ASSESSMENT OF HEALTH BENEFITS FROM USING BIODIESEL AS A TRANSPORTATION FUEL

Clean Fuels
ALLIANCE AMERICA

National Biodiesel Board

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TABLE OF CONTENTS

National Biodiesel Board / Assessment of Health Benefits
From Using Biodiesel as a Transportation Fuel
Trinity Consultants   1-1

National Biodiesel Board / Assessment of Health Benefits
From Using Biodiesel as a Transportation Fuel
Trinity Consultants   1-2

LIST OF FIGURES

National Biodiesel Board / Assessment of Health Benefits
From Using Biodiesel as a Transportation Fuel
Trinity Consultants   1-3

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

AADT	Annual Average Daily Traffic
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
B[a]anthracene	Benz[a]anthracene, a type of PAH
BenMAP-CE	Environmental Benefits Mapping and Analysis Program - Community Edition
BWHRA	(San Pedro) Bay-Wide Regional Human Health Risk Assessment Tool
CARB	California Air Resources Board
CalEnviroScreen	California Communities Environmental Health Screening Tool
CMAQ	Community Multiscale Air Quality Model
Cr(VI)	Hexavalent Chromium
CV	Contingent Valuation
D[a,h]anthracene	Dibenz[a,h]anthracene, a type of PAH
EMFAC	Emission Factor Model
EJSCREEN	Environmental Justice Screening and Mapping Tool
DPM	Diesel Particulate Matter
HAD	(Diesel) Hazard Assessment Document
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, a type of PAH

National Biodiesel Board / Assessment of Health Benefits
From Using Biodiesel as a Transportation Fuel
Trinity Consultants   1-6

LA	Los Angeles
LB	Long Beach
MEIR	Maximally Exposed Individual Resident
NAD	North American Datum
NATA	National Air Toxics Assessment
NEI	National Emissions Inventory
OEHHA	(California) Office of Environmental Health Hazard Assessment
NIOSH	National Institute for Occupational Safety and Health
PAH	Polycyclic Aromatic Hydrocarbon
$PM_{2.5}$	Particulate Matter with an Aerodynamic Diameter of ≤2.5 microns
PMI	Point of Maximum Impact
ppm	Parts Per Million
TSD	Technical Support Document
ULSD	Ultra-Low Sulfur Diesel
U.S. EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
WCWLB	Wilmington, Carson, and West Long Beach
WTP	Willingness-to-Pay

1. EXECUTIVE SUMMARY

This report assesses the health benefits of substituting biomass-based diesel in transportation-related sources currently fueled by conventional ultra-low sulfur diesel (ULSD or diesel fuel) in several Western States. The emission sources, data sources, models, and analytical techniques for each urbanized area were selected to provide the most comprehensive, robust, and transparent analysis possible within the schedule and budget limitations of the approved project. For all locations, Trinity has attempted to identify the communities believed to be most impacted by the emission sources modeled and has highlighted the benefits of biomass-based biodiesel to those specific communities to the degree possible.

1.1 Analysis Technique

The general analysis technique is a simplified, air toxic-based health risk assessment (HRA) of specific diesel fueled transportation-related sources in the areas selected. The 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, the analyses show the air toxic health risk benefits of fueling the modeled transportation-related sources with biomass-based diesel compared to ULSD.

Because health risk is directly proportional to the 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 ULSD combustion compared to biomass-based diesel combustion. This analysis translates those changes in toxicity values into risk metrics, including reductions in cancer risk (per million people) and reduction in cancer burden.

1.2 Locations

The following communities were assessed for health risk reductions due to the use of biomass-based diesel in place of ULSD for transportation sources:

> Wilmington, Carson, and West Long Beach, California
> San Bernardino, California
> South Fresno, California
> West Oakland, California
> Portland, Oregon
> Seattle, Washington
> Everett, Washington; and
> Denver, Colorado

Each of the above locations were selected for specific reasons discussed in more detail within this report but are generally those areas believed to be some of the most impacted by the transportation emission sources modeled. For each location, multiple and sometimes differing data sources and prior analyses were available. This provided an opportunity to carry-out several types of analyses, which can be broadly summarized as either "community wide" or "source specific." For several locations, both types of analyses were possible.

A secondary goal of this report is to compare and contrast the differences inherent in prior analyses, to examine the reasons for those differences, and to provide a bounded range of health risk benefits.

1.3 Summary of Results

1.3.1 Wilmington, Carson, and West Long Beach, California

It is expected that the baseline cancer risk associated with diesel fuel usage in the Wilmington, Carson, and West Long Beach (WCWLB) area lies somewhere between 16 and 1,817 excess cancer cases per million residents over a 70-year timeline. Assuming a full transition from traditional diesel fuel to biomass-based diesel, the baseline cancer risk in the WCWLB area is reduced to a value between 9 and 1,104 excess cancer cases per million residents.

The total cancer burden (cancer risk multiplied by affected population) for all census tracts in a 6-mile by 20-mile rectangle, consistent with the AB617 selected community, is 473 assuming the higher end of the risk range, with an expected reduction in cancer burden to a value of approximately 264 with the use of biomass-based diesel fuel in place of traditional diesel.

The site-specific HRA for WCWLB shows that local risk maxima from the ports are consistent with the evaluation of National Air Toxics Assessment (NATA) data.

1.3.2 West Oakland, California

It is expected that the baseline cancer risk associated with diesel usage in the West Oakland area lies somewhere between 7 and 533 excess cancer cases per million residents over a 70-year timeline. Assuming a full transition from traditional diesel to biomass-based diesel, the baseline cancer risk in West Oakland is reduced to a value between 4 and 298 excess cancer cases per million residents.

The total cancer burden for all census tracts in an 8-mile diameter circle centered over Oakland, consistent with the AB617 selected community, is 112 assuming the higher end of the risk range, with an expected reduction in cancer burden to a value of approximately 62 with the use of biomass-based diesel fuel in place of traditional diesel.

The site-specific HRA for the Port of Oakland shows that local risk maxima from the port are consistent with the evaluation of NATA data.

1.3.3 San Bernardino, California

It is expected that the baseline cancer risk associated with diesel fuel usage in the San Bernardino area lies somewhere between 2 and 377 excess cancer cases per million residents over a 70-year timeline. Assuming a full transition from traditional diesel to biomass-based diesel, the baseline cancer risk in San Bernardino is reduced to a value between 1 and 210 excess cancer cases per million residents.

The total cancer burden for all census tracts in a 7-mile diameter circle centered over the eastern edge of San Bernardino International airport is 33 assuming the higher end of the risk range, with an expected reduction in cancer burden to a value of approximately 19 with the use of biomass-based diesel fuel in place of traditional ULSD.

The site-specific HRA for San Bernardino shows that local risk maxima from a local project including regional highways and interstates are consistent with the evaluation of NATA data.

1.3.4   Everett, Washington

It is expected that the baseline cancer risk associated with diesel fuel usage in the Everett, Washington area lies somewhere between 5 and 1,313 excess cancer cases per million residents over a 70-year timeline. Assuming a full transition from traditional diesel to biomass-based diesel, the baseline cancer risk in Everett is reduced to a value between 3 and 733 excess cancer cases per million residents.

The total cancer burden for all census tracts in a 5-mile diameter circle centered over the center of Everett is 126 assuming the higher end of the risk range, with an expected reduction in cancer burden to a value of approximately 70 with the use of biomass-based diesel fuel in place of traditional diesel.

The site specific HRA for Everett shows that local risk maxima from a local project including regional highways and interstates are consistent with the evaluation of NATA data.

1.3.5   Seattle, Washington

It is expected that the baseline cancer risk associated with diesel fuel usage in the Seattle, Washington area lies somewhere between 11 and 1,442 excess cancer cases per million residents over a 70-year timeline. Assuming a full transition from traditional diesel to biomass-based diesel fuel, the baseline cancer risk in Seattle is reduced to a value between 6 and 804 excess cancer cases per million residents.

The total cancer burden for all census tracts in a 5-mile diameter circle centered over the center of Seattle is 755 assuming the higher end of the risk range, with an expected reduction in cancer burden to a value of approximately 421 with the use of biomass-based diesel fuel in place of traditional diesel.

The site specific HRA for Seattle shows that local risk maxima from a local project including regional highways and interstates are consistent with the evaluation of NATA data.

1.3.6   Portland, Oregon

It is expected that the baseline cancer risk associated with diesel fuel usage in the Portland, Oregon area lies somewhere between 5 and 651 excess cancer cases per million residents over a 70-year timeline. Assuming a full transition from traditional diesel to biomass-based diesel, the baseline cancer risk in Portland is reduced to a value between 3 and 363 excess cancer cases per million residents.

The total cancer burden for all census tracts in a 5-mile diameter circle centered over the center of Portland is 189 assuming the higher end of the risk range, with an expected reduction in cancer burden to a value of approximately 106 with the use of biomass-based diesel fuel in place of traditional diesel.

The site specific HRA for Portland shows that local risk maxima from a local project including regional highways and interstates is consistent with the evaluation of NATA data.

1.3.7   Denver, Colorado

It is expected that the baseline cancer risk associated with diesel fuel usage in the Denver, Colorado area lies somewhere between 8 and 1,209 excess cancer cases per million residents over a 70-year timeline. Assuming a full transition from traditional diesel to biomass-based diesel, the baseline cancer risk in Denver is reduced to a value between 4 and 675 excess cancer cases per million residents.

The total cancer burden for all census tracts in a 5-mile diameter circle centered over the center of Denver is 552 assuming the higher end of the risk range, with an expected reduction in cancer burden to a value of approximately 308 with the use of biomass-based diesel fuel in place of traditional diesel.

The site specific HRA for Denver shows that local risk maxima from a local project including regional highways and interstates are consistent with the evaluation of NATA data.

1.3.8   South Fresno, California

It is expected that the baseline cancer risk associated with diesel fuel usage in the South Fresno, California area lies somewhere between 8 and 491 excess cancer cases per million residents over a 70-year timeline. Assuming a full transition from traditional diesel to biomass-based diesel, the baseline cancer risk in South Fresno is reduced to a value between 2 and 274 excess cancer cases per million residents.

The total cancer burden (cancer risk multiplied by affected population) for all census tracts in a 5-mile diameter circle centered over the center of Fresno is 208 assuming the higher end of the risk range, with an expected reduction in cancer burden to a value of approximately 116 with the use of biomass-based diesel fuel in place of traditional diesel.

A site-specific HRA was not performed for South Fresno because emissions data was not available for each emissions source group, and consequently a separate ambient impacts modeling analysis could not be performed for this site.

1.3.9   Valuation of Health Benefits

The monetary valuation of the health benefits associated with using biodiesel as a transportation fuel instead of ULSD was determined to be as follows for the locations evaluated:

> WCWLB, CA = $1,690 million   Seattle, WA = $253 million
> West Oakland, CA = $172 million   Portland, OR = $113 million
> San Bernardino, CA = $156 million   Denver, CO = $252 million
> Everett, WA = $48 million   South Fresno, CA = $28 million

1.4   Valuation of Health Benefit Results

The monetary valuation of the health benefits associated with using biodiesel as a transportation fuel was evaluated for each 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 health benefit valuations were calculated using U.S. EPA's BenMAP program, using inputs typically selected by CARB in demonstrating the benefits from their rulemakings. The overall benefit rates for each health endpoint are shown in Table 1-1, for both CARB valuations and those used in this report.

Table 1-1. Comparison of CARB versus BenMAP Valuation Results

Endpoint	CARB Valuation	BenMAP Valuation Used in this Report
Premature Mortality	$9,300,000 per death	$8,700,000 per death
Asthma Exacerbation	$52 per symptom day	$59 per symptom day
Minor Restricted Activity Days	$64 per day	$70 per day
Work Loss Days	$178 per day	$150 - $409 per day (depending on location)

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."[1] One element of EJ is "The same degree of protection from environmental and health hazards."[2]

As shown in the figures within this report, the health impacts of diesel emissions are disparately high in areas in close proximity to 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.

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[1] See: Environmental Justice | US EPA

[2] Ibid.

2. INTRODUCTION

2.1 Assessments of the Health Risk of Diesel Exhaust

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

With respect to this analysis, U.S. EPA's current stance on the toxicity of diesel particulate matter (DPM) as a carcinogen is outlined in the NATA Technical Support Document (TSD), which states the following about DPM in Section 5.4.6.

