ASSESSMENT OF HEALTH BENEFITS FROM USING BIODIESEL FUEL FOR ON-ROAD TRANSPORTATION SOURCES – BRONX, NY

Clean Fuels Alliance America

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March 2024

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LIST OF ABBREVIATIONS AND ACRONYMS

AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
ATS	AirToxScreen
B[a]anthracene	Benz[a]anthracene
BenMAP-CE	Environmental Benefits Mapping and Analysis Program - Community Edition
CARB	California Air Resources Board
CMAQ	Community Multiscale Air Quality Model
CT	Census Tract
Cr(VI)	Hexavalent Chromium
CV	Contingent Valuation
D[a,h]anthracene	Dibenz[a,h]anthracene
DSN	Data Series Name
EIA	U.S. Energy Information Administration
HAP	Hazardous Air Pollutant
HARP	Hot Spots Analysis & Reporting Program
HRA	Health Risk Assessment
In[1,2,3-cd]pyr	Indeno[1,2,3-cd]pyrene
LPG	Liquified Petroleum Gas
NEI	National Emissions Inventory
OEHHA	(California) Office of Environmental Health Hazard Assessment
PAH	Polycyclic Aromatic Hydrocarbon
$PM_{2.5}$	Particulate Matter with an Aerodynamic Diameter of ≤2.5 microns
SEDS	State Energy Data System
TSD	Technical Support Document
U.S. EPA	United States Environmental Protection Agency

WTP   Willingness-to-Pay

1. EXECUTIVE SUMMARY

This report assesses the health benefits of substituting biodiesel in on-road transportation sources that are currently fueled by diesel in Bronx, New York. The emission sources, data sources, models, and analytical techniques for this area were selected to provide the most comprehensive, robust, and transparent analysis possible within the schedule and budget limitations of the approved project.

1.1 Analysis Technique

The general analysis technique is a simplified, air toxic-based health risk assessment (HRA) of specific on road transportation sources in Bronx. These analyses do not attempt to replicate any existing HRA performed for a specific facility, correlate with monitored concentrations of specific pollutants, or quantify the full background health risk experienced in the area modeled. Rather, these analyses show the air toxic health risk benefits of using biodiesel for on road transportation compared to petroleum-based diesel.

Because health risk is directly proportional to the ground level concentrations of toxic air contaminants and established air pollutant toxicity values, the risk reduction percentage at any given receptor will be the same as the reduction in air pollutant toxicity from diesel combustion compared to biodiesel combustion. This analysis translates those changes in toxicity values into risk metrics, including reductions in cancer risk (per million people), reduction in cancer burden, and associated health benefits with a transition from traditional diesel to biodiesel.

USEPA's AirToxScreen (ATS) data was used to assess community-wide toxic pollutant concentrations and health risk values based on USEPA HRA procedures and pollutant toxicity values. The baseline and reduced ATS concentration data was also used in the California Hot Spots Analysis & Reporting Program (HARP) HRA software to produce risk values based on California toxicity values and risk calculation procedures.

Additionally, the majority of the census tracts in the Bronx are considered Potential Environmental Justice Areas (PEJA) by the New York State Department of Environmental Conservation (NY DEC)[1]. Of the 339 census tracts identified within the Bronx for census year 2018, 318 are considered PEJA by the NY DEC. Therefore, this analysis also includes a review of the impacts at PEJA census tracts.

1.2 Location

Bronx, New York was assessed for health risk reductions due to the transition from ULSD to the use of biodiesel for on-road transportation sources.

The extent of the full analysis encompasses the county of Bronx, NY as pictured in Figure 1-1. The PEJA analysis encompasses the census tracts containing NY DEC identified PEJA communities, as pictured in Figure 1-2.

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[1] NYSDEC PEJA Census Tract Data: https://data.gis.ny.gov/datasets/02d8ba023f90403c92f5523e8f3c8208_0/about
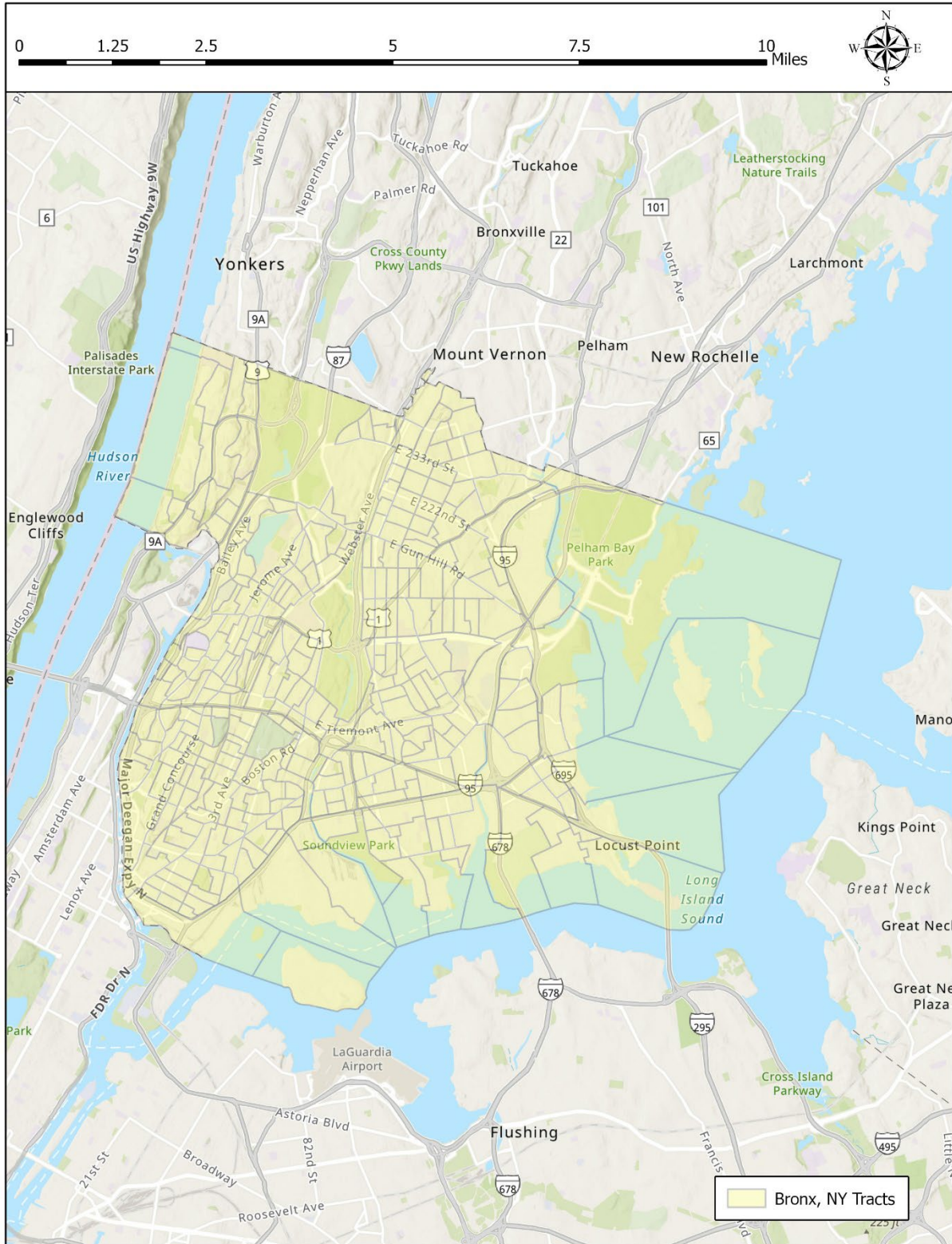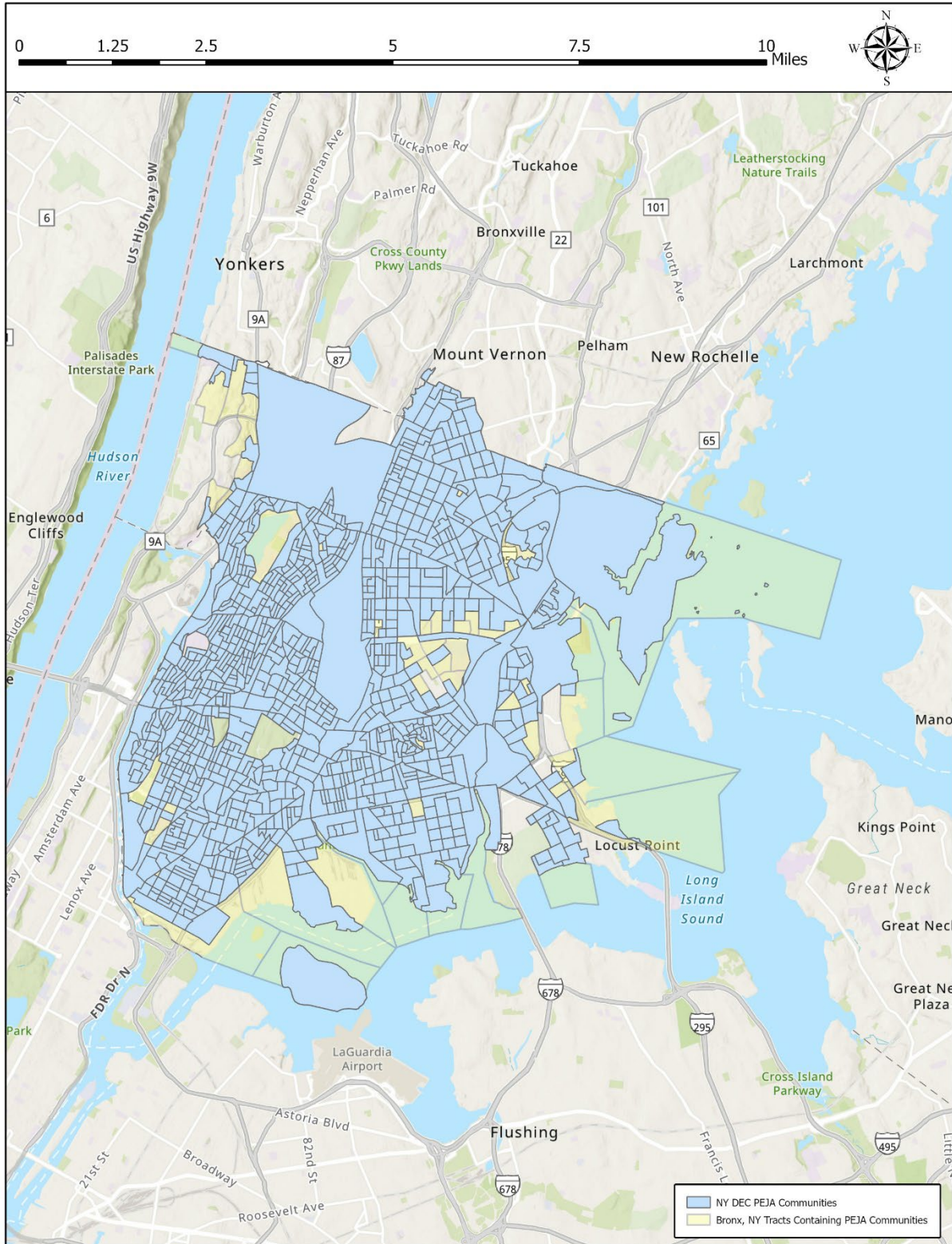
Figure 1-1. Bronx, NY Analysis Extent

