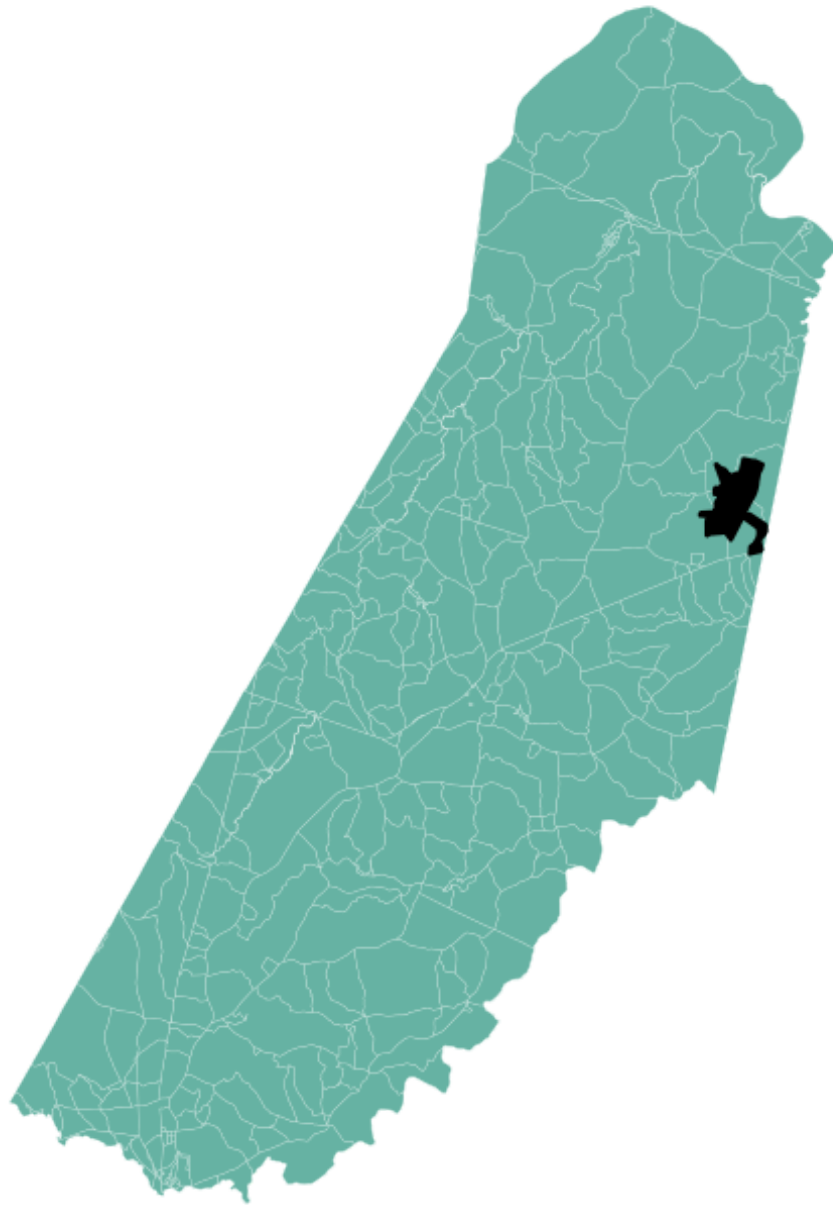


Demographic Report for the Surrounding Area of the Cumberland County Landfill



Joe Patten, PhD

Updated: 11/27/2022

Executive Summary

After thoroughly studying the demographic report provided for Green Ridge concerning their building of a landfill, I found severe deficiencies in the reporting, which lead to a bias in Green Ridge's favor. The purpose of this study is to evaluate and report the full demographic data in the area which would be affected by the proposed landfill. I show that building the proposed landfill in eastern Cumberland County presents an environmental justice concern as it would disproportionately impact minority and younger populations. It is important to note as well, that the residents of Cumberland County and surrounding counties have not had significant meaningful impact on a project which could affect their air quality, water quality and overall quality of life.

Race Analysis

In the affected area, the percentage of residents that are Black (alone) is 33.0%¹, which is 77.4% higher than the Black population percentage in Virginia, and 166% higher than the Black population percentage in the US. Even comparing the affected area with Cumberland County, which has a Black population percentage significantly higher than Virginia's Black population percentage, the affected area has a Black population percentage that is 12.6% higher than the Black population percentage in Cumberland County. Within a mile and a half of the landfill, there is a significantly larger percentage of Black residents compared with counties adjacent to Cumberland County, Virginia, and the US (with this percentage increasing the closer you get to the landfill).

Age Analysis

Of the residents living in the affected area, 32.1% are under 18 years of age. The affected area has 46.6% higher percent of residents under 18 than Virginia, and 57.4% higher percent of residents under 18 than Cumberland County. Of the Black (alone) residents living in the affected area, 40.5% are under 18 years of age. The affected area has 78.4% higher percent of Black residents under 18 than Virginia, and 121% higher percent of Black residents under 18 than Cumberland County. Within two miles of the landfill, there is a significantly larger percentage of residents under 18 compared with counties adjacent to Cumberland County, Virginia, and the US.

Meaningful Involvement

Many of the potentially affected residents in the community have not had appropriate

¹ This is likely an underestimate of the percent of residents that are Black in the area as this number was calculated from the 2020 Census. This Census was known to undercount the "Black or African American, American Indian or Alaska Native, Some Other Race, and Hispanic or Latino" populations and overcount the "White, Non-Hispanic White Alone, and Asian" populations. This was seen in the neighboring county of Buckingham County when Dominion Energy used Census data to calculate the minority population, but a door-to-door survey countered more residents, and a higher minority percentage in the affected area.

opportunity to participate in decisions about the landfill as many of the negotiations and planning was done behind closed doors months before the deal was announced. The residents had little to no say in the rulemaking decisions, and their concerns were not considered in the decision making process (as evidenced by the fact that it only took the Cumberland County Board of Supervisors 35 days from when they officially announced Green Ridge would be building a landfill in Cumberland County to when they officially approve Green Ridge's request to build the landfill).

Conclusions

The results of this study have shown that the building of the Green Ridge landfill will disproportionately affect minority and younger populations. By implementing closed door negotiation policies, residents were not given enough notice to properly show their disapproval of this project. It is, therefore, incumbent upon the Board of Supervisors of Cumberland County to do their due diligence and make a decision based on the full evidence report given here and to listen to the protests of their constituents. I urge a serious reconsideration for approval of this landfill.

About the Author

Joe Patten is a PhD Economist that has worked on a variety of public policy, developmental economics, and education economics projects. His relevant projects include an Affirmative Action and Human Capital Investment study in collaboration with professors and researchers from the University of Chicago and BYU, as well as a study estimating the impacts of state spending on community college enrollment. Dr. Patten is passionate about defending the interests of underrepresented groups and communities and using data and statistical analyses in a rigorous fashion to do so. In addition to a PhD in Economics, Dr. Patten also holds a Masters in Computer Science. Dr. Patten currently works at Capital One as a data scientist in the People Strategy and Analytics group. This report is independent of any third party influences and any views or opinions expressed in this study are Dr. Patten's and do not reflect the views of Capital One or any other entity.

Introduction

Environmental Justice

In 1994, the Clinton Administration issued Executive Order No. 12898² in order to address environmental justice in minority as well as low-income populations. According to the environmental justice toolkit, there are a number of factors that should be considered when identifying if a situation is an environmental justice concern:

- Whether individuals, certain neighborhoods, or federally recognized tribes suffer disproportionately adverse health or environmental effects from pollution or other environmental hazards;
- Whether individuals, certain neighborhoods, or federally recognized tribes suffer disproportionate risks or exposure to environmental hazards, or suffer disproportionately from the effects of past under enforcement of state or federal health or environmental laws;
- Whether individuals, certain neighborhoods, or federally recognized tribes have been denied an opportunity for meaningful involvement, as provided by law, in governmental decisionmaking relating to the distribution of environmental benefits or burdens. Such decisionmaking might involve permit processing and compliance activities.

The Environmental Justice toolkit³ defines Environmental Justice as 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.” Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the “negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal environmental programs and policies.” Meaningful involvement means that “(1) potentially affected community residents have an appropriate opportunity to participate in decisions about a proposed activity that will affect their environment and/or health; (2) the public’s contribution can influence the regulatory agency’s decision; (3) the concerns of all participants involved will be considered in the decision-making process; and (4) the decision makers seek out and facilitate the involvement of those potentially affected.”

The Environmental Protection Agency (EPA) reaffirmed its commitment to environmental justice by issuing a memorandum on August 9, 2001. The memorandum addressed two key principles; the first being that “environmental justice is achieved when everyone, regardless of race, culture, or income, enjoys the same degree of protection from environmental and health hazards and equal access to the decision making process to have a healthy environment in which to live, learn, and work.” The second principle is that “application of these existing statutory provisions is an important part of this Agency’s effort to prevent those communities from being subject to disproportionately high and adverse impacts, and environmental effects.”

² [Executive Order 12898](#)

³ [Toolkit for Assessing Potential Allegations of Environmental Injustices \(2015\)](#)

In July 2020, the 2020 Virginia General Assembly made their commitment to environmental justice clear by passing the Environmental Justice Act of Virginia. What does success in advancing environmental justice look like? According to their site⁴, the Department of Environmental Justice states that success does not simply involve checking boxes, but rather “putting a process in place to build trust, share understanding, and align values among community members, stakeholders, local, state and federal government, industry partners and [Department of Environmental Quality] (DEQ) staff.” The objective is to create “greater equity and justice for all Virginians.”

The objective of this report is two-fold. First, I show that the report used by Green Ridge Recycling and Disposal Facility, LLC (henceforth called Green Ridge) is misleading in its presentation of demographic results, and omits key information when determining if there is an environmental justice concern. Second, I show that there is indeed an environmental justice concern due to the case that the Black population as well as the population under the age of 18 will be disproportionately affected by putting in the landfill at the specified site. There is also significant evidence that the affected population has not had meaningful involvement in the siting process.

History of Cumberland County

Cumberland County was created in 1749 by the Virginia House of Burgesses from a portion of southern Goochland⁵. Since its origin, the primary industry in Cumberland County has been agriculture and during the antebellum period, the main crop was tobacco. Tobacco was generally grown on white owned plantations, where those doing the labor were Black slaves. In this area, each plantation had on average 24 slaves. According to the first census, in 1790, there were 4434 slaves, 3577 white residents, and 142 free non-white residents living in Cumberland County. Before the civil war, the free Black population in Cumberland County struggled despite being free. Free Black women often hired out their children as apprentices in order to make ends meet. Many free Blacks in the county performed unskilled labor on farms or worked as boatmen due to their professional opportunities being limited.

There were many laws and restrictions in Virginia that were imposed on free Blacks. White lawmakers created laws that restricted the ability of free Blacks to travel, enter certain occupations, carry weapons, educate themselves and their children, and assemble in public. Higher taxes and stricter penalties were also levied on free Blacks. Free Blacks were required to register periodically at the county courthouse and were also barred from voting and sitting on juries. It's hard to know if some of these laws and restrictions were actually enforced in Cumberland County. As noted by Jackson, “there is evidence to show that all of [the laws] were not always respected.” We do see evidence of free Blacks registering at the Cumberland County Courthouse.

⁴[Virginia Department of Environmental Quality, Environmental Justice site](#)

⁵[African-American Freedom in Antebellum Cumberland County, Virginia - Freedom: Personal Liberty and Private Law by Ellen Katz](#)

Although many of the rights of free Blacks were heavily restricted, the right to own land was free from restriction. The size of these properties owned by free Blacks ranged from less than 1 acre to 240 acres. Oftentimes, free Blacks in Cumberland County lived in close proximity to each other. One such cluster includes an area that is northeast of the county courthouse, close to the proposed landfill site. In the late 1800s and early 1900s, Black residents continued to settle in the area and build communities around where this proposed landfill site would be.

After the Civil War, even though the US ratified the 13th Amendment, which abolished slavery in the US, Black Virginians still faced intense discrimination and racism. Jim Crow laws further escalated this issue and led to further segregation.

Pine Grove School

Understanding the importance of education, Black citizens petitioned Cumberland County to build a school for their children. Pine Grove Elementary was built in 1916 in partnership with the Rosenwald fund. It was one of 382 Rosenwald schools set up to educate Black children in Virginia. Rosenwald schools were built not just out of want, but also out of necessity due to Jim Crow laws and the racism present in the country. This school (as well as other Rosenwald schools) was built more than 100 years ago by Julius Rosenwald and Booker T. Washington in order to “improve education opportunities for African American children in the American South”. The Black community raised \$500 to build the school, Cumberland County contributed \$1,000, and \$50 came from the Rosenwald fund. Four acres of land where the school would sit were donated by William and Olivia Miller. The school received its first students in the fall of 1917, and closed (as a school) in 1964 when the county desegregated its schools⁶. The school was repurposed as a community center and was used as a community hub well into the 1990s.

In 2019, Pine Grove School was listed as a historic site by the Virginia Department of Historic Resources. In 2021, the National Trust for Historic Preservation listed the site as one of 11 most endangered historic places of 2021⁷ as it sits just a few hundred feet from the proposed landfill, and a mere 1,000 feet from the disposal unit. In addition, Green Ridge plans to reroute some of the nearby roads to accommodate their trucks going to a from the landfill. One such road is the Pine Grove road, which is even older than the school sharing its name. The school is currently being restored so that it can serve as a cultural center for the community.

⁶ <https://www.dhr.virginia.gov/historic-registers/024-5082/>

⁷ <https://savingplaces.org/stories/11-most-endangered-historic-places-2021>

Green Ridge Landfill

The Green Ridge landfill will be situated on about 1,200 acres (to put things into perspective, Central Park in New York City is 843 acres; Green Ridge Landfill would be close to 42% larger than Central Park) on the eastern edge of Cumberland County right off Route 60. Green Ridge will accept between 3,500 and 5,000 tons of trash per day from municipalities located within 500 miles of the facility, excluding trash from New York and New Jersey. The disposal area where the trash will sit is approximately 240 acres. The disposal area will have a composite liner system made up of a clay liner covered with a 60 mil high-density polyethylene membrane (single liner). Green Ridge will have a 200 foot perimeter buffer at a minimum with adjacent properties (with the exception of the entrance road). According to its website⁸, Green Ridge will not accept any toxic or hazardous materials, nuclear waste, wastewater treatment sludge, fly ash or processed construction debris, such as sheetrock. It will accept non-hazardous household waste, construction and demolition debris and approved industrial waste. The landfill has an estimated life-span of 25-30+ years, after which it will cap and close off the disposal area. The landfill will continue to be monitored after its closure.

Due to the high amount of waste that the facility will take in each day, the Green Ridge landfill will be characterized as a mega landfill. This will be the first mega landfill built in the state of Virginia since 1997. Seven major, mega landfills were developed in the 1990s in the following counties: Amelia, Charles City, Gloucester, King and Queen, King George and Sussex. The nearest mega landfill to the Green Ridge site is the Maplewood landfill in Amelia, and is about 22 miles away. According to the 2021 Annual Solid Waste Report⁹, the Maplewood landfill has a capacity of 15,416,986 tons. As of the end of 2020, it only held 963,718.73 tons of trash, which is slightly more than 6% of its capacity. The expected remaining permitted life for the site was projected to be 125.8 years.

⁸ [Project Description from Green Ridge's website](#)

⁹ [2021 Annual Solid Waste Report for CY2020](#)

Negative Impacts of a Landfill

The main focus of this report is to identify if there is an environmental justice concern. This entails identifying if there is a risk posed on the population surrounding the landfill, and if that population contains a group or groups of people that would bear a disproportionate share of the landfill's impacts. This section briefly covers some research done on the negative impacts of living near a landfill. The Community and Environmental Defense Services (CEDS) group has compiled research that has been done on the negative impacts of living near a landfill. This section includes some excerpts from that compilation¹⁰. This is not meant to be comprehensive, and there are likely to be other negative impacts not explained here. A subsequent section will describe the demographics of the affected area.

Health Impacts

In a 2005 paper, researchers used U.S. Census and Toxic Release Inventory data to assess the mental health effects of living near a number of "industrial activities" including landfills¹¹. The researchers found that living close to industrial activities has a negative impact on mental health. They also found the impact is greater for minority and poor populations.

In a 2003 paper, researchers found increases in total suspended particulates (TSPs) was associated with increases in infant mortality rates. The researchers also found that the county-level impact of large changes in Total Suspended Particulates on infant mortality for blacks is 1.6 times that for whites¹².

In this 2001 paper, British researchers reported a small excess risk of congenital anomalies and low and very low birth weight in populations living with 2 kilometers (1.2 miles) of municipal landfills¹³.

In a 2011 paper, researchers reported that odors from a North Carolina municipal landfill were strongly associated with alteration of daily activities like going outside, negative mood states, mucosal irritation, and upper respiratory symptoms¹⁴. These adverse effects were experienced by those living at least 0.75 miles from the landfill. The researchers provided the following: "Although newer landfills may be better designed and operated than older facilities, communities near some Subtitle D landfills continue to report problems with noise, malodor, and animal pests. In the USA¹⁵ and North Carolina¹⁶, landfills tend to be disproportionately located in areas with lower housing values and larger concentrations of people of color. Poorer housing, lack of air conditioning and clothes driers, and dependence on the local neighborhood for recreation, make low income communities more vulnerable to impacts of pollutants than communities with

¹⁰ <https://ceds.org/landfill/#health>

¹¹ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3162363/>

¹² <https://www.jstor.org/stable/25053932?seq=1>

¹³ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC37394/>

¹⁴ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3143289/>

¹⁵ <https://pubmed.ncbi.nlm.nih.gov/20061348/>

¹⁶ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1964896/>

well-insulated homes where residents have the means to travel to other locations for exercise and entertainment at times when their homes and neighborhoods are affected by malodor.”

In a 2009 paper, researchers reported that odorous compound concentrations from facilities in France and Poland were affected by “failures of the landfill gas collection system, heavy truck traffic, machinery operations and compacting fresh waste”¹⁷.

