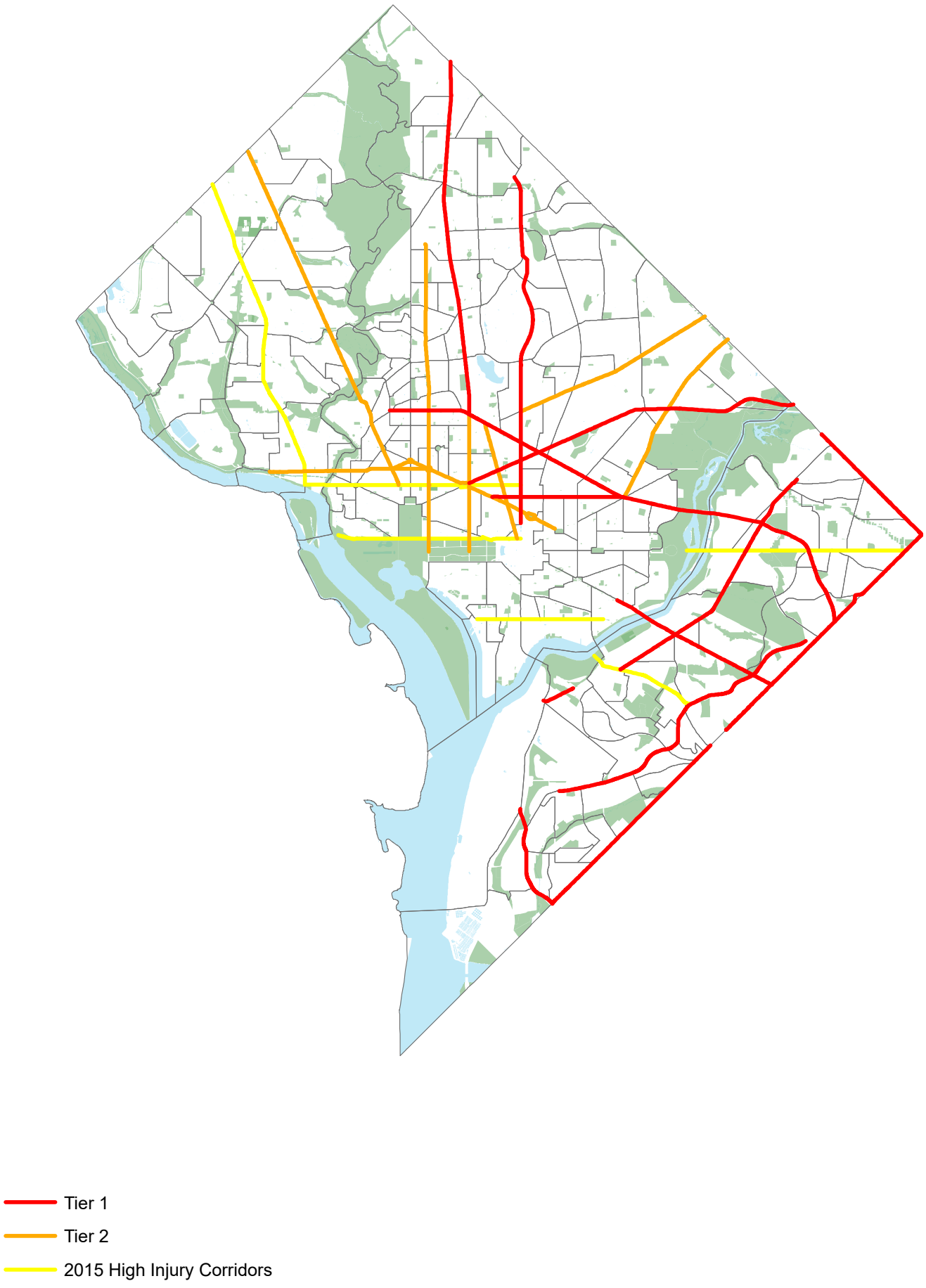


Figure 15: Total U.S. traffic deaths per 100,000 population, 2015-2019 (GHSA)



Map 21: High-injury network and arterial or higher roadways

Health factors

Asthma

PLACES data from the Centers for Disease Control (CDC), Robert Wood Johnson Foundation, and the CDC Foundation was used to analyze a series of health outcomes (limited by the scope and scale of this project) related to transportation for District of Columbia residents.

Figure 16 compares health outcomes nationally to those in the District of Columbia.

Higher asthma rates and mental health issues are associated with many types of environmental hazards, including air and noise pollution. While DC residents have lower rates on average of many illnesses, these averages mask racial, geographic and other disparities, and they do face higher rates of both asthma and mental health issues than the national average.

The District's heightened asthma rates are plausibly partially attributable to pollution concentration in certain neighborhoods and poor air quality due to proximity to environmental hazards such as cars, power plants, and construction equipment. For example, the American Lung Association reports that heightened levels of NO_2 causes reduced lung function and increased asthma attacks. Mental health problems can be attributed to a variety of elements.

Disease	United States	District of Columbia
Cancer (excluding skin cancer)	6.5%	5.1%
Chronic obstructive pulmonary disease	6.4%	3.7%
Coronary heart disease	6.4%	3.9%
Current asthma	9.3%	10.3%
Diagnosed diabetes	11.1%	7.3%
High blood pressure	32.6%	27.4%
High cholesterol	33.6%	26.6%
Mental health not good for >=14 days	13.5%	14.9%
No leisure-time physical activity	23.5%	16.7%
Obesity	31.9%	23.7%
Stroke	3.2%	2.6%
Visits to doctor for routine checkup within the past year	74.7%	68.6%

Figure 16: 2020 United States vs. District of Columbia health outcomes for adults (18 years old)

However, as one study by the Journal of Transport and Health shows, a long commute to work can increase "exposure to air pollution and noise, community severance and increased risks for personal and traffic safety."

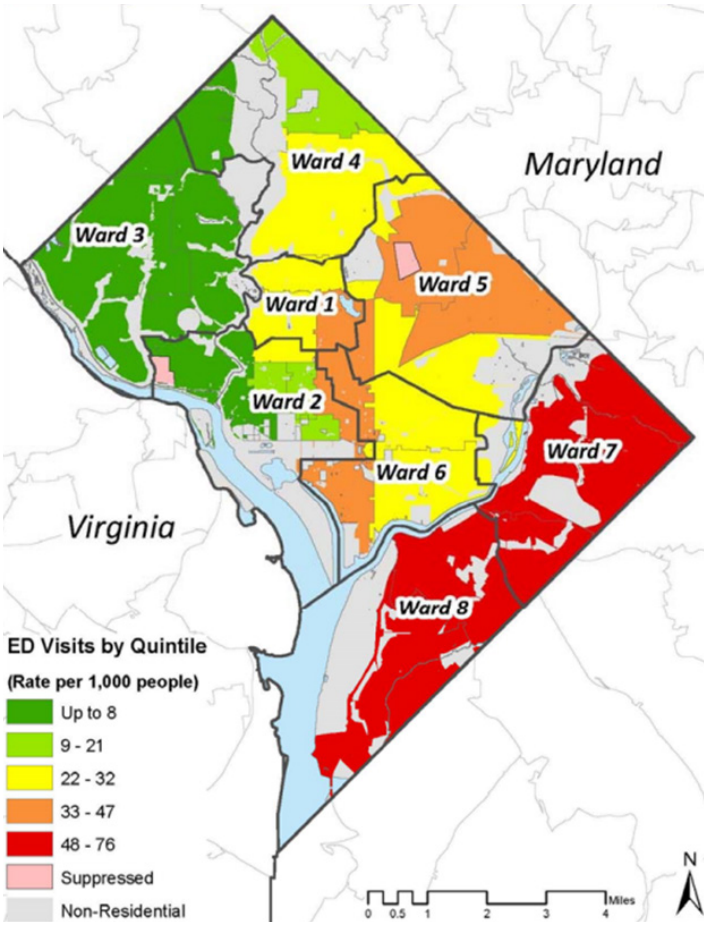
Though this report discusses analysis efforts on reducing airborne allergens as well as increasing physical activity, other work is being done in the District with the Healthy Housing Program to increase air quality in locations with environmental health hazards within homes.

Data from eight hospitals in the District of Columbia, compiled by Children's National Hospital, was studied to understand asthma-caused hospitalizations in children in the District. In the 5 years studied (2010-2015), thousands of DC residents were hospitalized due to a primary, secondary, or tertiary diagnosis of asthma.

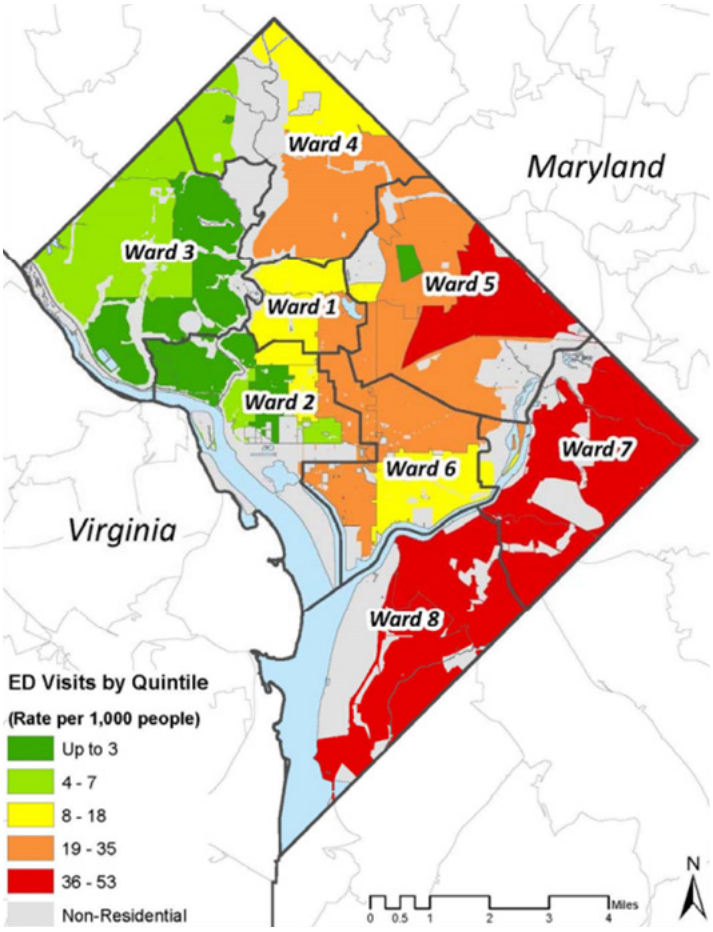
Figure 17 compares hospital visits and admissions from the visits amongst children, adults, and elderly populations, with the bottom row showing the percentages of visits that resulted in admissions for asthma among each age group. Maps 19-21 display locations of the visits.

Maps 19 and 20 demonstrate that asthma rates are significantly higher in Wards 7 and 8 than all other Wards in the District for children and adults. Ward 2 and Ward 5 have an increased rate of emergency room visits amongst those 65 and older. This also tracks with where older populations live within the District, as displayed in Map 7.

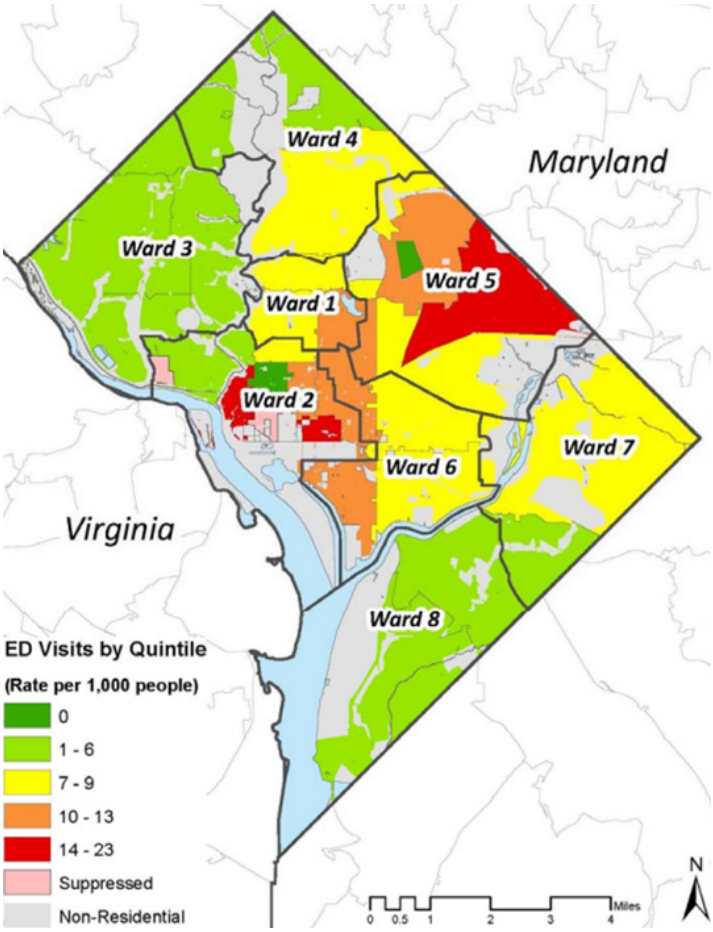
Researchers at Children's National Hospital found increased pediatric asthma morbidity could further be associated with decreased educational attainment and increased rates of violent crime. In this sense, the Social Determinants of Health (discussed earlier in the report) can and do overlap, and can cause more than one health issue in a person, or exacerbate existing issues.



Map 22: District of Columbia hospital visits/ admission due to asthma, ages 0-17 (Children's National)



Map 23: District of Columbia hospital visits/admission due to asthma, ages 18-64 (Children's National)



Map 24: District of Columbia hospital visits/ admission due to asthma, ages 65+ (Children's National)

	Children (<18 years old)	Adults (18-64 years old)	Seniors (> 65 years old)
Emergency Department Visits for Asthma	46,429	89,475	6,542
Admissions for Asthma	10,158	16,352	4,011
Admissions for Asthma	18.0%	15.5%	38.3%

Figure 17: District of Columbia hospital visits/admission due to asthma

***Emergency Department visit dataset includes "treat-and-release" visits. ED visits that resulted in hospital admission are included only in the Hospital Discharge dataset. Hospital Discharge dataset includes all hospital admissions, regardless of whether visits began in the ED, including transfers.**

Children's health

Youth trends in the District of Columbia are important to consider, as DC's younger population will influence overall trends for years to come. Using the data from the 2021 CDC Youth Risk Behavior Surveillance System (YRBSS), we looked for responses related to physical activity and health to better understand current trends of the District's younger populations.

Results from the survey showed that on average, about 32 percent of high school students would consider themselves physically active at least 60 minutes per day (figure 18). Males are more likely than females to be physically active, as are white students compared to students of all other races. The CDC reports that in 2017, 26.1 percent of high school students nationwide reported being physically active at least 60 minutes per day. This places DC above the national average, but still at quite a low rate.

Figure 18 shows results of the question on the survey on physical activity, and Figure 19 shows the results of the question on the survey on being overweight.

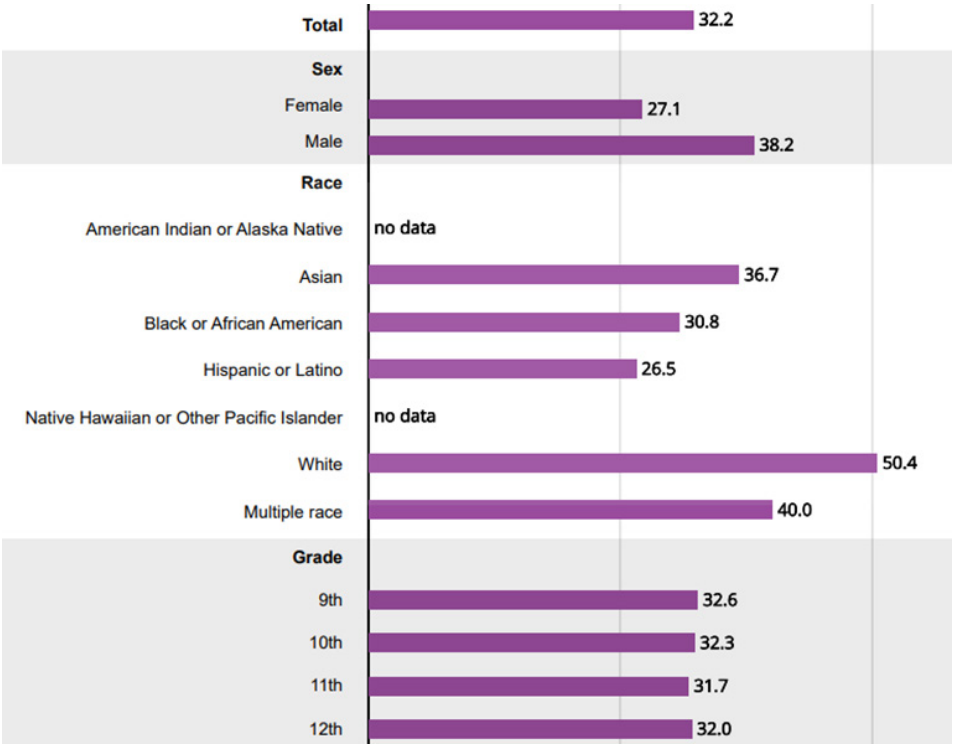


Figure 18: Percentage of high school students in DC who describe themselves physically active at least 60 minutes per day (YRBSS)

High school students described themselves as some form of "overweight" at an average of 27.1 percent amongst all youth surveyed in the District.