Figure 1-2. Bronx, NY PEJA Analysis Extent

1.3   Summary of Results

The following tables summarize the cancer risk data and health benefit values from the USEPA's ATS database, the California HARP model results, the localized roadway HRA results, and the USEPA's BenMAP model.

Table 1-1. ATS Total Cancer Risk and BenMAP Health Benefit Value Summary

Location	ATS Max Baseline Total Cancer Risk (10^{-6})	ATS Total Cancer Burden	BenMAP Health Benefit Value (million $)
Bronx, NY	37.1	44.5	599
Bronx, NY - PEJA	37.1	37.6	510

Table 1-2. Summary of ATS Risks from DPM Sources

Location	ATS Max Baseline DPM Cancer Risk (10^{-6})	ATS DPM Cancer Burden	Reduced ATS DPM Cancer Risk (10^{-6})	Reduced ATS DPM Cancer Burden
Bronx, NY	7.8	8.4	3.2	3.5
Bronx, NY – PEJA	7.8	7.3	3.2	3.0

Table 1-3. Hybrid ATS/HARP Risk Calculation Summary

Location	ATS/HARP Max Baseline DPM Cancer Risk (10^{-6})	ATS/HARP Baseline DPM Cancer Burden	ATS/HARP Max Reduced DPM Cancer Risk (10^{-6})	ATS/HARP Reduced DPM Cancer Burden
Bronx, NY	620.5	594	260.9	250
Bronx, NY – PEJA	620.5	509	260.9	214

1.3.1 Valuation of Health Benefits

The monetary valuation of the health benefits associated with using biodiesel as a residential heating oil was determined to be as follows for the locations evaluated:
> Bronx, NY = **$599,909,810**
> Bronx, NY – PEJA Communities = **$509,585,676**

1.4   Valuation of Health Benefits

The monetary valuation of the health benefits associated with using biodiesel as a residential heating oil was evaluated for the community. The benefits are based on reductions of ambient PM$_{2.5}$ concentrations as discussed within this report, coupled with the incidence/prevalence rates and population of the area. These benefits were calculated using U.S. EPA's BenMAP program. The overall benefit rates for each health endpoint are shown in Table 1-4 for the valuations used in this report.

Table 1-4. BenMAP Valuation Values – All Tracts

Health Impact Endpoint	$ Per Incidence
Acute Myocardial Infarction Nonfatal	$35,843.34
Asthma Symptoms Albuterol use	$0.00
ER visits All Cardiac Outcomes	$1,259.54
ER visits respiratory	$948.87
HA All Respiratory	$14,086.98
HA Alzheimers Disease	$12,830.79
HA Cardio- Cerebro- and Peripheral Vascular Disease	$16,654.25
HA Parkinsons Disease	$13,816.43
Incidence Asthma	$48,226.66
Incidence Hay Fever/Rhinitis	$650.88
Incidence Lung Cancer	$13,758.41
Incidence Out of Hospital Cardiac Arrest	$38,790.49
Incidence Stroke	$36,847.33
Minor Restricted Activity Days	$73.72
Mortality All Cause	$7,826,065.37
Work Loss Days	$154.05

The overall benefit rates are slightly different for the PEJA communities due to differing demographics in those communities. Those rates are shown in Table 1-5.