> *Diesel PM (DPM) mass (expressed as µg DPM/m3) has historically been used as a surrogate measure of exposure for whole diesel exhaust. Although uncertainty exists as to whether DPM is the most appropriate parameter to correlate with human health effects, it is considered a reasonable choice until more definitive information about the mechanisms of toxicity or mode(s) of action of diesel exhaust becomes available.*

In U.S. EPA's 2002 Diesel Health Assessment Document (Diesel HAD), exposure to diesel exhaust was classified as likely to be carcinogenic to humans by inhalation from environmental exposures, in accordance with the revised draft 1996/1999 U.S. EPA cancer guidelines. Several other agencies (National Institute for Occupational Safety and Health, the International Agency for Research on Cancer, the World Health Organization, California EPA and the U.S. Department of Health and Human Services) had made similar hazard classifications prior to 2002. U.S. EPA also concluded in the 2002 Diesel HAD that it was impossible to calculate a cancer unit risk for diesel exhaust due to limitations in the exposure data for the occupational groups or the absence of a dose-response relationship.

In the absence of a cancer unit risk, the Diesel HAD sought to provide additional insight into the significance of the diesel exhaust cancer hazard by estimating possible ranges of risk that might be present in the population. An exploratory analysis was used to characterize a possible risk range, and found that environmental risks from diesel exhaust exposure could plausibly range from a low of 10^{-5} to as high of 10^{-3} for long-term exposures. Because of uncertainties, the analysis acknowledged that "the risks could be lower than 10-5, and a zero risk from diesel exhaust exposure was not ruled out."

Additionally, the Diesel HAD document states in Section 1.9.1 that "[t]he results do not include exposures and risk from all compounds." Of note, the assessment does not quantify cancer risk from diesel PM, although EPA has concluded that "the general population is exposed to levels close to or overlapping with levels that have been linked to increased cancer risk in epidemiology studies."

The NATA study instead quantifies the carcinogenic effects of DPM using the toxicity factors and exposure levels comprising diesel exhaust. For this reason, this analysis will utilize the NATA determined DPM excess cancer risk values as a low-end estimate of baseline and reduced cancer risks.

2.1.2 California

The California Air Resources Board (CARB) has designated "particulate emissions from diesel-fueled engines," commonly referred to as diesel particulate matter or "DPM," as a Toxic Air Contaminant. This

determination is based primarily on evidence from occupational studies that show a link between exposure to DPM and lung cancer induction, as well as death from lung cancer.[3] According to CARB, 70% of known cancer risks are related to DPM air toxics in California, and is estimated to increase statewide cancer risk by 520 cancers per million residents exposed over a lifetime.

Additionally, the Office of Environmental Health Hazard Assessment (OEHHA) cancer unit risk factor is approximately 100 times greater than the cumulative cancer risks estimated by U.S. EPA for individual diesel exhaust components. As such, this analysis will generate excess cancer risk values based on the OEHHA DPM values using CARB's Hot Spots Analysis & Reporting Program (HARP) software as a high-end estimate of baseline and reduced cancer risks.

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[3] https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health

3.1   U.S. EPA

3.1.1   2014 National Air Toxics Assessment (NATA)

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 NATA.

According to the NATA TSD, "[t]he NATA is the U.S. EPA's ongoing thorough evaluation of air toxics across the United States." EPA developed NATA 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 NATA 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 NATA. The NATA 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 NATA:

> 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 NATA[4]. Those sources are not included in this analysis as only the directly calculated DPM concentrations are utilized, and the census-by-census analysis using NATA 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 NATA TSD states that DPM emissions from 2014 NEI sources were modeled using a hybrid approach with the Community Multiscale Air Quality (CMAQ) and AERMOD models for the 52 most prevalent and high-

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[4] This information was used to conduct the fuel heating oil analyses

risk toxics, including DPM. 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 (1 km in highly populated areas [>1 million population], 4 km in other areas), 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 52 toxics. All other toxics were modeled directly using AERMOD.

Section 5 describes how the NATA data was utilized to determine EPA derived DPM baseline and reduced risks, and OEHHA derived DPM baseline and reduced risks.

3.2   California

3.2.1   CalEnviroScreen

CARB has also generated an environmental justice tool known as the California Communities Environmental Health Screening Tool (CalEnviroScreen). CalEnviroScreen does not utilize NATA data for its environmental justice tool, and it provides a kilogram per day emission rate as opposed to DPM concentrations and health risks. According to the CalEnviroScreen report[5], DPM emissions for on-road sources were generated using CARB's on-road emissions model, EMFAC2013, to calculate county-wide estimates of DPM emissions for a July weekday. Non-road sources were calculated using county-wide estimates of DPM for a July weekday, extracted from CARB's emission inventory forecasting system.

Due to the overly conservative nature of using a maximum daily DPM emission rate for a 70-year analysis, CalEnviroScreen data was not analyzed for the selected locations. An initial model was run using CalEnviroScreen emission rates, analyzed using CARB's HARP program, and the cancer risk values were more than an order of magnitude higher than the EPA NATA assessment. An assessment utilizing CalEnviroScreen data would have generated unrealistically high baseline cancer risks.

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[5] Available at: https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3report.pdf#page=40

4. TOXICITY OF PETROLEUM DIESEL AND BIODIESEL EXHAUST

4.1 Toxicity of Petroleum-Derived Diesel Exhaust

4.1.1 U.S. EPA

As mentioned in Section 3 of this report, 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 4-1.

4.1.2 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 4-1. 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

4.2   Toxicity of Biodiesel Exhaust

Biodiesel exhaust is expected to be 72% less carcinogenic for than traditional diesel exhaust for "old technology" (pre-2010) engines.[6] For DPM, the estimated 72% reduction for biodiesel in pre-2010 engines was based on the average of DPM results reported in CARB 2011, NREL 2003, and NREL 2006, and Yanowitz and McCormick, 2009.

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[6] "Proposed Emission Reductions for Public Health Benefits from Biodiesel Study;" email from Floyd Vergara, NBB, to Jim Lyons, Trinity; August 4, 2020.

5.   HEALTH RISK ASSESSMENT METHODOLOGY

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

5.1   NATA Health Risk Assessment Methodology

The NATA 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, NATA derived DPM risks represent a low estimate of DPM cancer risks.

5.2   NATA/HARP Hybrid Risk Assessment Methodology

Because NATA 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[7].

5.3   Site-Specific Health Risk Assessments

Section 6 outlines how each site-specific health risk assessment was modeled. 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[8].

5.4   Valuation of Health Risk Benefits

The monetary valuation of health benefits from using biodiesel was evaluated using U.S. EPA's Environmental Benefits Mapping and Analysis Program - Community Edition (BenMAP), Version 1.5.0.[9] 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 PM2.5 emissions.[10] 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[11] (except as noted).

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

5.4.1 Geography, Incidence/Prevalence, and Population

For each community, 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.

5.4.2 Health Impacts

The health impacts analyzed consisted of the following:

> Premature Mortality (all causes).
> Asthma Exacerbation (including cough, shortness of breath, and wheeze)—together taken to mean "asthma attacks."
> 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. Hence, all available studies related to asthma endpoints were "pooled" using that functionality of BenMAP. 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.

5.4.3 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.

5.4.4   General Valuation Results

Specific results are provided below in Section 6, for each community. 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.

6. HEALTH RISK ASSESSMENT RESULTS

6.1 Wilmington, Carson, West Long Beach (WCWLB), CA

6.1.1 NATA Health Risks

The subsections below review the NATA data available for the WCWLB community. The data is outlined in the following order:

- Baseline NATA Total Cancer Risks
- Baseline NATA DPM Cancer Risks
- Reduced NATA DPM Cancer Risks

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

Figure 6-1 shows the Baseline NATA Total Cancer Risk. This total cancer risk encompasses all sources in the area.

Figure 6-2 shows those cancer risks specific to DPM emissions as determined using NATA raw data.

Figure 6-3 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the WCWLB community.

Because the NATA 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 WCWLB community.

6.1.1.1 NATA Risk Data

Figure 6-1. WCWLB Baseline NATA Total Cancer Risks
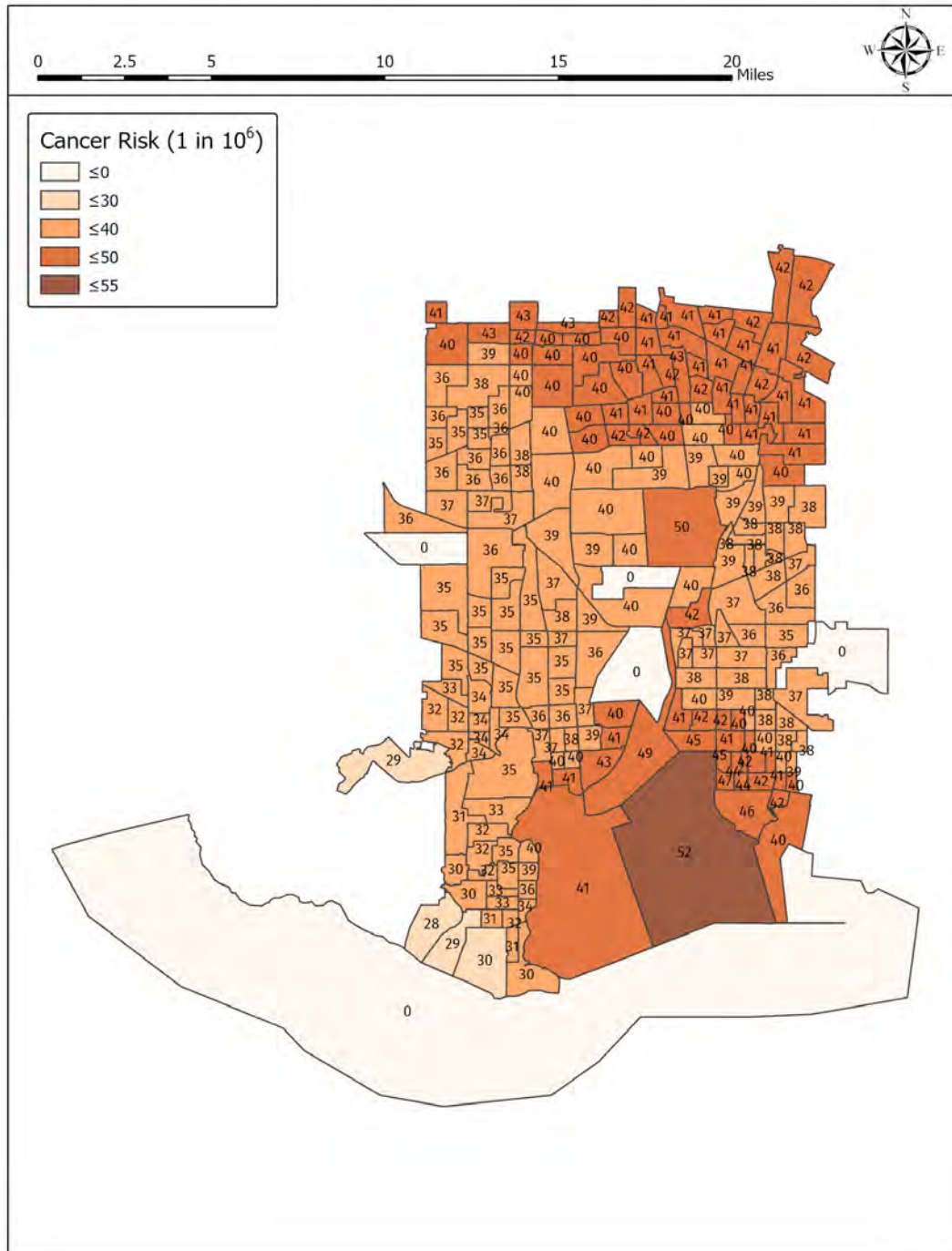
According to the NATA, the maximum baseline cancer risk in the WCWLB community is 51.6 cancer cases per million residents for census tract 06037980033, with a population of 61 residents. When accounting for all of the communities assessed, the total cancer burden for the WCWLB community is 39 cancer cases expected over a 70-year timeline among a total community population of 1,026,447.