The health benefits of physical activity, particularly at a young age, are very significant. With obesity increasing amongst youth and physical activity levels down, alternative outlets for children to increase their activity levels is a key potential source of health equity gains.

By providing safe infrastructure for them to walk and bicycle in, DC can increase their accessibility to school, work, sports, and after school activities while also making strides to increase physical activity rates and the overall health of DC's student population.

The American Heart Association states that benefits of physical activity include:

- Lower risk of heart disease, stroke, type 2 diabetes, high blood pressure, dementia and Alzheimer's, several types of cancer, and some complications of pregnancy
- Better sleep, including improvements in insomnia and obstructive sleep apnea
- Improved cognition, including memory, attention and processing speed
- Less weight gain, obesity and related chronic health conditions
- Better bone health and balance, with less risk of injury from falls
- Fewer symptoms of depression and anxiety
- Better quality of life and sense of overall well-being.

A short 10-minute walk, such as to school or work, has been shown to increase one's health and overall well-being. Providing all residents with infrastructure that allows them a safe place to exercise (sidewalks and biking facilities) or better access to locations for sports practice and gyms through public transit is key to increasing physical activity among DC's youth.

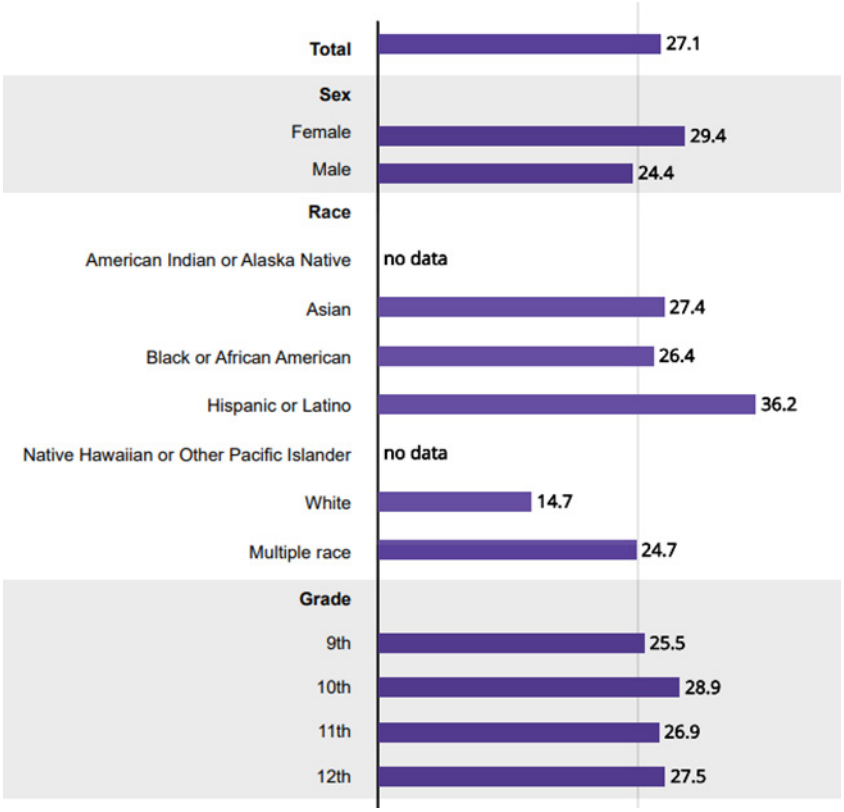
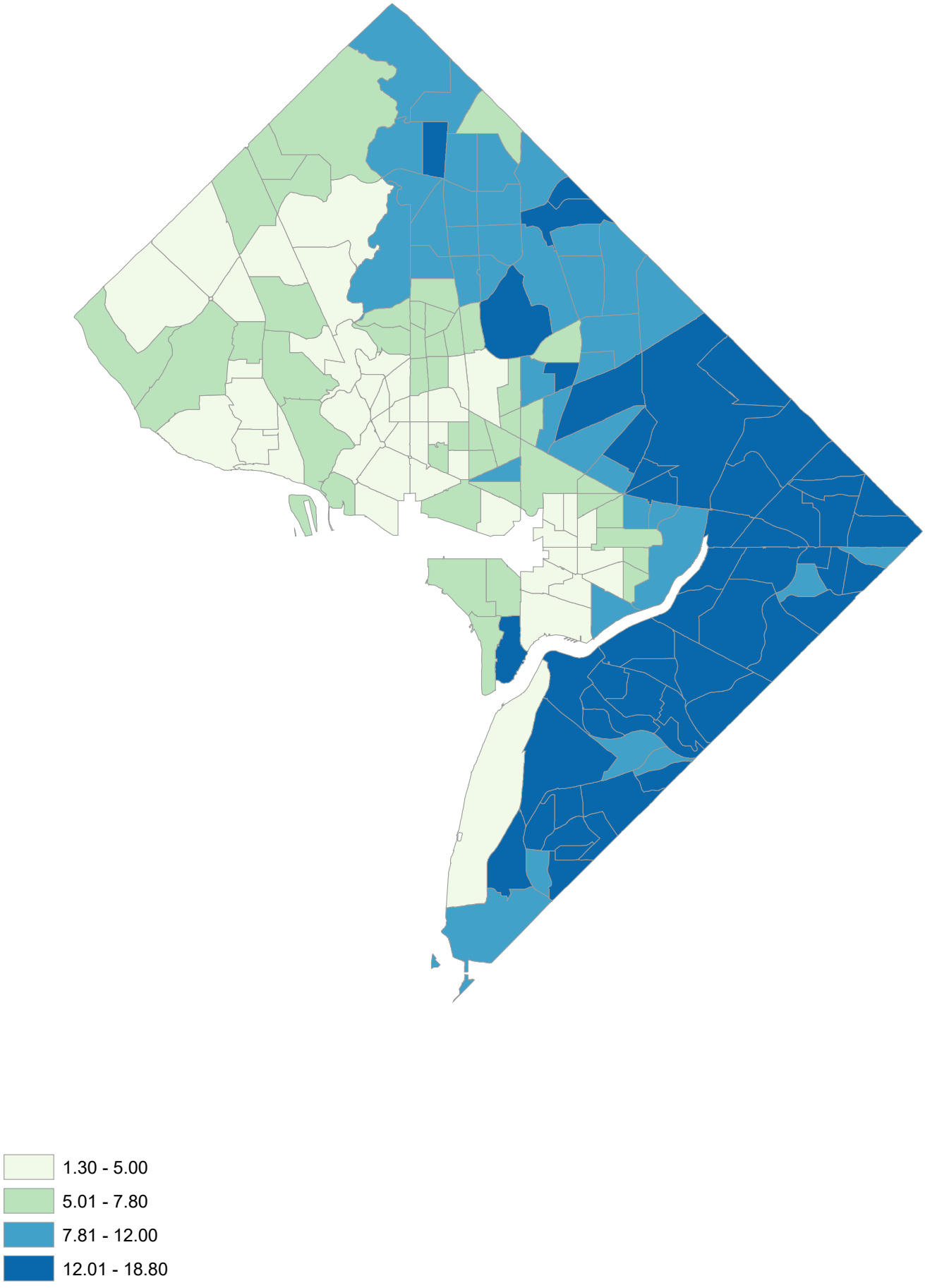


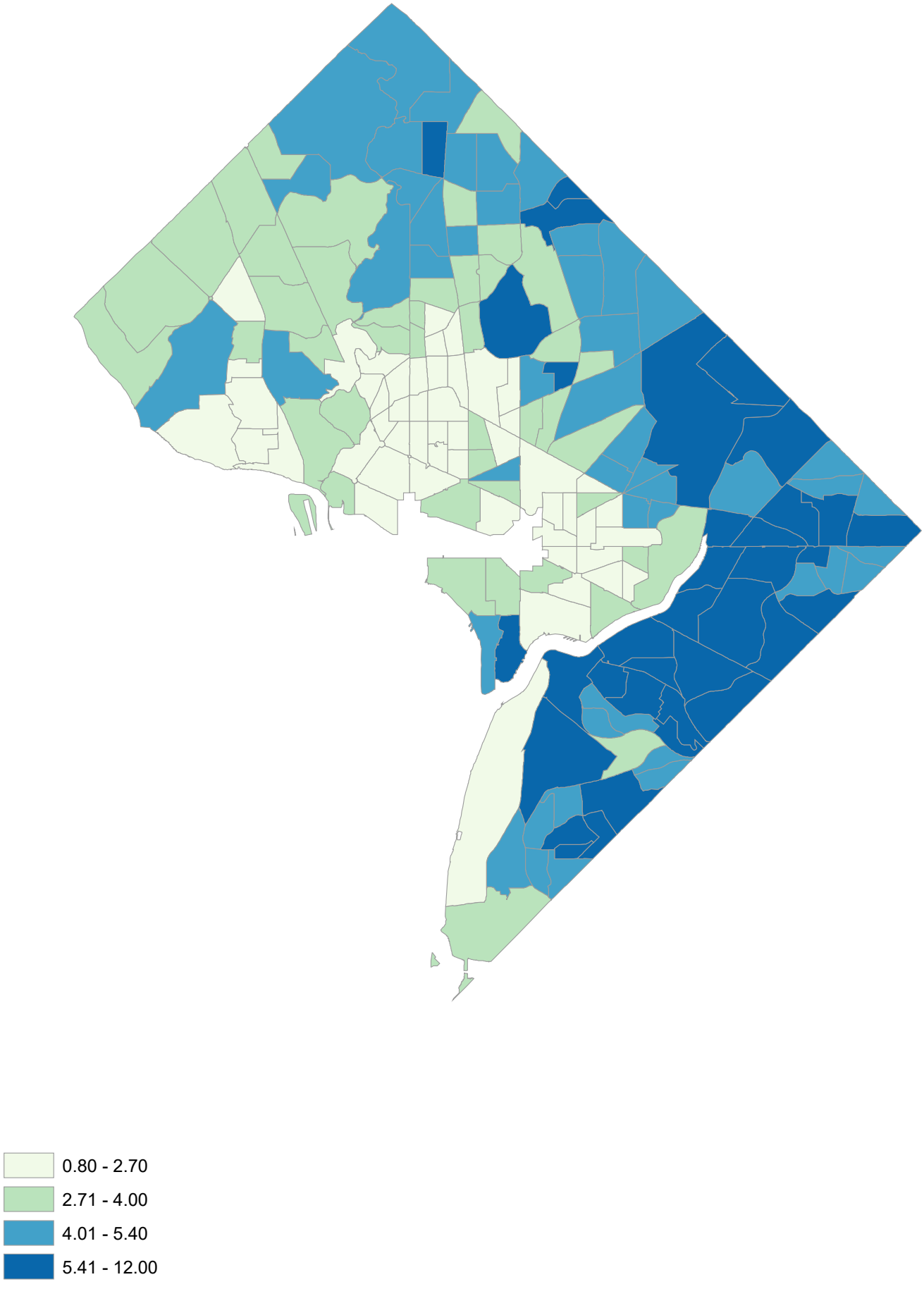
Figure 19: High school students who described themselves as slightly or very overweight 2021 (YRBSS)

Chronic conditions

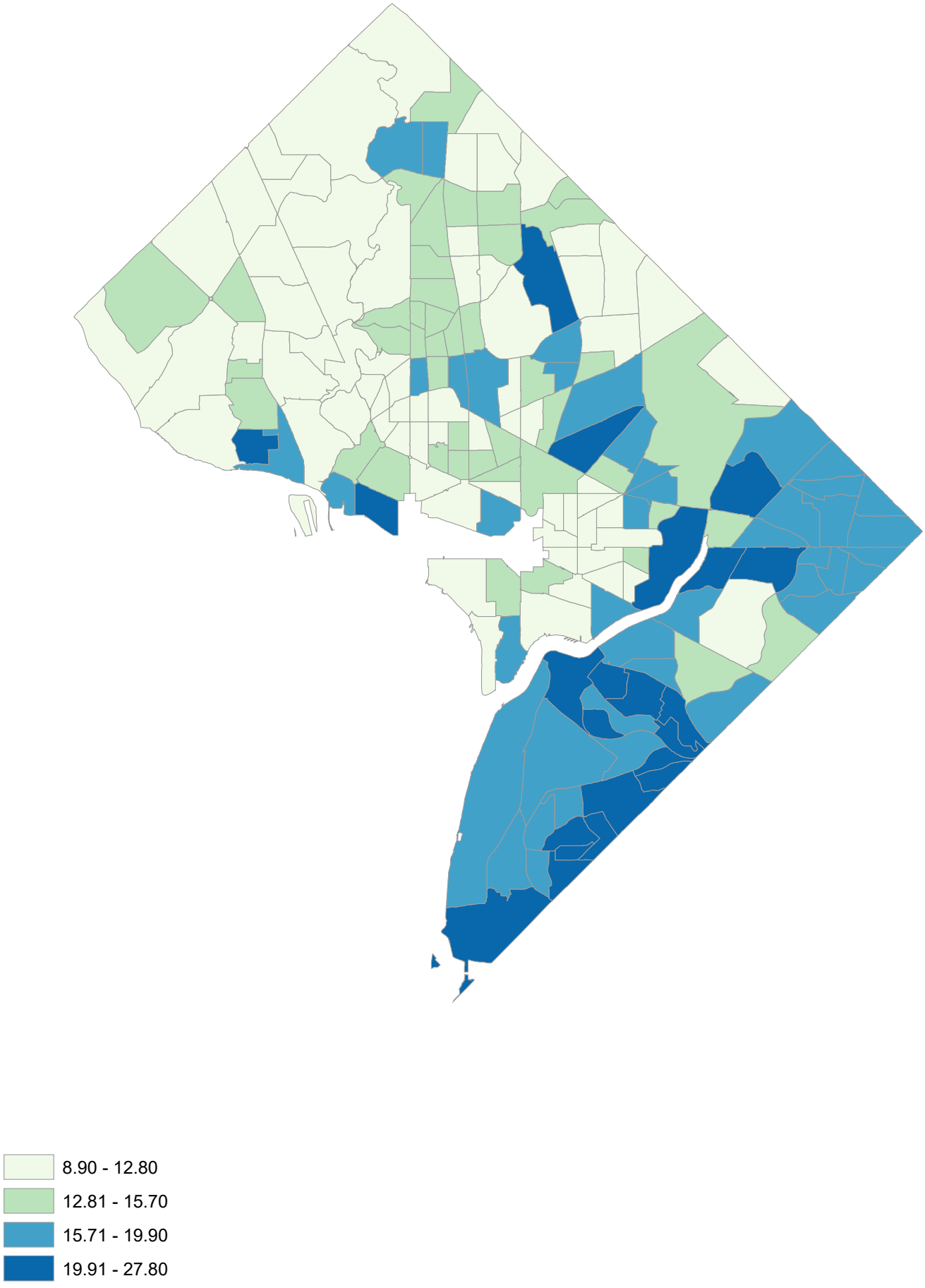
Clarifying where health conditions occur throughout the District helps us better understand further cross reference resources (in this report, transportation resources) that may help alleviate these conditions. The District displays a high concentration of health factors in Ward 7 and Ward 8 for Diabetes (Map 22), Coronary Heart Disease (Map 23), Mental Health Distress (Map 24), Obesity (Map 25), and High Blood Pressure (Map 26).