Table 1-5. BenMAP Valuation Values – PEJA Communities

Health Impact Endpoint	$ Per Incidence
Acute Myocardial Infarction Nonfatal	$35,804.75
Asthma Symptoms Albuterol use	$0.00
ER visits All Cardiac Outcomes	$1,259.54
ER visits respiratory	$948.87
HA All Respiratory	$14,031.76
HA Alzheimers Disease	$12,830.12
HA Cardio- Cerebro- and Peripheral Vascular Disease	$16,653.85
HA Parkinsons Disease	$13,816.12
Incidence Asthma	$48,226.66
Incidence Hay Fever/Rhinitis	$650.88
Incidence Lung Cancer	$13,747.54
Incidence Out of Hospital Cardiac Arrest	$38,790.49
Incidence Stroke	$36,847.33
Minor Restricted Activity Days	$73.72
Mortality All Cause	$7,826,065.37
Work Loss Days	$153.98

1.5 Importance of Health Benefits to Environmental Justice Communities

The U.S. EPA defines environmental Justice (EJ) 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."[2] One element of EJ is "The same degree of protection from environmental and health hazards."[3]

As shown in the figures within this report, the health impacts of diesel emissions are disparately high in areas near ports, railyards, distribution centers, freeways, and major roadways. These areas also frequently correspond to areas exhibiting elevated incidence rates of EJ metrics, such as:

- Asthma
- Low Birth Rate
- Cardiovascular Disease
- Low Education
- Linguistic Isolation
- Poverty
- Unemployment
- Housing Burden

These areas are also those with concentrated diesel engine activity of all categories (on-road, off-road, locomotives, and marine). Additionally, the fraction of the diesel engine "population" in these areas tends to be skewed toward conventional diesel engines, rather than new technology diesel engines equipped with particulate matter control systems and selective catalytic reduction (SCR) systems (to control emissions of nitrogen oxides). As such, EJ communities tend to be exposed to (i) higher concentrations of diesel exhaust in general, and (ii) higher concentrations of exhaust emitted by older diesel engines.

The thrust of this study is to demonstrate the benefits of the substitution of biodiesel for conventional diesel. The communities selected for this study were those identified to experience the highest emission rates, the highest ambient concentrations, and the highest risk levels due to diesel exhaust.

As described within this report, these benefits are credited to older technology diesel engines, which, in general, are those not meeting 2010 on-highway certification standards (for on-road engines), and those not meeting Tier 4 final certification standards (for nonroad engines). These benefits of biodiesel will therefore accrue to a much greater degree within EJ communities.

NY DEC identified PEJA communities are reviewed specifically in this analysis.

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[2] See: Environmental Justice | US EPA

[3] Ibid.

2.1 Health Risk of Traditional Diesel Combustion Sources

Diesel exhaust has been identified as an air toxic by the U.S. EPA and the California Air Resources Board (CARB). The following sections provide an overview of the diesel exhaust toxic review process performed by these agencies.

2.1.1 U.S. EPA Air Toxics Screening Assessment

U.S. EPA has generated an interactive tool, EJSCREEN, that allows the EPA to "better meet the Agency's responsibilities related to the protection of public health and the environment". EJSCREEN is an environmental justice mapping and screening tool that includes information such as census tract DPM concentrations and risk values. The basis for those risk values is the ATS.

EPA developed ATS as a state-of-the-science tool to inform both national and localized efforts to collect air toxics information, characterize emissions and help prioritize pollutants and areas of interest for further study to gain a better understanding of risks. The goal of ATS is to identify those air toxics which are of greatest potential concern in terms of contribution to population risk. Ambient and exposure concentrations and estimates of risk and hazard for air toxics in each state are typically generated at the census tract level.

U.S. EPA determines county-wide health risks from DPM by determining the health risks associated with individual component risks as part of the National Emission Inventory (NEI) dataset, which is subsequently evaluated in the ATS. The ATS also evaluates total DPM concentrations on a census tract level, even though that information is not used to generate risk values directly. Those DPM concentrations can be utilized in CARB's HARP program to determine overall DPM cancer risk values using OEHHA derived risk factors.

The types of sources that contribute to modeled DPM concentrations include the following sources identified in the ATS:

> On-road sources,
> Nonroad sources,
> Point-airport-ground support equipment,
> Point-locomotives,
> Nonpoint locomotives, and
> All PM from Diesel or residual-oil-fueled nonpoint commercial marine vessels.

It should be noted that while DPM emissions are not directly recorded for other nonpoint emission sources, such as fuel combustion of distillate fuel oil, the component Hazardous Air Pollutant (HAP) emissions of those sources are reported in the NEI and analyzed in the ATS. Those sources are not included in this analysis as only the directly calculated DPM concentrations are utilized, and the census-by-census analysis using ATS data is not a full picture of census-specific DPM emissions or concentrations. Therefore, these analyses using DPM concentrations are likely understating the potential baseline and reduced cancer risks estimated herein.

The ATS TSD states that the reported Hazardous Air Pollutant (HAP) emissions from the nonpoint 2017 NEI sources were modeled using a hybrid approach with the Community Multiscale Air Quality (CMAQ) and AERMOD models for the most prevalent and high-risk toxics. Coarse, region-wide impacts were determined on a county level using 12-kilometer grids in the CMAQ model. AERMOD was utilized to generate near-field

concentrations using gridded receptors 100 m apart in the area of interest, census block centroid receptors, and monitoring site receptors. These results were then weighted according to grid cell averages to determine census block and tract exposures for the toxics. All other toxics were modeled directly using AERMOD.

3. TOXICITY OF HEATING OIL COMBUSTION COMPOUNDS

3.1 Toxicity of Petroleum-Derived Diesel Exhaust

3.1.1 U.S. EPA

As mentioned previously, U.S. EPA does not have an explicit cancer risk value for total DPM. Instead, the cancer risk values of the individual components are utilized to generate an estimate of excess cancer cases. The individual components of DPM considered carcinogenic include the following compounds:

> Acetaldehyde
> Arsenic
> B[a]anthracene
> Benzene
> Beryllium
> 1,3-Butadiene
> Cadmium
> Cr(VI)
> Chrysene
> D[a,h]anthracene
> Formaldehyde
> In[1,2,3-cd]pyr
> Lead
> Naphthalene
> Nickel
> PAHs (as Benzo(a)pyrene)

The unit risk values of these pollutants are listed in Table 3-1.

3.1.2 CARB

Unlike EPA, OEHHA and CARB have generated a unit risk value for DPM exhaust. It should be noted, these unit risk values cannot be compared directly as the DPM unit risk is compared against 100% of diesel emissions, whereas there are varying degrees of composition for other compounds in diesel exhaust.

Table 3-1. Comparison of U.S. EPA and CARB Diesel Exhaust Toxicity Values

Compound	U.S. EPA Unit Risk $(\mu g/m^3)^{-1}$	CARB Unit Risk $(\mu g/m^3)^{-1}$
Diesel Exhaust	N/A	0.0003
Acetaldehyde	0.0000022	0.0000027
Arsenic	0.0043	0.0033
B[a]anthracene	0.00006	0.00011
Benzene	0.0000078	0.000029
Beryllium	0.0024	0.0024
1,3-Butadiene	0.00003	0.00017

Compound	U.S. EPA Unit Risk $(\mu g/m^3)^{-1}$	CARB Unit Risk $(\mu g/m^3)^{-1}$
Cadmium	0.0018	0.0042
Chrysene	0.0000006	0.000011
Cr(VI)	0.012	0.15
D[a,h]anthracene	0.0006	0.0012
Formaldehyde	0.000013	0.000006
In[1,2,3-cd]pyr	0.00006	0.00011
Lead	0	0.000012
Naphthalene	0.000034	0.000034
Nickel	0.00024	0.00026
PAHs (as Benzo(a)pyrene)	0.0006	0.0011

3.2   Toxicity of Biodiesel Exhaust

The combustion of biodiesel in compression ignition (diesel) engines is generally understood to produce significantly lower emissions of carcinogenic diesel particulate matter (DPM) compared to conventional petroleum-based ultra-low sulfur diesel (ULSD) in older engines that are not equipped with diesel particulate filters (DPFs) or diesel oxidation catalysts (DOCs). Trinity conducted a literature review of relevant studies focusing on the reductions of DPM emissions exhibited by various categories and ratings of diesel engines for both on-road and nonroad vehicles and equipment. The literature review confirmed that reductions in DPM emissions are observed in older-technology diesel engines. These are effectively engines certified to 2006 and earlier on-highway heavy-duty compression ignition standards and Tier 3 and earlier nonroad compression ignition (NRCI) engine standards. These engines make substantial contributions to total DPM emissions from on- and non-road sources as well as public exposure to DPM which is the focus of this study.