Figure 6-2. WCWLB Baseline NATA DPM Cancer Risks
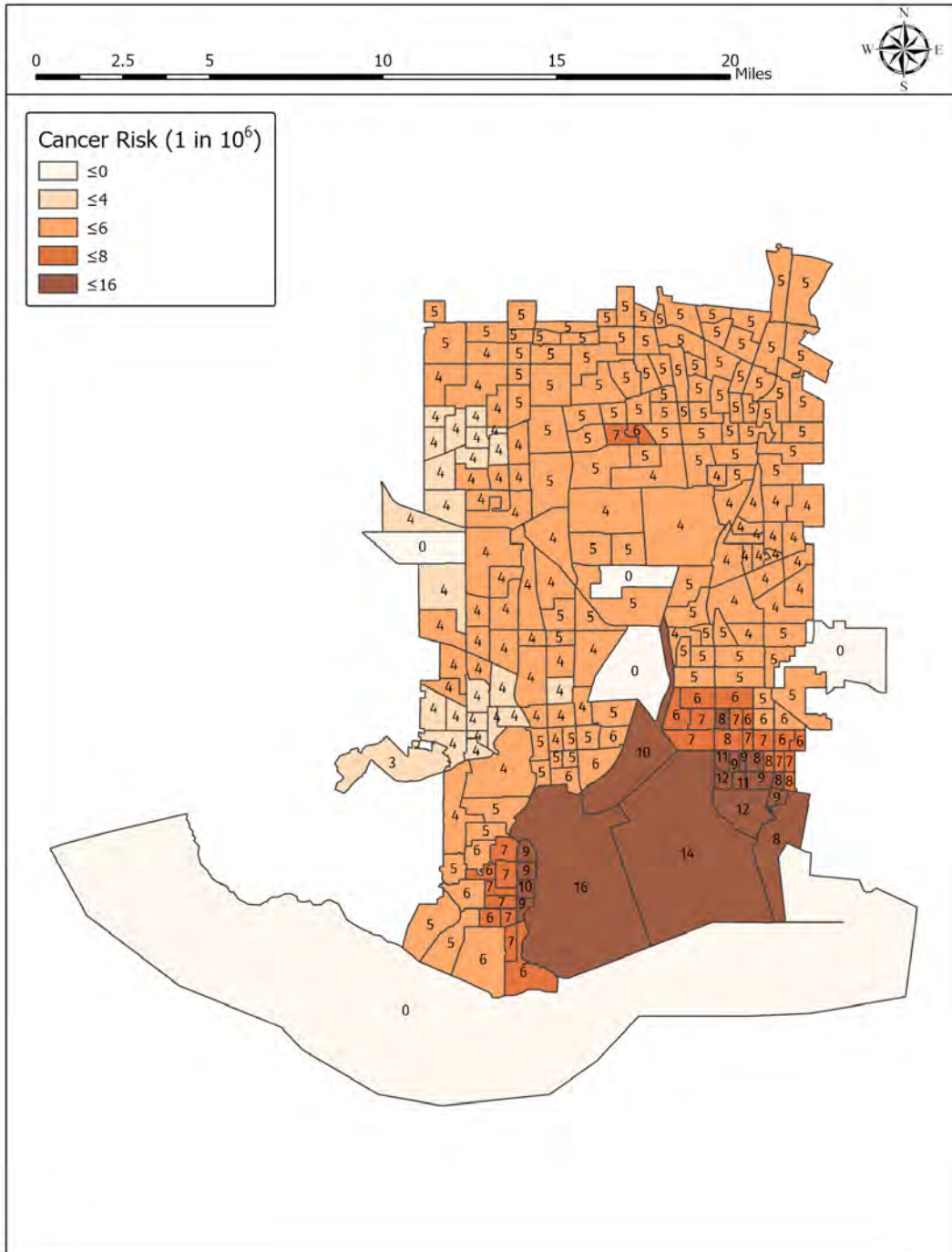
According to the NATA, the maximum DPM-specific baseline cancer risk in the WCWLB community is 16 cancer cases per million residents for census tract 06037980031, with a population of 1,245 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the WCWLB community is 5 cancer cases expected over a 70-year timeline among a total community population of 1,026,447.

Figure 6-3. WCWLB Reduced NATA DPM Cancer Risks

Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the WCWLB community becomes 9 cancer cases per million residents for census tract 06037980031, with a population of 1,245 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the WCWLB community becomes 3 cancer cases expected over a 70-year timeline among a total community population of 1,026,447.

6.1.1.2 NATA Data with HARP Risk Factors

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

- Baseline NATA DPM Concentrations
- Baseline NATA/HARP DPM Hybrid Risks
- Reduced NATA/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 NATA were therefore utilized to determine cancer risks in combination with OEHHA cancer unit risk values. The NATA DPM concentrations are shown, along with baseline and reduced cancer risks using CARB's HARP program.

Figure 6-4 shows the baseline DPM concentrations provided by the NATA.

Figure 6-5 shows the baseline DPM-specific cancer risks as determined using the NATA concentration values and CARB's HARP program.

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

Because this hybrid NATA/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 WCWLB community.

Figure 6-4. WCWLB Baseline NATA DPM Concentrations
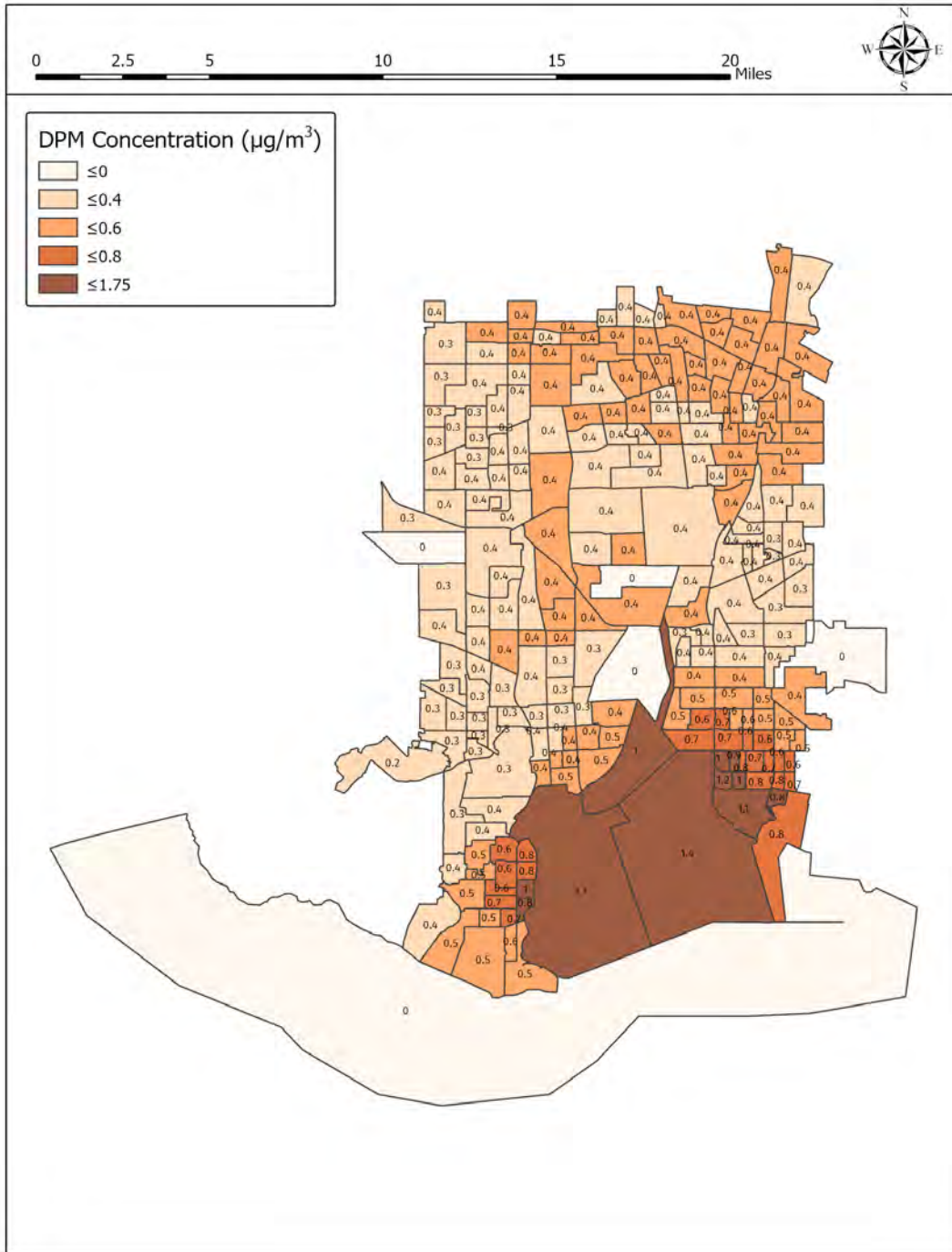
According to the NATA, the maximum baseline DPM concentration in the WCWLB community is 1.7 µg/m^3 for census tract 06037980031, with a population of 1,245 residents. The average DPM concentration of the WCWLB community is 0.45 µg/m^3.