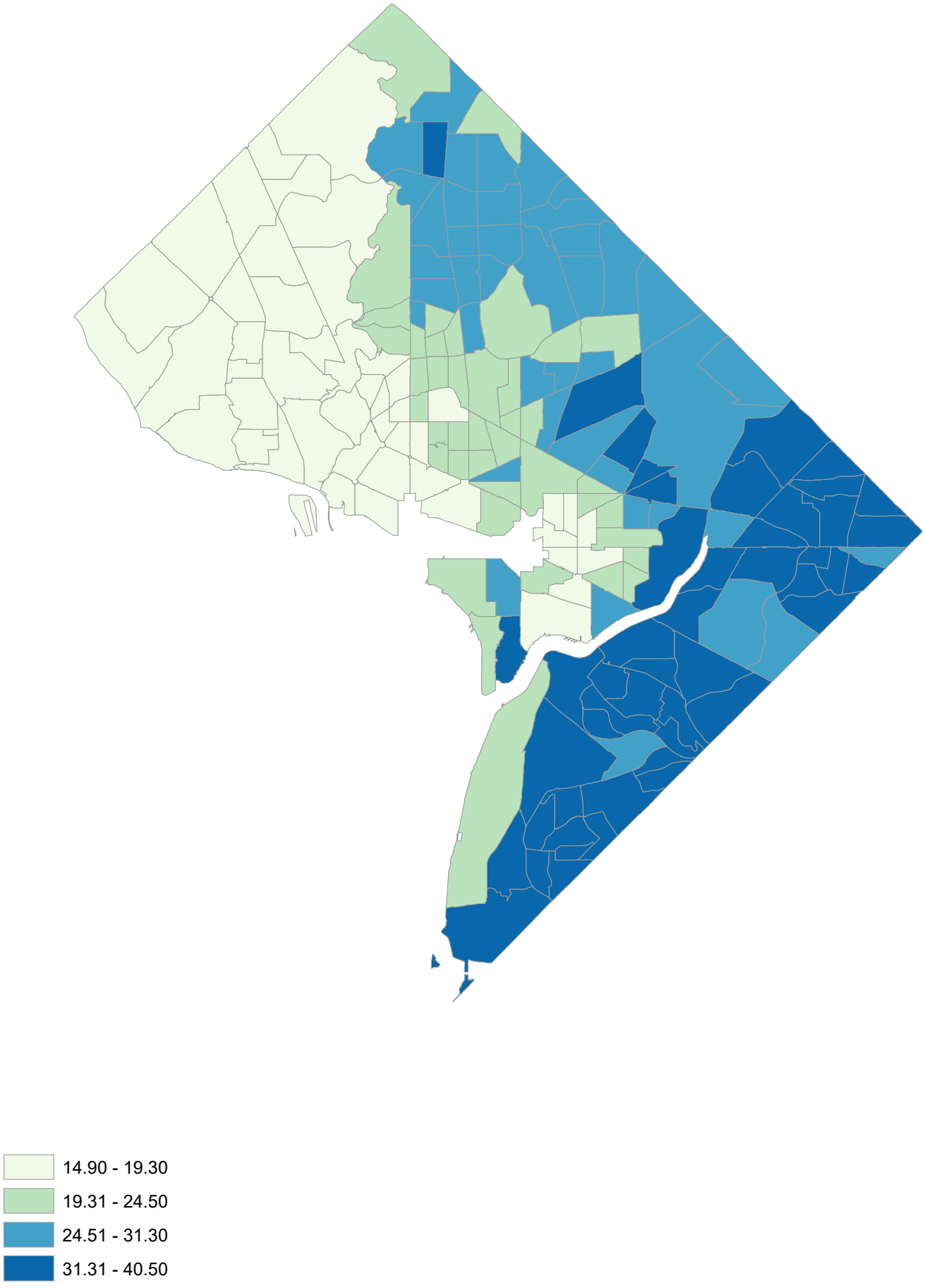
Map 25: Diabetes crude prevalence percentage (CDC PLACES data)



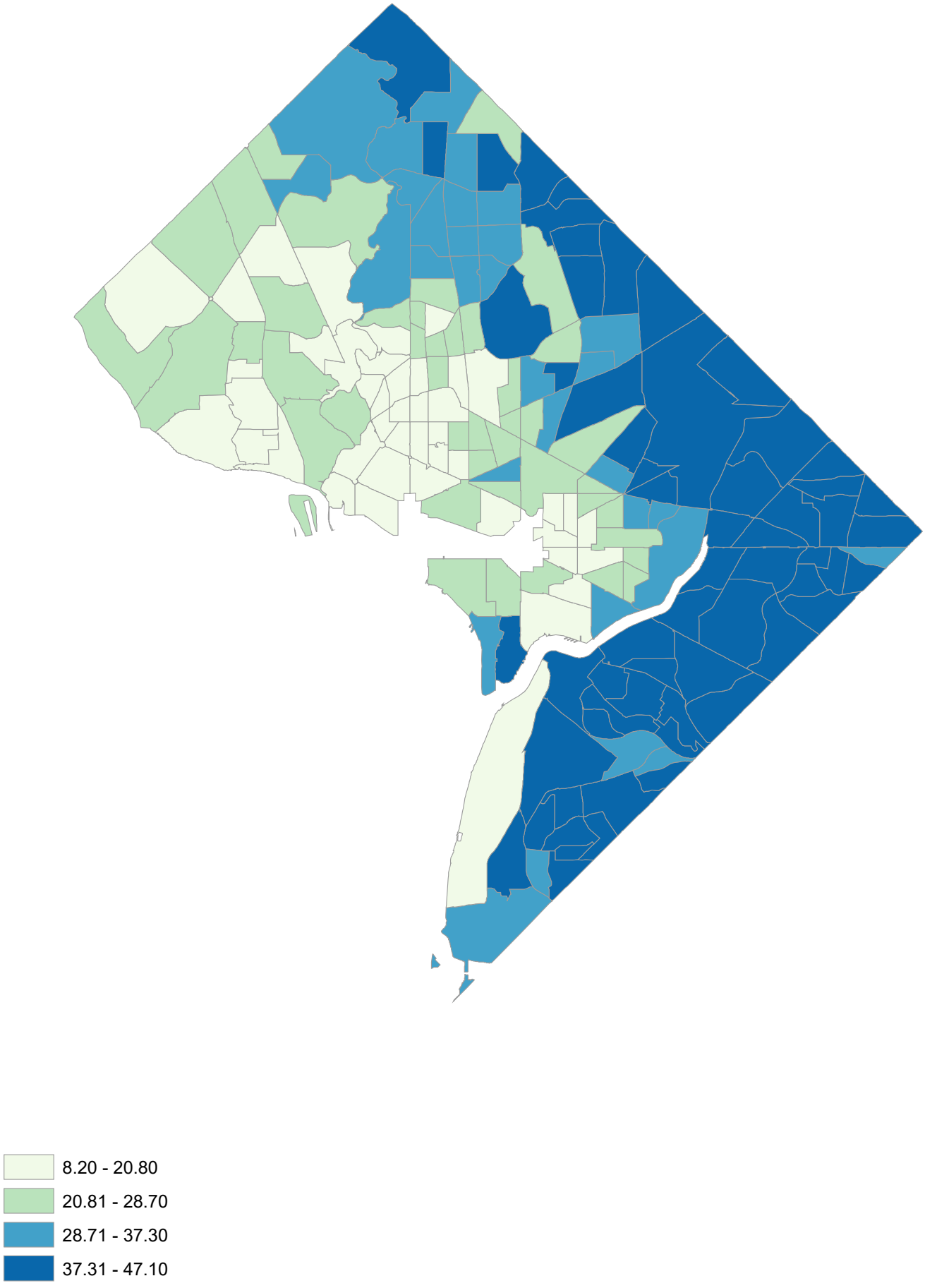
Map 26: Coronary heart disease overall prevalence percentage (CDC PLACES data)



Map 27: Mental health distress overall prevalence percentage (CDC PLACES data)



Map 28: Obesity overall prevalence percentage (CDC PLACES data)



Map 29: High blood pressure overall prevalence percentage (CDC PLACES data)

Methods and questions

Numerous studies have linked physical inactivity with higher rates of obesity and being overweight, which increases the risk of cancer, heart disease, hypertension, and type 2 diabetes. People are being injured and killed on our roadways. While cars provide a means of travel for people every day, they also kill people and make them sick, often at young ages and in ways that can replicate across generations.

This report has sought to make a case for investing in better mobility for underserved populations such as people of color, whose transportation access has been historically underinvested in, in ways that don't contribute to the negative health outcomes we've discussed. Neighborhoods where the median income is below $50,000, and where the majority of residents are Black or Hispanic, experience higher levels of health problems associated with pollution and traffic violence, such as asthma and traffic fatalities. Focusing resources on improving modes of transportation that don't exacerbate these outcomes is a key mechanism for improving health equity.

Do areas with high concentrations of traffic volume and highways also have high incidences of environmental factors?

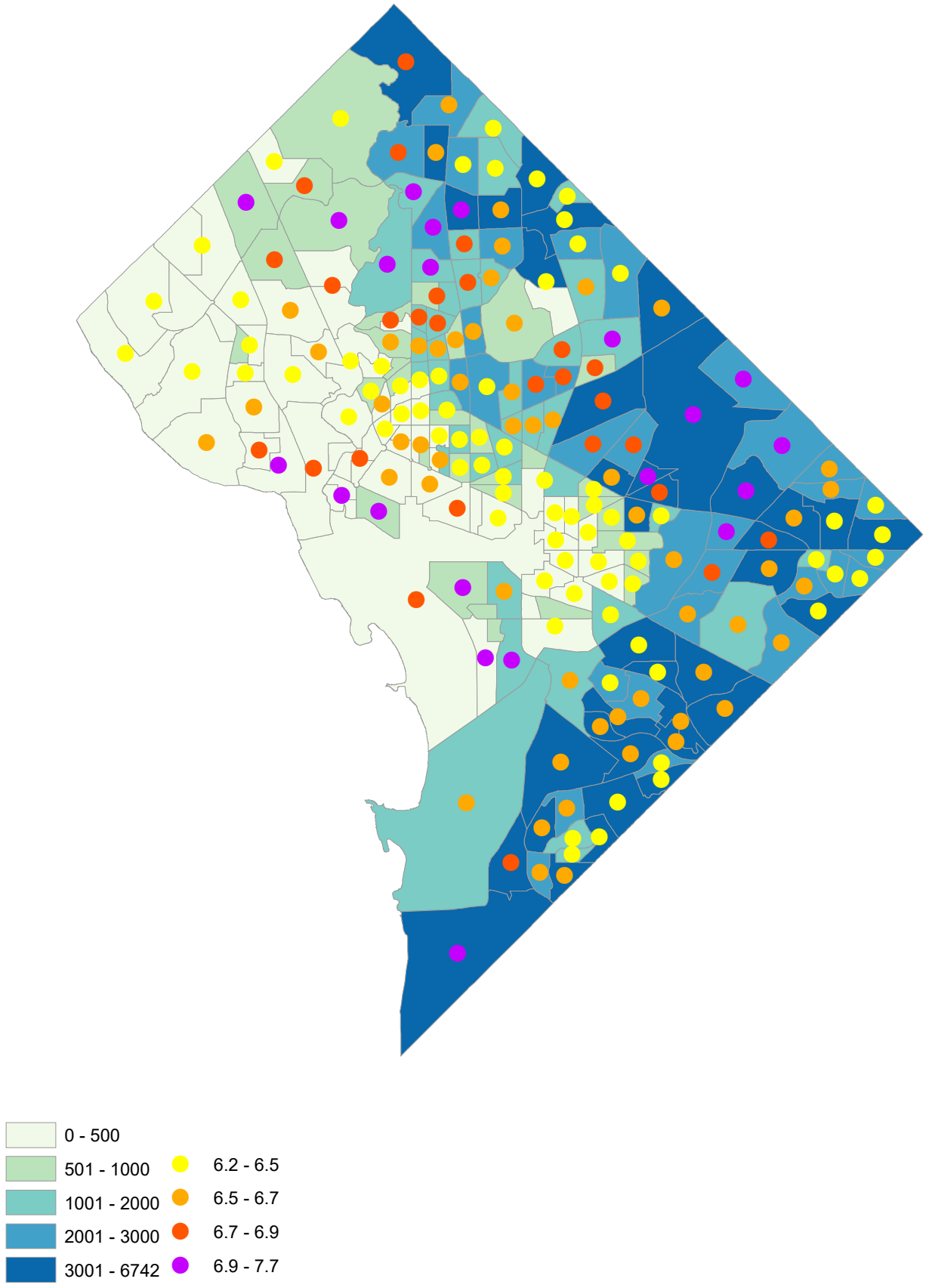
As discussed above, NO_2, is one of the primary contributors to pollution, so what happens if you overlay the roadway network of high volume roads with the concentrations of NO_2? The result is shown in Map 32, and displays that the higher the concentration of high volume roadways and highways, the higher the rates of NO_2 that occur.

Do environmental factors that affect public health occur at different rates throughout the District?

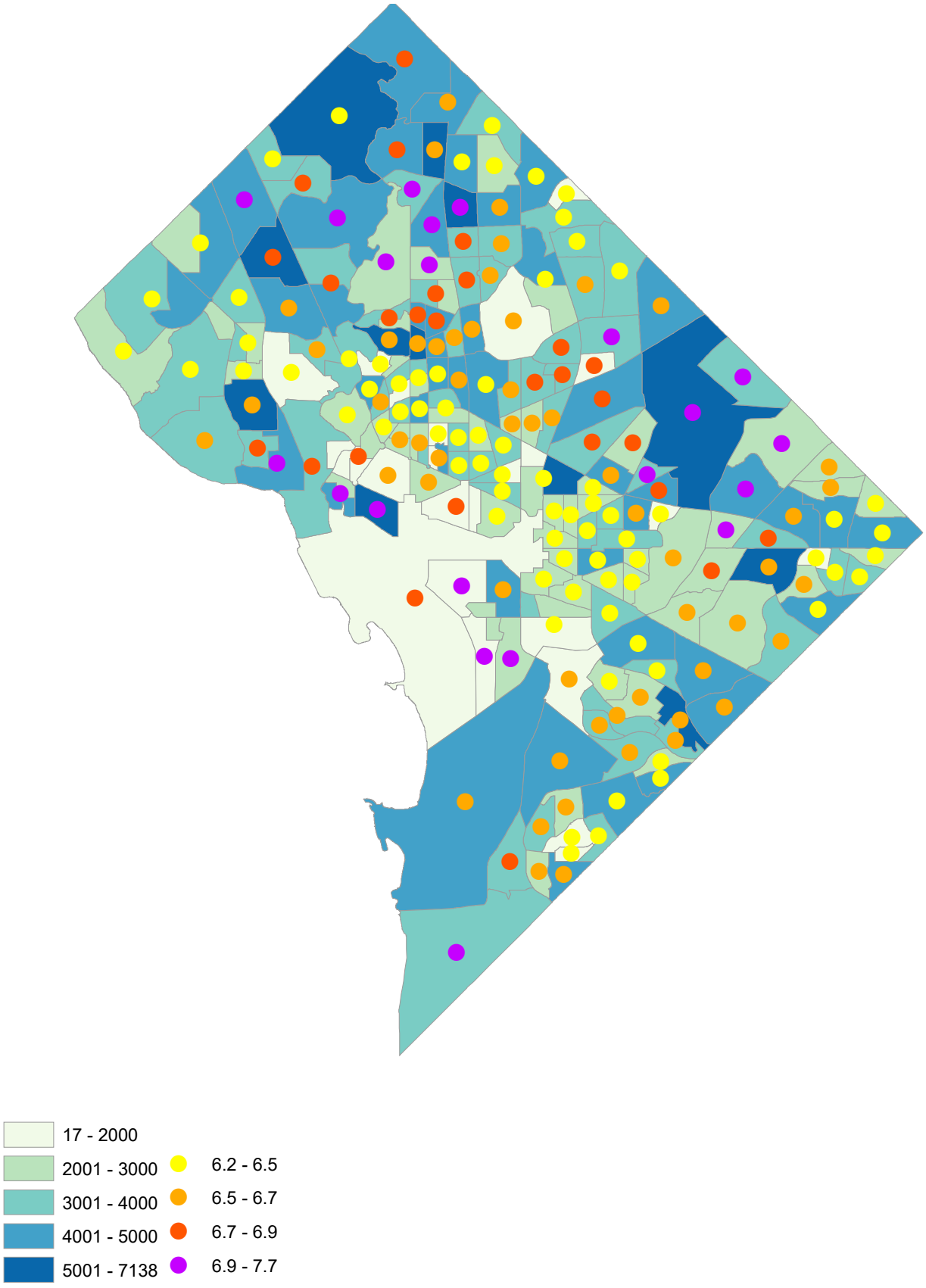
A University of Washington study found that, on average, communities of color were 2.5 times more likely than white communities to be exposed to traffic-related nitrogen dioxide concentrations above the World Health Organization guidelines. A study by the Environmental Protection Agency (EPA) showed that regardless of income level, African-Americans, Hispanics, Asians, and people of color are exposed at a disproportionate level to $PM_{2.5}$. According to the American Lung Association, "Due to decades of residential segregation, African-Americans tend to live where there is greater exposure to air pollution."