The sponsor of this study, the Clean Fuels Alliance America (CFAA), formerly known as the National Biodiesel Board, directed Trinity to assume that the reduction in DPM emissions due to the use of B100 in older Diesel engines is 72% based on emissions data for a specific engine contained in CARB's Biodiesel Characterization and NOx Mitigation Study (October 2011).[4] Trinity, as directed by CFAA, applied this reduction percentage to older-technology on-road and nonroad engines as described in this report to produce an upper-bound (i.e., maximum) estimate of the potential benefits that biodiesel can provide in the communities that are the focus of this study. It is again important to note that no reductions due to biodiesel use were assumed to occur with newer technology diesel engines equipped with factory DOCs or DPFs.

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[4] See (CARB, 2011), Table ES-9 for PM reductions exhibited by a 2000 model year Caterpillar C-15 engine operating on soy-based and animal-based B100.

4.   HEALTH RISK ASSESSMENT METHODOLOGY

The following subsections describe how health risk values were determined for each type of health risk assessment.

4.1   ATS Health Risk Assessment Methodology

The ATS provides overall DPM concentrations, individual source contributions to the total DPM concentration, and individual source risk values. Because DPM risks are not calculated directly, the baseline DPM risks for this evaluation are assumed to equal only those risks from sources that explicitly emit DPM. Therefore, ATS derived DPM risks represent a low estimate of DPM cancer risks.

4.2   ATS/HARP Hybrid Risk Assessment Methodology

Because ATS provides DPM concentrations on a census tract basis, those values are able to be evaluated in CARB's HARP program to determine cancer risks with OEHHA-specific unit risk values. The overall cancer risk from DPM is approximately 100 times higher using OEHHA's unit risk value as opposed to the cumulative risk from the individual component unit risk values derived by EPA.

For all HARP runs, a population-wide assessment was conducted using a 70-year exposure period, with all default values as assigned by the OEHHA Risk Assessment Guidelines[5].

4.3   Valuation of Health Risk Benefits

The monetary valuation of health benefits from using biodiesel was evaluated using USEPA's Environmental Benefits Mapping and Analysis Program - Community Edition (BenMAP), Version 1.5.8.[6] BenMAP is capable of calculating the reduction in incidence or prevalence of negative health impacts associated with a corresponding reduction in ambient $PM_{2.5}$ concentration. BenMAP also allows for the valuation of these reductions based on the use of user-specified valuation functions.

The methodology contained within BenMAP is routinely used by CARB to estimate the health benefits of various rulemaking activities aimed at reducing $PM_{2.5}$ emissions.[7] For this reason, the assumptions and model inputs that were selected for this analysis are based on CARB's methodology as described in detail in Appendix J of the California Truck and Bus Initial Statement of Reasons[8] (except as noted).

4.3.1 Geography, Incidence/Prevalence, and Population

For the Bronx, benefits were calculated on a census tract basis, with total benefits equaling the aggregation of all census tracts within each analysis community. Incidence/prevalence rates were selected from BenMAP default data sets. The population dataset was derived from U.S. Census data at the smallest geographic unit, which is the county level. The analysis selected included a population growth estimate to reflect the 2020 calendar year.

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[5] https://oehha.ca.gov/media/downloads/crnr/2015guidancemanual.pdf
[6] https://www.epa.gov/benmap
[7] https://ww2.arb.ca.gov/resources/documents/carbs-methodology-estimating-health-effects-air-pollution
[8] https://ww3.arb.ca.gov/regact/2010/truckbus10/correctedappj.pdf

4.3.2 Health Impacts

The health impacts analyzed consist of the following:

- Acute Myocardial Infractions (AMIs, or heart attacks)
- Asthma Symptoms – Albuterol Use
- Emergency Room (ER) Visits – All Cardiac Outcomes
- ER Visits – Respiratory
- Hospital Admissions (HA) – All Respiratory
- HA – Alzheimer's Disease
- HA – Cardio-, Cerebro-, and Peripheral Vascular Disease
- HA – Parkinson's Disease
- HA – Respiratory-2
- Incidence – Asthma
- Incidence – Hay Fever/Rhinitis
- Incidence – Lung Cancer
- Incidence – Out of Hospital Cardiac Arrest
- Incidence – Stroke
- Minor Restricted Activity Days
- Mortality – All Causes
- Premature Mortality (all causes)
- Acute respiratory symptoms resulting in "minor restricted activity days"
- Work loss days

The above health impacts, or "endpoints" are those routinely used by CARB during their rulemaking, and hence were used for this analysis.

For each endpoint, BenMAP requires the user to select one or more health impact functions. Each health impact function option represents a technical study reflecting the relationship between $PM_{2.5}$ concentrations and the health impact "endpoint" that is being studied. With regard to the above health impact endpoints, the studies relied upon were selected based on those used in the CARB analyses previously stated, to the degree possible.

Specifically, for the endpoint of "premature death" (which includes cancer deaths), the analysis relied upon the study *Pope et al., 2002*, which is also the study CARB has primarily relied upon. For the asthma exacerbation endpoint, the study CARB relied upon is not included within BenMAP. The latest version of BenMAP did not indicate any incidences of asthma exacerbation. For acute respiratory symptoms resulting in minor restricted activity days, the analysis relied upon the study *Ostro and Rothschild, 1989*. And finally, for work loss days, the study *Ostro, 1987* was selected, which is also a study CARB has primarily relied upon.

It is important to note that the endpoint of premature deaths calculated by BenMAP is not equivalent to the cancer burden values discussed in this report. This is because the endpoint of premature death encompasses all causes, including both lung cancer and ischemic heart disease. In contrast, the metric of cancer burden includes all types of cancers attributed to $PM_{2.5}$ exposure. Likewise, cancer burden relates to incidence rate of cancer, which is not the same as the premature death endpoint. Many cancer cases do not result in death, and hence, cancer burden reductions will always be higher than avoided premature deaths calculated by BenMAP.

4.3.3 Valuation Functions

Valuation functions assign a value to each health impact "endpoint." Of the above health impacts, reduced premature mortality will always dominate the overall benefit value under any scenario. However, to document the use of BenMAP, it is important to document the valuation functions used for each endpoint included in this project.

- For the endpoint of premature mortally, the BenMAP standard valuation function "based on 26 value-of-life studies" was selected.
- For the health impact endpoint of asthma exacerbation, all of the available health impact functions within BenMAP were pooled to derive a result.
- For the acute respiratory endpoint of minor restricted activity days, the standard EPA valuation function of "WTP: 1 day, CV studies" was selected.
- For the endpoint of work loss days, the standard EPA valuation function of median work loss days, county specific was selected.

4.3.4 General Valuation Results

Specific results are provided below in Section 5. In a general, it is noted that the overall value of benefits is sensitive to (1) the extent of geographic area analyzed, and (2) the population living within that same geographic area. That is, analyses performed over a broader area, and encompassing a greater population, will produce greater benefits.
[9].

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[9] 2019 AirToxScreen Data

5. HEALTH RISK ASSESSMENT RESULTS

5.1.1 ATS Modeling

The subsections below review the ATS data available for the Bronx. The data is outlined in the following order:

- Baseline ATS Total Cancer Risks
- Baseline ATS DPM Cancer Risks
- Reduced ATS DPM Cancer Risks

As stated previously, ATS indirectly determines DPM cancer risk by utilizing the individual exhaust component emission rates and toxicity factors. The census tract DPM concentrations provided by ATS are not utilized to determine cancer risks in the ATS evaluation. Therefore, census tract DPM concentrations are not shown in this section, and the ATS-specific review only utilizes ATS raw data to determine the health risk reductions due to a change to biodiesel.