In a 2014 paper, Italian researchers reviewed the findings from 61 other studies and noted the possibility that area residents would be exposed to potentially toxic compounds and nuisances such as odors¹⁸. The researchers studied emissions from a landfill located in Italy. They found that risks for cancer and non-cancer were orders of magnitude below World Health Organization acceptable levels.

In a 1995 paper, Canadian researchers reported an elevated risk of cancer among those living in the landfill vicinity¹⁹.

In a 2003 paper, British researchers reported an increased risk of death from “other congenital anomalies of nervous system” for those living near a landfill²⁰.

Other Impacts

In a 2005 paper, a Northeast Regional Center for Rural Development researcher reviewed nine studies of landfill property value effects conducted in six states and Ontario²¹. Each of the nine studies examined the value of a large number of properties in the vicinity of landfills. The researcher concluded that a high-volume landfill (> 500 waste tons/day) reduces the value of adjacent residential properties by 12.9%. The impact of high-volume landfills decreases by 5.9% for each mile between a landfill and a residential property out to two- or three-miles. This result is not too surprising given that all else being equal, individuals prefer a home that is not close to a landfill over a home that is close to one. Thus, willingness to pay for the home near a landfill is lower, so price would reflect this.

Landfills generate a tremendous amount of truck traffic. An increase in heavy truck traffic can lower property value and increase accidents as well as noise. The noise alone can substantially lower property value when truck traffic increases. The noise from heavy truck traffic lowers property value at a rate 30 to 50 times greater than cars²². This is because at 50 feet heavy

¹⁷ <https://journals.sagepub.com/doi/10.1177/0734242X093334616>

¹⁸ <https://www.sciencedirect.com/science/article/pii/S0160412014000749>

¹⁹ <https://pubmed.ncbi.nlm.nih.gov/8572719/>

²⁰ <https://pubmed.ncbi.nlm.nih.gov/15702893/>

²¹ <https://aese.psu.edu/nercrd/publications/rdp/rdp27.pdf>

²² <https://www.vtpi.org/tca/tca0511.pdf>

trucks emit noise 16 times louder than car traffic. With regard to accidents, a fatality is twice as likely when a car is involved in a crash with a truck vs. another car²³.

Children and fetuses are an extremely vulnerable population that would be disproportionately impacted by a landfill. In addition to suffering from effects listed above, they could also suffer from more indirect and long-term effects. In utero health could “persist through adulthood and affect long term health, human capital accumulation, labor market outcomes, family structure, and welfare dependency”²⁴.

Potential Vulnerability to Exposure

In addition to reporting demographic information like race and age, it is also necessary to evaluate measures that could indicate vulnerability to exposure. There are certain indicators that would make affected residents more likely to be impacted by a landfill. Some populations might have higher sensitivities that result from age, lifestyle choices, genetics, etc. Other indicators include:

- Lack of access to public transportation
- Lack of access to hospitals and doctors, or healthcare in general
- High prevalence of smoking
- High prevalence of obesity
- Low income levels and high poverty rates
- Lack of access to healthy food
- Lack of access to alternative sources of drinking water
- Lack of ability to meaningfully participate in the environmental decisionmaking process

I evaluate metrics that are related to these indicators at the county level in the next section.

²³<https://web.archive.org/web/20141031190625/http://www.truckline.com/ATA%20Docs/News%20and%20Information/Reports%20Trends%20and%20Statistics/02%2012%2013%20--%20FINAL%202013%20Car-Truck%20Fault%20Paper.pdf>

²⁴ <https://www.aeaweb.org/articles?id=10.1257/jep.25.3.153>

Cumberland County Statistics

Cumberland County has a rich Black background and history. According to the 2020 Census, it still has a large Black population, as Black (alone) residents make up 29.3% of the county population which means it is 58% above the percent of Black residents in Virginia. Cumberland County is in the 77th percentile (meaning it has a higher percentage of Black residents than 77% of the other Virginian counties) in terms of the percent of Black residents in its population when ranked against other Virginian counties. More information about these numbers can be found in Table 7. These numbers are similar to what was seen in the 2010 Census, which estimated that Black residents made up 32.6% of the population in Cumberland County, meaning that in 2010, the percentage of Black residents in Cumberland County was 68% above the percent of Black residents in Virginia.

In 2020, the median income for Cumberland County, VA was \$50,565, which was 51% below the median income for Virginia and 33.5% below the median income for the US. Fig. 1 shows how the median household income for Cumberland County has changed over the years, and how it compares with other neighboring counties. The Small Area Income and Poverty Estimates (SAIPE)²⁵ Program estimates the poverty rate for Cumberland County was 13.5% in 2020 while the statewide poverty rate was 9.2%. Additionally, the poverty rate for individuals under 18 in the county was 22% while the statewide under 18 poverty rate was 12.2%. According to the poverty level and the median income, it becomes quite clear that due to the rampant poverty in Cumberland County, residents are likely more vulnerable to pollution and negative externalities.

²⁵ The program produces estimates by modeling income and poverty estimates by combining survey data with population estimates and administrative records.

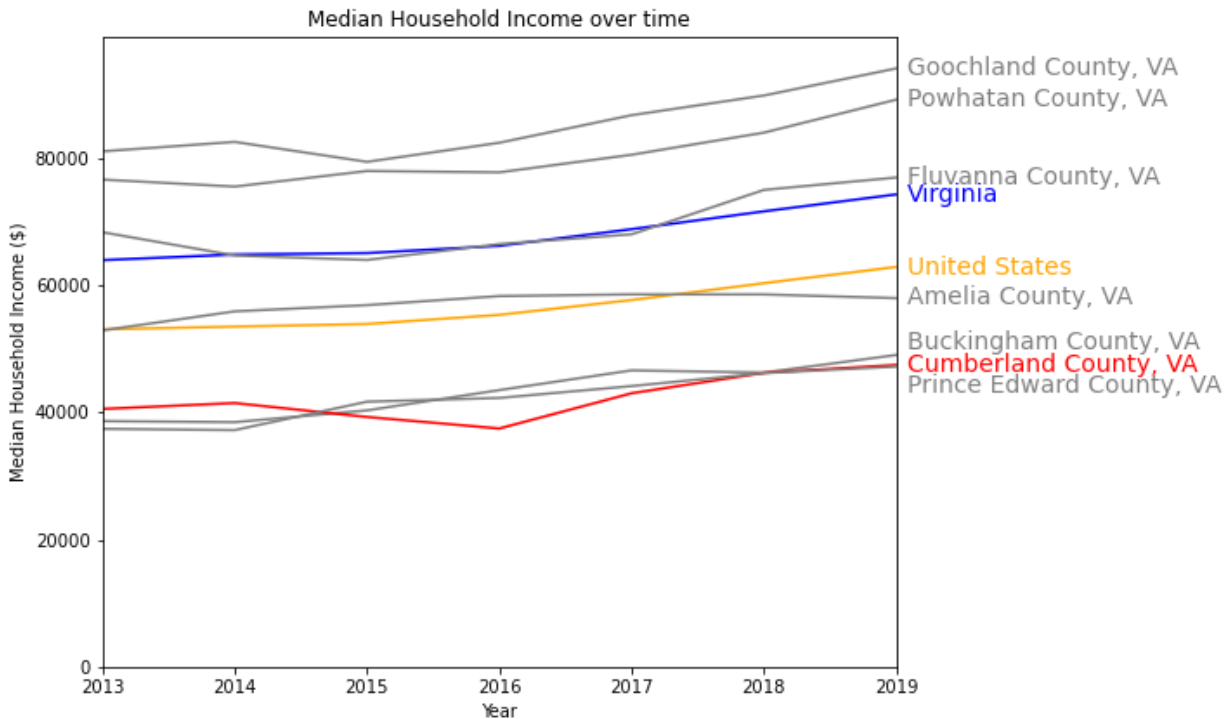


Figure 1: The plot above shows how the median household income in Cumberland County compares with other neighboring counties. In 2019, the median household income in Cumberland County was \$47,469.

According to the Technical Guidance for Assessing Environmental Justice in Regulatory Analysis from the EPA, “both high exposures and increased individual susceptibility to environmental stressors may lead to a predisposition to higher health risks among minority populations or low-income populations”²⁶. Fig. 2, Fig. 3, and Fig. 4 show what the prevalence of smoking, adult obesity, and diabetes is in Cumberland County, respectively, and how those rates compare with neighboring counties. In 2021, Cumberland County had an adult smoker prevalence of 23.1%, meaning that it had a higher adult smoker rate than 71.6% of the counties in Virginia. It also had a diabetes rate of 18%, meaning that it had a higher adult smoker rate than 91% of the counties in Virginia. Lastly, Cumberland County had an adult obesity rate of 43.2%, which means Cumberland County had a higher obesity prevalence than 92% of the rest of counties in Virginia. The population in Cumberland County is a highly vulnerable population due to its poor health behaviors.

²⁶ https://www.epa.gov/sites/default/files/2016-06/documents/ejtg_5_6_16_v5.1.pdf

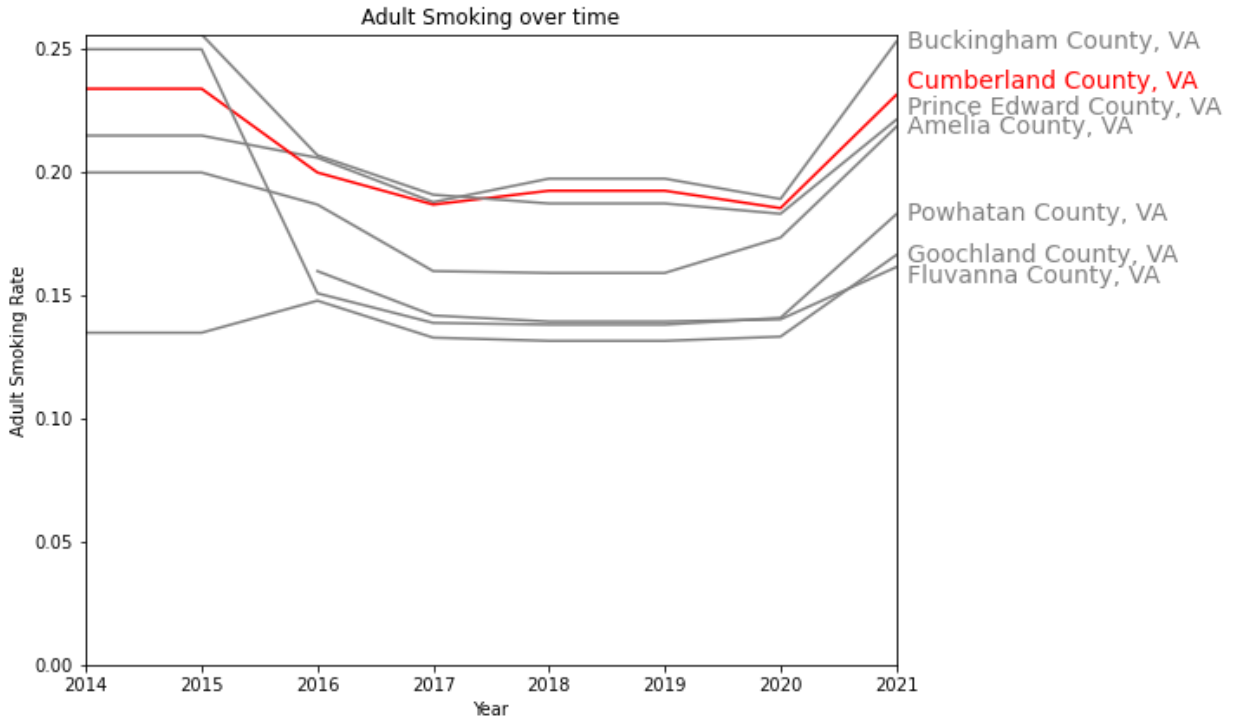


Figure 2: The plot above shows how the adult smoking rate for Cumberland County compares with other neighboring counties. In 2021, 23.1 percent of adults in Cumberland County smoked.

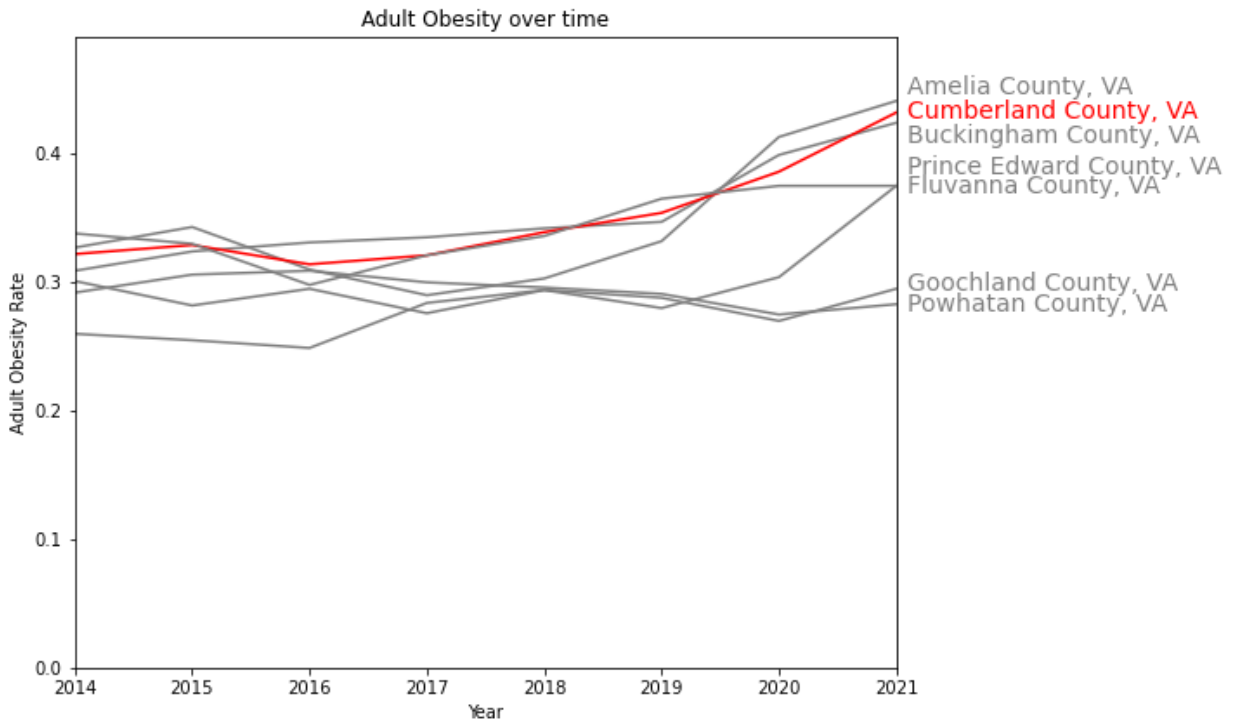


Figure 3: The plot above shows how the obesity rate for Cumberland County compares with other neighboring counties. In 2021, 43.2 percent of residents in Cumberland County were obese.

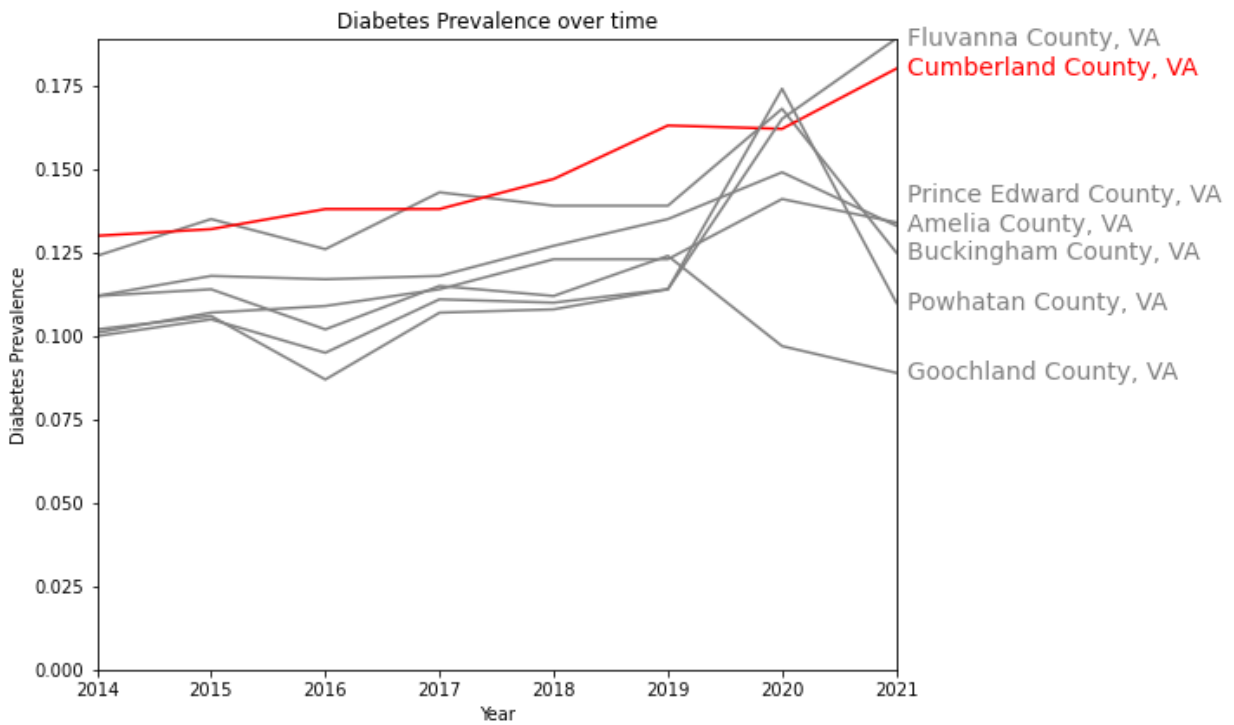


Figure 4: The plot above shows how diabetes prevalence for Cumberland County compares with other neighboring counties. In 2021, 18 percent of residents in Cumberland County had diabetes.