Communities of color in the District experience different levels of both $PM_{2.5}$ and NO_2, depending on location. But maps 33 - 36 do show a correlation between Hispanic populations and $PM_{2.5}$ and NO_2 exposure; and furthermore that pollution exposure is a factor for many communities of color that already experience other health burdens.

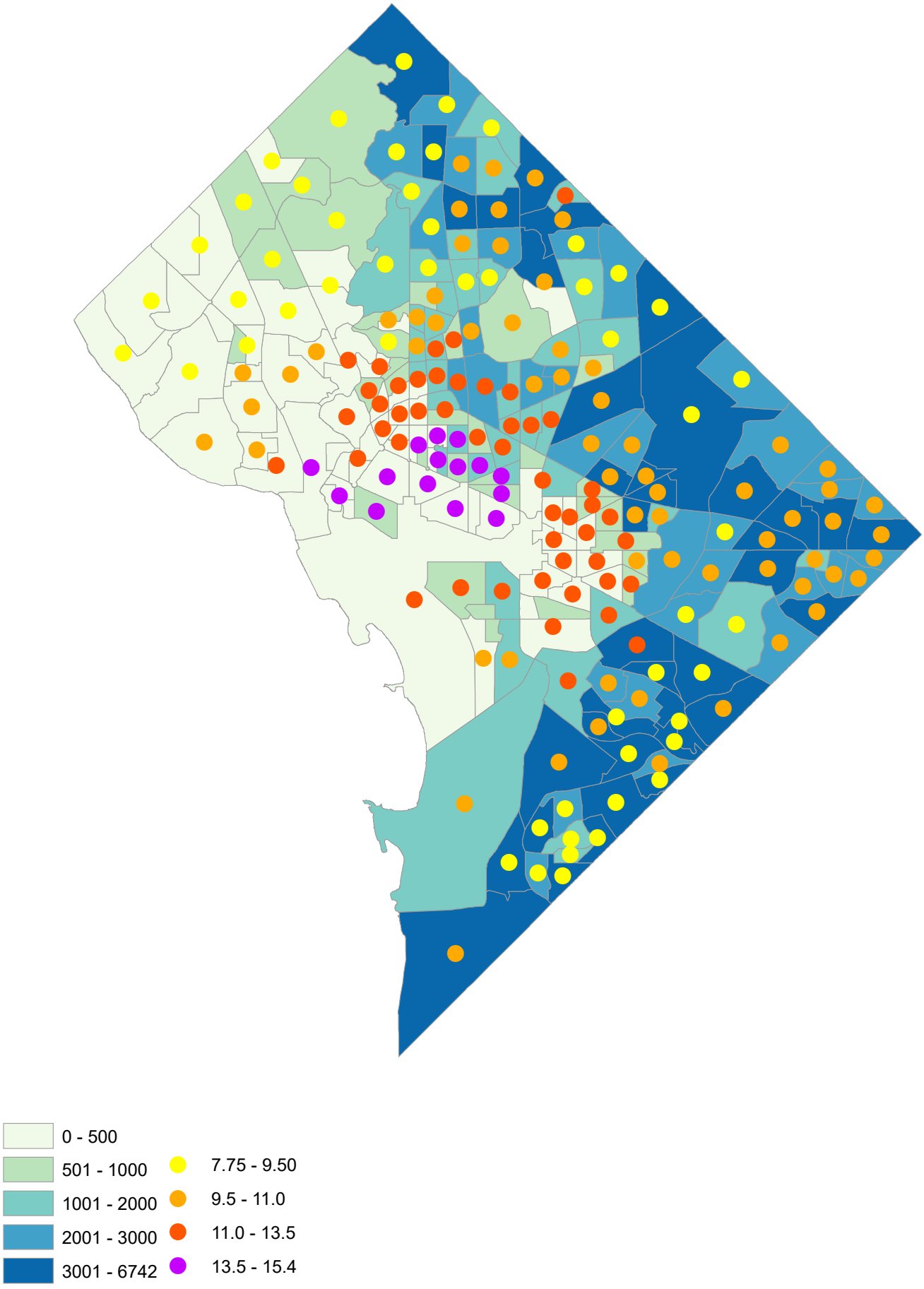
While there are other correlations to consider, this report's data analysis shows that census tracts with higher rates of poverty also have an increased likelihood of having $PM_{2.5}$ and NO_2 in their neighborhood, as shown in Map 37 and 38.



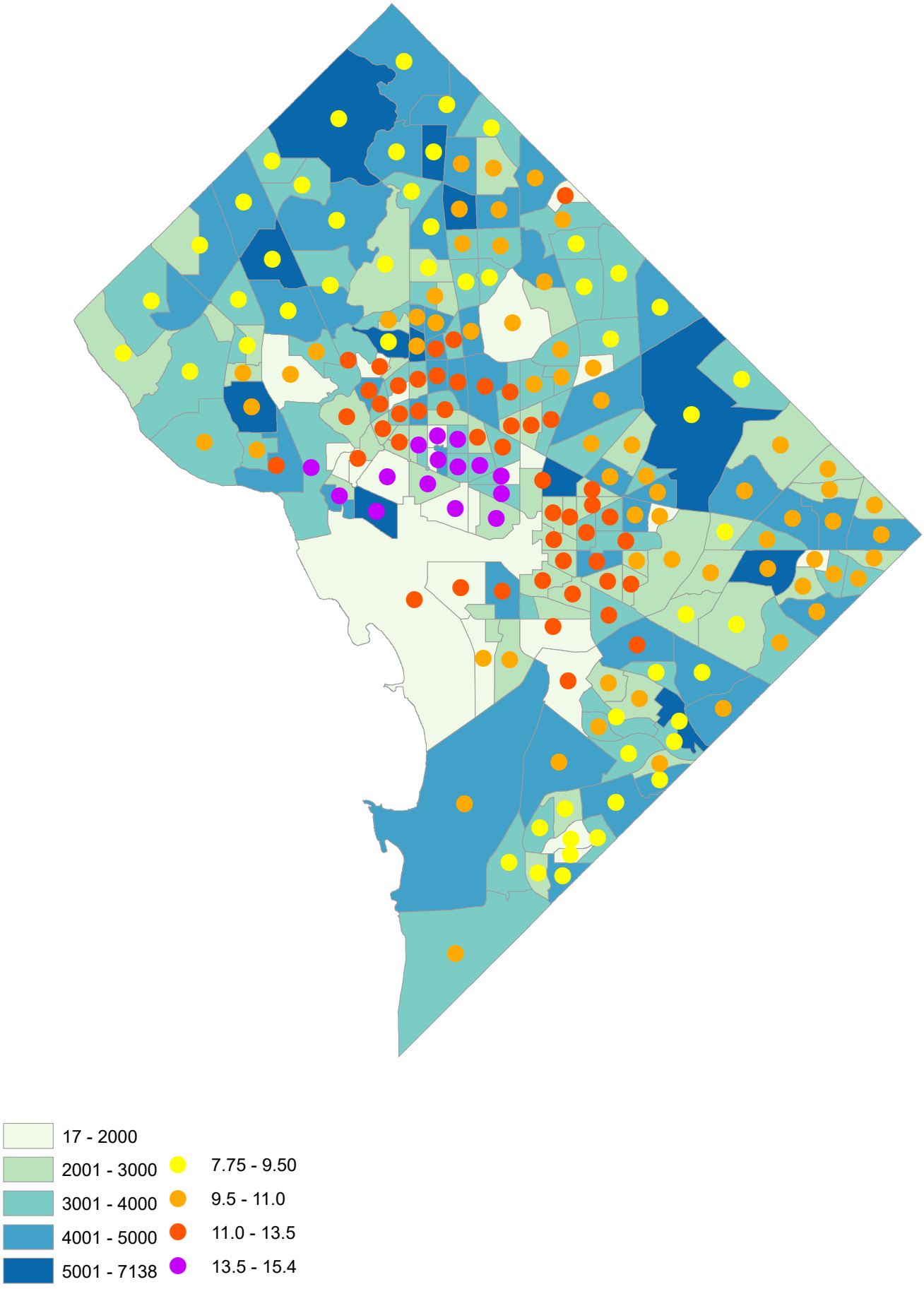
Map 30: Total Black or African-American population and PM2.5



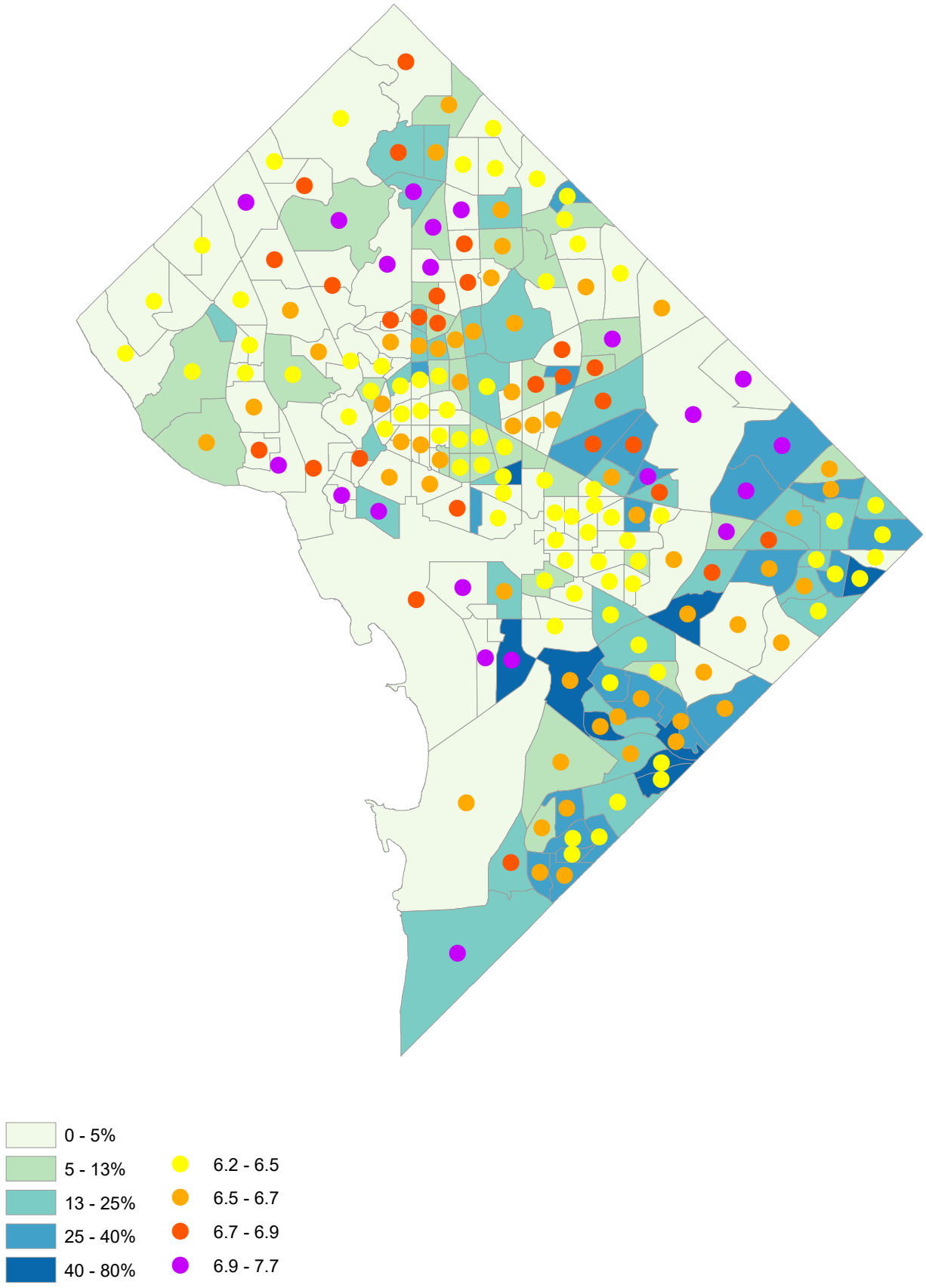
Map 31: Total Hispanic or Latino population and PM2.5



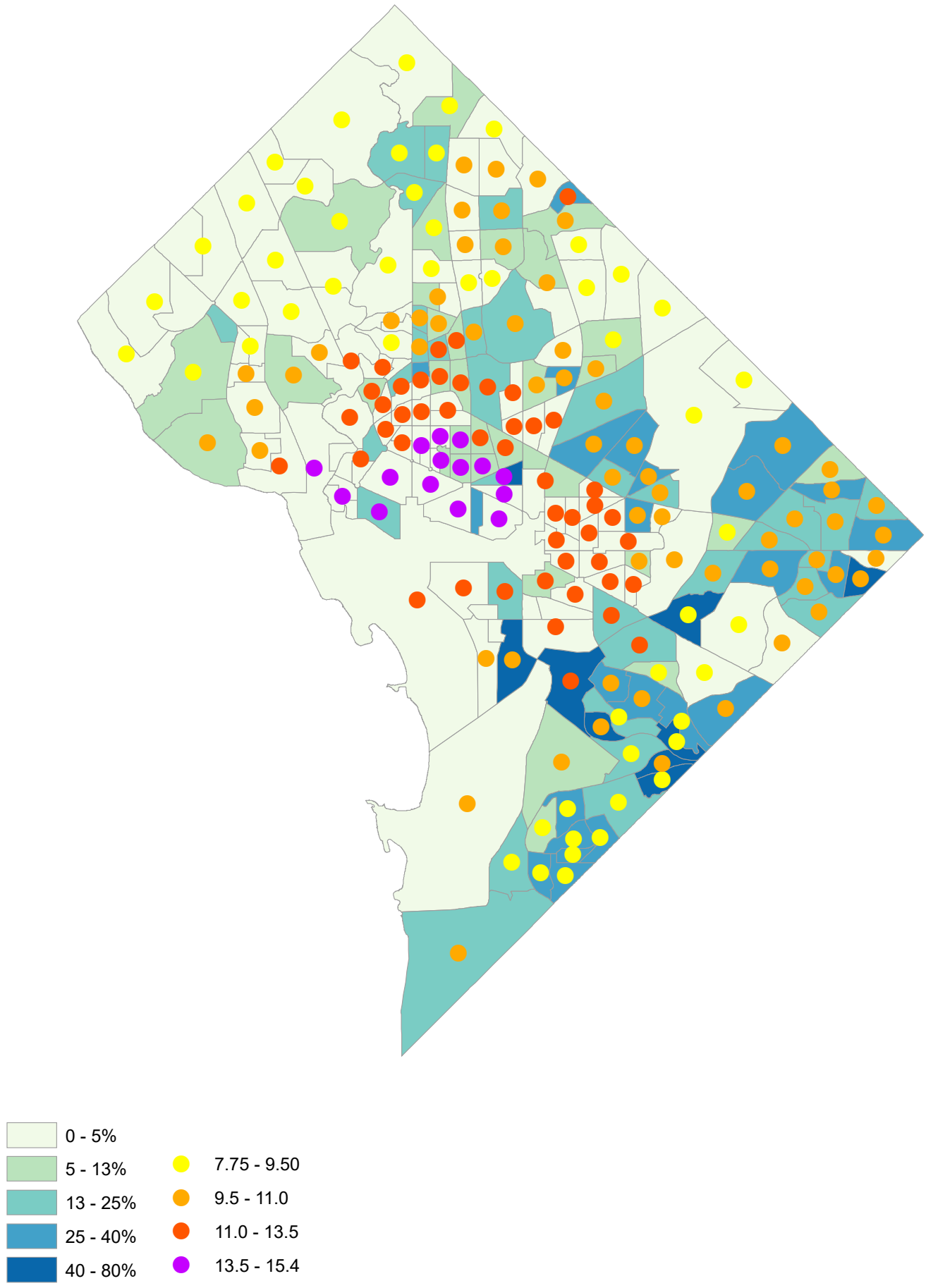
Map 32: Total Black or African-American population and No2