Error! Reference source not found. shows the Baseline ATS Total Cancer Risk. This total cancer risk encompasses all sources in the area.

Error! Reference source not found. shows those cancer risks specific to DPM emissions as determined using ATS raw data.

Error! Reference source not found. shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the Bronx.

Because the ATS analysis utilized EPA-specific health risk values, the baseline and reduced cancer risks will be orders of magnitude lower than any equivalent analysis using OEHHA risk values. Therefore, the results of this analysis can be considered the low-end estimate of baseline and reduced cancer risks in the Bronx.
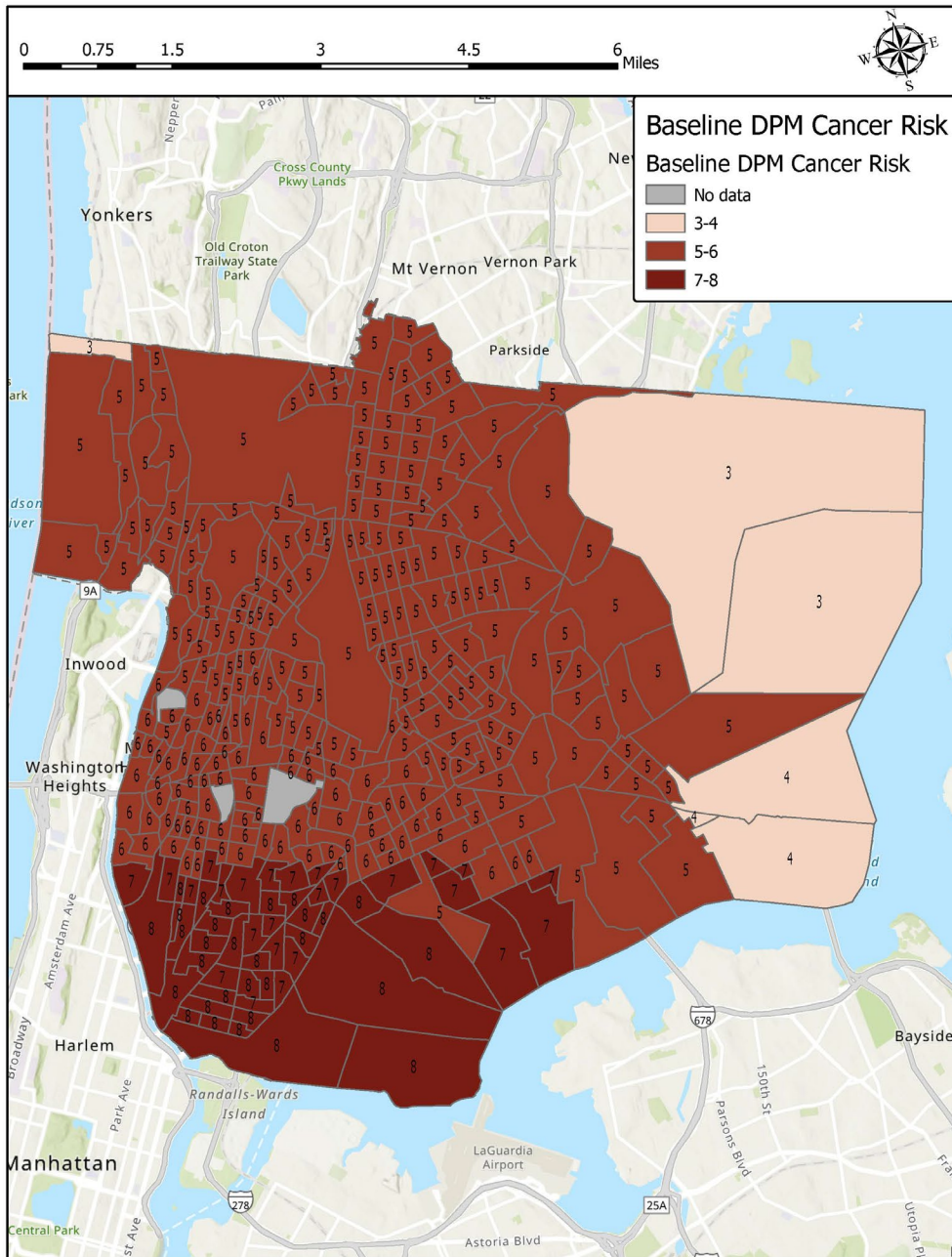
**Figure 5-1. Bronx Baseline ATS Total Cancer Risks**
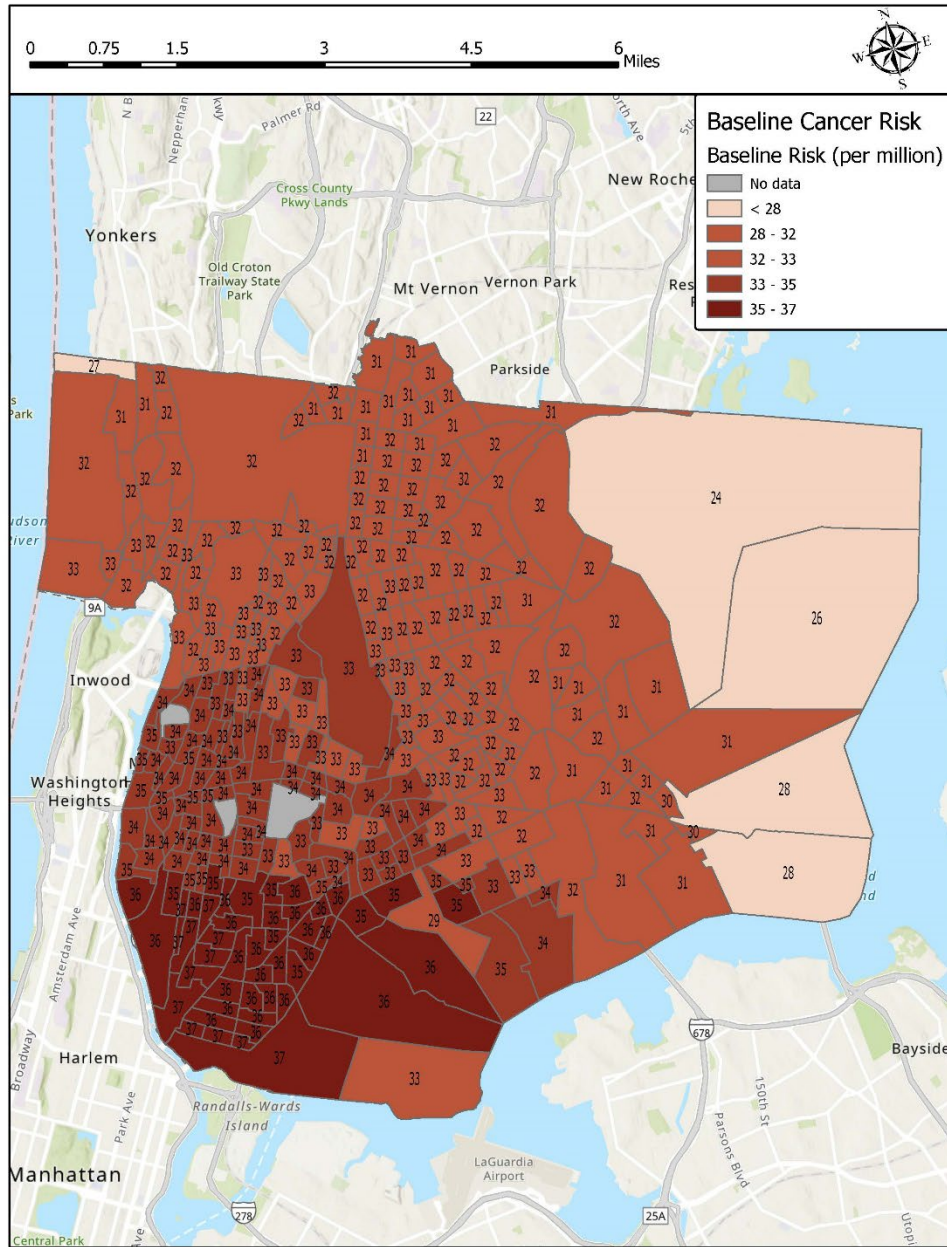
According to the ATS, the maximum baseline cancer risk in the Bronx is 37.14 cancer cases per million residents for census tract 36005001900, with a population of 191,251 residents and a PEJA community. When accounting for all the communities assessed, the total cancer burden for the Bronx is 44.5 cancer cases expected over a 70-year timeline among a total community population of 1,337,657. When accounting for only PEJA communities, the total cancer burden for the Bronx is 37.6 cancer cases expected over a 70-year timeline among a total community population of 1,116,511.