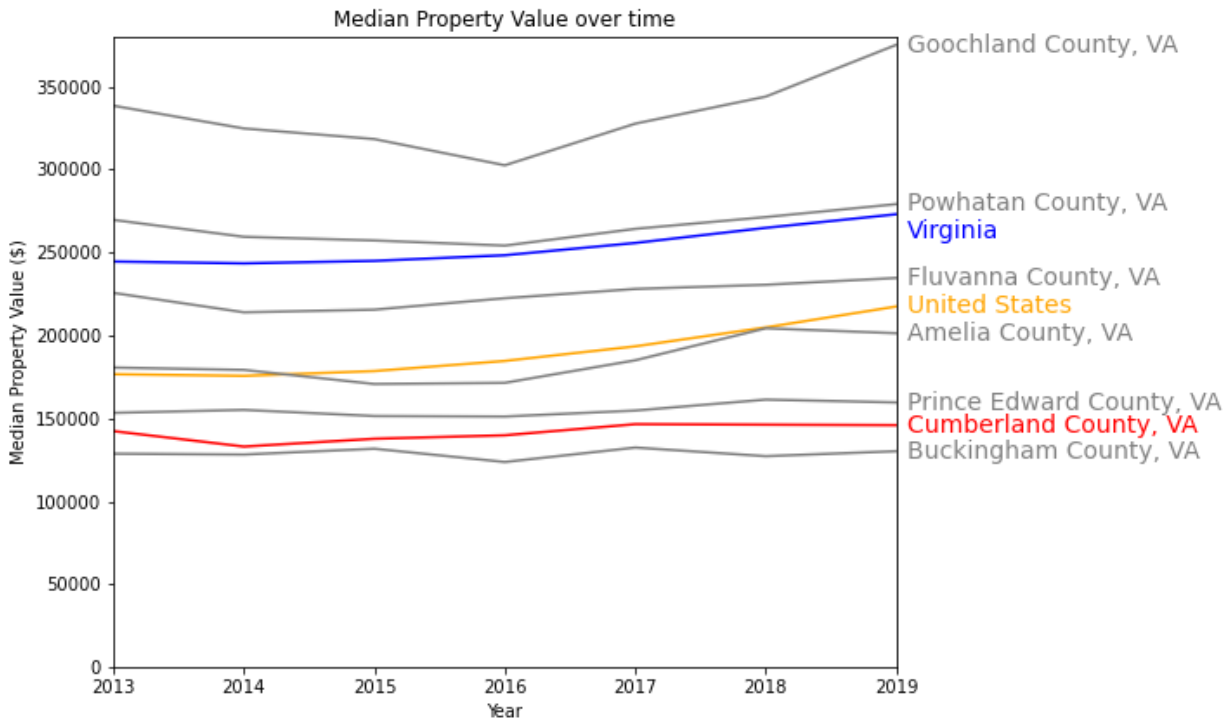


Figure 5: The plot above shows how the median property value in Cumberland County compares with other neighboring counties. In 2019, the median property value in Cumberland County was \$146,000.

Transportation could also be an important indicator of vulnerability to environmental stressors. Cumberland County is a rural county and has very little to no access to public transportation. According to the American Community Survey, Cumberland County has the highest average commute time to work²⁷. Fig. 6 and Fig. 7 show how median commute time and motor vehicle crash deaths per 100,000 residents from 2013 to 2019 in Cumberland County compares with neighboring counties as well as the United States and Virginia.

²⁷ American Community Survey 5-year 2019, 2020

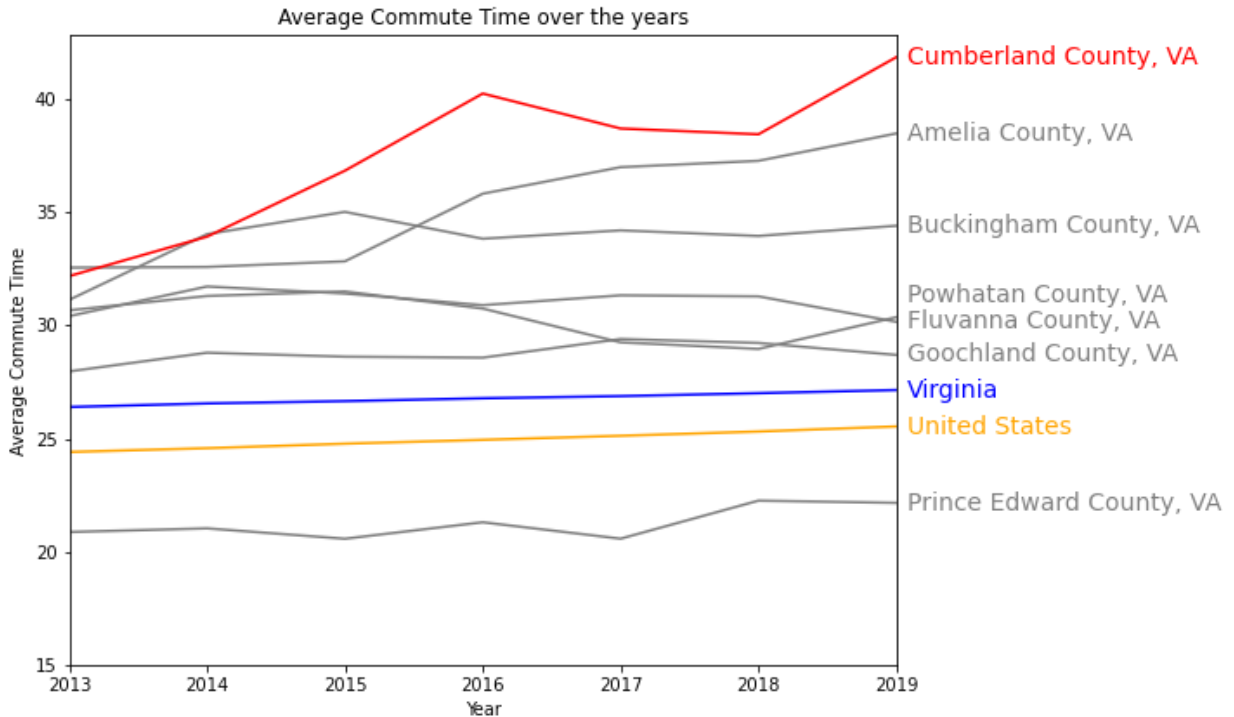


Figure 6: The plot above shows how the average commute time in Cumberland County compares with other neighboring counties. In 2019, the average commute time in Cumberland County was 41.8 minutes.

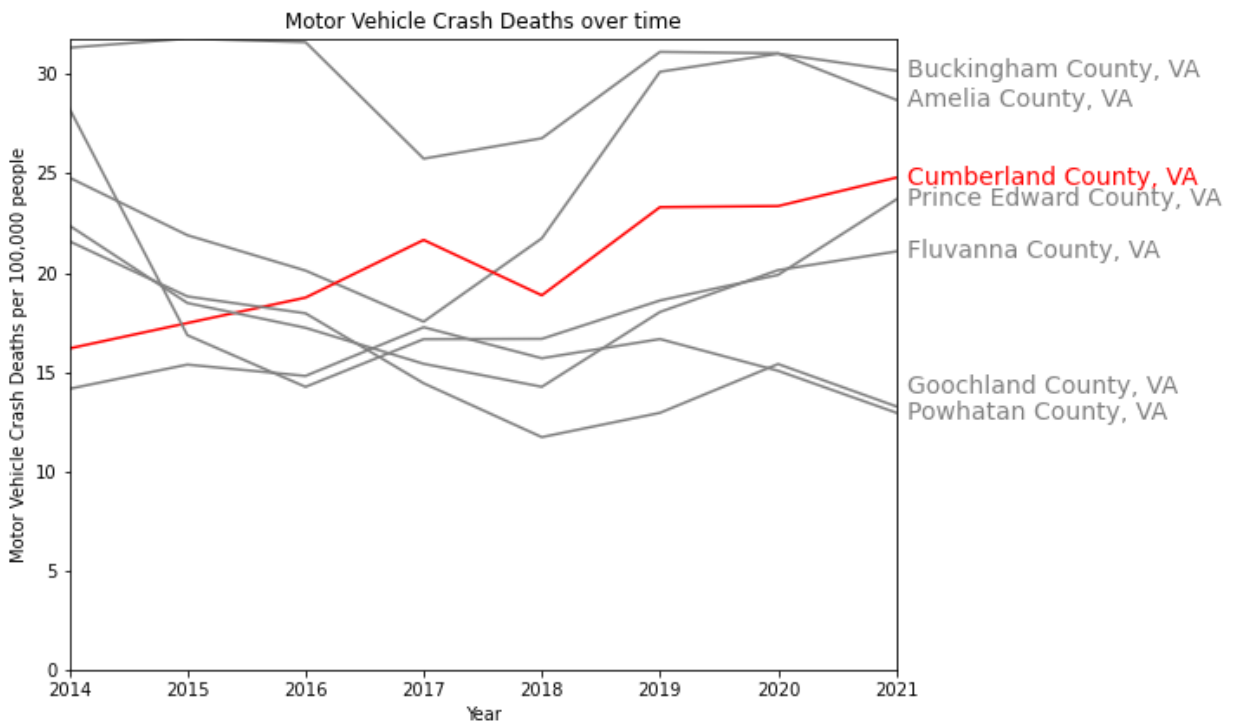


Figure 7: The plot above shows how the motor vehicle crash deaths per 100,000 people in

Cumberland County compares with other neighboring counties. In 2019, there were 24.8 motor vehicle crash deaths per 100,000 people in Cumberland County.

Susceptibility Measures

In order to assess a potential EJ concern, it is imperative to evaluate the potential for higher exposures to an environmental stressor and the potential for higher susceptibility to adverse effects of the stressor for population groups of concern. In addition to the figures in this section, Table 1 and Table 2 show additional metrics and rates that would indicate that individuals in Cumberland County may be more susceptible or may increase exposure to environmental stressors²⁸. The Technical Guidance for Assessing Environmental Justice in Regulatory Analysis²⁹ states that social context and social stratification can shape determinants of health such as:

- **Material Circumstances:** Table 1 shows that for the county, 19% of residents have limited access to healthy foods, which is 375% above the state average. Also, 52.1% do not have access to a large grocery store, which is 155% above the state average.
- **Behavioral and Biological Factors:** Fig. 2 shows smoking prevalence in the county as well as neighboring counties. The smoking rate is 23.1% among adults in the county, which is 35% above Virginia. Fig. 4 shows diabetes prevalence in the county. Eighteen percent of adults are diagnosed with diabetes, which is 73% above the state average.
- **Health Care System:** In the county, 11% of the population are uninsured, which is 22% above Virginia. Primary care doctor availability per capita for the county is approximately 76% below the state average.
- **Psychological Circumstances:** Mental health provider rate is about 81% lower in Cumberland County than in Virginia as shown in Table 2. The percentage of adults reporting poor mental health 14 days or more per month is 17%, which is 31% higher than the state average.

²⁸[2022 Virginia State Report](#)

²⁹https://www.epa.gov/sites/default/files/2016-06/documents/ejtg_5_6_16_v5.1.pdf

Metric	Cumberland County	Percentile Compared with VA Counties	Virginia	Percent above (+) or below (-) Virginia Total
% Limited Access to Healthy Foods	19	97%	4	375%
% Long Commute - Drives Alone	63	87%	41	54%
% Enrolled in Free or Reduced Lunch	80	86%	45	78%
% Driving Deaths with Alcohol Involvement	40	81%	30	33%
% Children in Poverty	22	77%	12	83%
% Physically Inactive	33	75%	25	32%
% Insufficient Sleep	41	73%	39	5%
% Severe Housing Problems	14	72%	14	0%
% Frequent Mental Distress	17	71%	13	31%
Average Number of Mentally Unhealthy Days	5	70%	4.2	19%
Average Number of Physically Unhealthy Days	4.5	69%	3.7	22%
% Fair or Poor Health	22	68%	16	38%
Suicide Rate (Age-Adjusted)	20	63%	13	54%
% Unemployed	6.1	62%	6.2	-2%
% Frequent Physical Distress	14	62%	11	27%
Preventable Hospitalization Rate	4299	61%	3896	10%
% Low birthweight	9	61%	8	12%
% Uninsured	11	59%	9	22%
% household income required for childcare expenses	25	59%	25	0%
% Food Insecure	11	55%	9	22%
% without access to large grocery store	52.1	-	20.4	155%

Table 1: Health metrics for Cumberland County and Virginia given by the 2022 Virginia State Report.

Metric	Cumberland County	Percentile Compared with VA Counties	Virginia	Percent above (+) or below (-) Virginia Total
Mental Health Provider Rate	40	24%	207	-81%
% Broadband Access	71	25%	86	-17%
High School Graduation Rate	88	29%	88	0%
Household Income (Black)	40245	31%	52929	-24%
% With Access to Exercise Opportunities	41	37%	78	-47%
% Completed High School	86	37%	90	-4%
Food Environment Index	6.7	4%	8.8	-24%
Average Grade Performance	3.2	45%	3.2	0%
Primary Care Physicians Rate	40	51%	76	-47%
Life Expectancy	78.6	66%	79.1	-1%
Spending per-pupil	11876	69%	12622	-6%

Table 2: Additional health metrics for Cumberland County and Virginia given by the 2022 Virginia State Report.

Highly Susceptible Groups

There are certain groups that are more susceptible to environmental stressors. One particular group is children. In this report, I show that the affected areas contain a high population of individuals that are under the age of 18. This population may be of higher risk as 80% of Cumberland County students are enrolled in free or reduced lunch, which is 78% higher than the state average. Also, the children poverty rate in Cumberland County is 22%, which is 83% higher than the state children poverty rate.

The presented metrics on health, behavior, access to resources, as well as other measures evaluated in this section provides solid evidence that Cumberland County residents are highly susceptible to environmental stressors.

Methodology

Previous Demographic Study Flaws

Green Ridge contracted Mangum Economics to conduct a demographic report as well as an economic impact study³⁰. The results of those analyses can be found on the Green Ridge site under resources. Both analyses were flawed and came to misleading conclusions. As the purpose of this report is to analyze the potentially affected community where the landfill will be, I will only focus on the flaws in their demographic report. This report will also propose different methods and sources of data to address these flaws.

The All-or-Nothing Approach

The authors took a point near the landfill, drew a circle around that point with a certain radius, and evaluated some demographic statistics reported by the US Census Bureau. They used 1, 2.2, 4.2, and 6.2 mile radii. They then stated that using this approach, they would get “all of the people living within [each circle].” However, this statement is misleading. For data from the census, the smallest unit one can use is the block level³¹ (it cannot be determined where individuals live in a block). Thus, a researcher cannot precisely estimate the number of individuals within X miles of a certain point; he/she would have to use block level data to estimate this. One problem is, how do you characterize when a block is in the circle? After talking with GeoLytics, the company that Mangum Economics used to estimate the number of individuals in different circles, there are 3 ways a block can be in a circle. The first way is if any part of a block is in the circle, the second way is if the whole part of the block is in the circle, and the last way is if the centroid (based on the distribution of land, not population) of a block is in the circle. The authors do not say which method they used; however, using any of these three approaches lead to significant issues. Notice that when using any of the three approaches, either a block is in or is not in the circle. There is no middle ground; this is an all-or-nothing approach and can lead to biased results.

The Weighted Approach

Instead using this all-or-nothing approach, I have chosen to estimate the demographic data within X miles of a point by using the following formula:

$$circlePopulation = \sum_{i=1}^n blockPopulation_i \cdot \frac{Area(circleBuffer \cap block_i)}{Area(block_i)}$$

³⁰ [Demographic Report done by Mangum Economics](#)

³¹ The smallest unit one can use for decennial Census data is the block level. However, the smallest unit one can use for American Community Survey data (which contains more socioeconomic data like income and property value) is the block group level. A block group generally contains several blocks.

where $blockPopulation_i$ is population in block i , $Area(circleBuffer \cap block_i)$ is the area that is common (in other words the area of the intersection) to the $circleBuffer$ and $block_i$. Notice that if a $block_i$ and $circleBuffer$ do not have any common area, then $block_i$ does not affect or contribute to the $circlePopulation$ as desired.

Of course this estimate is not perfect. For one, in order for it to be completely accurate, individuals would have to be uniformly distributed in a block, and their characteristics, like race or ethnicity, would have to be uniformly distributed (not in clusters like what we might typically see). Despite this, this approach gives a much better estimate of demographics in a region than the all-or-nothing approaches, as the all-or-nothing approaches treat a block essentially as if all of the population live in one tiny spot in that block. This report will use a weighted approach to estimate demographics.

Centroid

Another flaw from the demographic study is that the authors did not use the centroid of the proposed disposal unit, or even of the landfill itself, but instead used a point that was farther southeast of both of these centroids. Using the figures included in the Demographic report provided by Mangum Economics, I was able to find the point around which they created their circle buffers³². The point they used is not even in the landfill site, but it is right next to the driveway up to the landfill. This will obviously bias results³³. Fig. 8 shows why this is the case. For example, a 1 mile buffer around the point does not include the population that is directly northwest of the disposal unit (the buffer does not even contain all of the disposal unit), but it does include some Powhatan residents that are more than 1 mile away from the disposal unit³⁴. This problem persists even when increasing the buffer radius as it does not truly capture the most affected population.

³² Using the weighted approach explained previously in this section, I find that the report produced by Mangum Economics underestimates Black population counts even when using their point. Again, it is not clear how they calculated their estimates.

³³ A major concern to residents near a landfill is pollution to the environment. Thus, proximity to the disposal unit, or at the very least the landfill site, is

³⁴ The demographics of Powhatan County compared with Cumberland County is significantly different, even when looking at regions that are close to the county line.