Map 33: Total Hispanic or Latino population and No2



Map 34: Percentage of families in poverty and PM2.5



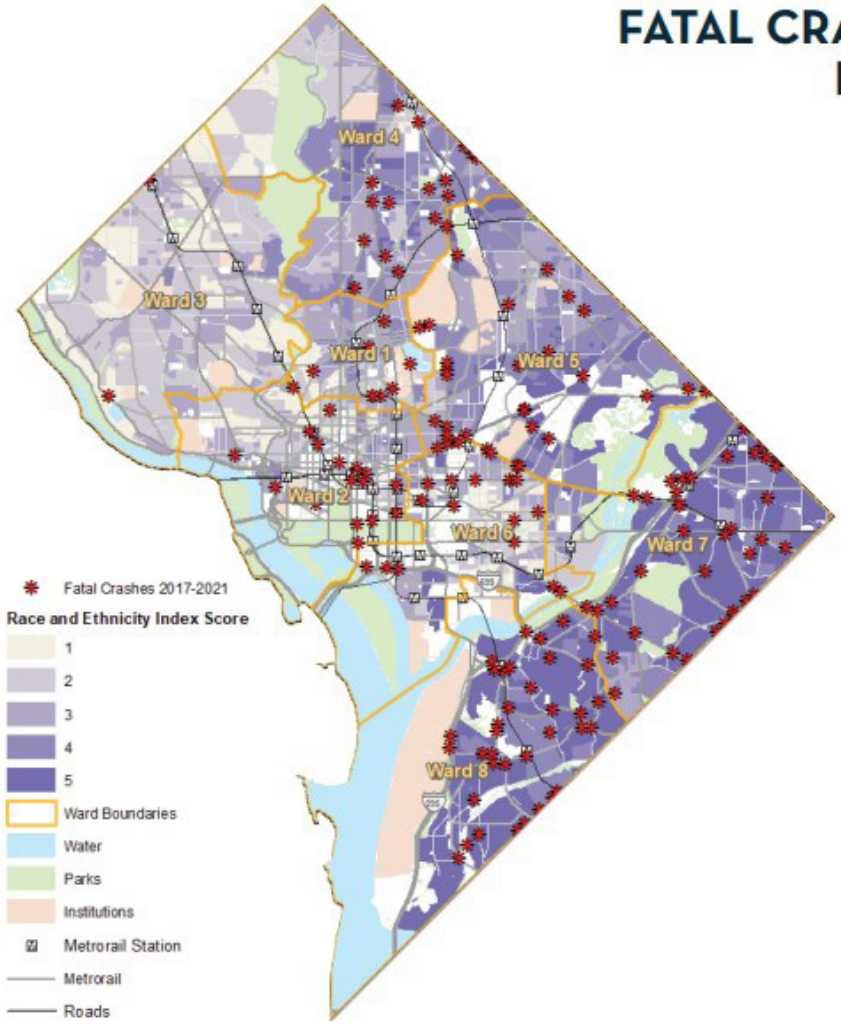
Map 35: Percentage of families in poverty and NO2

Where is traffic violence occurring in the District related to infrastructure and Black or communities of color? Is public transit available in these communities at the same rate as other communities?

Vision Zero is a city-wide plan that seeks to reduce pedestrian fatalities in the District to zero by the year 2024, and has failed in every sense to make progress toward its goals.

The aforementioned 2022 DDOT Vision Zero Update outlines fatal and injury crashes occurring at a higher rate in the District in areas of Black, Indigenous, and people of color, low-income or populations experiencing poverty and homelessness. Figure 20 below is from the report.

The locations for the High Injury Network overlaid with maps from Black or African-American (Map 39) and Hispanic or Latino (Map 40) census tracts are shown below. Many of the corridors with the highest concentration of fatal and injury crashes in the District are occurring in neighborhoods with a majority of residents of color.



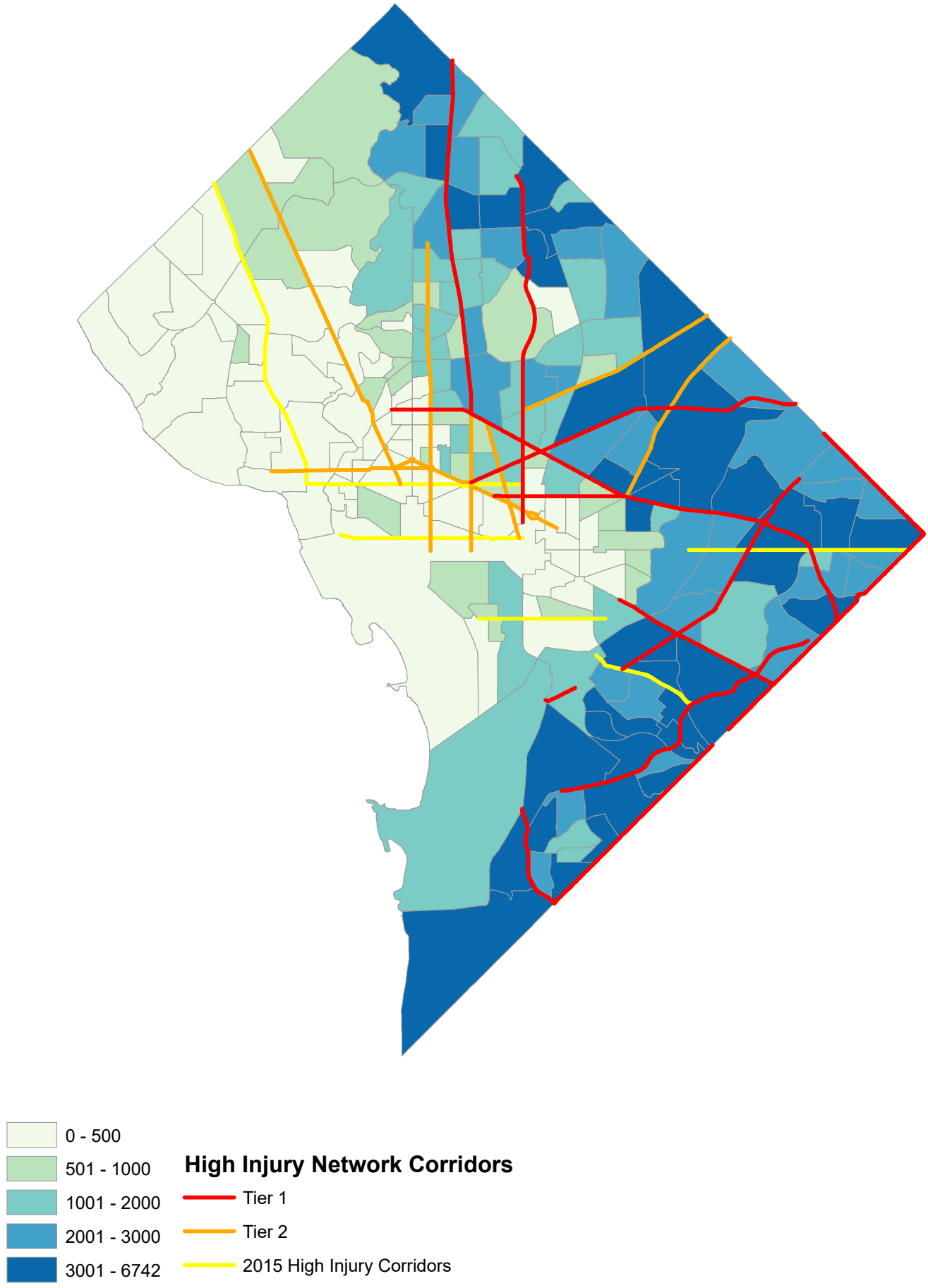
FATAL CRASHES COMPARED TO RACE AND ETHNICITY

2017-2021

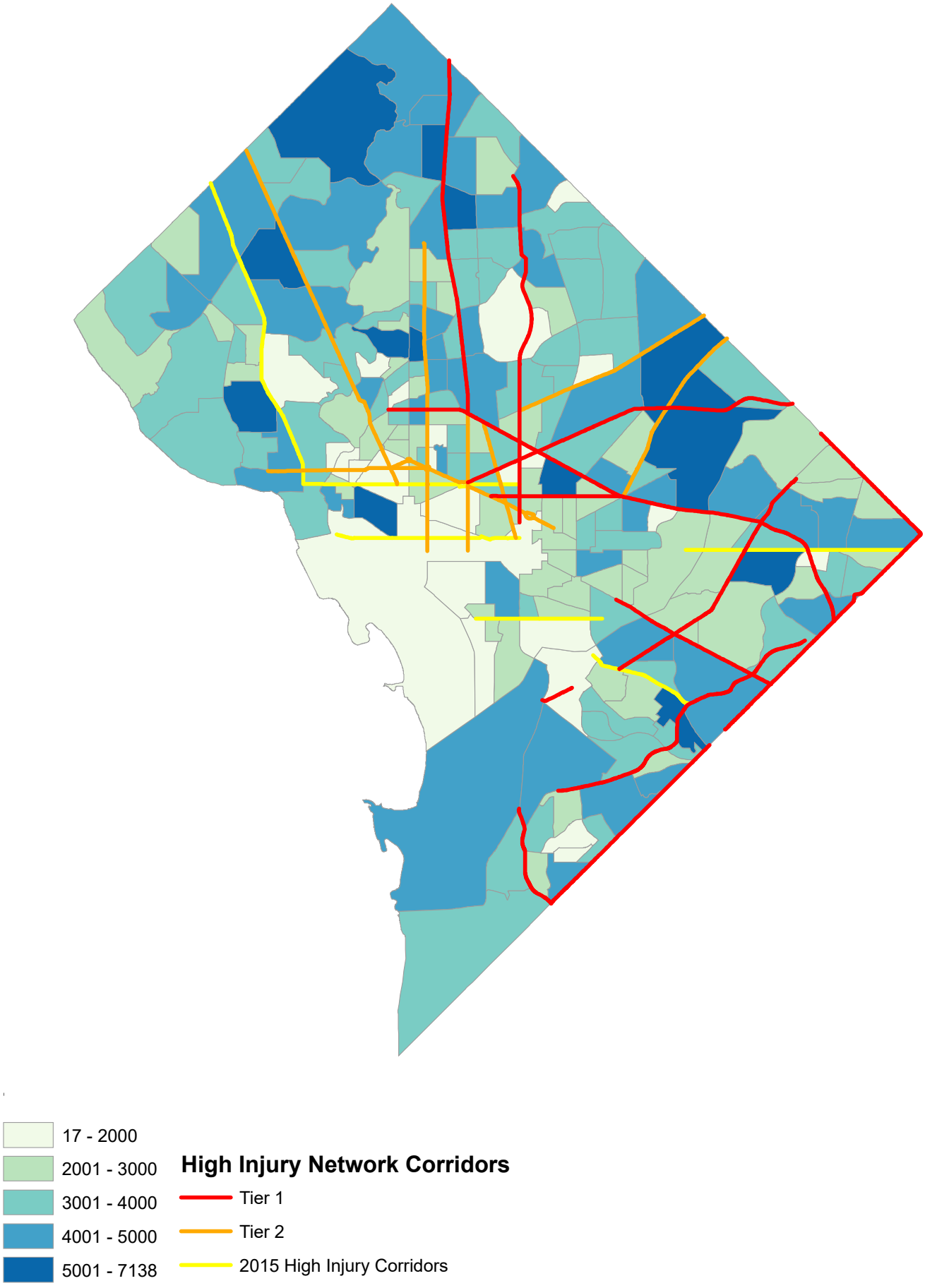
Ward	Reported Traffic Injuries, 2017-2021	Fatalities, 2017-2021	Annual Injury rate per 100k population	Annual Fatality rate per 100k population
1	2,347	9	625	1.9
2	4,748	23	1,216	4.8
3	1,773	4	451	0.9
4	3,257	13	882	2.8
5	6,463	34	1,595	7.0
6	5,764	22	1,518	4.8
7	**7,043**	**38**	**1,892**	**8.2**
8	**6,261**	**44**	**1,652**	**9.6**
DC Total	30,390	188	1,228	5.0

*Injury crash data based on MPD reports. Reported fatalities are sourced from MPD as well as US Park Police press releases.

Figure 20: Fatal crashes compared to race and ethnicity (DDOT)



Map 36: High Injury Network and total Black or African-American population



Map 37: High Injury Network and total Hispanic or Latino population

Conclusion

Discussion

When factoring in the air quality, asthma rates, traffic crashes, and traffic fatalities, the census tracts displayed in Map 41 would be seen as the most and least burdened census tracts in the District. This ranking was determined by creating a point system based on the following categories:

- N02: 1-4 points based on tier (George Washington University Data)
- PM2.5: 1-4 points based on tier (George Washington University Data)
- Asthma: 1-5 points based on tier (from Adult Asthma from Children's National)
- HIN Tier 1: 2 points if a HIN Tier 1 segment/ intersection is in the census tract (DDOT)
- HIN Tier 2: 1 point if a HIN Tier 2 segment/ intersection is in the census tract (DDOT)

All categories were added together to get a final total and mapped below.

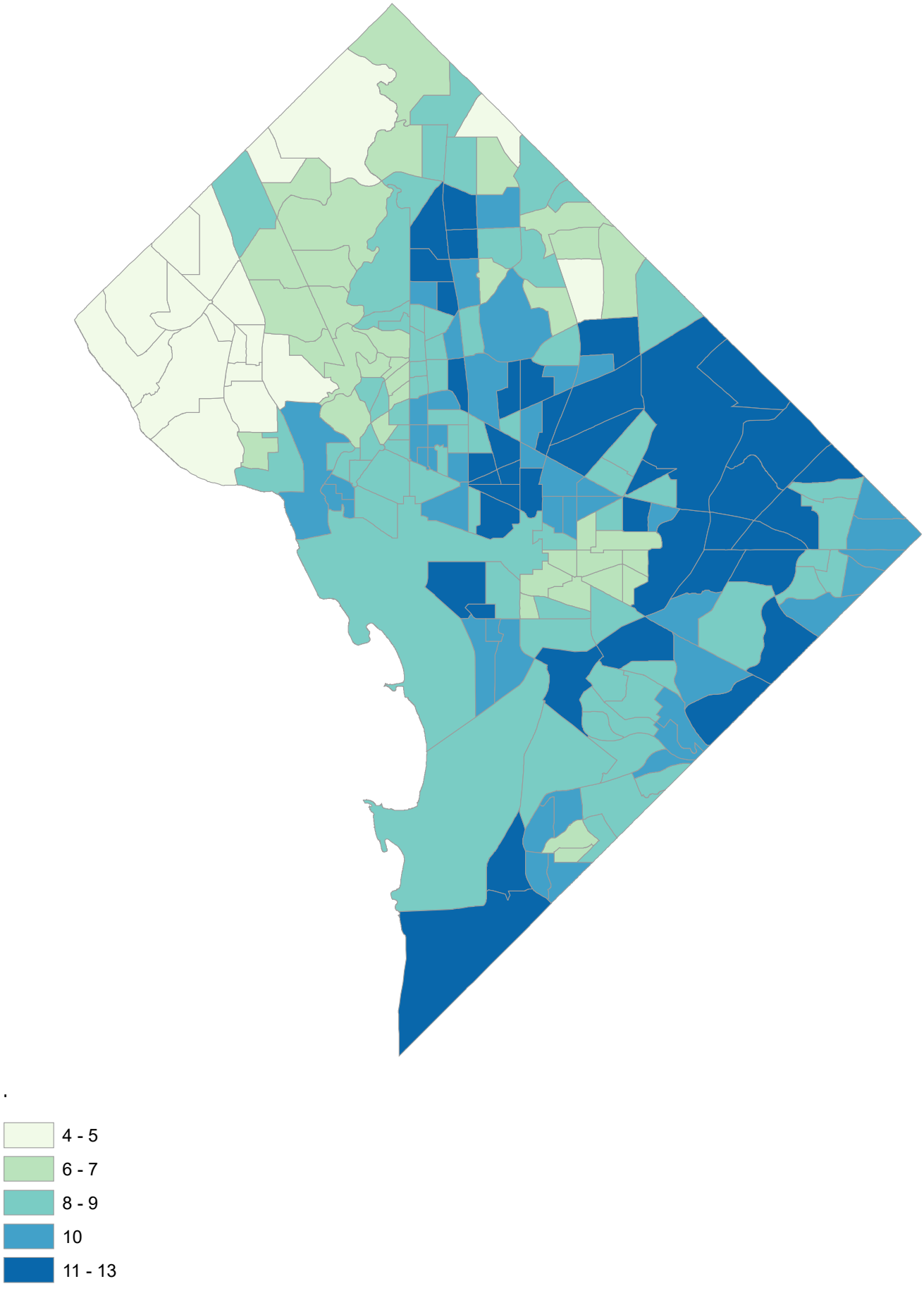
Why does this matter?