Figure 6-5. WCWLB Baseline NATA/HARP DPM Hybrid Risks
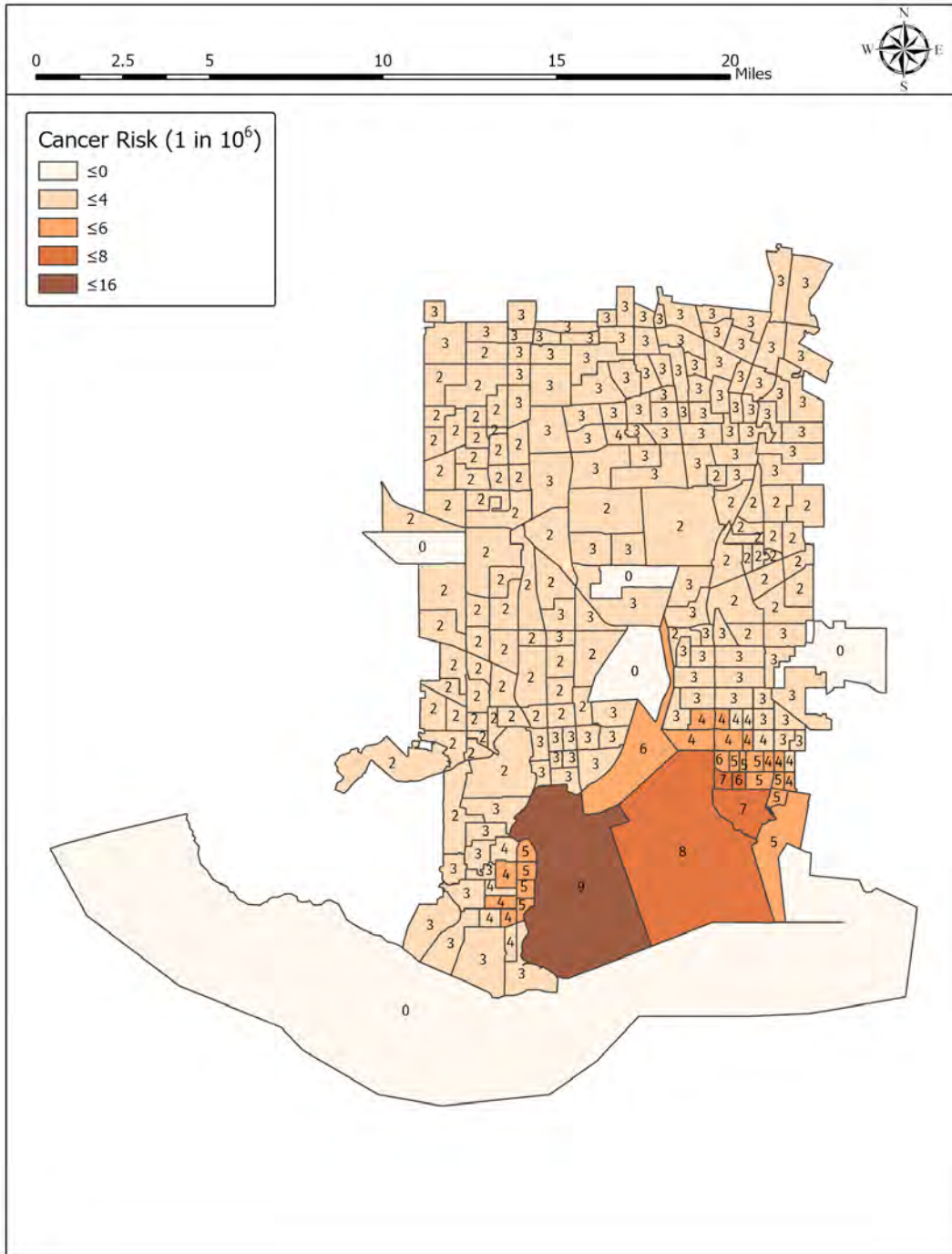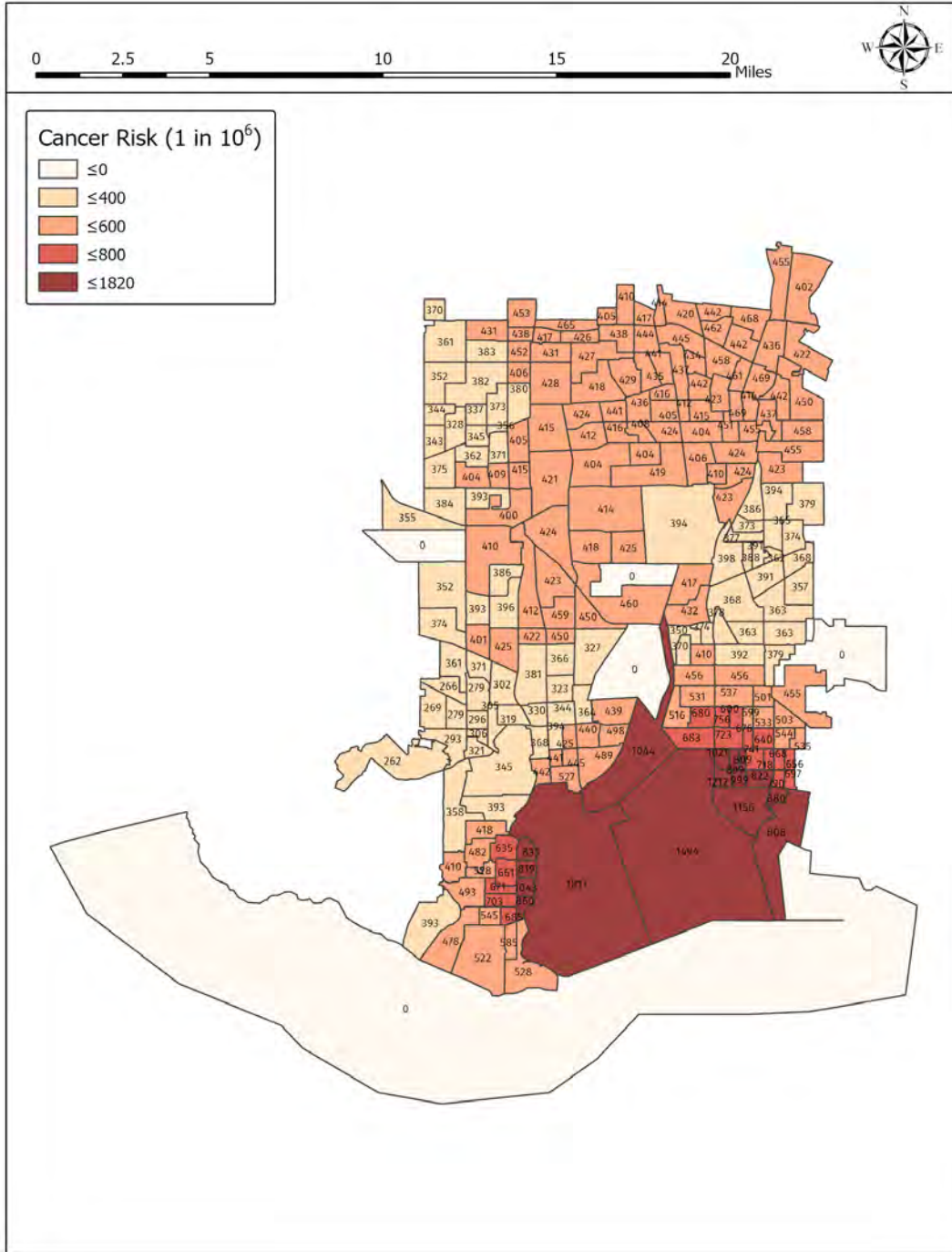

Using NATA DPM concentrations and OEHHA cancer unit risk values, the maximum DPM-specific baseline cancer risk in the WCWLB community is 1,817 cancer cases per million residents for census tract 06037980031, with a population of 1,245 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the WCWLB community is 473 cancer cases expected over a 70-year timeline among a total community population of 1,026,447.

Figure 6-6. WCWLB Reduced NATA/HARP DPM Hybrid Risks
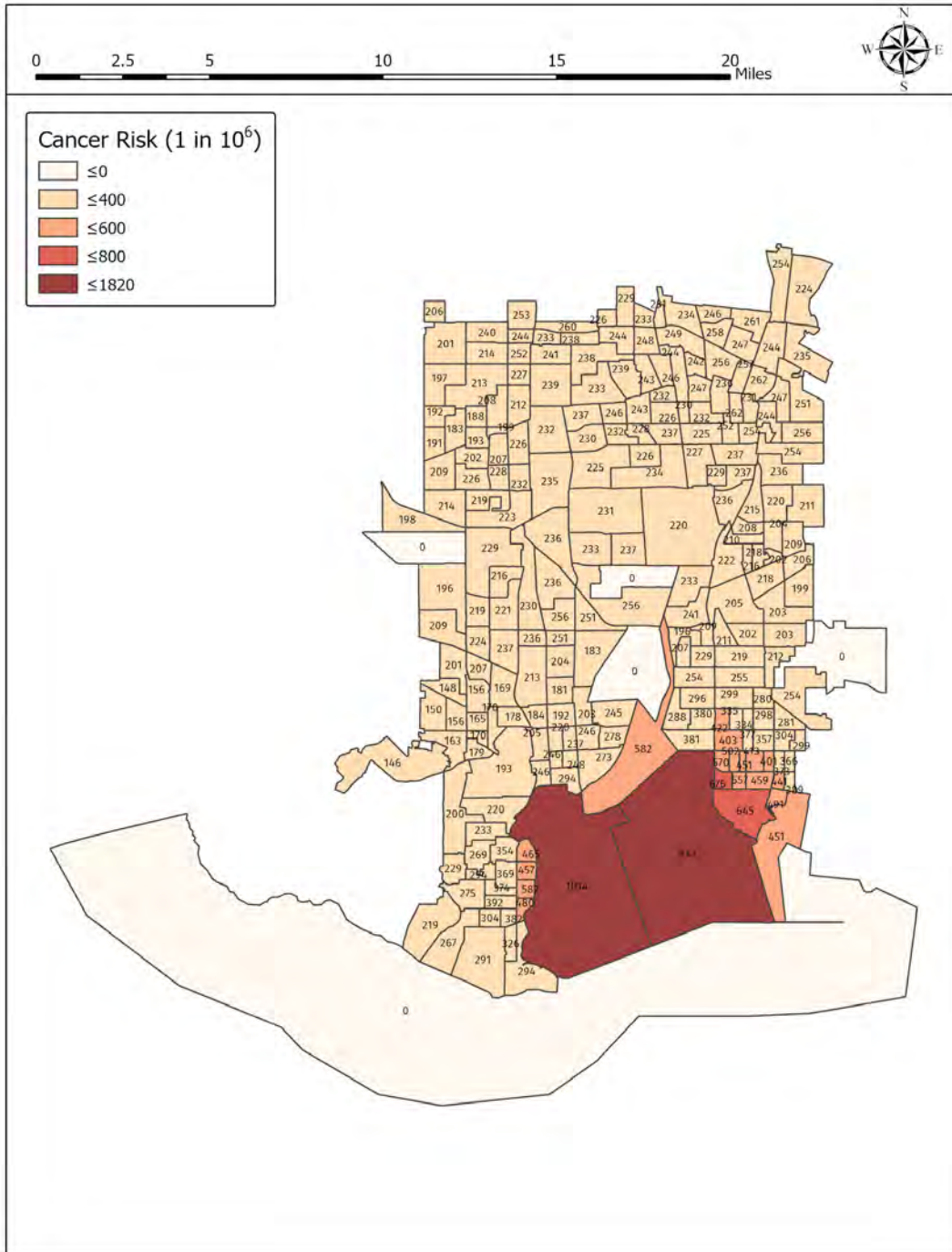
Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the WCWLB community becomes 1,014 cancer cases per million residents for census tract 06037980031, with a population of 1,245 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the WCWLB community becomes 264 cancer cases expected over a 70-year timeline among a total community population of 1,026,447.

6.1.2   Ports of LA and LB Site-Specific Health Risk Assessment

While the NATA report is a good tool for general community assessment of health risks, it should not be utilized to infer findings for specific areas. In order to determine refined health benefits from transition to biodiesel in an existing area of concern, a site-specific HRA was conducted for the Port of Los Angeles, Port of Long Beach, and San Pedro Bay. The following sources were utilized to generate the HRA.

- Port of Los Angeles Inventory of Air Emissions – 2019 (September 2020)[12]
- Port of Long Beach 2019 Air Emission Inventory (September 2020)[13]
- San Pedro Bay ports Emissions Inventory Methodology Report, Version 1 – 2019[14]

In December 2019, the Ports of Los Angeles and Long Beach in collaboration released the *Bay-Wide Regional Human Health Risk Assessment Tool for Diesel Exhaust Particulate Matter (DPM)*[15] (BWHRA Tool). The BWHRA Tool consisted of three major components: (1) a DPM emission inventory of the mobile equipment operating at the Ports, (2) air dispersion modeling, and (3) an assessment of cancer risks from exposure to airborne DPM.

Of these three components only the emissions inventory changes each year, and each Port has updated their inventory on an annual basis, with the most recent inventories being prepared in 2020, reflecting calendar year 2019 emissions.[16] The emission inventories include the source categories of: ocean-going vessels, commercial harbor craft, cargo handling equipment, locomotives, and on-road heavy-duty diesel trucks (operating on and off of port property).

It is also noted that the third component of the BWHRA Tool changed in 2015, when OEHHA released their updated *Air Toxics Hot Spots Program Guidance Manual.*[17]

By using the current emission inventories, and applying the current (updated) HRA procedures, it is possible to update the original 2009 BWHRA Tool. In doing so, the same source placement and source release parameters from the original BWHRA Tool were maintained to the degree possible, with only the current (2019) emission rates substituted for the original values. Additionally, DPM emissions from ocean-going vessels were omitted from the HRA update on the basis that they are likely incapable of being converted to biodiesel.

The result is a partial HRA reflecting only the port sources that may be capable of being converted to biodiesel. And based on these results, the reduction in health risk due to biodiesel was applied to show the potential benefits to the affected community.

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[12] https://kentico.portoflosangeles.org/getmedia/4696ff1a-a441-4ee8-95ad-abe1d4cddf5e/2019_Air_Emissions_Inventory

[13] https://safety4sea.com/wp-content/uploads/2020/10/Port-of-Long-Beach-Air-Emissions-Inventory-2019-2020_10.pdf

[14] https://kentico.portoflosangeles.org/getmedia/3559520c-b85d-45ad-ad68-9947c34b980d/WV_FINAL_SPBP_Emissions_Inventory-_Methodology_4-25-19_scg

[15] https://kentico.portoflosangeles.org/getmedia/09cc224c-a05b-43d5-a0bd-ea49a9189855/12_21_2010_CAAP_Appendix_B_1
[16] https://kentico.portoflosangeles.org/getmedia/4696ff1a-a441-4ee8-95ad-abe1d4cddf5e/2019_Air_Emissions_Inventory and https://safety4sea.com/wp-content/uploads/2020/10/Port-of-Long-Beach-Air-Emissions-Inventory-2019-2020_10.pdf.

[17] Notice of Adoption of Air Toxics Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments 2015 | OEHHA (ca.gov)

The aforementioned emissions sources were modeled with the following source groups in AERMOD, representing the associated emission rates listed in Table 6-1.