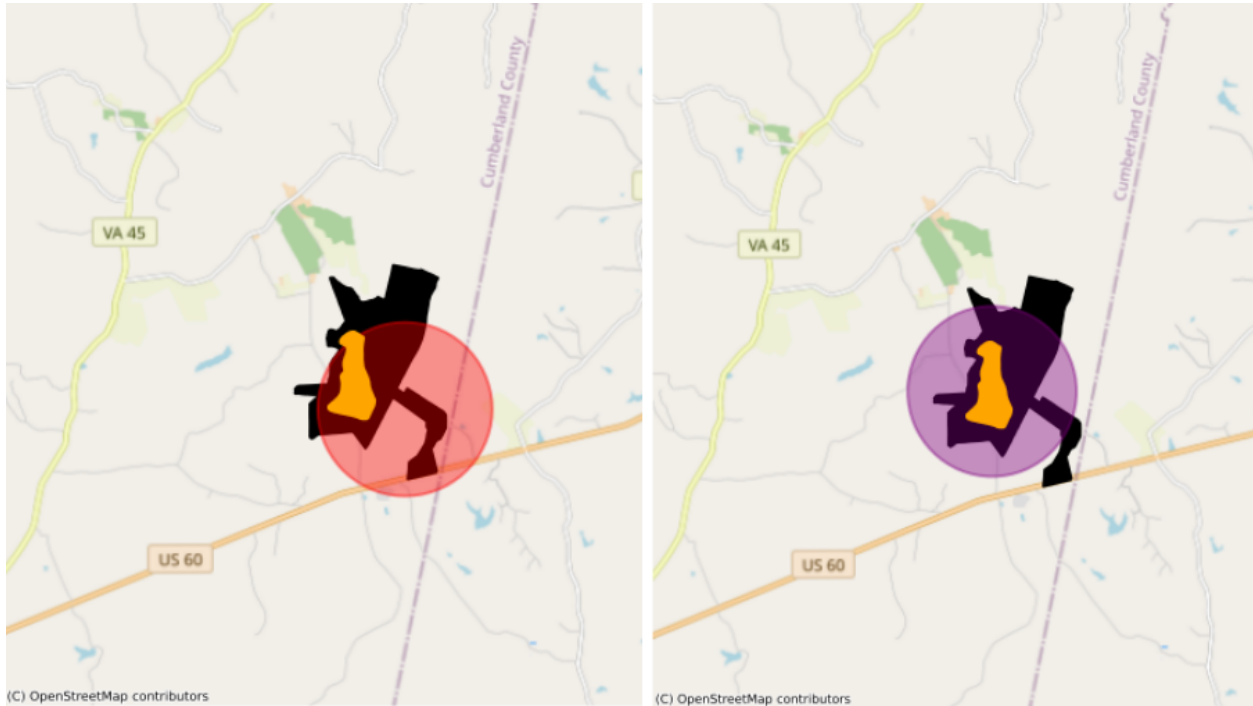


Figure 8: The left plot shows the 1 mile buffer that Mangum Economics used to estimate the demographics around the landfill. The center of that circle is just south of the driveway going up to the landfill. Notice that this buffer does not even contain the disposal unit, thus does not really capture the population that would be affected. Bias is still an issue when expanding the buffer.

The plot on the right shows a 1 mile circle buffer (in purple) when using the centroid of the disposal unit.

Landfill Buffer versus Circle

Using a circle approach is still not the optimal approach as it does not accurately identify the blocks that are within a certain distance of the landfill. Using figure 2 in the study done by Mangum Economics, there is one point on the 2.2 mile radius circle that is 1 mile away from the landfill. All other points on the circumference of the circle are more than 1 mile away (this is due to the fact that the proposed landfill is not a circle). In this study I not only use circle buffers around a centroid, but also use landfill buffers (buffers that are drawn around the edge of the landfill) to estimate the demography around the landfill. I use shape files of the disposal unit and the landfill, and then create the appropriate buffers. Fig. 9 shows example buffers around the landfill and around the disposal unit.

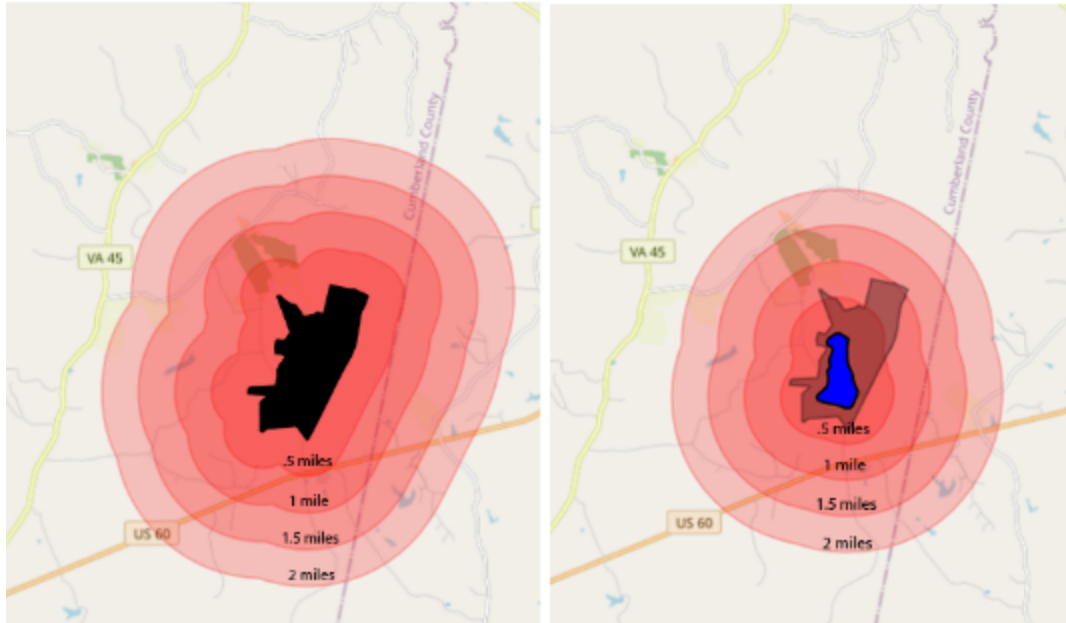


Figure 9: The left plot shows half mile buffers (up to 2 miles) around the landfill; the right plot shows half mile buffers (up to 2 miles) around the disposal unit - shown in blue.

Ecological Fallacy

Another potential issue is using data that is aggregated to a larger community level. This would make an analysis subject to ecological fallacy. Ecological fallacy can arise when an inference is made about individuals based on aggregate data of a (large) group. An example of this is given by Banzhaf et al. in 2019³⁵ and can be seen in Fig. 10. Suppose that sources of pollution (shown with yellow triangles) occur in neighborhoods where people of color are in the majority (shown in blue). If we examine each square (which represents a neighborhood) as shown in Fig. 10A, it becomes apparent that pollution sources occur in neighborhoods of color. However, if we were to aggregate the data as shown in Fig. 10B, it would appear that both white neighborhoods and neighborhoods of color are equally exposed to pollution sources. Thus, using the groupings shown in Fig. 10B would suggest that there is no evidence of environmental racism when in fact there is.

³⁵ <https://www.aeaweb.org/articles?id=10.1257/jep.33.1.185>

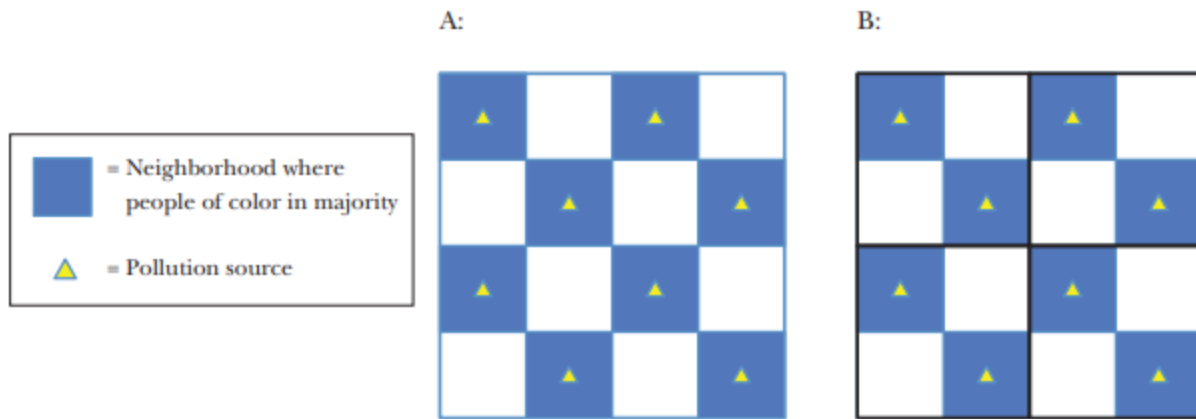


Figure 10: An example of ecological fallacy is given by Banzhaf et al. (2019). Suppose that sources of pollution (shown with yellow triangles) occur in neighborhoods where people of color are in the majority (shown in blue). If we examine each square (which represents a neighborhood) as shown in Fig. panel A, it becomes apparent that pollution sources occur in the neighborhoods of color. However, if we were to aggregate the data as shown in panel B, it would appear that both the white neighborhoods and neighborhoods of color are equally exposed to pollution sources. Thus, using the groupings shown in panel B would suggest that there is no evidence of environmental racism when in fact there is.

The report done by Mangum Economics is subject to this type of fallacy. The authors use data from two different sources: the American Community Survey (ACS) and the decennial Census. Of course, this makes sense in a demographic study as both collect and report demographic statistics of population in the US. However, there are major differences between Census and ACS data. Using ACS data does not allow a researcher to evaluate smaller areas or neighborhoods (especially in rural areas) that would be most affected.

Likewise, expanding the area of interest could lead to ecological fallacy. The Mangum Economics report looks at demographics up to 6.2 miles away from the point they used. From the studies regarding the negative impacts of landfills, the general finding is that the closer one lives to a landfill, the more exposed they are. Many of the studies focused their findings on the population within 1 mile of a landfill. An individual that lives within 1 mile from a landfill is significantly more likely to experience negative effects when compared with an individual that lives 5-6 miles from the landfill. In this report, I concentrate on the population living closest to the landfill site.

Blocks versus Block Groups

First, the Census aggregates their data at a much smaller (geographical) area, thus it better captures the demographics of smaller neighborhoods or communities. The smallest geographical area used in the Census is the block. A block is defined as a “statistical area bounded by visible features such as roads, streams, and railroad tracks, and by nonvisible boundaries such as property lines, city township, school district, county limits and short line of

sight extensions of roads”³⁶. Not to be confused with “city blocks”, blocks tend to be small in area and typically resemble a block in urban areas; whereas in suburban and rural areas, blocks tend to be large in area, irregularly shaped, and bounded by a variety of geographic features. In some remote areas, a block may encompass hundreds of square miles. You can think of a block, or even the combination of a few adjacent blocks, as the squares that are pictured in A. The proposed landfill sits in 4 blocks.

The lowest level of aggregation for ACS data is the block group. A block group is a combination of several blocks. Up until 2020, the block group that would include the landfill contained a total of 84 blocks. The whole area of this block group makes up 37.6 square miles (about 24,083 acres), which is about 65% larger than the area of Manhattan. It contains neighborhoods around highway 60, neighborhoods near the Pine Grove school, neighborhoods on the east side of highway 45 (north of highway 60), and a major portion of Cartersville (which is near the James River)³⁷. When talking with Cumberland County residents, many stated that residents of Cartersville were more well off than the average Cumberland County resident (especially those living near the James River). Looking at houses sold in the block group supports this observation, as the most expensive houses sold in the last few years were located in Cartersville, which is north of the proposed landfill site³⁸. This is definitely an aggregation issue that should have been addressed in the report done by Mangum Economics³⁹.

High Margins of Error

Another major difference between the Census and the ACS is that the Census tries to reach out to every household in order to get an accurate count of the US population. On the other hand, the ACS collects a sample from the population in order to estimate demographics. The ACS includes margins of error with their estimates. The margin of error for data at the block group level is usually fairly high due to the block group sample size being so small. For example, the median household annual income in 2017 was \$54,659 with a margin of error of \$54,047, meaning that we are 90% confident that the true median household income for the block groups lies between \$612 and \$108,706 (this does not ultimately tell us much). This margin of error is extremely large. These estimates tend to vary by quite a bit year over year. This can be seen in the median household income reported (or not reported) in the two years after. In 2018, the sample for the block group was not large enough, so a median household income was not reported. The next year, the median household income was \$34,543 with a margin of error of \$29,964⁴⁰.

³⁶ [What are Census Blocks?](#)

³⁷ The James River is about 7 to 8 miles away from the landfill.

³⁸ The two most expensive houses sold in the block group were sold for \$1.02 million, and \$850,000, which were both located in Cartersville according to Zillow.com.

³⁹ [The Technical Guidance for Assessing Environmental Justice in Regulatory Analysis \(2016\)](#), a current best practice is to “discuss any particular challenges of aggregation issues related to the choice of spatial scale.”

⁴⁰ American Community Survey 5-year 2017, 2018, 2019

Due to the margins of error being extremely large, a researcher is not able to say if the median household income in the block group is statistically significantly different than the median household incomes for Virginia, Cumberland County, or even the rural part of Virginia. The block group estimates vary largely from year to year. Additionally, the geographic area of the block group is extremely large. Thus, it might contain different communities of different income levels and demographics. As shown in Fig. 11, the distribution of incomes in the block group where the landfill is located is bimodal. This could be evidence of two different populations: a wealthy population and a poor population. That said, I cannot rely too heavily on this distribution as the margins of error for each bin are extremely high.

In any case, the size of area could lead to masking potential environmental justice concerns⁴¹. From the 2020 Census, the percent of Black (alone) residents in the blocks where the proposed landfill is was about 33%⁴². Looking at the other blocks in the block group (not including the blocks where the landfill would be), the percentage of Black (alone) residents is nearly half that, at 17.8%. This would present a situation like what is described in Fig. 10B. For these reasons, it is not recommended to use block group level demographic data to describe the community around the landfill as Mangum Economics has done.

⁴¹ <https://www.jstor.org/stable/42956368?seq=1>

⁴² The Black population could even be higher as the 2020 Census was shown to have undercounted Black, low-income, and younger populations.

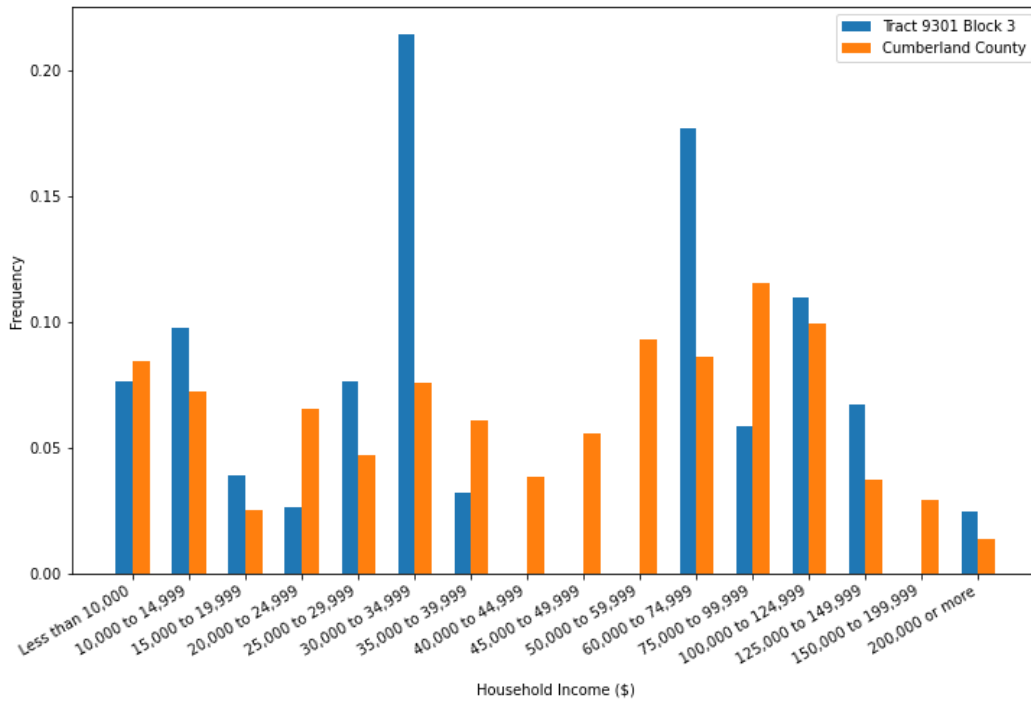


Figure 11: The plot above shows the distribution of household income in Cumberland County (in orange) as well as Tract 9301 Block Group 3 (in blue) for the year 2019.

The Affected Area

The affected area is defined as the area or community of concern. There are many approaches a researcher might take to define the affected area. I will first start by evaluating the blocks that the landfill will be in, and then I will expand my analysis by drawing a border around the landfill and estimating demographics a certain distance from the landfill by using the weighted approach discussed in the methodology section.

The proposed landfill sits in tract 9301.01, blocks 3019, 3023, 3025, and 3026⁴³. These blocks together make up 8.39 square miles, or 5,368 acres (recall that the entire area of the landfill as well as the driveway leading up to the landfill would be about 1,200 acres, so the landfill takes up about 22% of the affected area blocks). In 2020, the Census recorded 94 households in the affected area, which had a population of 224 residents⁴⁴. In this affected area, there was a population density of 26.7 residents per square mile⁴⁵. The residents of the affected area would be affected most by the landfill (increased likelihood of water contamination, odor prevalence, noise and air pollution, etc). In this section, I treat blocks 3019, 3023, 3025, and 3026 in tract 9301.01 as the affected area. Fig. 12 shows the landfill (in blue) and the affected blocks (outlined in black). The Pine Grove school is denoted with a red dot and lies a few hundred feet from the landfill, and about 1,000 feet from the disposal unit.

⁴³ For the 2010 Census, the proposed landfill sits in tract 9301, blocks 3039, 3051, 3054, and 3062. The actual aggregate area these blocks make is almost identical to the aggregate area of the affected blocks from the 2020 Census.

⁴⁴ There was an average 2.38 residents per household in the affected area according to the 2020 Census.