In order to choose modes that are optimal for health and other human development indicators, DC residents need to have accessible, reliable options other than driving cars. As shown in Figure 21, many factors can determine a person's mode choice.

Making it an easy choice for an individual to commute via biking, walking, train, or bus, changes can create wider demand. Fewer people on roadways means less congestion and less pollution. In the 2022 Vision Zero Update, DC Mayor Muriel Bowser outlined a plan to include a goal to lower vehicle-miles-traveled (VMT) per capita and embrace the safe-systems approach, which has so far failed to yield reductions in traffic fatalities particularly in underserved communities.

When building new infrastructure, providing multiple safe options for travel to all District residents should be the highest priority.
How can investing in transit and active transportation boost health equity in DC?
Mixed modes are an important way to lower the barrier to entry into alternative transportation methods. A person may not bike five miles to their destination, but they may bike one mile to a bus that takes them to their destination instead of utilizing their personal vehicle, if the infrastructure is available and adequate.

We also must consider how to make public transit consistently available and timely. One study shows, giving users access to real-time data increases reliability, and that reliability increases use. Frequency and reliability are similarly compelling factors, which is why the District's investments in bus priority infrastructure may correspond to health gains once they are properly enforced.



Map 38: Census tracts rankings for air quality, asthma rates, traffic crashes, and traffic fatalities

Improving the health of all citizens, but particularly mitigating disproportionate environmental impacts can be achieved by focusing on areas that are hit the hardest, which are typically low-income communities of color. One way to target this change is through Low-emission zones. Low-emission zones (LEZs) are defined by National Association of City Transportation Officials (NACTO) as "areas within cities where the use of emitting vehicles is regulated through restrictions or financial charges. LEZs provide a way for cities to pilot urban mobility solutions to tackle air pollution and congestion in a designated zone rather than across a whole city." The advantage to this method is that it can be targeted to the areas that have the highest levels of pollution affecting the health of District residents.

Cities that have "road pricing," a type of LEZ also known as "congestion pricing", report numerous positive health impacts for residents including: decreased air pollution, carbon emissions, road damage, and traffic crashes. Road pricing charges a fee to customers for using certain roads during the peak times of the day/week. It can incentivize drivers to use other modes of transportation, it can fund other public transportation projects in the District, and it can reduce air pollution and traffic violence. The revenue generated from road pricing can be reinvested in public transit, expanding access to public transportation and reducing travel burdens on communities in need. A study on road or congestion pricing in the District of Columbia is set to be released in early 2024, and outlines a plan to use these initiatives to help the District, much like other cities outside the United States have done and New York City plans to do.

How can these findings be taken forward?

Elected officials are encouraged to use the data in this report to help inform decisions relating to health and transportation in the District, which can also be applied to neighboring jurisdictions. Advocates and residents of the District may find the information useful in connecting your concerns to policies that can help, in discussion with your elected officials. What infrastructure does your neighborhood need for residents to breathe cleaner air and be safe from car crashes, while getting where you need to go? What health and safety concerns do you have that buses, biking, or walking can help mitigate?
We have an obligation to increase the health and safety of our communities. This report strives to provide data and resources for DC to understand the areas that have differing resources and health outcomes, and to marshal the strengths and knowledge of the health, transportation and other sectors in addressing them together.

Data availability

Limitations, like in any study, occur due to limitations of data due to availability and access. Data supporting this study are directly available from:

Environmental factors
- Anenberg, Mohegh, et al. (2022)
- van Donkelaar et al. (2021)

Crash data
- District of Columbia Vision Zero Traffic Fatalities and Injury Crashes (arcgis.com)
- Open Data DC
- Crashes in DC, Open Data DC

Health data
- Impact DC Asthma Clinic | Children's National Hospital (childrensnational.org)
- PLACES: Local Data for Better Health, CDC
- DC Health Matters
- Youth Risk Behavior Surveillance System (YRBSS), CDC

Open Data DC
- ACS Demographic Characteristics DC Census Tract | ACS Demographic Characteristics
- DC Census Tract, Open Data DC, 2017-2021 ACS
- Open Data DC

Data supporting this study are available on a case-by-case basis from:

High Injury Network
- District Department of Transportation

Environmental Factors Census tract data
- Gaige Kerr (gaigekerr@gwu.edu)

Traffic Reduction Impact Analysis

Traffic Reduction Impact Analysis for R.W.J. Foundation

Methods, Results, and Data Dictionary

D. Taylor Reich, independent consultant, for Greater Greater Washington
2023-09-10

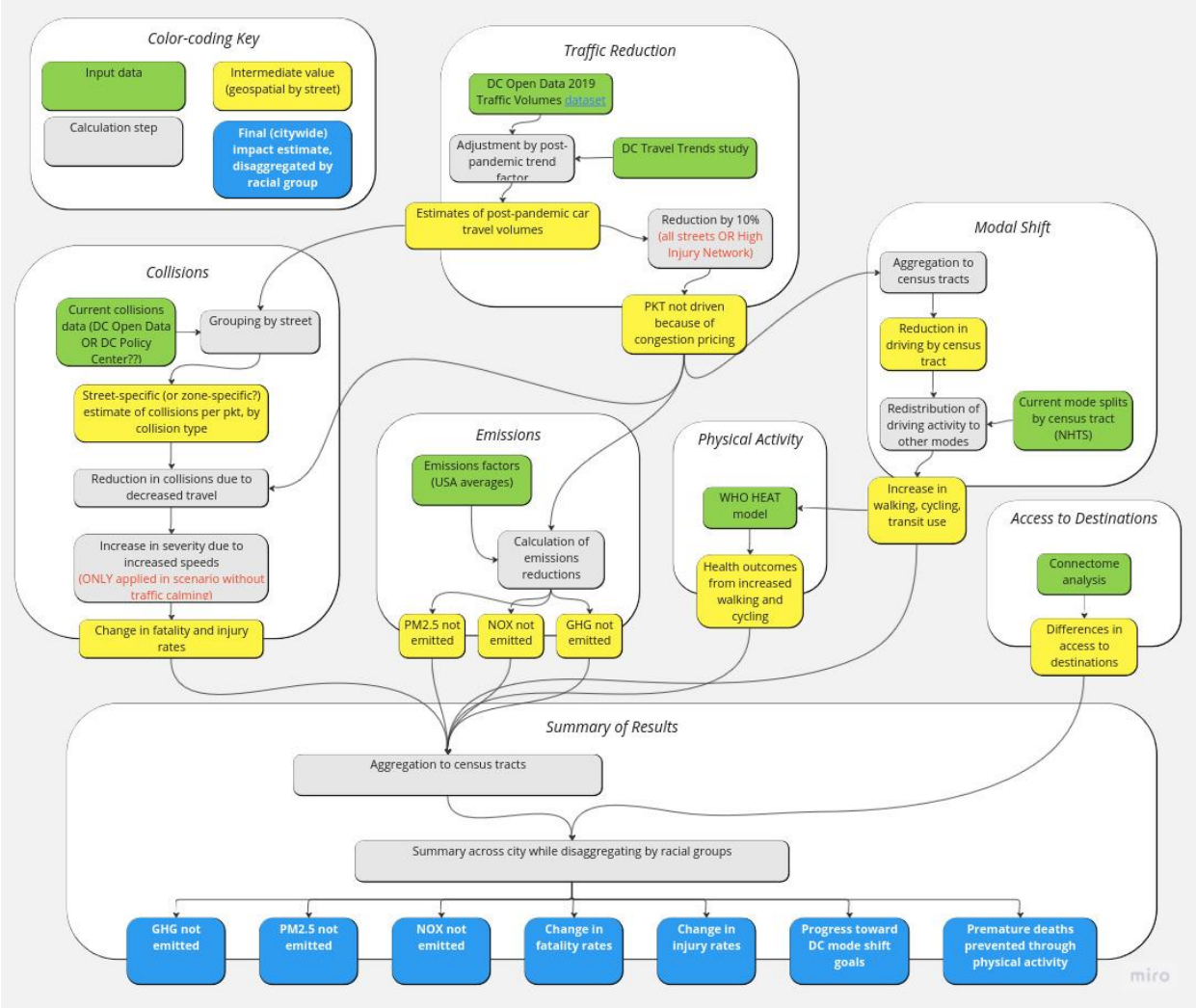
Introduction

This study estimates impacts that could be caused by a hypothetical traffic reduction scenario that would reduce car travel on all streets within the District of Columbia by 10%. The study also investigates an additional traffic calming scenario that would negate increased car speeds which would otherwise result from traffic reduction while simultaneously improving conditions for people walking.

The study looks at six categories of potential ways by which traffic reduction (and, in some cases, traffic calming) could have an impact on the residents of DC.

There are also two sections to this document that explain how the estimates were aggregated and shared.

Flowchart summary of methods



This traffic reduction scenario is 'hypothetical' because it is not meant to reflect the impacts of any particular policy - there is not necessarily a single policy that DC could enact to achieve this scenario. The exception to this in the study is in Section 6, *Access to Destinations*, which rather than modeling the impacts of a general reduction in traffic instead looks at a specific congestion pricing policy -- a charge of $5 to enter a downtown cordon area.

1: Traffic Reduction

We began by estimating the potential effect of a traffic reduction policy on levels of vehicle activity in DC:

- We used the most recent pre-COVID available dataset on traffic volumes in DC, the DC Open Data *2019 Traffic Volumes* dataset.[1]

[1] https://opendata.dc.gov/datasets/DCGIS::2019-traffic-volume/

- We also used the DC Open Data *2020 Traffic Volumes* dataset for traffic volumes during the pandemic.[2] This data is only used in Section 3, *Collisions*.
- We multiplied those volumes by a *pandemic trend factor* of 0.70, to estimate the 30% reduction in overall driving activity 2019-2022 due to the COVID-19 pandemic, with the understanding that the 2022 levels represent a "new normal". This 70% factor is from the (forthcoming) *DC Travel Trends Report* by Nelson\Nygaard, which used Location-Based Services data from StreetLight Data.[3] We use a citywide factor because no more detailed information is available. We refer to this as "post-pandemic traffic," and we measure it in vehicle-kilometers traveled.
- In turn, we multiplied that result by a *traffic reduction factor* of 0.90, representing a 10% reduction in overall car traffic. This 10% factor is taken as a given in the analysis - it is not the result of any particular research. Because our traffic reduction is city-wide, it is not the same as a 10% reduction in traffic entering a downtown congestion-pricing zone. We refer to this reduced traffic as *post-policy traffic*.
- Finally, we estimated *traffic avoided* as the difference between *post-pandemic traffic* and *post-policy traffic*.

Note that this estimation of traffic reduction only includes traffic on streets included in the Open Data DC *Traffic Volumes* dataset, which tend to be main streets and not neighborhood streets. Since the substantial portion of car travel in DC that occurs on neighborhood streets is not included in our analysis, it is likely that all following estimates of impact are conservative.

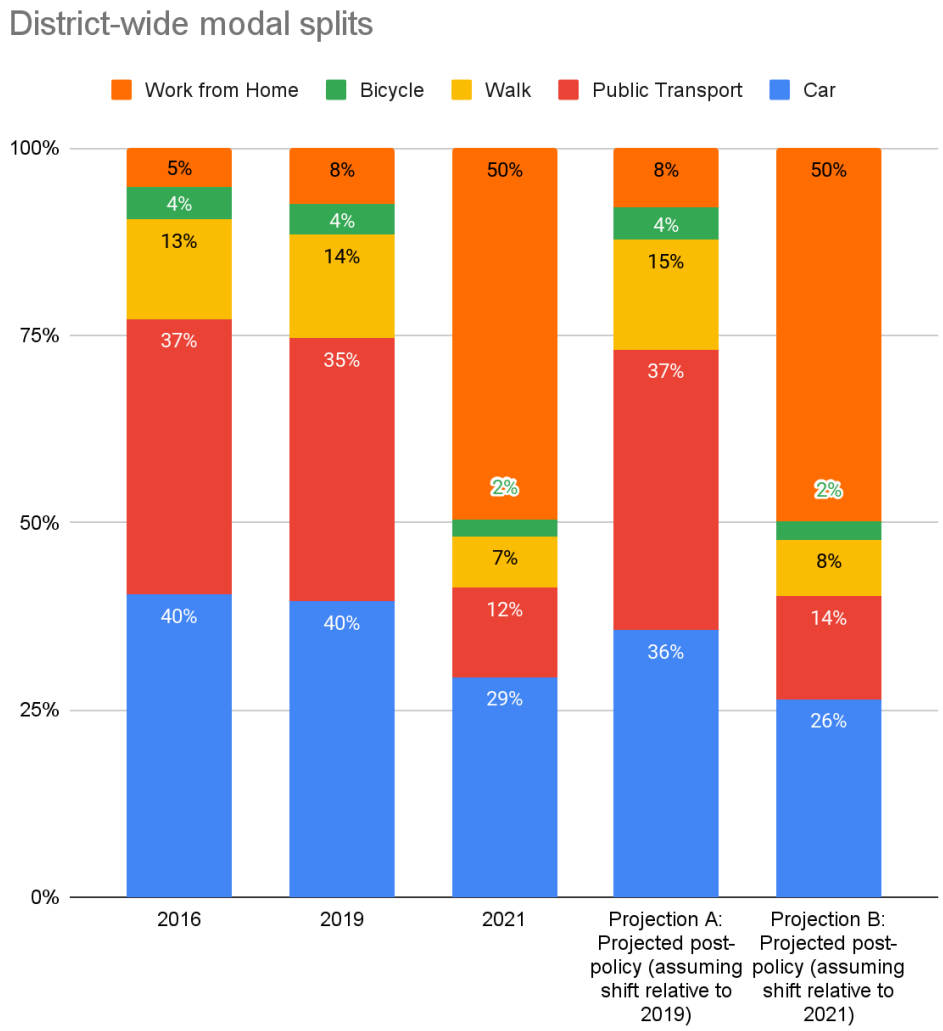
2: Modal Shift

We estimate modal shift from *traffic avoided* to other modes on the proportional basis of existing non-car modal splits for commuting, taken from the American Community Survey for 2019 at the level of Public Use Microdata Areas (PUMAs) in ACS table S0801, and including work-from-home (or rather, "trip not made") as a potential other mode.[4] We chose to use modal splits from 2019 rather than 2021 because 2021 includes COVID-19 lockdowns.

This is a rough approximation. It estimates shift from cars to other modes on the proportional basis of current commuting behavior, not current travel behavior in general, which probably results in an overestimation of public transport and an underestimation of walking and cycling (which will result in more conservative conclusions in Section 5, Physical Activity). The inclusion of "trip not made" as a possibility, on the proportional basis of current work-from-home commuting, is also conservative (it may be that working from home is already at a maximum). The

[2] https://opendata.dc.gov/maps/DCGIS::2020-traffic-volume
[3] Report to be published
[4] https://data.census.gov/table?g=040XX00US11$7950000&tid=ACSST1Y2021.S0801

results can be converted to District-wide estimates of modal split, as in *Fig. B*, and compared to policy goals for modal shift.[5]



Based on the available data, the most recent of which dates from 2021, it is still unclear what the post-pandemic "new normal" will be. Thus it is unclear what will be the baseline relative to which the traffic reduction policy will cause District-wide modal shift. We provide two possibilities. If the reader believes that the "new normal" will more closely approximate 2019 travel patterns, then Projection A will reflect the results of the traffic reduction policy relative to that baseline. If the reader believes that the "new normal" will more closely approximate 2021 conditions, then they should focus on Projection B. Both projections are identical in the proportion of car travel prevented, and the modes to which that travel shifts. The truth likely lies somewhere in between the two.

5 https://sustainable.dc.gov/sites/default/files/dc/sites/sustainable/page_content/attachments/SDC2%20Transportation.pdf

This modal shift approximates a change in travel activity occurring along each roadway (or possibly along a parallel route). It does not necessarily equal a modal shift occurring among residents of the surroundings of each roadway. For example: The traffic reduction policy may result in fewer commuters driving from Maryland to downtown DC via the Suitland Parkway, instead traveling by public transport or working from home. This decrease in car commuting from the suburbs - rather than a modal shift within Ward 8 - will be responsible for some portion of the benefit in air quality and road safety accruing to residents of that ward.