Table 6-1. Ports of LA and LB Source Groups and Emission Rates

Source Group	Description	DPM Emissions (tpy)	Proportion of "Old Technology" Engine Emissions
HARBORLA	LA Harbor Craft	26	100%
HARBORLB	LB Harbor Craft	22	100%
RAIL_LA	LA Locomotives	32	100%
RAIL_LB	LB Locomotives	21	100%
ROAD_LA	LA Heavy Duty Vehicles	9	81.2%
ROAD_LB	LB Heavy Duty Vehicles	7	81.2%
CARGO_LA	LA Cargo Handling Equipment	5	38.2%
CARGO_LB	LB Cargo Handling Equipment	3	38.2%

These sources were modeled with unit emission rates in AERMOD, and the associated emission rates in Table 6-1 were input into CARB's HARP software to determine cancer risks from the DPM concentrations determined by AERMOD. While dispersion characteristics remained the same between baseline and reduced modeling scenarios, emission rates were reduced according to the number of "old technology" engines combusting diesel, based on source type. The table above shows the Proportion of "Old Technology" Engine Emissions where the DPM reduction factor was taken into account. The subsequent figures show the baseline and reduced cancer risk isopleths from the analysis and include information on the maximally exposed individual resident (MEIR) receptor for the analysis.

Figure 6-7. Baseline WCWLB Health Risk Assessment Isopleths
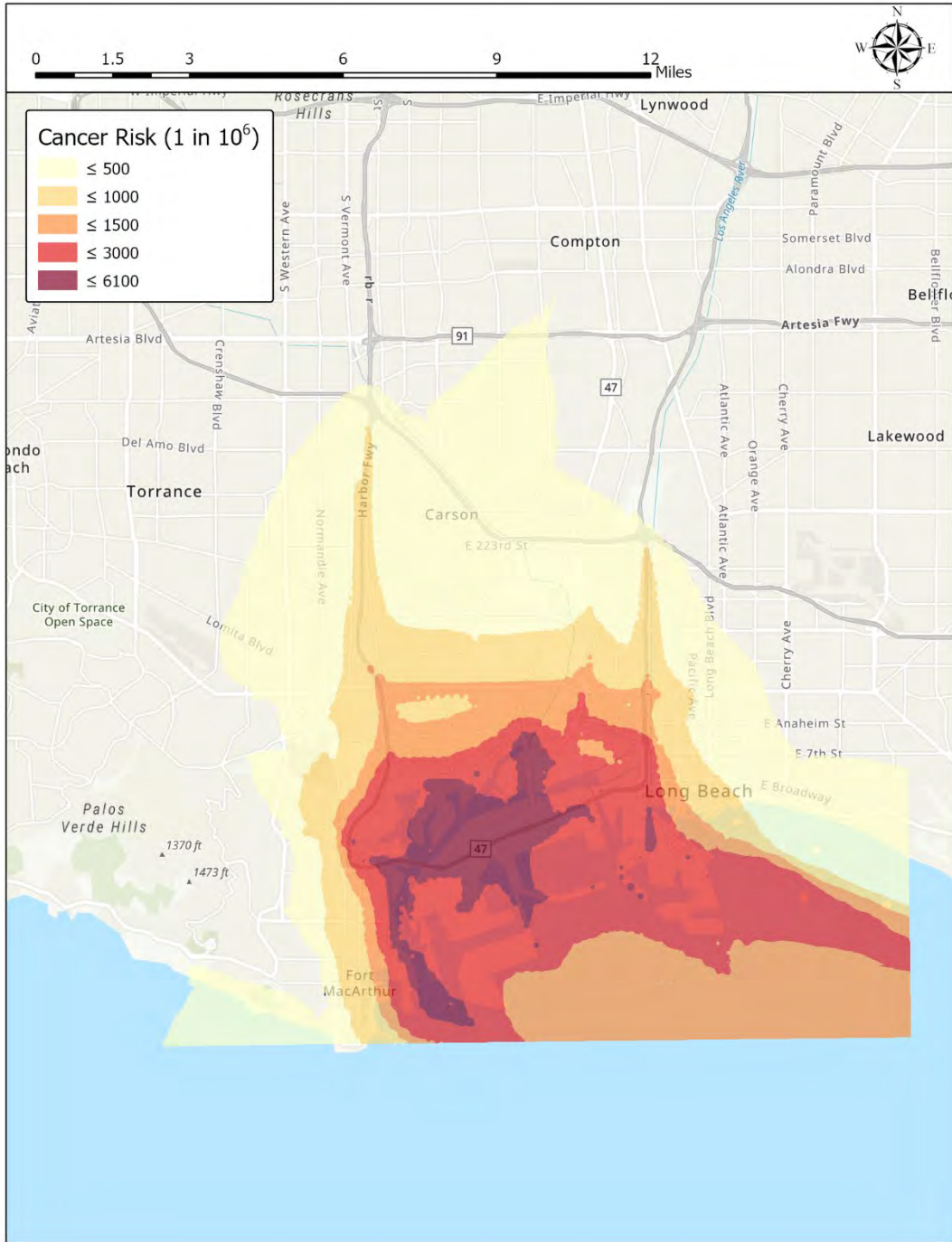
The site-specific HRA shows that the point of maximum impact (PMI) is substantially higher than the NATA/HARP evaluation, with an impact of 6,112 cancer cases per million residents. This PMI does not occur at a residential receptor, though, and does not represent an actual risk to residences in the area. The MEIR occurs at 381,299 m E, and 3,734,946 m N (NAD 83, UTM Zone 11), with a baseline risk of 3,155 cancer cases per million residents. This MEIR is higher than the NATA/HARP hybrid risks evaluated for that census

tract (06037296210) with a risk of 833 in a million, demonstrating the inability of the NATA to determine local maxima in cancer risks.

Figure 6-8. Reduced WCWLB Health Risk Assessment Risk Isopleths
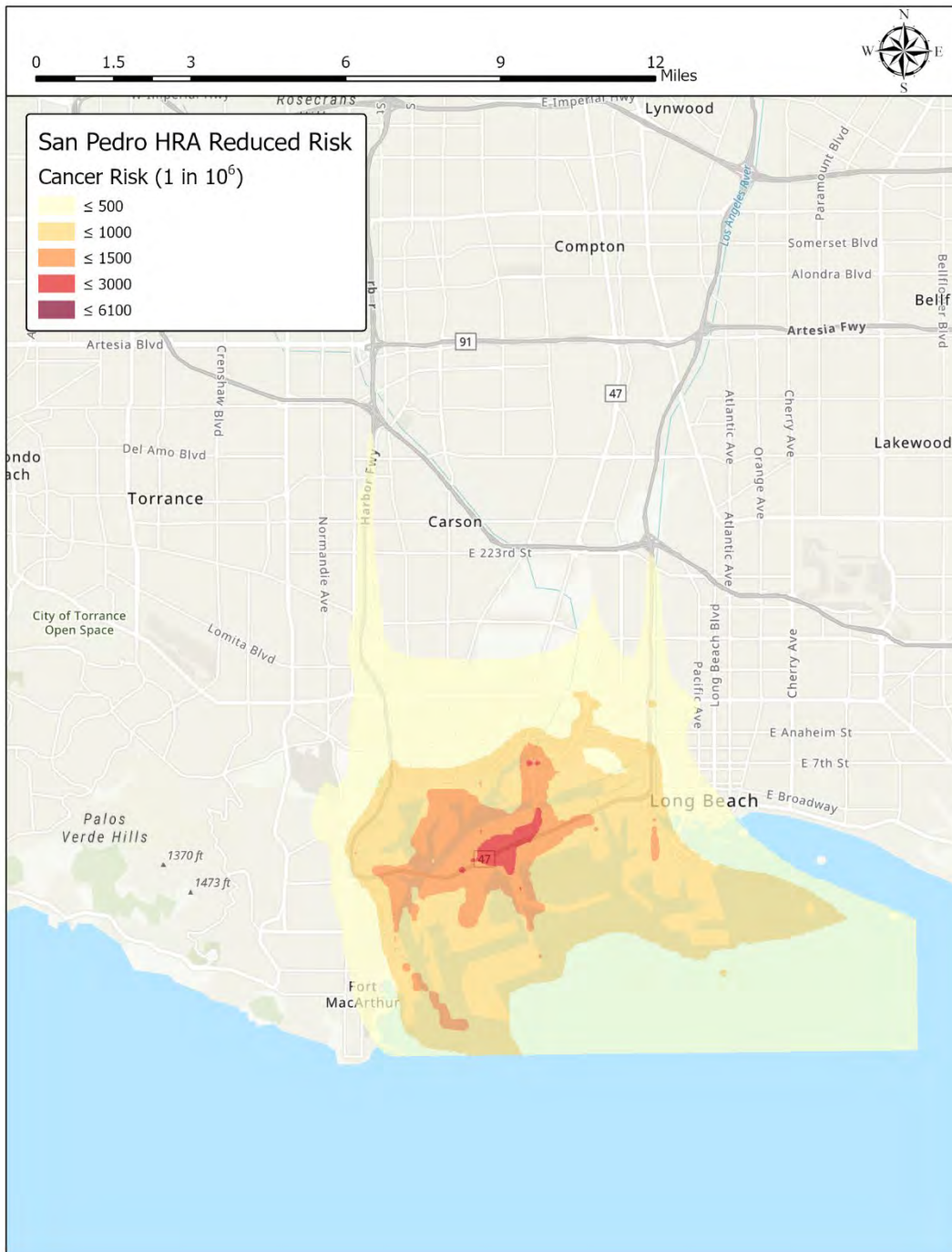
The reduced cancer risk PMI and MEIR are 1,898 and 1,043.1 in one million, respectively, both in the same locations as the baseline risk plots. This represents a risk reduction of 2,000 in one million at the MEIR.

6.1.3 Valuation of Health Benefits

The health benefits of reduced PM$_{2.5}$ exposure were modeled using U.S.EPA's BenMAP model according to the methodology described under Section 4.7. The results are shown in Table 6-2 below.

Table 6-2. WCWLB Valuation of Reduced Incidence Benefits

Endpoint	Reduced Incidence	Benefit Value
Premature Mortality	191.7	$1,668,354,771
Asthma Exacerbation	121,589	$7,161,686
Minor Restricted Activity Days	150,127	$10,446,076
Work Loss Days	25,533	$4,072,884
Total		**$1,690,035,418**

6.2   West Oakland, CA

6.2.1   NATA Risks

The subsections below review the NATA data available for the West Oakland community. The data is outlined in the following order:

- Baseline NATA Total Cancer Risks
- Baseline NATA DPM Cancer Risks
- Reduced NATA DPM Cancer Risks

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

Figure 6-9 shows the Baseline NATA Total Cancer Risk. This total cancer risk encompasses all sources in the area.

Figure 6-10 shows those cancer risks specific to DPM emissions as determined using NATA raw data.

Figure 6-11 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the West Oakland community.

Because the NATA 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 West Oakland community.