⁴⁵ [The population density for the affected area is likely underestimated due to population for the affected area likely being underestimated in the 2020 Census.](#)

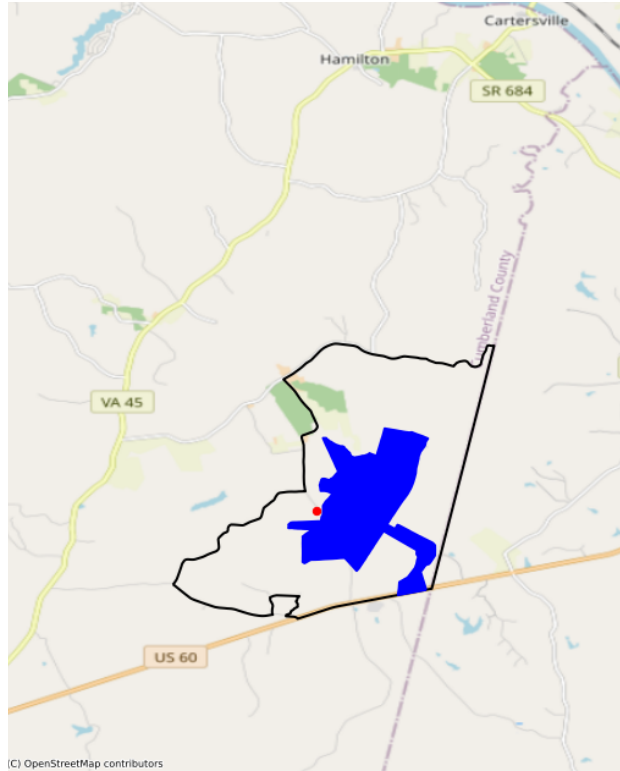


Figure 12: The above plot shows the landfill and drive to the landfill (in blue), the Pine Grove School (in red) and the area of blocks (as outlined by the black line) that make up the affected area. Blocks 3019, 3023, 3025, and 3026 of tract 9301.01 from the 2020 Census make up the affected area.

Race Analysis

Affected Blocks

Table 2 shows the percent of residents that are Black alone as well as the percent of residents that are Black alone or Black in combination with other races from the 2020 Census. The affected area has a Black (alone) population of 33%, which is 76.3% higher than the Black population in Virginia, and 166% higher than the Black population in the US. Even comparing the affected area with Cumberland County, which has a Black population significantly higher than Virginia’s Black population, the affected area has a Black population that is 12.6% higher than the Black population in Cumberland County. Fig. 24 in the appendix shows a graphical visualization of the affected area compares with other populations. The 2010 Census (which is the Census that Mangum Economics would have used for their report) shows an even higher percent of Black residents living in the affected area (Black alone made up 37.4% of residents, while Black alone or Black in combination with other races made up 41.9% of residents). Results from the 2010 Census can be seen in Table 3.

	Affected Area	Census Tract	Cumberland County	Adjacent Counties	Virginia
Population	224	3,283	9,675	143,922	8,631,393
Blank Alone, Percent	33.0%	23.7%	29.3%	19.9%	18.6%
Blank Alone or in Combination, Percent	33.9%	26.3%	31.5%	21.7%	20.9%

Table 2: The above table lists the population count as well as the percent of Black residents in the affected area, the census tract where the landfill resides, Cumberland County, adjacent counties to Cumberland County, and Virginia using 2020 Census data.

Note that these counts likely underestimate how many Black residents actually live in the area as both the 2010 and 2020 Censuses are known to have underestimated the number of Black residents^{46 47}. This issue of undercounting Black residents was seen in the next county over, when Dominion Energy used Census data and flawed methods to state that there was no environmental injustice with the building and operation of the Atlantic Coast Pipeline

⁴⁶ https://www.census.gov/newsroom/releases/archives/2010_census/cb12-95.html

⁴⁷ <https://www2.census.gov/programs-surveys/decennial/covrage-measurement/pes/national-census-covrage-estimates-by-demographic-characteristics.pdf>

compressor station in Buckingham County^{48 49}. However, an anthropologist and a couple of volunteers from the area created an initiative (which I will call the Union Hill Survey) to go door-to-door to collect the demographics of households that would be affected by the compressor station. This group found that when compared with using Census data, the door-to-door survey results yielded significantly higher Black population counts.

Using the weighted method on Census 2020 data to estimate the demographics of the population around the compressor station⁵⁰, I found that the Census underestimates the percent of Black residents by about 23 to 35 percentage points, or in other words, by about 59% to 88% in this area. It is likely that the percent of Black residents in the affected area in Cumberland County is also significantly underestimated. If they were underestimated by the same amount, the percent of Black residents in the affected area could actually be about 52% to 62% of total residents. However, it is hard to tell if the affected area in Cumberland County suffers from the same magnitude of undercounting that the affected area in Buckingham County did.

	Affected Area	Census Tract ⁵¹	Cumberland County	Adjacent Counties	Virginia
Population	198	6,516	10,052	128,658	8,001,024
Blank Alone, Percent	37.4%	30.8%	32.6%	22.3%	19.4%
Blank Alone or in Combination, Percent	41.9%	31.9%	33.9%	23.1%	20.7%

Table 3: The above table lists the population count as well as the percent of Black residents in the affected area, the census tract where the landfill resides, Cumberland County, adjacent counties to Cumberland County, and Virginia using 2010 Census data.

Distribution Check

Table 4 shows a summary of the Black (alone) population for each block in the affected area. Each block has a Black population that is higher than the Virginia Black population. The last column shows how each block from the affected area compares with all blocks in Virginia. Notice each block in the affected area has a Black population that is higher than 80% of all Virginia Census blocks (except for block 3026 which has a Black population that is higher than

⁴⁸<http://www.friendsofbuckinghamva.org/friends/wp-content/uploads/2018/12/Fjord-Union-Hill-Community-Household-Study-12-17-18-Lakshmi-Fjord.pdf>

⁴⁹<https://www.friendsofbuckinghamva.org/friends/dominion-energy-environmental-racism-a-case-study-in-how-to-lie-with-maps/>

⁵⁰ I used a 1.1 mile radius from the compressor I as my buffer. This is the same distance used in the Union Hill Survey

⁵¹ The Census Tract that the affected area was in was larger (both in acreage and population) in 2010 than in 2020.

77% of all Virginia Census blocks). All of the blocks had a Black population greater than Virginia, and 3 of the 4 blocks had a Black population greater than Cumberland County's Black population.

Block	Total Population	Black (alone) Population	Black (alone) Population, percent	Virginia Percentile
3019	29	10	34.48%	82.34%
3023	110	34	30.91%	80.17%
3025	58	23	39.66%	84.52%
3026	27	7	25.93%	77.07%

Table 4: The above table lists the population count as well as the percent of Black residents in each block of the affected area. The last column includes the percentile of the Black (alone) percent, or in other, the percent of blocks in Virginia that a particular block had a higher percentage of Black residents.

Centroid Buffer

First, I take the centroid of the proposed landfill, and then draw a circle (which I will call a buffer) with a radius of X miles around the centroid point. I then estimate the population demographics within that buffer using Census data. As explained in a previous section, it is impossible to say with 100% certainty what the demographics are within one of these buffers due to only having data down to the block level as blocks are often irregular shapes and sizes and are not uniform. However, using the weighted approach introduced in the methodology section, I can estimate demographics within that buffer.

Fig. 13 shows estimates of the percent of residents that are Black (alone) residing in Cumberland County that are within a certain distance from the centroid of the landfill. As can be seen from the blue line, the percent of Black (alone) residents living close to the landfill is significantly higher than the percent of Black (alone) residents living in Virginia (shown with the red dotted line), or even is the percent of Black (alone) residents living in counties adjacent to Cumberland County (shown with the black dotted line). This is true even out to 3 miles from the landfill.

Expanding the analysis to include both Cumberland and Powhatan residents yields similar results. As can be seen from the orange line, the percent of Black (alone) residents living close to the landfill is significantly higher than the percent of Black (alone) residents living in Virginia (shown with the red dotted line), or even is the percent of Black (alone) residents living in counties adjacent to Cumberland County (shown with the black dotted line). This is true even out to 1.5 miles from the landfill.

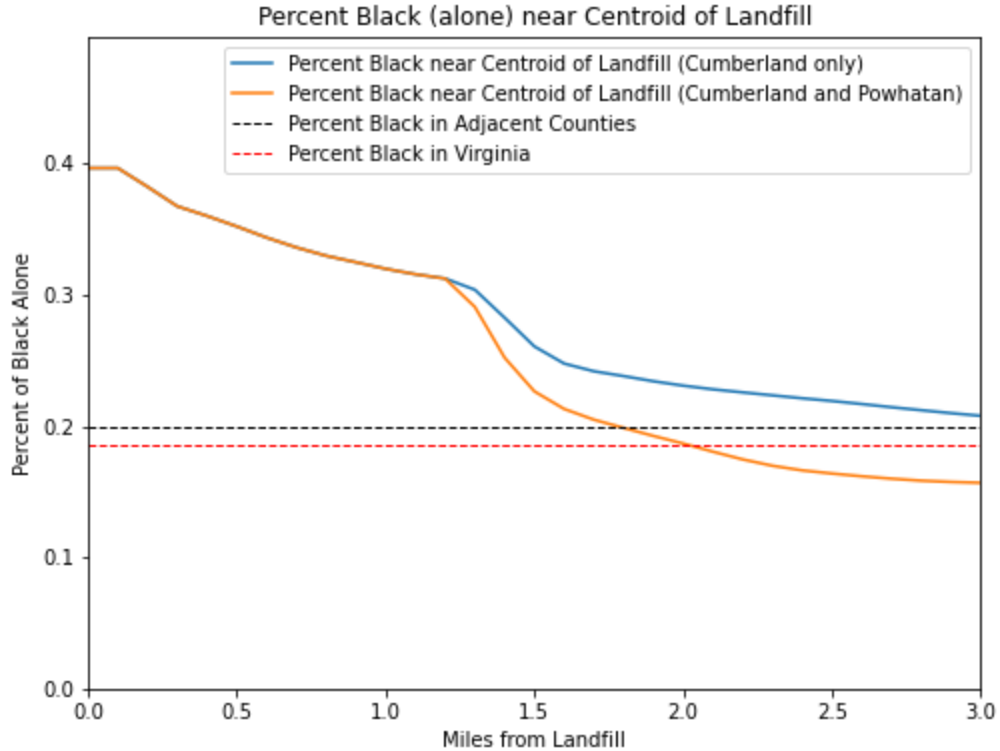


Figure 13: The plot above shows the percent of Black (alone) residents near the centroid of the landfill. The blue line includes only Cumberland residents, while the orange line includes both Cumberland and Powhatan residents. The black dotted line is the percent of Black residents in counties adjacent to Cumberland County, and the red dotted line is the percent of Black residents in Virginia.

For both populations (Cumberland only, and Cumberland and Powhatan), within 1 mile of the centroid of the landfill, I estimate that the percent Black (alone) is above 30%. This percentage increases as the buffer shrinks. Thus, the population closest to the landfill contains a relatively high percentage of Black residents.

Landfill Buffer

As explained in the methodology section, using a circle around a point to estimate the demography around the landfill is not an ideal approach since the landfill is not a circle. Using a shape file for the landfill, I can create a more representative buffer and thus more accurately estimate the demographics around the area. I will do my analysis using two different shape files:

1. Landfill
2. Disposal Unit

Fig. 14 shows the landfill (purple), the actual disposal unit (orange), and the driveway going up to the landfill (in blue) as proposed by Green Ridge.

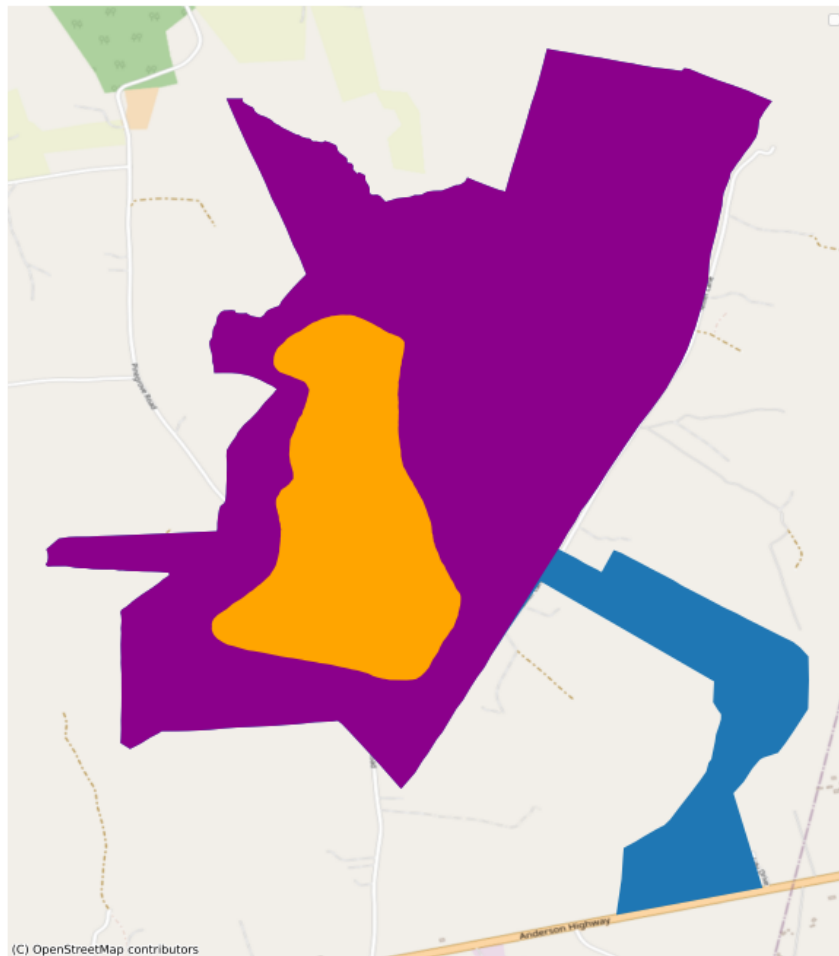


Figure 14: The plot above shows the landfill (in purple), the disposal unit (in orange), and the driveway leading up to the landfill (in blue).

Fig. 15 shows estimates of the percent of residents that are Black (alone) residing in Cumberland County that are within a certain distance of the landfill (in orange) as well as the disposal unit (in blue). As can be seen from figure, the percent of Black residents living close to the landfill is significantly higher than the percent of Black residents living in Virginia (shown with the red dotted line), or even is the percent of Black (alone) residents living in counties adjacent to Cumberland County (shown with the black dotted line).

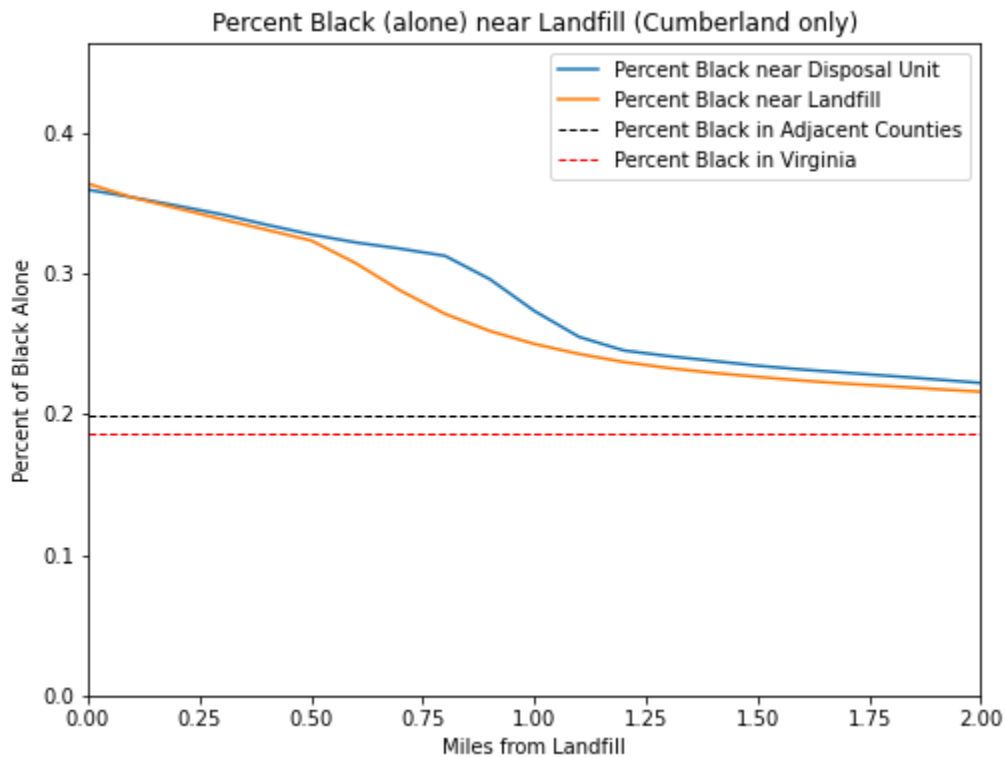


Figure 15: The above plot shows the percent of Black (alone) Cumberland residents near the landfill (as shown by the orange line), and the percent of Black (alone) Cumberland residents near the disposal unit (shown in blue). The black dotted line is the percent of Black residents in counties adjacent to Cumberland County, and the red dotted line is the percent of Black residents in Virginia.

Expanding the analysis to include Powhatan County residents yields similar results. Fig. 16 shows estimates of the percent of residents that are Black (alone) residing in Cumberland County and Powhatan County that are within a certain distance from the landfill. As can be seen in the figure, the percent of Black residents living close to the landfill is higher than the percent of Black residents living in Virginia (shown with the red dotted line) up to 1.5 miles, or even the percent of Black residents living in counties adjacent to Cumberland County (shown with the black dotted line) up to 1.25 miles.