Figure 5-2. Bronx Baseline ATS DPM Cancer Risks

According to the ATS, the maximum DPM-specific baseline cancer risk in the Bronx is 8 cancer cases per million residents for census tract 36005000100, with a population of 4,001 residents and a PEJA community. When accounting for all the communities assessed, the baseline DPM-specific cancer burden for the Bronx is 8.4 cancer cases expected over a 70-year timeline among a total community population of 1,337,657. When accounting for only PEJA communities, the baseline DPM-specific cancer burden for the Bronx is 7.4 cancer cases expected over a 70-year timeline among a total community population of 1,116,511.

Figure 5-3. Bronx Reduced ATS DPM Cancer Risks
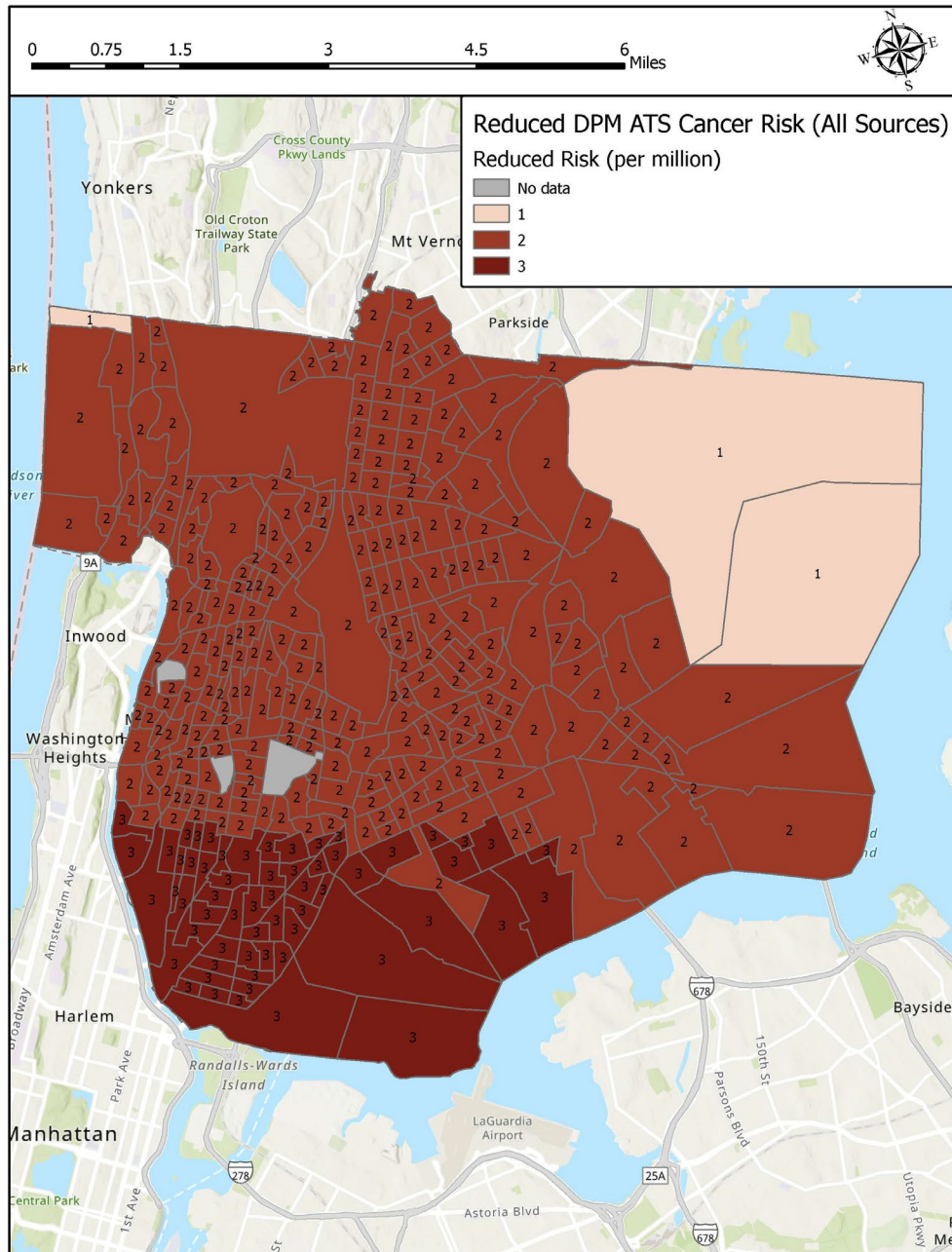
Applying the biodiesel exhaust reduction factor outlined in Section 3.2, the maximum DPM-specific reduced cancer risk in the Bronx becomes 3 cancer cases per million residents for census tract 36005000100, with a population of 337,606 residents and a PEJA community. When accounting for all the communities assessed, the reduced DPM-specific cancer burden for the Bronx becomes 3.2 cancer cases expected over a 70-year timeline among a total community population of 1,337,657. When accounting for PEJA communities only, the reduced DPM-specific cancer burden for the Bronx becomes 3 cancer cases expected over a 70-year timeline among a total community population of 1,116,511.

5.1.1.2 *ATS Data with HARP Risk Factors*

The subsections below utilize the DPM concentration values provided by the ATS, which are then evaluated using CARB's HARP program with OEHHA cancer unit risk values. The data is outlined in the following order:

•   Baseline ATS DPM Concentrations
•   Baseline ATS/HARP DPM Hybrid Risks
•   Reduced ATS/HARP DPM Hybrid Risks