6.2.1.1 NATA Risk Data

Figure 6-9. West Oakland NATA Total Baseline Cancer Risk
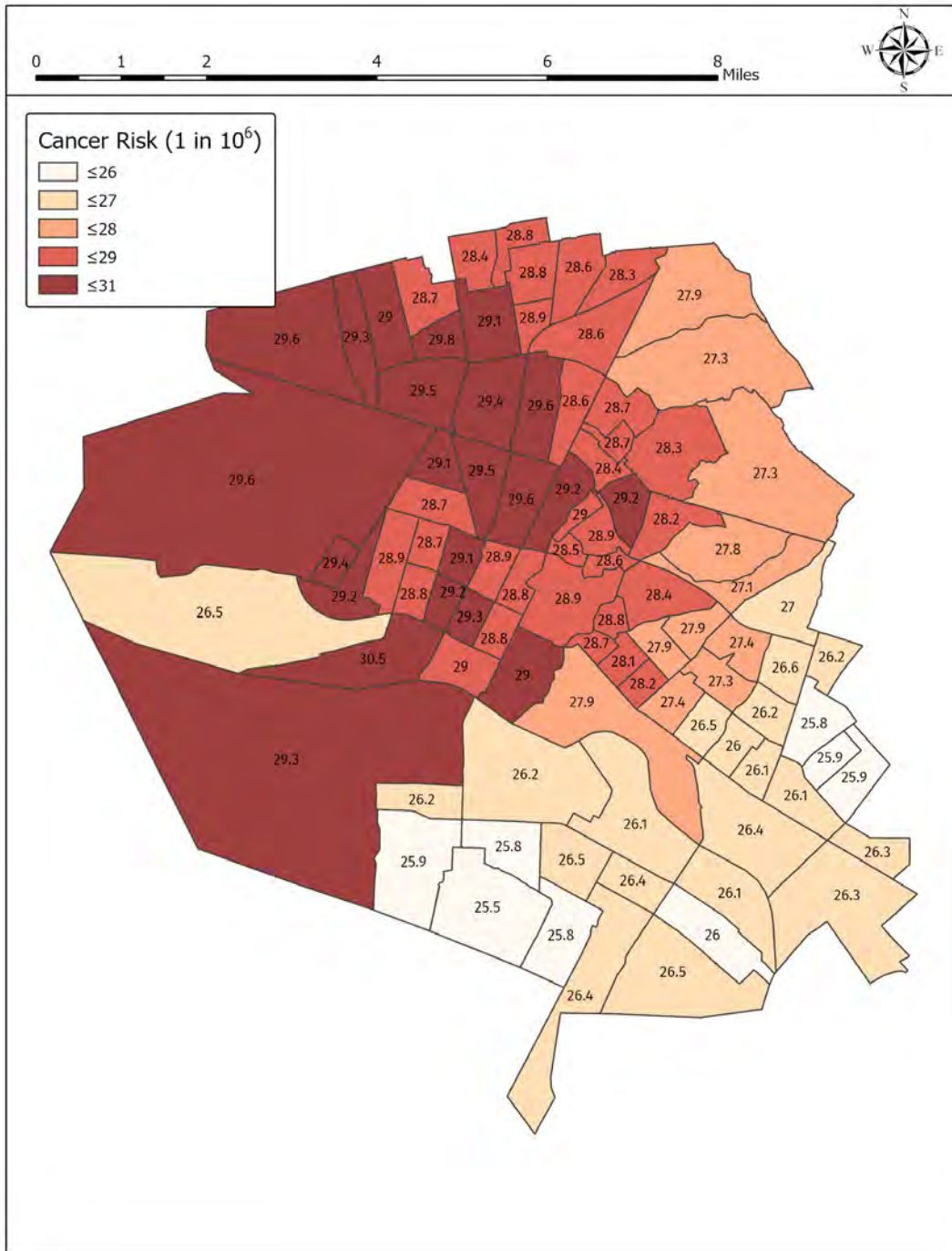
According to the NATA, the maximum baseline cancer risk in the West Oakland community is 30 cancer cases per million residents for census tract 06001982000, with a population of 71 residents. When accounting for all of the communities assessed, the total cancer burden for the West Oakland community is 9 cancer cases expected over a 70-year timeline among a total community population of 310,842.

Figure 6-10. West Oakland NATA Diesel PM Baseline Cancer Risk

According to the NATA, the maximum DPM-specific baseline cancer risk in the West Oakland community is 7 cancer cases per million residents for census tract 06001982000, with a population of 71 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the West

Oakland community is 1 cancer case expected over a 70-year timeline among a total community population of 310,842.

Figure 6-11. West Oakland NATA Diesel PM Reduced Cancer Risk

Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the West Oakland community becomes 4 cancer cases per million residents for census tract

06001982000, with a population of 71 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the West Oakland community becomes 1 cancer case expected over a 70-year timeline among a total community population of 310,842.

6.2.1.2   NATA Data with HARP Risk Factors

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

- Baseline NATA DPM Concentrations
- Baseline NATA/HARP DPM Hybrid Risks
- Reduced NATA/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 NATA were therefore utilized to determine cancer risks in combination with OEHHA cancer unit risk values. The NATA DPM concentrations are shown, along with baseline and reduced cancer risks using CARB's HARP program.

Figure 6-12 shows the baseline DPM concentrations provided by the NATA.

Figure 6-13Figure 6-5 shows the baseline DPM-specific cancer risks as determined using the NATA concentration values and CARB's HARP program.

Figure 6-14 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the West Oakland community.

Because this hybrid NATA/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 West Oakland community.

Figure 6-12. West Oakland Baseline NATA PM Concentration
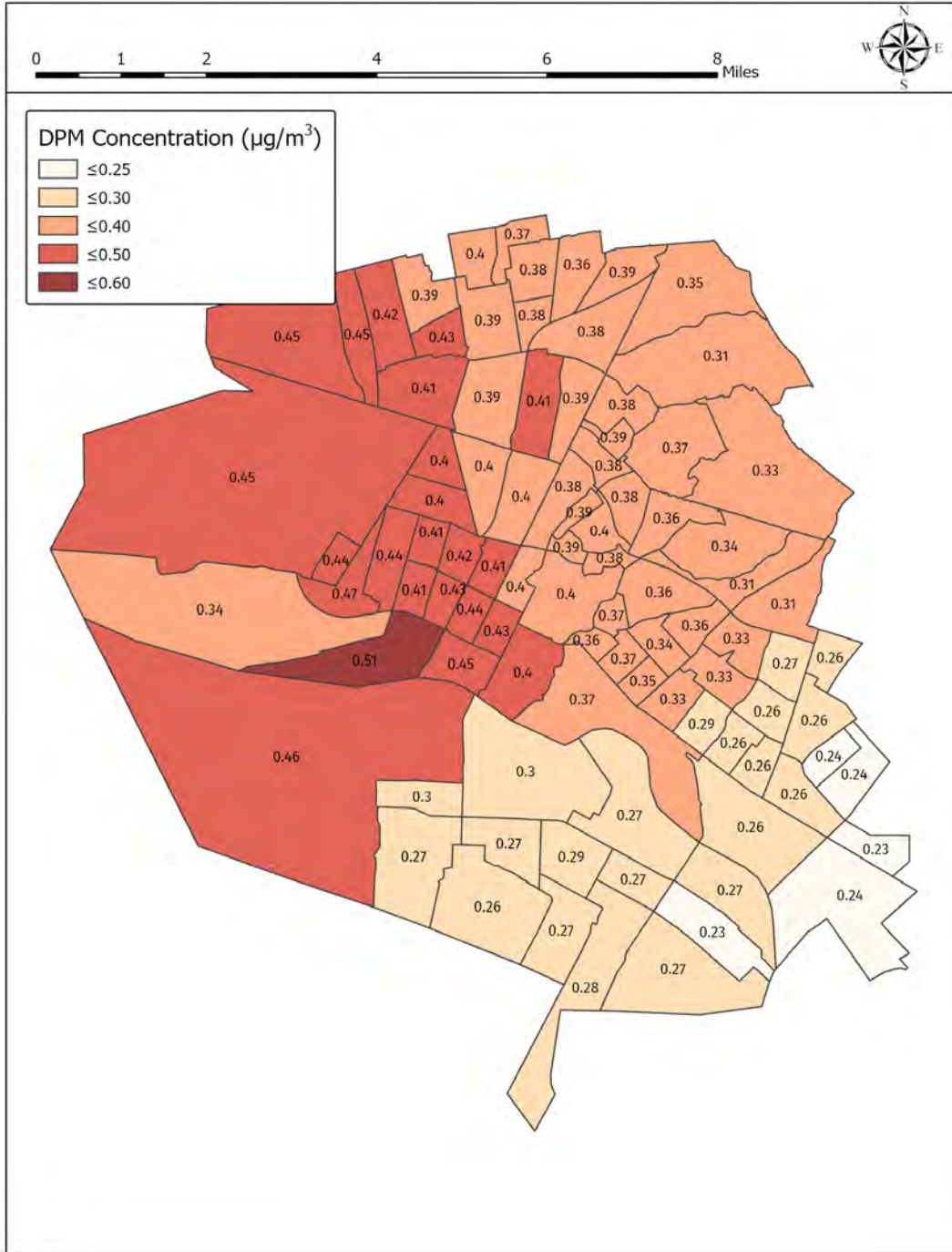
According to the NATA, the maximum baseline DPM concentration in the West Oakland community is 0.5 μg/m³ for census tract 06001982000, with a population of 71 residents. The average DPM concentration of the West Oakland community is 0.36 μg/m³.

Figure 6-13. West Oakland NATA/HARP Hybrid Baseline Risk
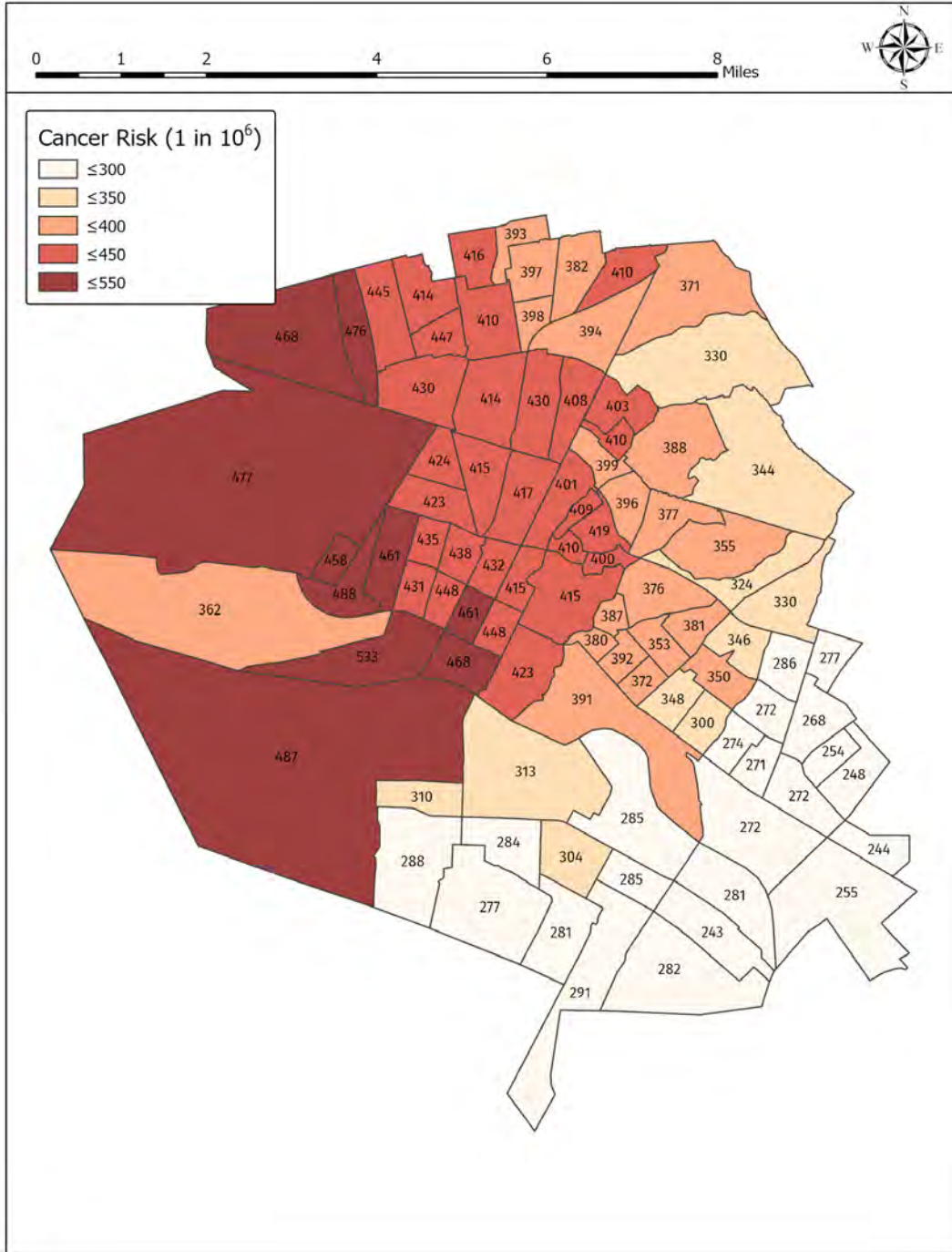
Using NATA DPM concentrations and OEHHA cancer unit risk values, the maximum DPM-specific baseline cancer risk in the West Oakland community is 533 cancer cases per million residents for census tract 06001982000, with a population of 71 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the West Oakland community is 112 cancer cases expected over a 70-year timeline among a total community population of 310,842.

Figure 6-14. West Oakland NATA/HARP Hybrid Reduced Risk

Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the West Oakland community becomes 298 cancer cases per million residents for census tract 06001982000, with a population of 71 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the West Oakland community becomes 62 cancer cases expected over a 70-year timeline among a total community population of 310,842.