We make the assumption that all cars are single-occupancy private cars, transporting only the driver. On one hand, this will tend to underestimate modal shift because, in reality, a minority of cars contain at least one passenger, but on the other hand it will overestimate modal shift because some of those car trips are by taxi or ridehailing vehicles, which usually have a substantial amount of 'deadheading' without a passenger. We expect that the two effects will cancel out, and the difference will be within the study's margin of error.

3: Collisions

A reduction in traffic will have two oppositional effects on road safety. The first effect is that, by reducing the number of cars on the road, it will reduce levels of exposure to collisions. For example, all else being equal, a 1% drop in vehicle travel will cause a 1% drop in injuries and fatalities. But all else is not equal. The second effect is an increase in speeds. By reducing traffic, the remaining vehicles on the road are able to move more quickly, considerably increasing the risk of collisions causing injuries or deaths per vehicle-kilometer traveled. Reducing traffic means that there will be fewer cars, but that each car will be more dangerous.[6]

The second effect, the increased danger per vehicle-km, could be negated through use of traffic calming interventions that would reduce speeds to their pre-pandemic levels. To model this potential outcome, we include a *traffic calming scenario*. In this scenario, along with the traffic reduction policy which reduces all DC-wide car travel by 10%, there are also traffic calming measures that maintain road speeds at pre-policy levels.

It is important to note that these results are all approximate, more so than the other categories of impact estimated in this study. Studying traffic collisions, and in particular traffic deaths, is very difficult due to the small sample sizes available, and so it is impossible to make precise predictions. However, we believe that the general direction and scale of these evaluations are relatively accurate: that traffic reduction unaccompanied by traffic calming will increase injuries and deaths, especially among Black people, while the combination of traffic reduction and traffic calming will decrease injuries and deaths, though with a less clear racial breakdown.

[6] https://journals.sagepub.com/doi/epub/10.1177/03611981221103239

To estimate the impacts of the traffic reduction policy on injuries and deaths from collisions, we did the following:

- We calculated injuries and deaths per vehicle-kilometer, broken down by car and non-car road users, in 2020 and 2022. by comparing known or estimated traffic volumes (see Section 1) with the DC Open Data *Crashes in DC* dataset.[7]
- We assumed that the increase in per-vehicle-kilometer injuries and fatalities caused by increased speeds would be reflected in the collision rates from 2020, when roads were nearly empty. This is probably an overestimate.
    - In the case of the *traffic calming scenario*, we skip this step. Instead, we use pe-km collision rates from 2019. For each racial group, we then take the maximum reduction in injuries and deaths between those rates and the post-policy rates.
- We multiplied the projected *post-policy traffic* by the per-vehicle-km collision rates from 2020 to estimate post-policy injuries and deaths, and compared these to the injuries and deaths observed in 2022.

	Traffic reduction only					
	Ped + Cyclist injuries avoided	Ped + Cyclist deaths avoided	Driver + Passenger injuries avoided	Driver + Passenger deaths avoided	Total injuries avoided	Total deaths avoided
White non-Hispanic	-50	2	-200	-4	-200	-2
Hispanic or Latino	-20	0.4	-90	-0.7	-100	-0.4
Black non-Hispanic	-70	-2	-800	-7	-800	-9
Asian non-Hispanic	-6	0.3	-20	-0.6	-30	-0.3
Other	-7	0.1	-50	-0.6	-60	-0.5
Total	-200	1	-1000	-10	-1000	-10

	Traffic reduction + Traffic calming					
	Ped + Cyclist injuries avoided	Ped + Cyclist deaths avoided	Driver + Passenger injuries avoided	Driver + Passenger deaths avoided	Total injuries avoided	Total deaths avoided
White non-Hispanic	20	2	70	0.2	90	2
Hispanic or Latino	4	0.4	20	0.04	30	0.4

[7] https://opendata.dc.gov/datasets/crashes-in-dc/explore

Black non-Hispanic	20	0.3	100	0.3	100	0.6
Asian non-Hispanic	3	0.3	10	0.02	10	0.3
Other	2	0.1	10	0.03	10	0.2
Total	40	3	200	0.6	300	4

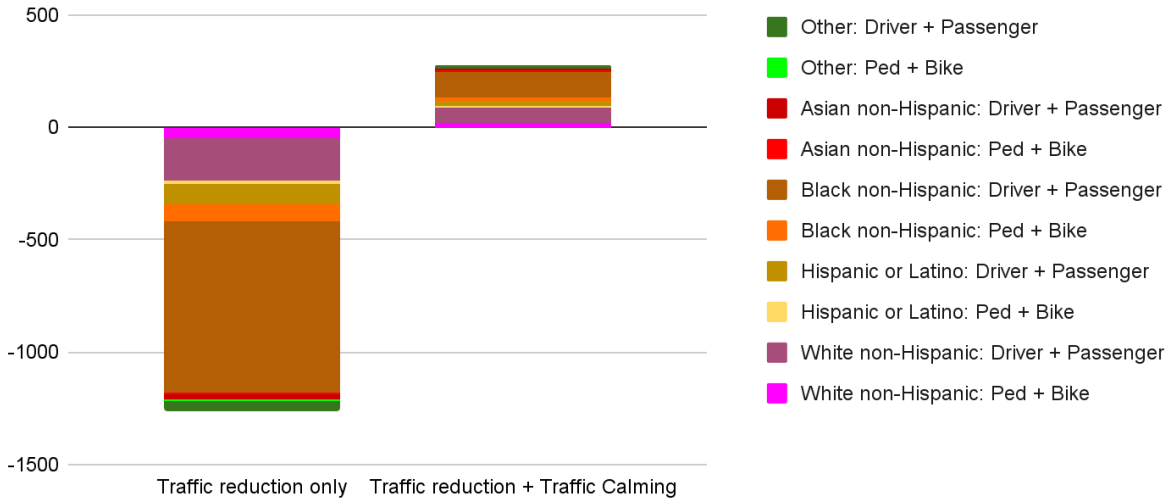
We estimate that the traffic reduction policy, by itself, will cause more injuries and deaths than it prevents -- and moreover, that the distribution of injuries and deaths will be racially uneven.

Traffic reduction alone stands to substantially reduce road injuries among White people while increasing injuries among Black people, particularly among Black drivers and passengers. The pattern is similar for deaths: traffic reduction alone may increase deaths among all racial groups, but especially so for Black drivers and passengers.

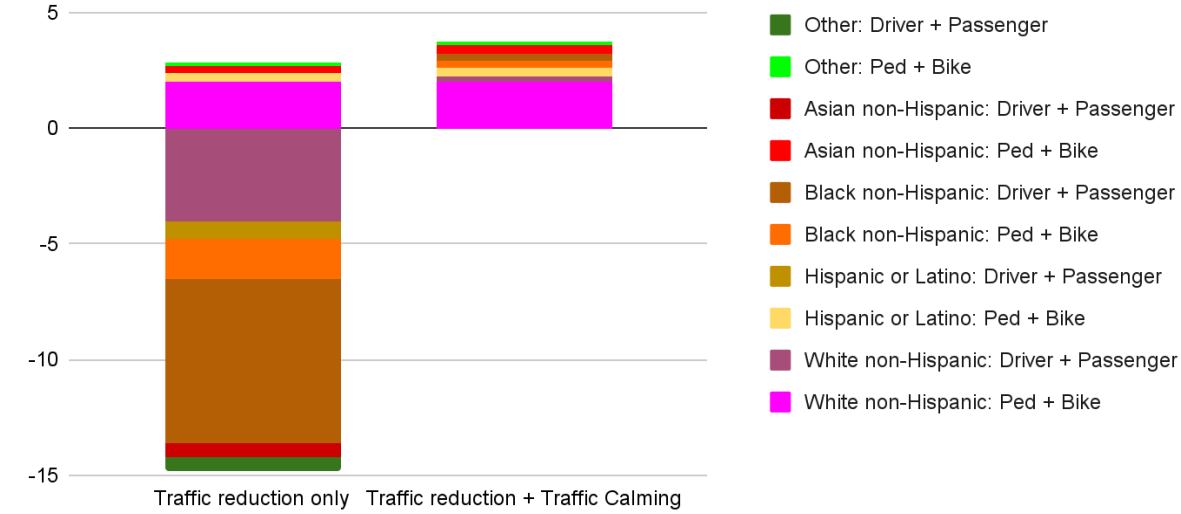
Traffic calming would negate all the harmful impacts of traffic reduction, while keeping the beneficial ones. It would cause a substantial reduction in injuries, especially among Black drivers and passengers, and in deaths, especially among White pedestrians and cyclists.

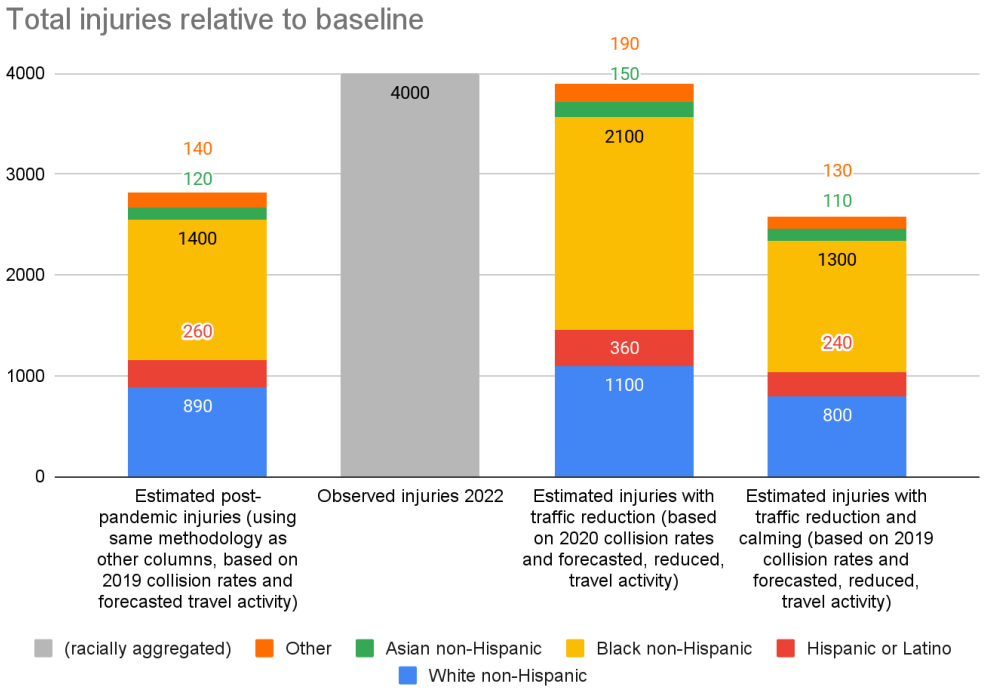
Overall, the combination of traffic calming and traffic reduction stands to save about 6 lives per year, while traffic reduction alone could cause about the same number of deaths.

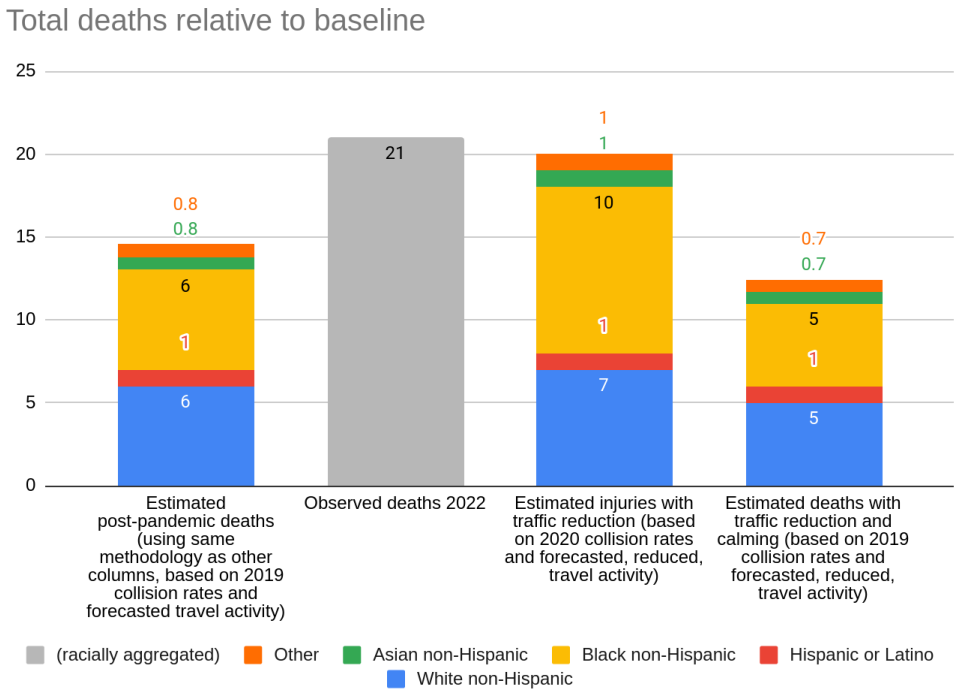
Injuries caused and avoided due to traffic reduction and traffic calming (negative numbers: injuries caused)



Deaths caused and avoided due to traffic reduction and traffic calming (negative numbers: deaths caused)







Note that our estimates of total post-pandemic (pre-policy) injuries and deaths differ substantially from observed injuries and deaths in 2022. The latter are much higher.

This illustrates the imprecision of all estimates in this section, which are based on numbers that are difficult to analyze statistically, but it does not necessarily negate the main conclusion of the analysis -- that reducing traffic without also calming it causes increased danger, especially to DC's Black population.

4: Emissions

In order to estimate reductions in emissions, and the geographical distribution, we multiply *traffic avoided* by emissions factors (in grams per vehicle-kilometer) for each of four pollutants:

- The emissions factors for carbon monoxide (CO), nitrogen oxides (NO_x), and particulate matter (PM2.5) are from the U.S. Bureau of Transportation Statistics,[8] assuming an average USA light duty vehicle (passenger car or SUV) from 2012, the average age of a car in the USA.
- The emissions factor for greenhouse gases (CO_2eq) is from the Environmental Protection Agency,[9] representing a USA-wide average.

	Emissions prevented by traffic reduction annually (metric tonnes)			
	Carbon Monoxide	Nitrogen Oxides	Particulate Matter (PM2.5)	Greenhouse Gases (CO2-eq)
White non-Hispanic	980	87	1.7	55,000
Hispanic or Latino	230	21	0.4	13,000
Black non-Hispanic	1,600	140	2.7	90,000
Asian non-Hispanic	120	11	0.2	6,800
Other	150	14	0.3	8,600
total	3,100	270	5.2	170,000

This reduction in greenhouse gas emissions is equivalent to about 50 wind turbines, 40,000 cars taken off the road, or preventing the burning of 1,000 railcars full of coal. This represents a 2% reduction in District-wide GHG emissions from all sources relative

[8] https://www.bts.gov/content/estimated-national-average-vehicle-emissions-rates-vehicle-vehicle-type-using-gasoline-and

[9] https://www.epa.gov/greenvehicles/tailpipe-greenhouse-gas-emissions-typical-passenger-vehicle

to 2019, or a 10% reduction in District-wide GHG emissions from transportation[10], 1/6th of the Sustainable DC goal.[11]

We have allocated the reduction in emissions across racial groups on the basis of racial population distributions in the census tracts where emissions are prevented. For example, if 10 tonnes of carbon monoxide (CO) emissions are prevented in a tract that is 70% White and 30% Black, we have allocated a reduction of 7 tonnes of CO exposure to DC's White population and 3 tonnes to the Black population.

We find that, although the District's populations of Black and White residents are of nearly the same size, Black residents would enjoy a much greater benefit from reduced emissions caused by the traffic reduction policy.

5: Physical Activity

We use the World Health Organization's *Health Economic Assessment Tool*[12] to establish health benefits of physical activity per 1,000 kilometers walked or bicycled per day, given current all-cause mortality rates in Washington DC. We find that:

- Per 1,000 daily kilometers walked (365,000 annual km), 0.42 premature deaths are prevented per year.
- Per 1,000 daily kilometers walked (365,000 annual km), 0.14 premature deaths are prevented per year.