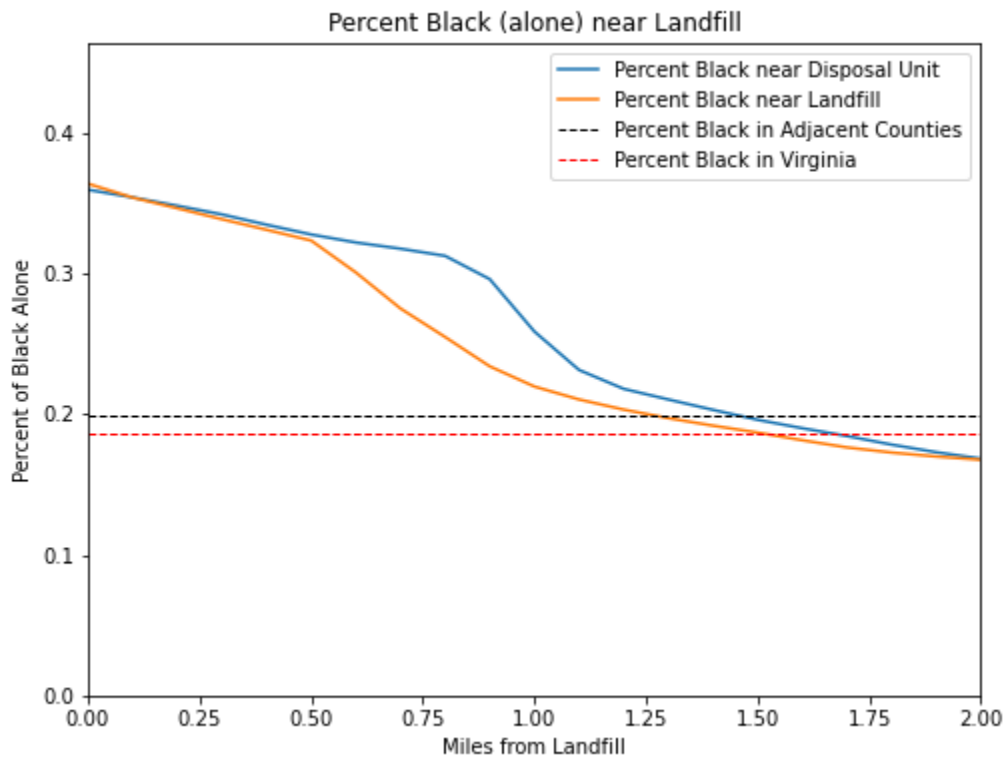


Figure 16: The above plot shows the percent of Black (alone) Cumberland and Powhatan residents near the landfill (as shown by the orange line), and the percent of Black (alone) Cumberland and Powhatan residents near the disposal unit (shown in blue). The black dotted line is the percent of Black residents in counties adjacent to Cumberland County, and the red dotted line is the percent of Black residents in Virginia.

Results

As shown using all three approaches (evaluating the blocks the landfill is in, using a circle buffer around the landfill centroid, and using buffers around the landfill and disposal unit), I find that the population most likely to be impacted by the landfill is disproportionately Black, with percent of Black residents within 1 mile of the landfill being above 30%. Even still, the estimates presented in this section are likely underestimated due to the 2020 Census undercounting the Black

population⁵², thus, the percentage of Black residents could be a lot higher than my analysis shows. In order to get an accurate estimate of the percent of Black residents by the landfill, it is encouraged to do a door-to-door survey like the one done for the Union Hill Study⁵³.

⁵²<https://www2.census.gov/programs-surveys/decennial/coversage-measurement/pes/national-census-coversage-estimates-by-demographic-characteristics.pdf>

⁵³<http://www.friendsofbuckinghamva.org/friends/wp-content/uploads/2018/12/Fjord-Union-Hill-Community-Household-Study-12-17-18-Lakshmi-Fjord.pdf>

Age Analysis

Affected Blocks

Again, I first focus on the blocks where the proposed landfill will be located (tract 9301.01, blocks 3019, 3023, 3025, 3026). Table 5 shows the percent of residents that are under 18 years of age in the affected blocks using the 2020 Census. The table also includes the percentage of blocks where the affected blocks have a higher percent of residents that are under 18. Table 7 in the appendix shows the percentage of population under 18 for the entire affected area and how it compares with other populations. Of the residents living in the affected area, 32.1% are under 18 years of age. The affected area had 46.6% higher percent of residents under 18 than Virginia and 57.4% higher percent of residents under 18 than Cumberland County. Fig. 25 in the appendix shows a graphical visualization of the affected area compares with other populations.

Block	Percent of Population Under 18	Virginia Percentile	Neighboring Counties Percentile	Powhatan and Cumberland Percentile	Cumberland Percentile	Blocks of Similar Size Percentile
3019	34.48%	82.25%	82.21%	82.19%	80.38%	84.38%
3023	23.64%	57.76%	61.14%	58.65%	61.08%	58.05%
3025	43.10%	90.59%	89.13%	89.06%	86.71%	96.91%
3026	40.74%	88.84%	87.70%	87.15%	85.44%	92.48%

Table 5: The above table lists the percent of the population under 18 years of age residents in each block of the affected area.

Table 6 shows the percent of Black residents that are under 18 years of age in the affected blocks using the 2020 Census. Table 7 in the appendix shows the percentage of the Black population under 18 for the entire affected area and how it compares with other populations. Of the Black (alone) residents living in the affected area, 40.5% are under 18 years of age. The affected area had 78.4% higher percent of Black residents under 18 than Virginia, and 121% higher percent of Black residents under 18 than Cumberland County. Fig. 26 in the appendix shows a graphical visualization of the affected area compares with other populations when comparing the percent of residents that are both Black and under the 18 years of age. Fig. 27 in the appendix shows a graphical visualization of the affected area compares with other populations when comparing the percent of Black residents that are under the 18 years of age⁵⁴.

⁵⁴ There is a subtle difference between Fig. 26 and Fig. 27. Fig. 27 uses Black residents as the denominator to measure the percent of Black residents that are under the age of 18 in an area, whereas Fig. 26 uses all residents as the denominator in order to measure the percent of all residents that are Black and under the age of 18..

Block	Percent of Black (alone) Population Under 18	Virginia Percentile	Neighboring Counties Percentile	Powhatan and Cumberland Percentile	Cumberland Percentile	Blocks of Similar Size Percentile
3019	70.00%	87.83%	86.83%	87.62%	88.98%	84.68%
3023	38.24%	76.85%	76.77%	78.78%	77.97%	89.51%
3025	34.78%	74.56%	75.26%	78.39%	77.12%	71.65%
3026	28.57%	68.40%	71.75%	75.64%	73.73%	67.44%

Table 6: The above table lists the percent of the Black population under 18 years of age residents in each block of the affected area as well as the percentiles in various populations.

These statistics are a bit higher than what was seen in the 2010 Census⁵⁵, although the affected area still had a relatively high percentage of residents that were under 18 as well as a high percentage of Black (alone) residents that were under 18.

⁵⁵There are a number of reasons (net migration to the area, children getting older, and children being born) why the percent of the population under 18 could change from Census to Census. It's not abnormal to see a large change in this statistic from Census to Census as the time between each Census is 10 years.

Centroid Buffer

Fig. 17 shows estimates of the percent of residents that are under 18 years of age residing in Cumberland County that are within a certain distance from the centroid of the landfill. As can be seen in the figure, the percent of residents under 18 living close to the landfill is significantly higher than the percent of residents under 18 living in Virginia (shown with the red dotted line), or even the percent of residents under 18 living in counties adjacent to Cumberland County (shown with the black dotted line). Within 1 mile of the centroid of the landfill, I estimate that the percent of residents under 18 is above 30%, with the percent increasing the closer to the landfill the population is.

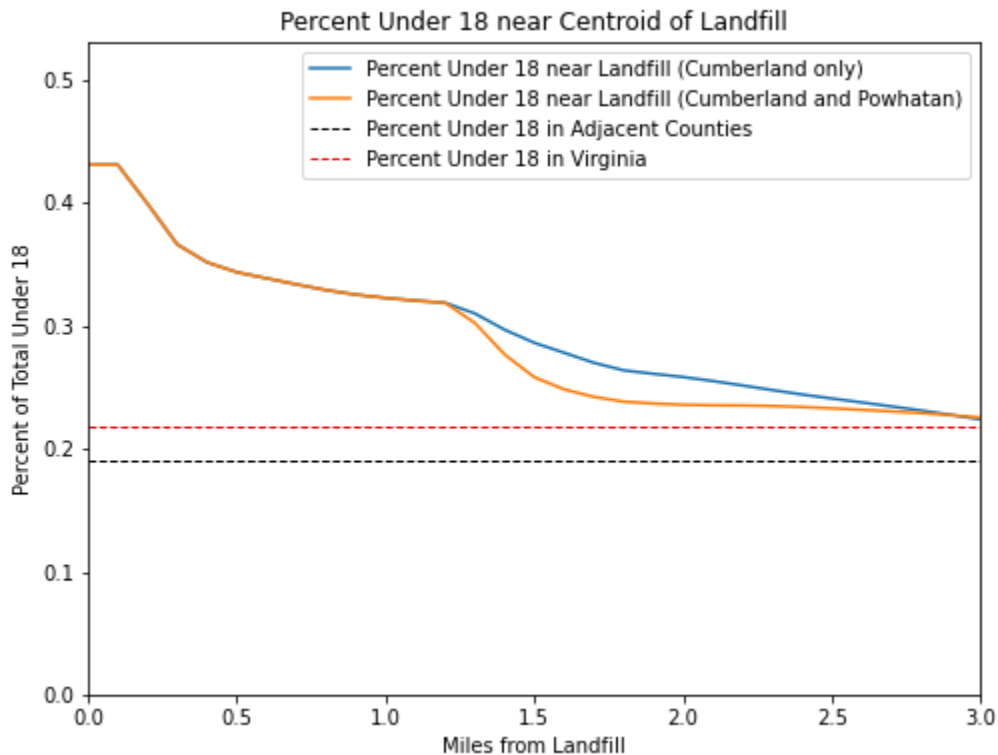


Figure 17: The plot above shows the percent of persons under 18 near the centroid of the landfill. The blue line includes only Cumberland residents, while the orange line includes both Cumberland and Powhatan residents. The black dotted line is the percent of persons under 18 in counties adjacent to Cumberland County, and the red dotted line is the percent of persons under 18 in Virginia.

Fig. 18 shows estimates of the percent of Black (alone) residents that are under 18 years old residing in Cumberland County that are within a certain distance from the centroid of the landfill. As can be seen in the figure, the percent of Black residents under 18 living close to the landfill is significantly higher than the percent of Black residents under 18 living in Virginia (shown with the red dotted line), or even is the percent of Black residents under 18 living in counties adjacent to Cumberland County (shown with the black dotted line). Within 1 mile of the centroid of the landfill, I estimate that the percent of Black residents under 18 is above 35%.

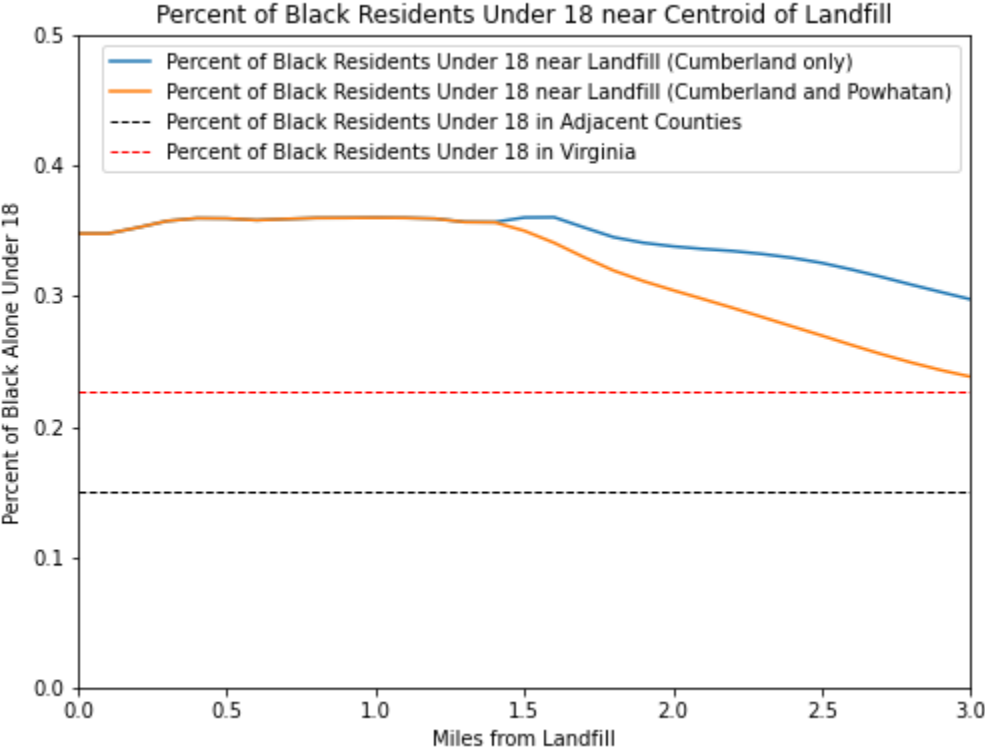


Figure 18: The plot above shows the percent of Black (alone) persons under 18 near the centroid of the landfill. The blue line includes only Cumberland residents, while the orange line includes both Cumberland and Powhatan residents. The black dotted line is the percent of Black persons under 18 in counties adjacent to Cumberland County, and the red dotted line is the percent of Black persons under 18 in Virginia.

Landfill Buffer

Fig. 19 shows estimates of the percent of residents that are under 18 years old residing in Cumberland County that are within a certain distance from the landfill. As can be seen from figure, the percent of residents under 18 living close to the landfill is significantly higher than the percent of residents under 18 living in Virginia (shown with the red dotted line), or even is the percent of residents under 18 living in counties adjacent to Cumberland County (shown with the black dotted line).

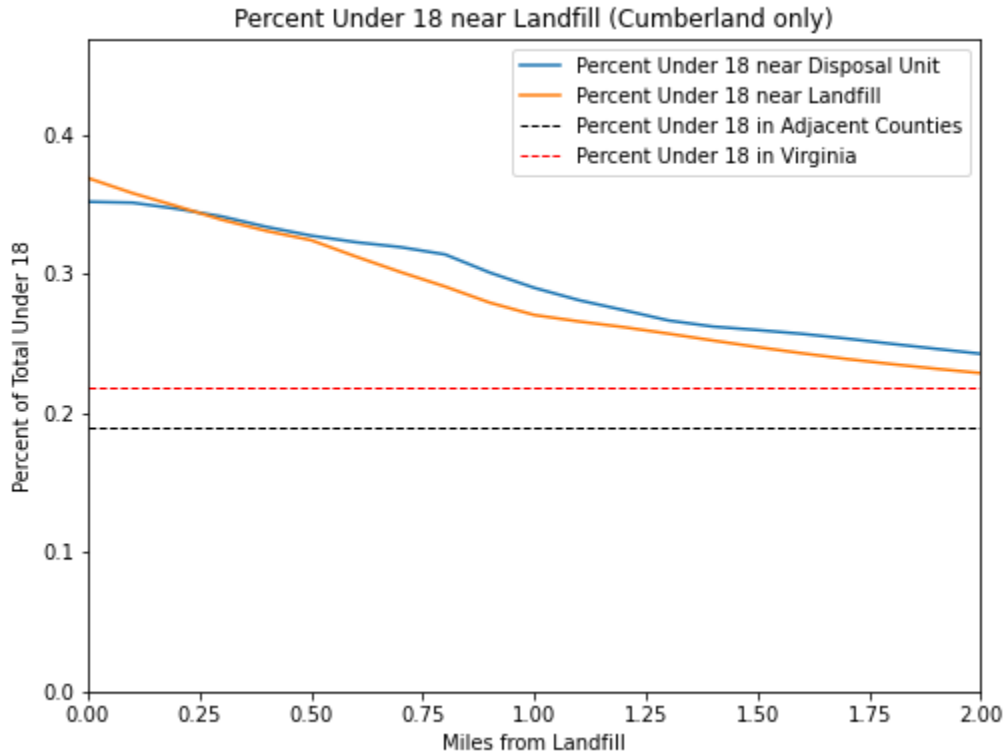


Figure 19: The above plot shows the percent of Cumberland persons under 18 near the landfill (as shown by the orange line), and the percent of Cumberland persons under 18 near the disposal unit (shown in blue). The black dotted line is the percent of persons under 18 counties adjacent to Cumberland County, and the red dotted line is the percent of persons under 18 in Virginia.

Expanding the analysis to include Powhatan County residents yields similar results. Fig. 20 shows estimates of the percent of residents that are under 18 years old residing in Cumberland County and Powhatan County that are within a certain distance from the landfill. As can be seen in the figure, the percent of residents under 18 living close to the landfill is significantly higher than the percent of residents under 18 living in Virginia (shown with the red dotted line), or even is the percent of residents under 18 living in counties adjacent to Cumberland County (shown with the black dotted line).

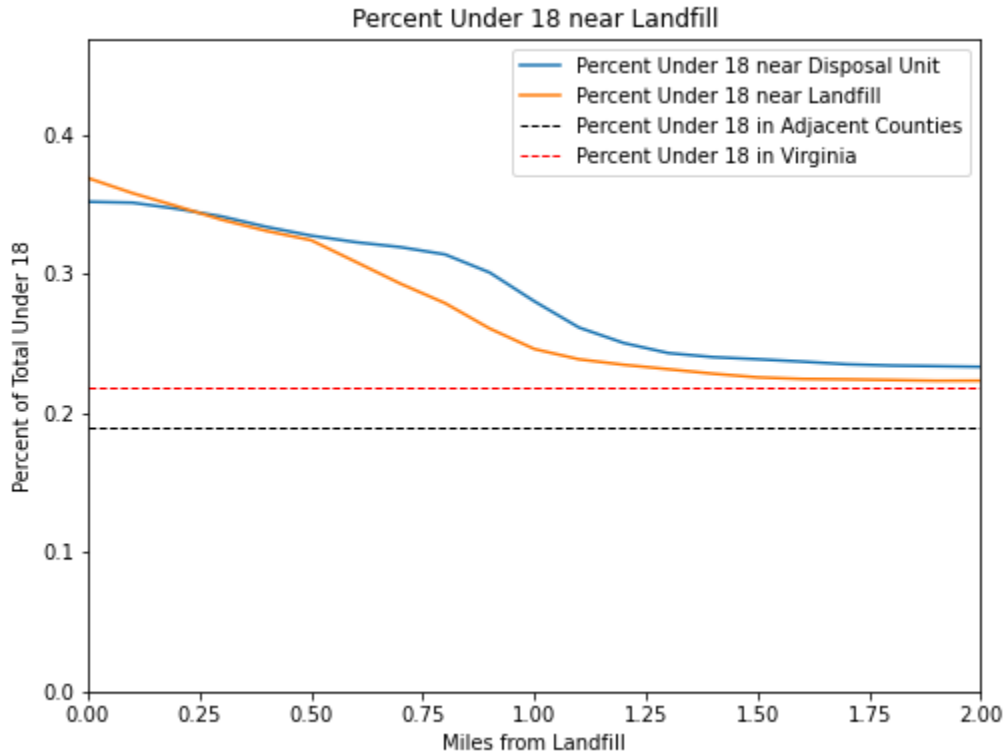


Figure 20: The above plot shows the percent of Cumberland and Powhatan persons under 18 near the landfill (as shown by the orange line), and the percent of Cumberland and Powhatan persons under 18 near the disposal unit (shown in blue). The black dotted line is the percent of persons under 18 counties adjacent to Cumberland County, and the red dotted line is the percent of persons under 18 in Virginia.