6.2.2 Port of Oakland Site Specific Health Risk Assessment

While the NATA report is a good tool for general community assessment of health risks, it should not be utilized to infer findings for specific areas. In order to determine refined health benefits from transition to biodiesel in an existing area of concern, a site-specific HRA was conducted for the Port of Oakland. The following sources were utilized to generate the HRA.

- Port of Oakland 2017 Seaport Air Emissions Inventory[18]

The aforementioned emissions sources were modeled with the following source groups in AERMOD, representing the associated emission rates listed in Table 6-3.

Table 6-3. Port of Oakland Source Groups and Emission Rates

Source Group	Description	DPM Emissions (tpy)	Proportion of "Old Technology" Engine Emissions
LOCO	Locomotives	0.3	100%
TRUCK	Heavy Duty Trucks	0.13	85.2%
HARBOR	Harbor Craft	6.5	100%
TRUCK_A	Truck Area Source (onsite activities)	0.13	85.2%
CHE_A	Cargo Handling Equipment	1.6	53.7%

These sources were modeled with unit emission rates in AERMOD, and the associated emission rates in Table 6-1 were input into CARB's HARP software to determine cancer risks from the DPM concentrations determined by AERMOD. While dispersion characteristics remained the same between baseline and reduced modeling scenarios, emission rates were reduced according to the number of "old technology" engines combusting diesel, based on source type. The table above shows the Proportion of "Old Technology" Engine Emissions where the DPM reduction factor was taken into account. The subsequent figures show the baseline and reduced cancer risk isopleths from the analysis and include information on the MEIR receptor for the analysis.

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[18] https://www.portofoakland.com/files/PDF/Port_Oakland_2017_Emissions_Inventory.pdf

Figure 6-15. Port of Oakland Health Risk Assessment Baseline Isopleth
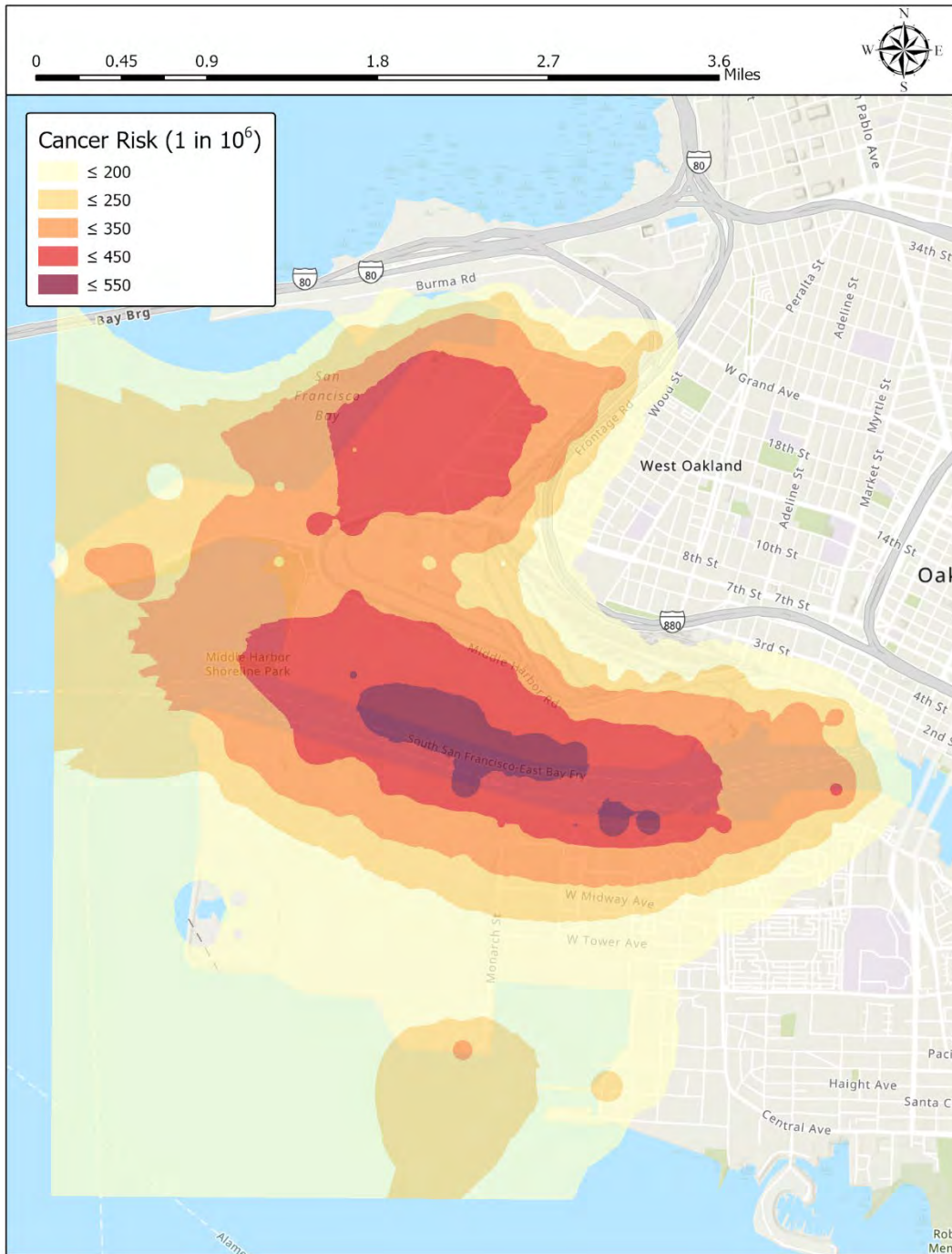
The site-specific HRA shows that the point of maximum impact (PMI) is nearly the same as the NATA/HARP evaluation, with an impact of 535 cancer cases per million residents. This PMI does not occur at a residential receptor, though, and does not represent an actual risk to residences in the area. The MEIR occurs at 561,916 m E, and 4,182,492 m N (NAD 83, UTM Zone 10), with a baseline risk of 283 cancer cases per million residents. This MEIR is lower than the NATA/HARP hybrid risks evaluated for that census

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6-25

tract (06001428700) with a risk of 487 in a million, implying most of the risk in West Oakland is from sources other than the port.

Figure 6-16. Port of Oakland Health Risk Assessment Reduced Risk Isopleth
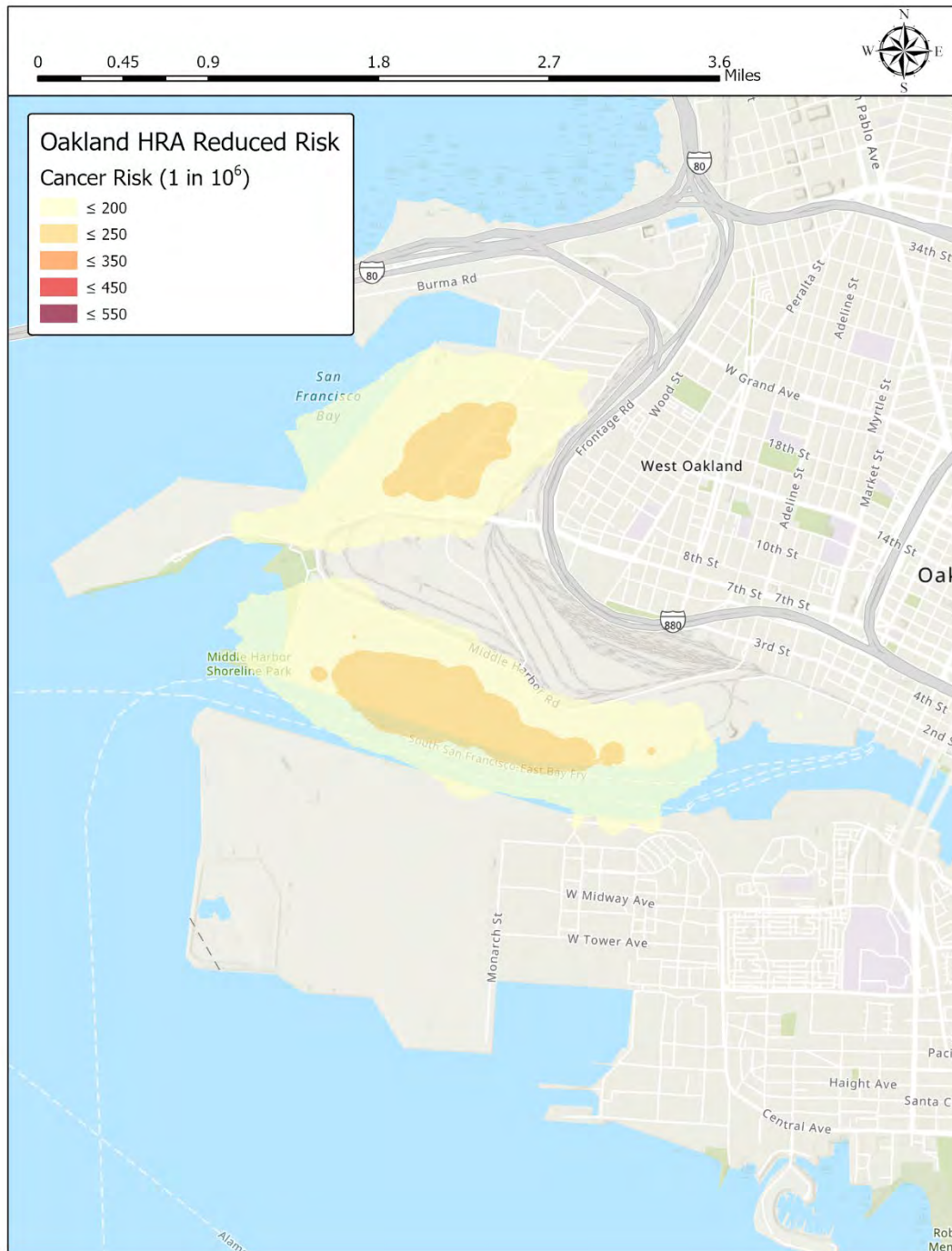
The reduced cancer risk PMI and MEIR are 235 and 97 in 1 million, respectively, both in the same locations as the baseline risk plots. This represents a risk reduction of 186 in 1 million at the MEIR.

6.2.3   Valuation of Health Benefits

The health benefits of reduced PM$_{2.5}$ exposure were modeled using U.S.EPA's BenMAP model according to the methodology described under Section 4.7. The results are shown in Table 6-4 below.

Table 6-4. West Oakland Valuation of Reduced Incidence Benefits

Endpoint	Reduced Incidence	Benefit Value
Premature Mortality	19.5	$169,345,490
Asthma Exacerbation	11,837	$697,184
Minor Restricted Activity Days	15,565	$1,083,069
Work Loss Days	2,650	$591,571
Total		**$171,717,314**

6.3   San Bernardino, CA

6.3.1   NATA Health Risks

The subsections below review the NATA data available for the San Bernardino community. The data is outlined in the following order:

- Baseline NATA Total Cancer Risks
- Baseline NATA DPM Cancer Risks
- Reduced NATA DPM Cancer Risks

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

Figure 6-17 shows the Baseline NATA Total Cancer Risk. This total cancer risk encompasses all sources in the area.

Figure 6-18 shows those cancer risks specific to DPM emissions as determined using NATA raw data.

Figure 6-19 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the community of San Bernardino, California.

Because the NATA 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 San Bernardino community.