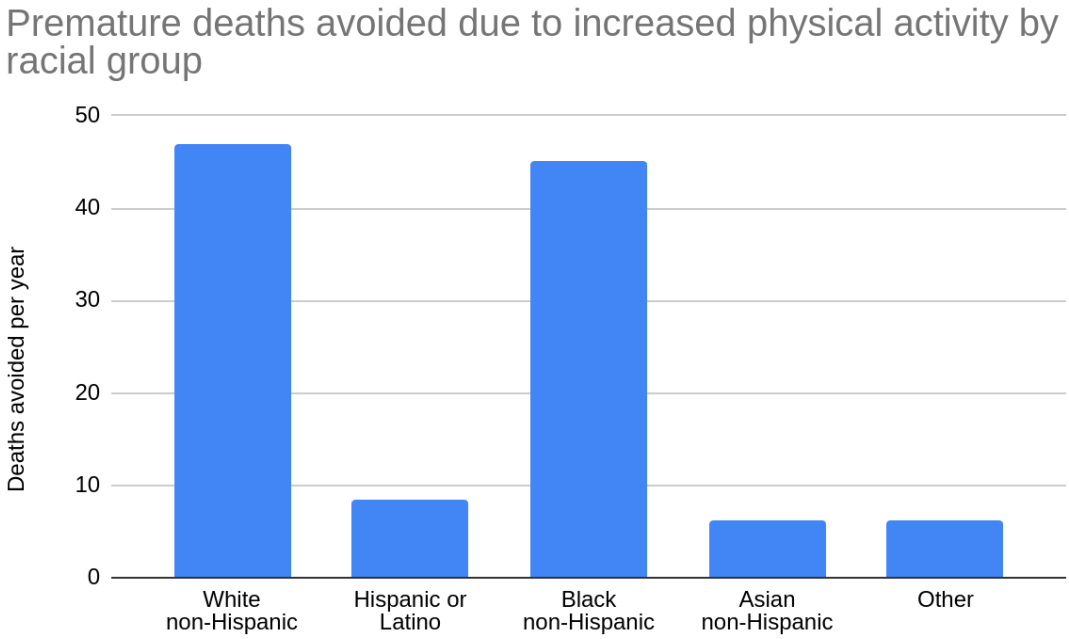
We then multiply these factors by the estimated increases in walking and cycling resulting from modal shift (see Section 2).

Note that this analysis of health impacts does not take into account existing health disparities across geographies. In this sense, it conservatively underestimates the benefit of traffic reduction for marginalized communities: populations with higher rates of premature mortality from non-communicable diseases stand to derive a greater benefit from increased rates of physical activity.

[10] https://doee.dc.gov/service/greenhouse-gas-inventories

[11] https://sustainable.dc.gov/sites/default/files/dc/sites/sustainable/page_content/attachments/SDC2%20Transportation.pdf

[12] https://www.heatwalkingcycling.org/#start_tool



Increased physical activity due to traffic reduction could prevent more than 100 premature deaths per year. This number cannot be directly compared to the deaths caused or avoided in Section 3, because the kinds of deaths happen at different times.

6: Access to Destinations

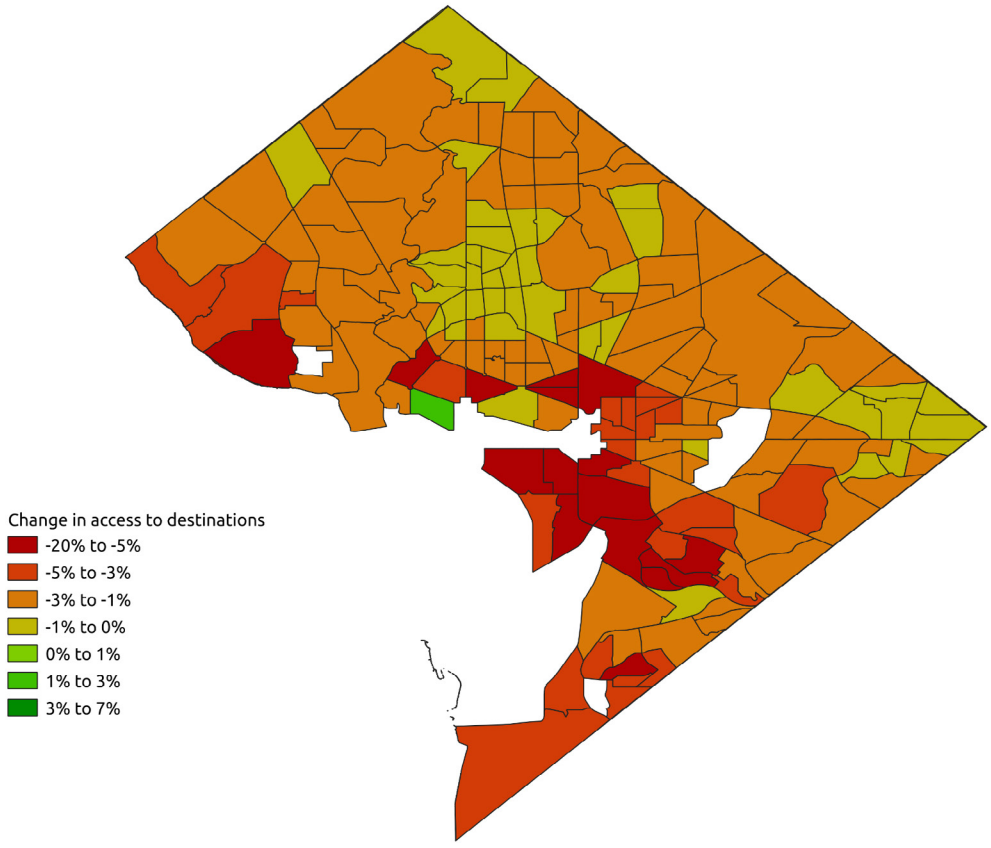
We modeled the impacts of traffic reduction on access to destination using the *connectome* methodology, described in technical detail in a forthcoming report to be published with Greater Greater Washington. The connectome methodology measures the ability of each city resident to reach each potential destination of interest. It also assesses the impact of various scenarios on those levels of access -- in this case, the impact of a traffic reduction policy and the impact of traffic calming measures that maintain current speeds despite that reduction in traffic volumes.

We investigated these two scenarios:

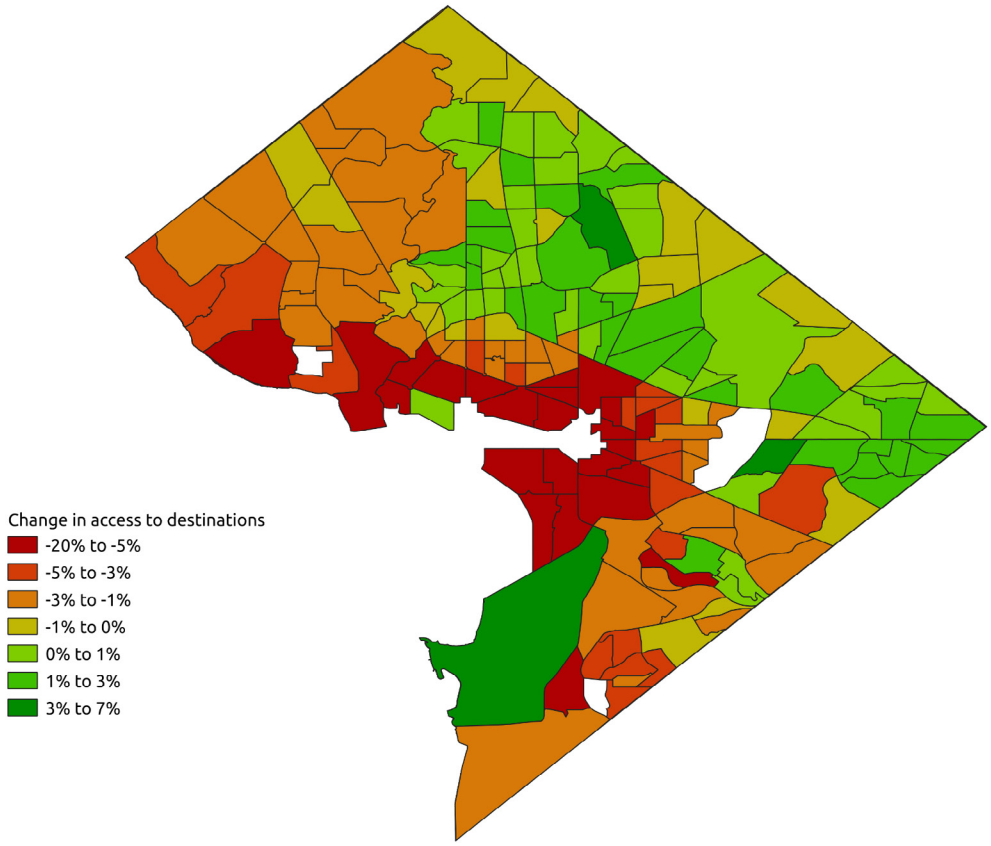
- Our first alternative scenario modeled a traffic reduction policy consisting of a $5 congestion pricing cordon charge around downtown DC, despite the fact that this policy would not necessarily cause the 10% reduction in citywide traffic discussed elsewhere in this study.
- Our second scenario adds traffic calming to the effects of cordon pricing, including two factors: First, a negation of the increase in speeds that would be caused by congestion pricing; second, a 10% increase in the overall convenience of walking on all streets, representing safer and more comfortable infrastructure (especially important for the elderly, the young, caregivers, and people with disabilities) as well as decreased wait times at crossings.

We find that congestion pricing alone would reduce the average resident's access-to-destinations by about 2.3% in DC. The increase in the cost of driving would reduce access, while the increase in car travel speeds would compensate for a fraction of that increase. The impact would be distributed remarkably evenly across races. White, Black, and Asian residents would experience almost exactly the same reduction in access, while Hispanic or Latino residents' reduction in access would be slightly less.

Change in access-to-destinations caused by congestion pricing only

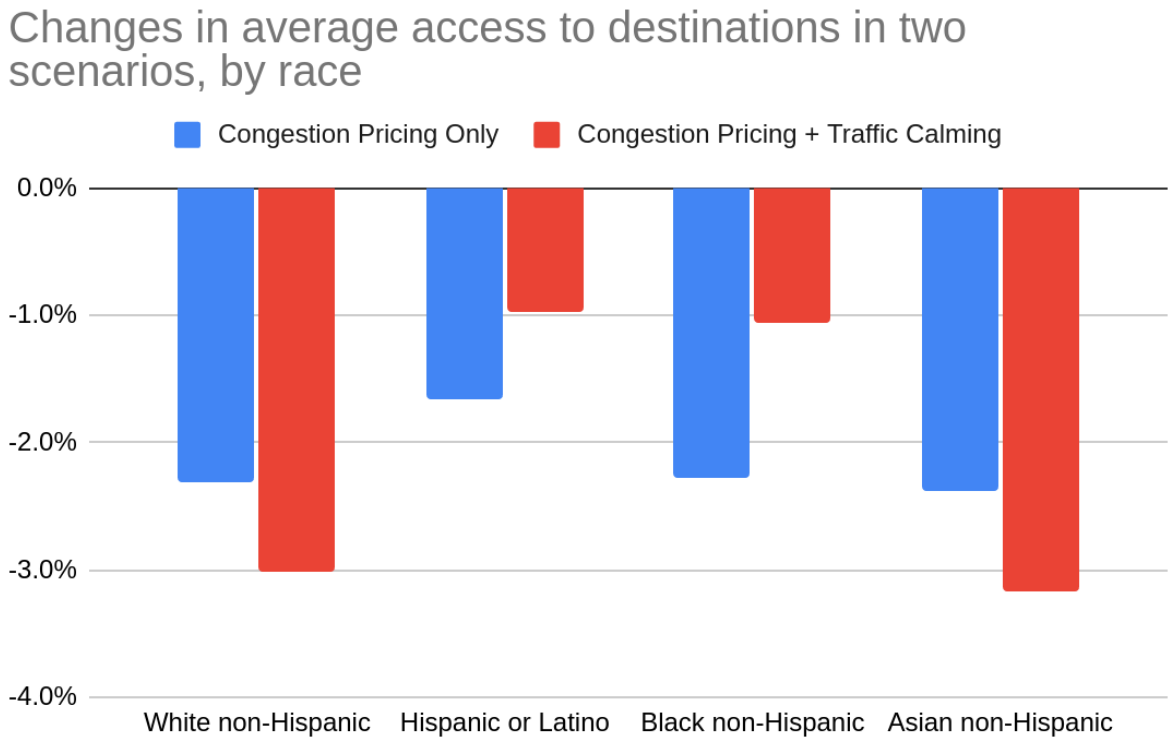


Change in access-to-destinations caused by congestion pricing combined with traffic calming



The combination of congestion pricing and traffic calming would cause no further reduction in the average Washingtonian's access-to-destinations. The average levels of access by car would decrease, since drivers would no longer enjoy faster car speeds but would still face the cost of the congestion charge. However, average levels of access by walking would increase, compensating on average for that decrease in access by car. This compensation would not be equally distributed across races:

- Traffic calming would significantly mitigate the reduction in access that Black residents would experience from congestion pricing. Without traffic calming, congestion pricing would decrease their access to destinations by 2.3%. But Black residents, often living in denser neighborhoods and owning fewer cars, have a lot to gain from improved walkability. The combination of congestion pricing and traffic calming would decrease their access by only 1%. Hispanic or Latino residents would see a similar, though slightly less dramatic, benefit.
- Traffic calming would further reduce access for White and Asian residents. For these populations with higher rates of car ownership, the decrease in car speeds would outweigh the increase in the convenience of walking. Their loss of access-to-destinations would become more severe, going from a 2.3% reduction with congestion pricing only to a 3% reduction when traffic calming is added.



7: Aggregation of Results

Using census tracts, we aggregate the impact measurements into the following groups:

- White non-Hispanic
- Hispanic or Latino
- Black non-Hispanic
- Asian non-Hispanic
- Other

Impacts for modal shift, collisions, emissions, and physical activity are aggregated as sums, while impacts for access to destinations are aggregated as averages by racial group.

8: Data Dictionary

This methodological report is accompanied by three datasets:

- racial_results.csv
    - A summary file listing the impacts across DC's population, aggregated by racial group as described in Section 7
- streets_impacts.gpkg
    - A geospatial file in geopackage format giving estimated impacts at the level of streets (based on the DC Open Data *Traffic Volumes 2019* dataset).
- tracts_impacts.gpkg
    - A geospatial file in geopackage format giving estimated impacts at the level of census tracts.
- *RWJF GGWash results*
    - A Google Sheets file containing the graphs used to visualize data for this report, prepared using the data in *racial_results.csv*.

A note about certainty: All these files give precise floating-point numbers (eg., 53,233.43), a level of precision far beyond the actual meaning of the study. They should not be read or used in other applications with that level of precision. The actual confidence of the results is only

In all of these files, the estimates of impact are defined as follows, with their geographic scope varying between files.:

value name	meaning	units	notes
vkt_avoided	The estimated reduction in car traffic resulting from the policy.	vehicle-km traveled	
[mode]_increase	The estimated increase in travel by other modes: ● PT: public transport ● walk: walking ● bike: Bicycle ● wfh: trips not taken or shortened, "shifted" to work-from-home, e-commerce, trip-chaining, or substitution of alternate destinations	person-km traveled	
[road-user]_[collision-type]_avoided[_tc]	Estimated reductions in collisions by category of road user and by injured/killed. Road users: ● nmt: pedestrians and cyclists ● car: drivers and passengers	injuries or deaths	Because of the infrequent nature of injuries and deaths on roadways, these numbers are not statistically meaningful at the street or tract level, and are only available aggregated to the District-wide level in *RWJF*

	_tc signifies estimates for the Traffic Calming scenario. Estimates for the scenario with only Traffic Reduction lack this suffix.		*GGWash results* and presented in this report.
[gas]_avoided	Estimated reduction in pollutant emissions, by gas: ● CO: carbon monoxide ● NOx: nitrogen oxides ● PM2.5: particulate matter of less than 2.5 microns ● CO2eq: carbon dioxide-equivalent greenhouse gases	grams	
premature_deaths_avoided	Estimated prevention of premature deaths through the reduction in noncommunicable diseases caused by increased physical activity from walking and cycling.	deaths	
access_change_[scenario]	Change in overall access to destinations for the traffic-reduction only scenario ('cordon') and traffic-reduction + traffic-calming scenario ['tc']	Proportion change in overall access-to-destinations	Numbers are given as a proportion -- for example, -0.020 represents a 2% reduction in access.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