Fig. 21 shows estimates of the percent of Black (alone) residents that are under 18 years old residing in Cumberland County that are within a certain distance from the landfill. As can be seen in the figure, the percent of Black residents under 18 living close to the landfill is significantly higher than the percent of Black residents under 18 living in Virginia (shown with the red dotted line), or even is the percent of Black residents under 18 living in counties adjacent to Cumberland County (shown with the black dotted line).

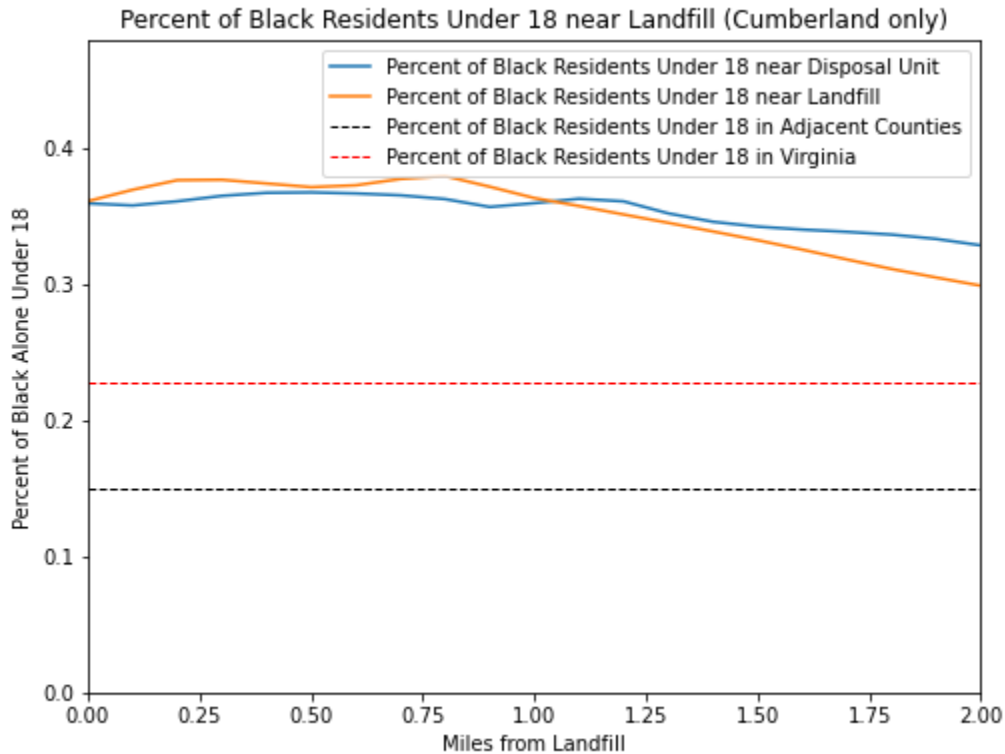


Figure 21: The above plot shows the percent of Cumberland Black persons under 18 near the landfill (as shown by the orange line), and the percent of Cumberland Black persons under 18 near the disposal unit (shown in blue). The black dotted line is the percent of Black persons under 18 counties adjacent to Cumberland County, and the red dotted line is the percent of Black persons under 18 in Virginia.

Fig. 22 shows estimates of the percent of Black (alone) residents that are under 18 years old residing in Cumberland County and Powhatan County that are within a certain distance from the landfill. As can be seen in the figure, the percent of Black residents under 18 living close to the landfill is significantly higher than the percent of Black residents under 18 living in Virginia (shown with the red dotted line), or even is the percent of Black residents under 18 living in counties adjacent to Cumberland County (shown with the black dotted line).

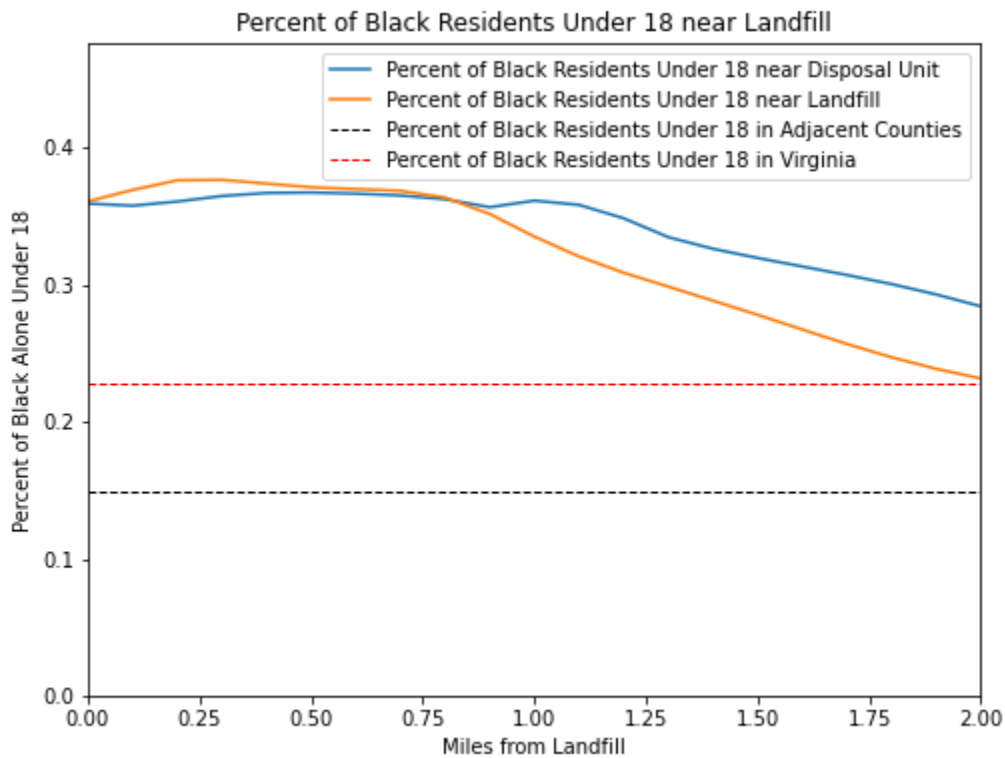


Figure 22: The above plot shows the percent of Cumberland and Powhatan Black persons under 18 near the landfill (as shown by the orange line), and the percent of Cumberland and Powhatan Black persons under 18 near the disposal unit (shown in blue). The black dotted line is the percent of Black persons under 18 counties adjacent to Cumberland County, and the red dotted line is the percent of Black persons under 18 in Virginia.

Results

As shown using all three approaches (evaluating the blocks the landfill is in, using a circle buffer around the landfill centroid, and using buffers around the landfill and disposal unit), I find that the population most likely to be impacted by the landfill is disproportionately young. Similarly, the percentage of Black residents under the age of 18 in the area around the landfill is significantly higher than other comparison populations.

Meaningful Involvement

There is also evidence that the community did not have meaningful involvement. The Technical Guidance for Assessing Environmental Justice in Regulatory Analysis (2016)⁵⁶ defines meaningful involvement as indicating that:

1. potentially affected populations have an appropriate opportunity to participate in decisions about a proposed activity [i.e., rulemaking] that will affect their environment and/or health;
2. the population's contribution can influence [the EPA's] rulemaking decisions;
3. the concerns of all participants involved will be considered in the decision-making process; and
4. [the EPA will] seek out and facilitate the involvement of population's potentially affected by EPA's rulemaking process

Many from the community felt like the Green Ridge Landfill was a done deal from the beginning. The original proposal was approved in only 35 days despite there being major pushback from the community⁵⁷. On May 25, 2018, Green Ridge, owned by County Waste of Virginia (now a subsidiary of GFL), submitted a rezoning request and conditional use permit to Cumberland County. This was the first time Cumberland County residents had heard that Green Ridge was planning on building a landfill in their community. On June 7, the Cumberland County Board of Supervisors, along with some representatives from Green Ridge, held an information session about the proposed landfill. After presenting information about the future landfill, residents of Cumberland County and Powhatan, many who live close to the site, voiced their concerns. Some of the worries expressed were about health impacts, increased traffic, property values significantly decreasing, etc. One main concern that constantly came up was that the community (both residents from Cumberland County and Powhatan) felt blind sided.

One June 18, the Cumberland County Planning Commission met to go over the Conditional Use Permit submitted by Green Ridge. Afterwards, the chairman started the public hearing to hear any concerns or questions. There were a total of 32 individuals who signed up to speak. Of those 32 individuals, 26 voiced their opposition to the landfill, 5 deferred their speaking time to individuals that wanted more time to voice their opposition⁵⁸, and 1 individual did not express their opinion, but asked questions about compensation, odor, monitoring, and the liner being used. No one voiced their support for the project. Many of the concerns were similar to what the

⁵⁶ https://www.epa.gov/sites/default/files/2016-06/documents/ejtg_5_6_16_v5.1.pdf

⁵⁷ For context, there was a period of 9 months of meetings and negotiations for the Amelia Courthouse Landfill before the conditional use permit was approved.

⁵⁸ I define an "opposition vote" when either someone says they oppose the landfill, if they voice a concern about negative effects about the landfill, or ask the Board of Supervisors or the Planning Commission to hold off on voting.

residents brought up in the information session. This planning meeting was adjourned to June 25.

On June 28, the Board of Supervisors met to vote on the rezoning request and the conditional use permit. The first vote was for the rezoning request. There were a total of 56 people who signed up to speak. Forty-one opposed the landfill, 12 declined to speak, and only 3 said they supported the landfill. The Board of Supervisors then voted 3-2 in favor of the rezoning request. Many individuals wanted the board of supervisors to have the residents vote. The next vote was for the conditional use permit. Sixty-nine signed up to speak. Of those 69, 31 opposed the landfill, 3 asked neutral questions (it was not clear if they opposed or supported the landfill), and 28 declined to speak. One of the Board of Supervisors mentioned that he received an email in support of the landfill, which he read during this time. The Board again voted 3-2 in favor of the conditional use permit. Thus, during the June 28th and June 18th meetings (the meetings in which we had information on the questions being asked) - there were a total of 98 times that someone opposed the landfill, only 4 times (3 if you do not count the email) that someone voiced their support for the landfill, and 4 times that someone asked a neutral question.

From reading the transcripts of these meetings as well as interviews from after these meetings, there seems to be a clear sentiment from the community: they feel like they had no say in the matter. The community felt like the initial approval process was rushed, and they also felt like other factors (like health, safety, indirect costs, etc) were not considered.

Discussion

Necessity of Mega Landfill

One of the lawyers associated with the landfill project stated that the “[garbage] industry is necessary and would be a good industry for Cumberland”⁵⁹. It is true that this industry is necessary, but it is not true that another landfill is needed or that it needs to be in Cumberland County.

As stated previously, there are multiple mega landfills already in Virginia that still have a lot of vacant space. The landfill in Amelia county, just 30 minutes driving from the proposed landfill site in Cumberland County, was only at about 6% of capacity as of 2020, even though it was opened in the 90s. It’s clear that in terms of volumetric capacity, another landfill in the area is not needed. There is an argument (for building a landfill) that it would benefit a garbage pickup company, in this case GFL, if they owned a landfill as they would not have to pay to use another company’s landfill. As stated in the economic impact from Mangum Economics⁶⁰, only 4 companies operate private landfills in Virginia (Waste Management, Republic, Shoosmith, and CFS). Thus, on the surface, it makes sense that another company operates a landfill in the state. A major issue not discussed is that the incentive structure of building landfills in a private market contributes to an inefficient number of landfills. This is the case with this situation as there is a nearby mega landfill that is nearly empty, and won’t be full for another 100+ years, but we are still entertaining the idea of building another mega landfill. The granting of permits from the DEQ should be approached with this consideration in mind.

Costs

Another argument from the economic impact study is that Cumberland County and its residents would benefit from the landfill. The study states that the county would see an annual average of \$2.48 million over the facility’s anticipated 30-year operational life. The study outlines the various sources of revenue that come from the landfill, but does not outline any of the costs (or opportunity costs) associated with the project. For example, there is no discussion about road maintenance costs, increased medical costs, decreased property values, or reduced influx of residents due to the project.

Road maintenance is an issue as there will be 175 to 250 truckloads on average each day⁶¹. It might not seem like this would be an issue; however, garbage trucks do an extreme amount of damage to roads. “Most deterioration is associated with use; and the damage caused by vehicles goes up much more than proportionately with size and weight. Hence, costs associated

⁵⁹ [Cumberland County Planning Commission Meeting - June 18, 2018](#)

⁶⁰ [Economics and Fiscal Contributions to Cumberland County & Virginia Report by Mangum Economics](#)

⁶¹ <https://greenridgeva.com/frequently-asked-questions.html>

with maintenance are greater for trips made by heavy vehicles”⁶². Researchers found that in Fort Collins, Colorado, a residential trash truck was the equivalent to 1,279 passenger cars⁶³.

The economic impact report also does not take into account medical costs. These costs could include healthcare costs that are a direct result of the pollution caused by the landfill. It could also include costs coming from an increase of fatal or debilitating crashes caused by the increase in the volume of trucks on roads near the landfill⁶⁴. Lastly, as stated in a previous section of this report, this landfill could have lasting impacts on childrens’ lives. This cost is hard to estimate as it would not only include direct impacts of landfill pollution (like asthma or cancer), but it would also include other impacts like a child’s school performance.

The landfill would also have an impact on property values. A 2005 study found that landfills that accept high volumes of waste (500 tons per day or more), “decrease adjacent residential property values by 12.9% on average,” and this impact “diminishes with distance at a gradient of 5.9% per mile.” It is difficult to say how much exactly this landfill will affect property values, but the fact that this is a mega landfill, and that it sits on a major highway that enters Cumberland County, means that this impact could be rather large.

The building of a landfill on highway 60 (which is the major roadway from the metropolitan area of Richmond to Cumberland County), could have a significant effect on the influx of residents coming into the county. As a result of COVID as well as other factors, rural areas have seen an increase in real estate demand. One major contributing factor is that remote work is becoming more popular. Cumberland County is a desirable place as real estate is cheaper than neighboring counties. Building a mega landfill on highway 60 would most likely decrease demand for housing in Cumberland County. This could lead to either the amount of Cumberland County residents decreasing, property values decreasing, or both.

There are a multitude of other costs that would be incurred if a mega landfill were to be built in Cumberland County. A thorough economic impact study should be conducted to consider these costs. The question remains, what are other alternative sources of revenue that Cumberland County could look into? The landfill will only generate revenue for 30 or so years (and would of course come with many costs). There are other projects that could be done that would have a more lasting effect on the community and local economy. One example is a big-box store. Cumberland County currently does not have a big-box store. A big-box store would provide several jobs to the community, revenue through taxes, and would also draw more individuals, families, and businesses to Cumberland County.

GFL and Green Ridge

A common concern from residents is that GFL, the company that owns Green Ridge, does not have a good relationship with its customers. Looking at the Richmond metropolitan area, GFL

⁶² <https://www.lrrb.org/pdf/201432.pdf>

⁶³ https://www.fcgov.com/recycling/pdf/Trash_Services_Study_Final_Report_2008.pdf?143654808

⁶⁴ [Relative Contribution/Fault in Car-Truck Crashes](#)

has a combined rating of 1.1 out of 5⁶⁵, which is significantly lower than other garbage companies in the area. County Waste, GFL, and the individuals involved with Green Ridge have a history of troubling violations⁶⁶. Residents are concerned that GFL and Green Ridge will put the opportunity for profit over the care and safety of Cumberland County and Powhatan residents.

⁶⁵ [92 Google Reviews as of 7/6/2021](#). 1 is the lowest score an individual can give, and 5 is the highest score.

⁶⁶ <https://www.deq.virginia.gov/get-involved/topics-of-interest/green-ridge-landfill>

Conclusions

Using a variety of different approaches on 2020 Census data, this study shows that the area around the proposed landfill site has a high percentage of Black (alone) residents (33.0% of population) as well as a high percentage of children (32.1% of population) and Black children (40.5% of Black population). These numbers are significantly higher when compared with other populations (like Virginia, adjacent counties, Cumberland County, etc). This study provides solid evidence that this is a case of environmental injustice.

Additionally, the percentage of Black residents near the landfill is likely higher than 33% due to the undercounting of Black residents in the 2020 Census. This was seen in the Union Hill Study done in the neighboring county of Buckingham. Thus, it is recommended that a door-to-door survey be taken of residents around the proposed landfill site. This survey could also include socioeconomic as well as health questions to provide better information concerning the demographics of the area. A concern with a door-to-door survey like this is that the response rate might be low, and thus it would present an undercounting issue similar to what has been seen in the most recent Censuses. In order to mitigate this issue, it is strongly encouraged that those who are conducting the survey be residents of the area. Also, it should be clear to the participants of the survey that the results would be anonymized and aggregated to a level where data would not have identifying information.

This study also finds evidence that Cumberland County contains a population that is very vulnerable to environmental hazards. The building of the Green Ridge Landfill in the proposed area is clearly an environmental justice concern as it will disproportionately impact these vulnerable populations. It would destroy the historical integrity of the community built by freed Blacks and their descendants. It is recommended that if Green Ridge or Cumberland County do not stop this project, that the DEQ Environmental Justice Office or the EPA step in to address this environmental injustice.