As stated previously, OEHHA cancer unit risk values can be orders of magnitude higher than EPA risk values. The census tract DPM concentrations provided by ATS were therefore utilized to determine cancer risks in combination with OEHHA cancer unit risk values. The ATS DPM concentrations are shown, along with baseline and reduced cancer risks using CARB's HARP program.
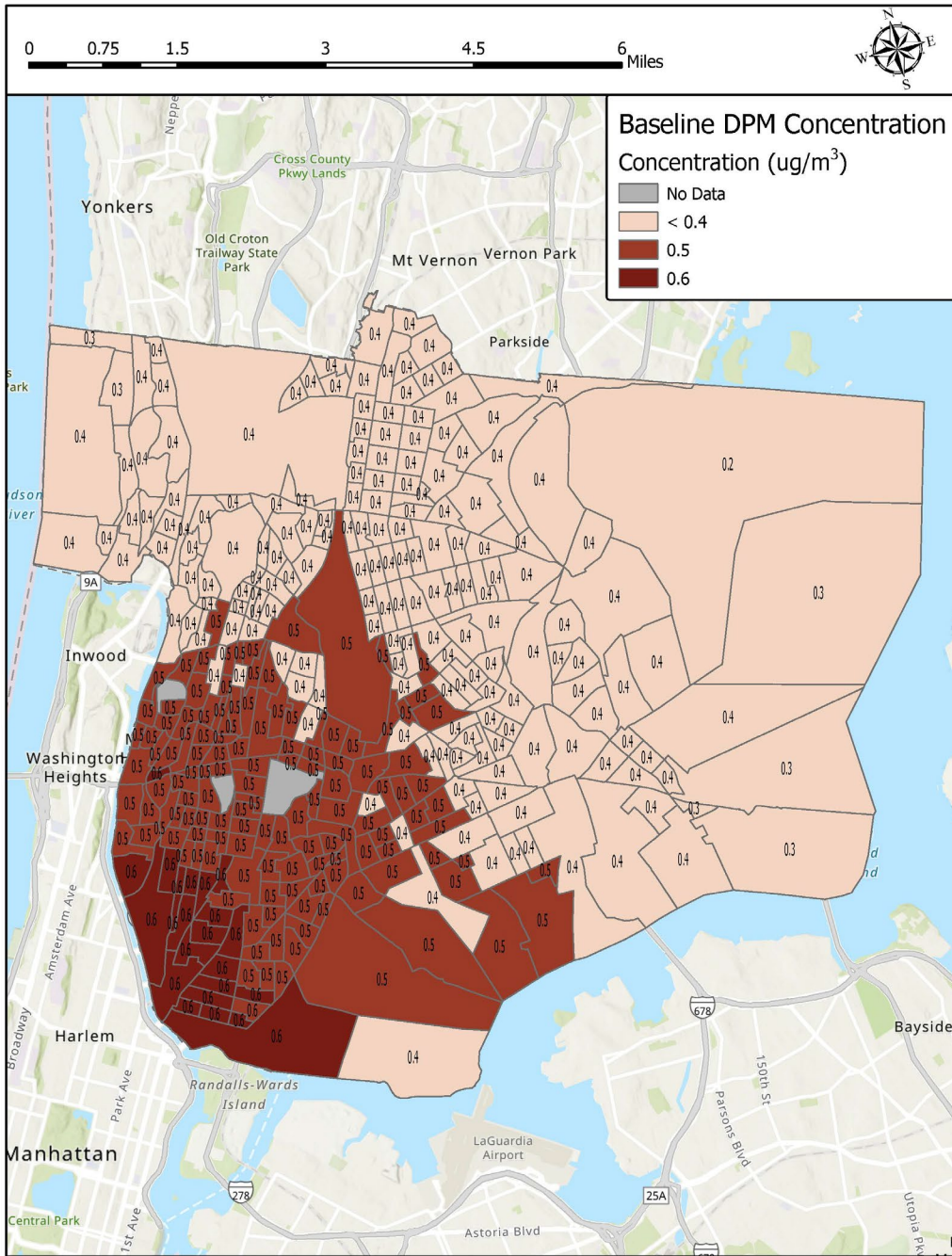
Figure 5-4 shows the baseline DPM concentrations provided by the ATS.

Figure 5-5 shows the baseline DPM-specific cancer risks as determined using the ATS concentration values and CARB's HARP program.

Figure 5-6 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the Bronx.

Because this hybrid ATS/HARP analysis utilized OEHHA specific health risk values, the baseline and reduced cancer risks are orders of magnitude higher than an equivalent analysis using EPA cancer unit risk values. Therefore, the results of this analysis can be considered the high-end estimate of baseline and reduced cancer risks in the Bronx.

Figure 5-4. Bronx ATS Baseline DPM Concentration


According to the ATS, the maximum baseline DPM concentration in the Bronx is 0.63 μg/m³ for census tract 36005005100, with a population of 61,475 residents, and a PEJA community. The average DPM concentration of the Bronx is 0.45 μg/m³.

Figure 5-5. Bronx Baseline ATS/HARP Hybrid Risks
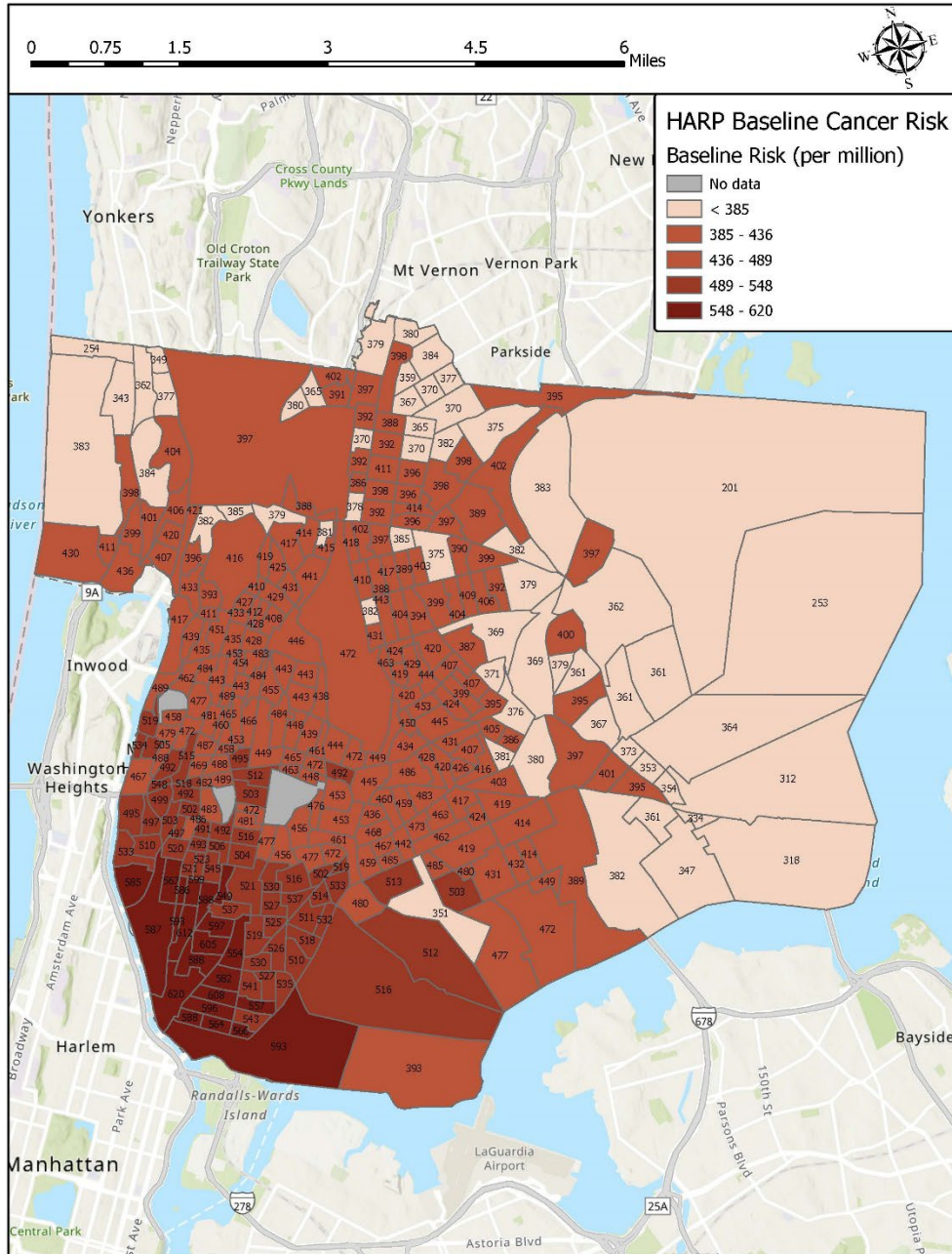
Using ATS DPM concentrations and OEHHA cancer unit risk values, the maximum DPM-specific baseline cancer risk in the Bronx is 620 cancer cases per million residents for census tract 36005005100, with a population of 61,475 residents, and a PEJA community. When accounting for all the communities assessed, the baseline DPM-specific cancer burden for the Bronx is 594 cancer cases expected over a 70-year timeline among a total community population of 1,337,657. When accounting for only PEJA communities, the baseline DPM-specific cancer burden for the Bronx is 509 cancer cases expected over a 70-year timeline among a total community population of 1,116,511.