Appendix

	Affected Area	Census Tract	Cumberland County	Adjacent Counties	Virginia	USA
Population	224	3,283	9,675	143,922	8,631,393	334,735,155
Black Alone, Percent	33.0%	23.7%	29.3%	19.9%	18.6%	12.3%
Black Alone or In Combination, Percent	33.9%	26.3%	31.5%	21.7%	20.9%	14.2%
Persons Under 18, Percent	32.1%	20.2%	20.4%	19.0%	21.9%	22.0%
Black Alone Persons Under 18, Percent	40.5%	18.8%	18.3%	15.0%	22.7%	24.7%
Black Alone or In Combination Persons Under 18, Percent	40.8%	22.2%	21.0%	18.0%	25.4%	27.2%

Table 7: The above table lists the population count, percent of Black residents, percent of persons under 18, and percent of Black persons under 18 in the affected area, the census tract where the landfill resides, Cumberland County, adjacent counties to Cumberland County, Virginia, and the US using 2020 Census data.

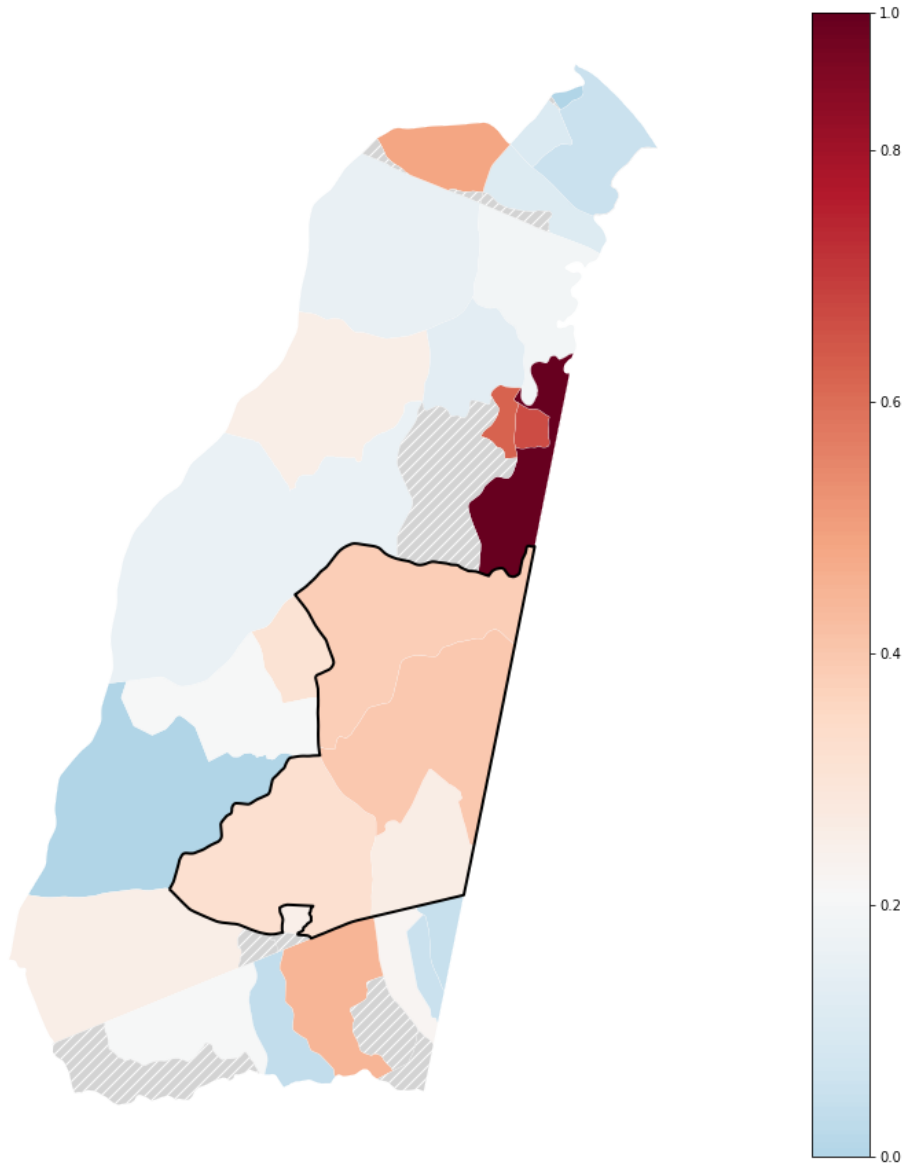


Figure 23: The above figure illustrates the Black (alone) percentage for each block. Blocks that have a higher percentage of Black residents than Virginia are colored red, while those that have a lower percentage of Black residents than Virginia are colored in blue. Blocks in the affected area are outlined in black.

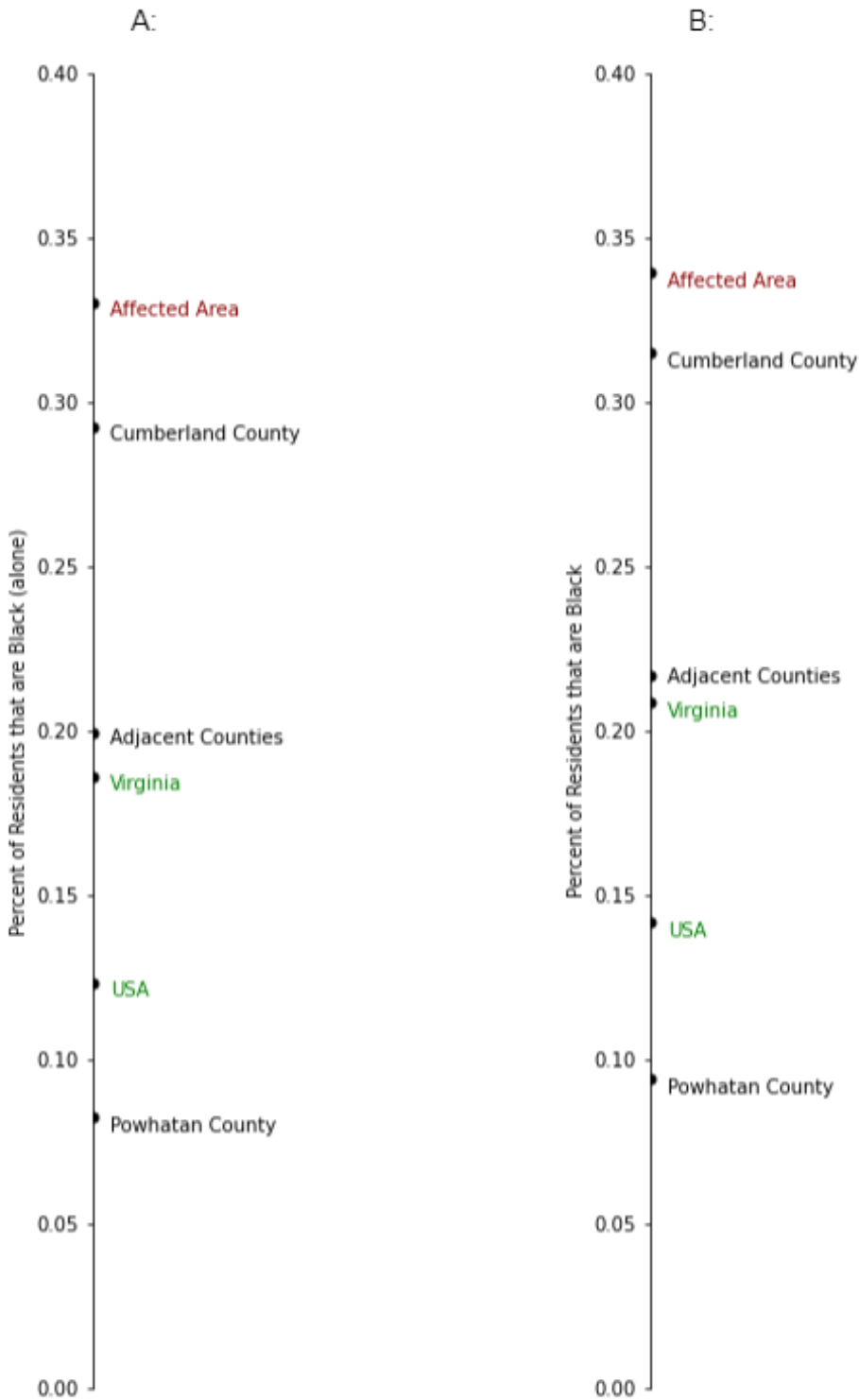


Figure 24: The left panel (A) shows the percent of residents that are Black (alone) in the affected area (defined by the blocks where the landfill would reside), Cumberland County, Powhatan County, adjacent counties (to Cumberland County), Virginia, and the USA. The right panel (B) shows the percent of residents that are Black (alone or in combination).

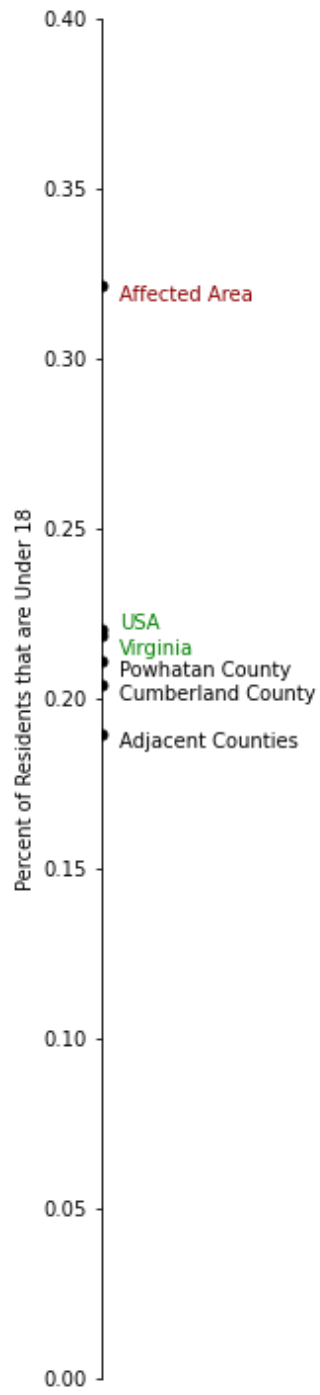


Figure 25: The above plot shows the percent of residents under the age of 18 for the affected area (defined as the blocks where the landfill would reside), Cumberland County, Powhatan County, adjacent counties (to Cumberland County), Virginia, and the USA.

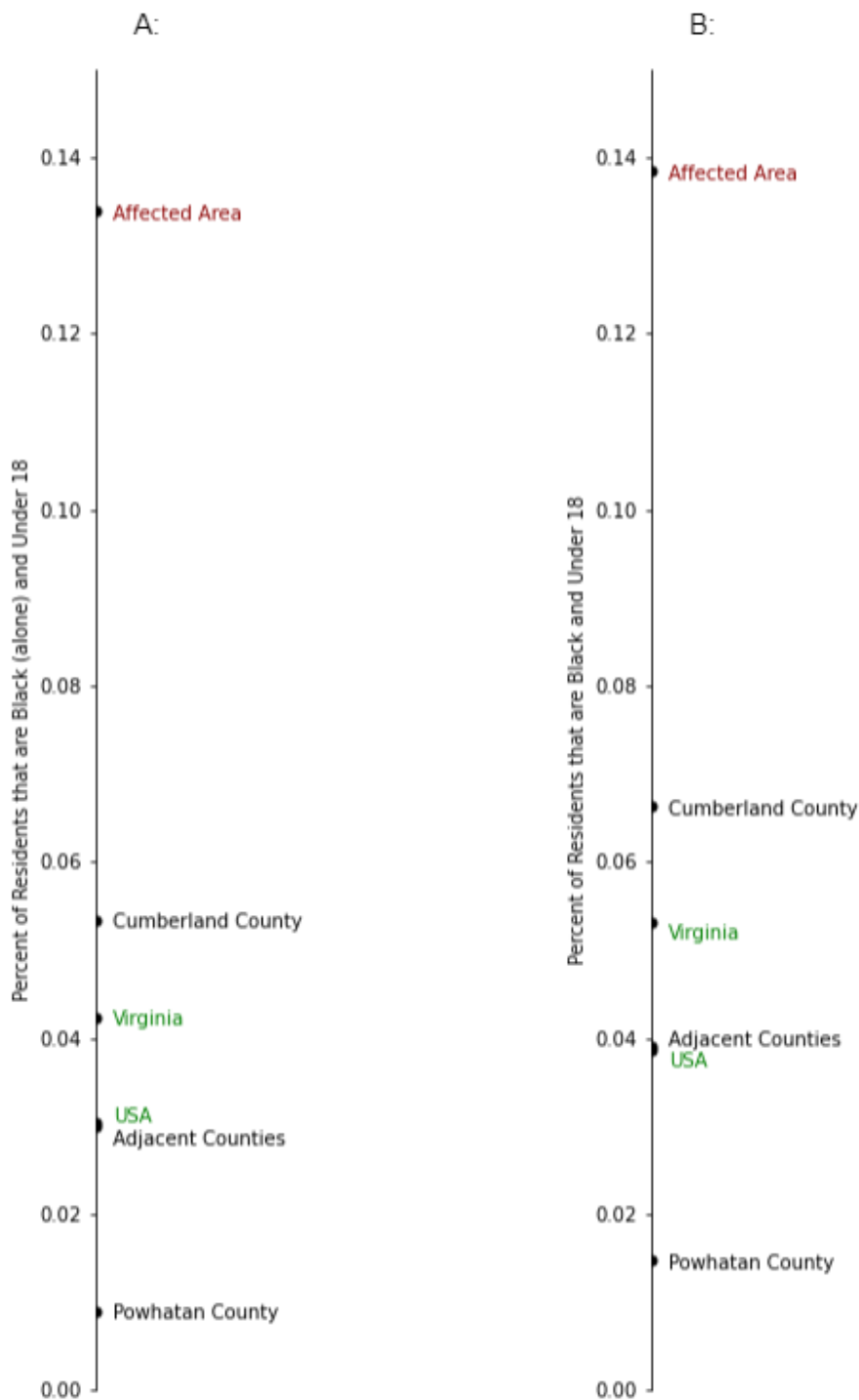


Figure 26: The left panel (A) shows the percent of residents that are Black (alone) and under the age of 18 in the affected area (defined by the blocks where the landfill would reside), Cumberland County, Powhatan County, adjacent counties (to Cumberland County), Virginia, and the USA. The right panel (B) shows the percent of residents that are Black (alone or in combination) and under the age of 18.

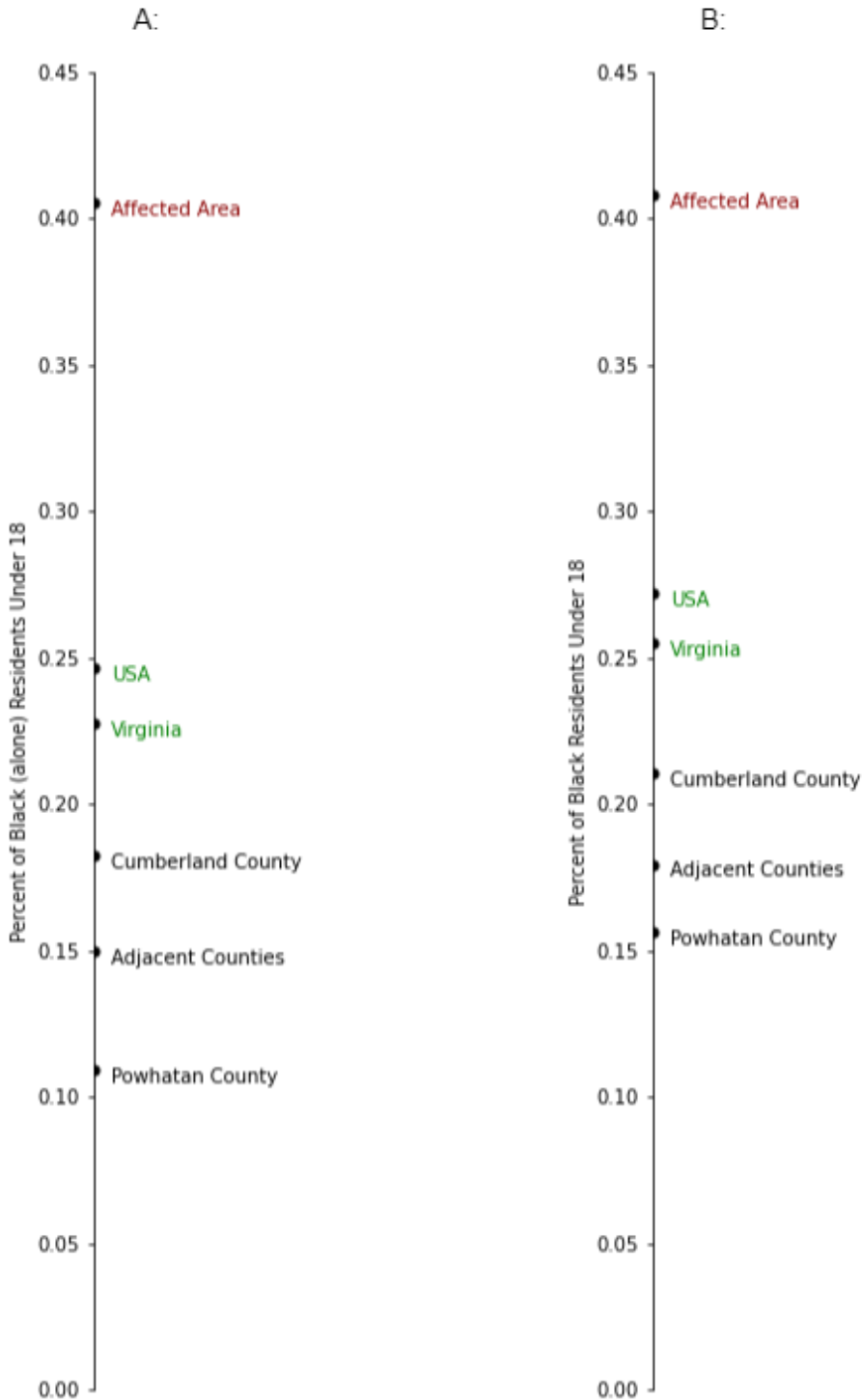


Figure 27: The left panel (A) shows the percent of Black (alone) residents that are under the age of 18 in the affected area (defined by the blocks where the landfill would reside), Cumberland County, Powhatan County, adjacent counties (to Cumberland County), Virginia, and the USA. The right panel (B) shows the percent of Black (alone or in combination) residents that are under the age of 18.