Figure 5-6. Bronx Reduced ATS/HARP Hybrid Risks
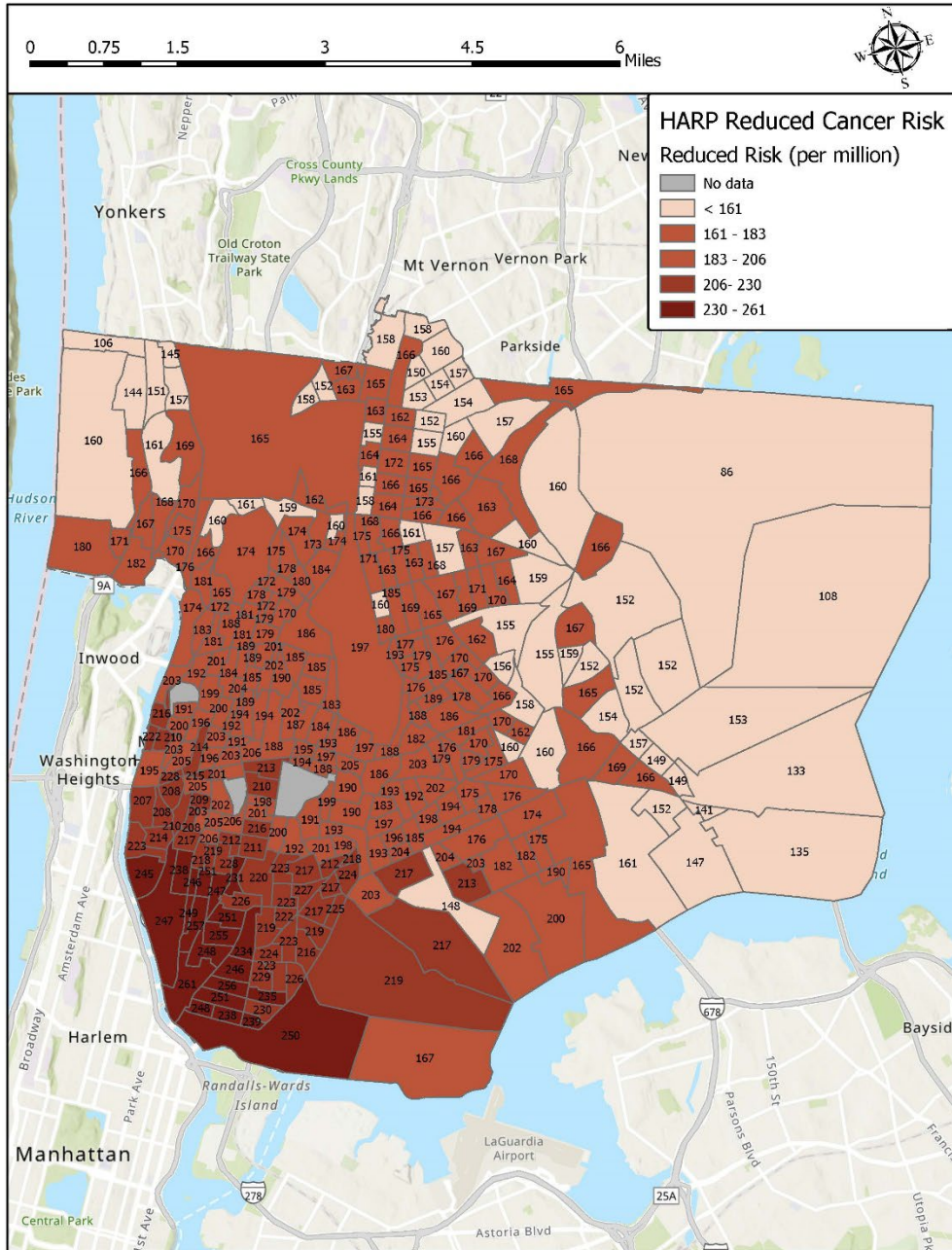
Applying the biodiesel exhaust reduction factor outlined in Section 3.2, the maximum DPM-specific reduced cancer risk in the Bronx becomes 261 cancer cases per million residents for census tract 36005005100, with a population of 61,475 residents. When accounting for all the communities assessed, the reduced DPM-specific cancer burden for the Bronx becomes 250 cancer cases expected over a 70-year timeline among a total community population of 1,337,657. When accounting for only PEJA communities, the reduced DPM-specific cancer burden for the Bronx becomes 214 cancer cases expected over a 70-year timeline among a total community population of 1,116,511.

5.1.2 Valuation of Health Benefits – All Tracts

The health benefits of reduced PM$_{2.5}$ exposure were modeled using USEPA's Ben-MAP according to the methodology described under Section 4.3. The results are shown in Table 5-1 below.

Table 5-1. Bronx Valuation of Reduced Incidence Benefits – All Tracts

Health Impact Endpoint	Reduced Incidence	Benefit Value
Acute Myocardial Infarction Nonfatal	177.5	$6,362,746
Asthma Symptoms Albuterol use	0.0	$0
ER visits All Cardiac Outcomes	30.3	$38,136
ER visits respiratory	111.0	$105,372
HA All Respiratory	19.4	$272,864
HA Alzheimers Disease	39.1	$501,137
HA Cardio- Cerebro- and Peripheral Vascular Disease	10.5	$175,630
HA Parkinsons Disease	5.7	$79,276
HA Respiratory-2	1.8	$0
HA Respiratory-2 HA All Respiratory	21.2	$0
Incidence Asthma	204.5	$9,863,057
Incidence Hay Fever/Rhinitis	1,276.6	$830,889
Incidence Lung Cancer	11.3	$155,413
Incidence Out of Hospital Cardiac Arrest	1.3	$50,760
Incidence Stroke	4.3	$158,398
Minor Restricted Activity Days	73,546.5	$5,421,716
Mortality All Cause	73.3	$573,958,729
Work Loss Days	12,565.7	$1,935,686
Total		**$599,909,810**

5.1.3 Valuation of Health Benefits – PEJA Communities

The health benefits of reduced PM$_{2.5}$ exposure were modeled using USEPA's Ben-MAP according to the methodology described under Section 4.3. The results for only the PEJA communities are shown in Table 5-2 below.

Table 5-2. Bronx Valuation of Reduced Incidence Benefits – PEJA Communities

Health Impact Endpoint	Reduced Incidence	Benefit Value
Acute Myocardial Infarction Nonfatal	151.5	$5,424,049
Asthma Symptoms Albuterol use	0.0	$0
ER visits All Cardiac Outcomes	25.9	$32,678
ER visits respiratory	96.2	$91,286
HA All Respiratory	16.7	$234,947
HA Alzheimers Disease	33.1	$424,880
HA Cardio- Cerebro- and Peripheral Vascular Disease	9.0	$149,475
HA Parkinsons Disease	4.9	$67,495
HA Respiratory-2	1.6	$0
HA Respiratory-2 HA All Respiratory	18.3	$0
Incidence Asthma	176.9	$8,532,150
Incidence Hay Fever/Rhinitis	1,093.0	$711,380
Incidence Lung Cancer	9.6	$132,266
Incidence Out of Hospital Cardiac Arrest	1.1	$43,494
Incidence Stroke	3.7	$134,949
Minor Restricted Activity Days	64,183.9	$4,731,523
Mortality All Cause	62.3	$487,181,745
Work Loss Days	10,997.4	$1,693,359
Total		**$509,585,676**