6.3.1.1 NATA Risk Data

Figure 6-17. San Bernardino Baseline NATA Total Cancer Risks
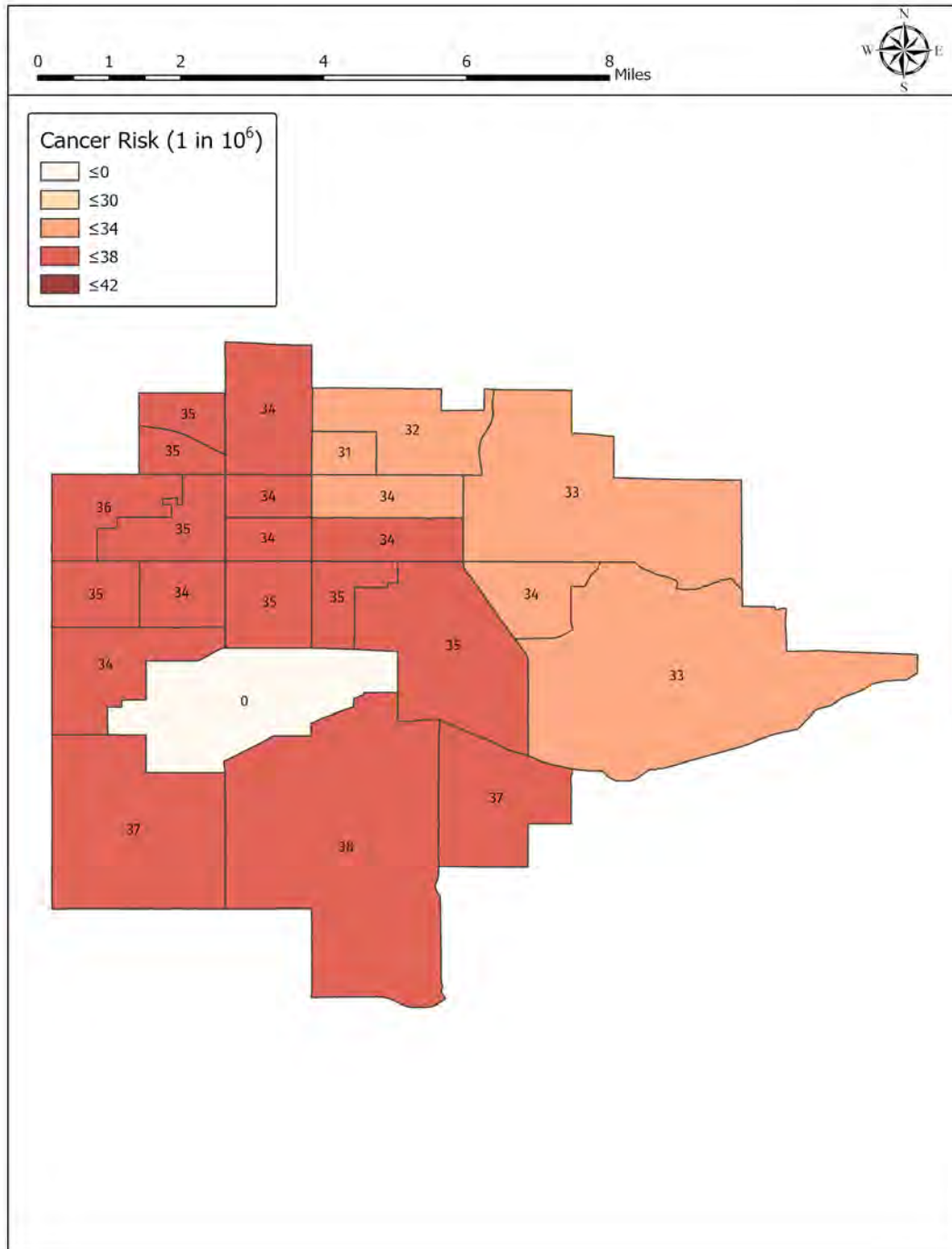
According to the NATA, the maximum baseline cancer risk in the San Bernardino community is 37.75 cancer cases per million residents for census tract 06071007800, with a population of 4,912 residents. When accounting for all of the communities assessed, the total cancer burden for the San Bernardino community is 4 cancer cases expected over a 70-year timeline among a total community population of 124,732.

Figure 6-18. San Bernardino Baseline NATA DPM Cancer Risks
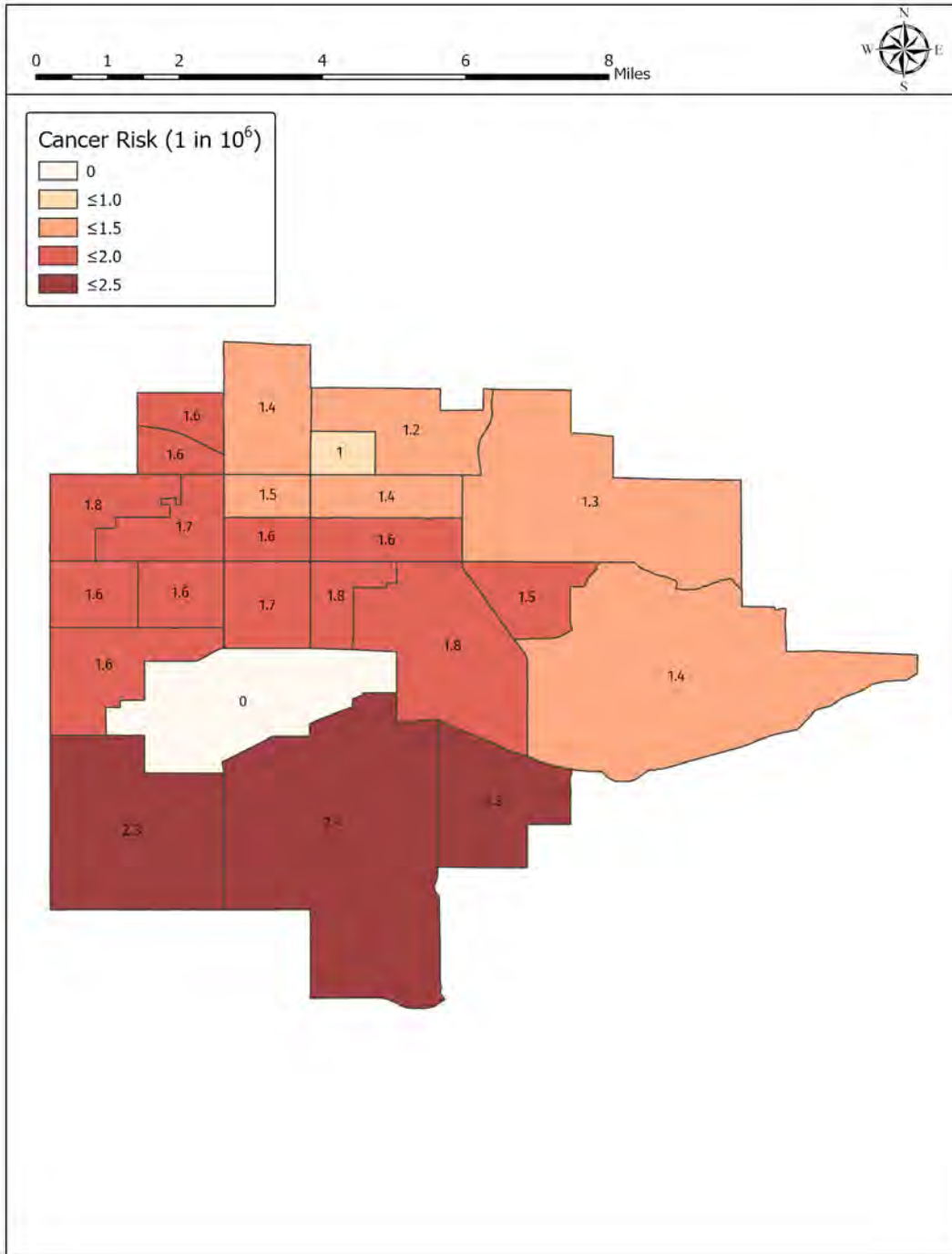
According to the NATA, the maximum DPM-specific baseline cancer risk in the San Bernardino community is 2 cancer cases per million residents for census tract 06071007800, with a population of 4,912 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the San Bernardino community is <1 cancer case expected over a 70-year timeline among a total community population of 124,732

Figure 6-19. San Bernardino Reduced NATA DPM Cancer Risks
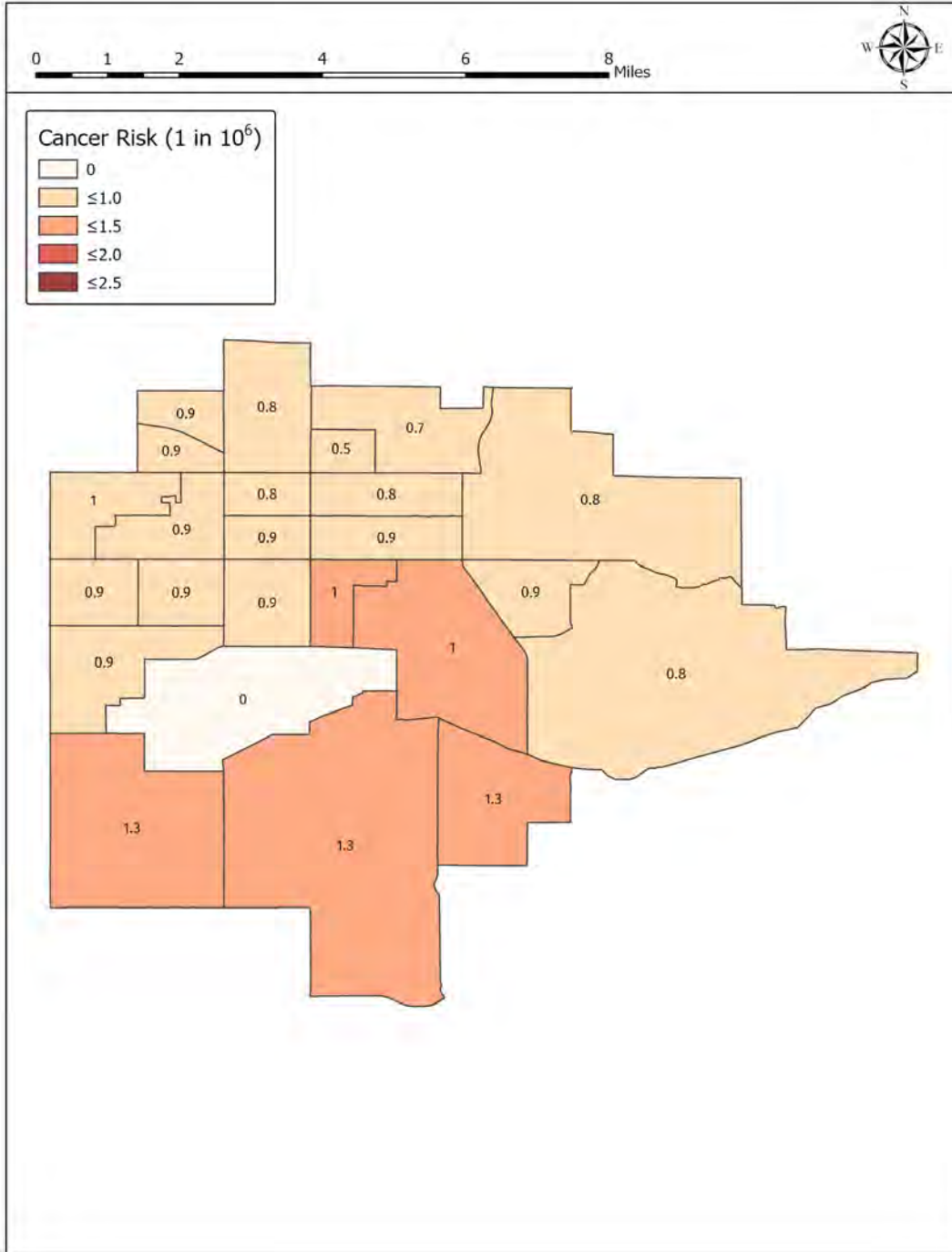
Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the San Bernardino community becomes 1.3 cancer cases per million residents for census tract 06071007800, with a population of 4,912 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the San Bernardino community remains <1 cancer case expected over a 70-year timeline among a total community population of 124,732

6.3.1.2 NATA Data with HARP Risk Factors.

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

- Baseline NATA DPM Concentrations
- Baseline NATA/HARP DPM Hybrid Risks
- Reduced NATA/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 NATA were therefore utilized to determine cancer risks in combination with OEHHA cancer unit risk values. The NATA DPM concentrations are shown, along with baseline and reduced cancer risks using CARB's HARP program.

Figure 6-20 shows the baseline DPM concentrations provided by the NATA.

Figure 6-21 shows the baseline DPM-specific cancer risks as determined using the NATA concentration values and CARB's HARP program.

Figure 6-22 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the San Bernardino community.

Because this hybrid NATA/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 San Bernardino community.

Figure 6-20. San Bernardino Baseline NATA DPM Concentrations

According to the NATA, the maximum baseline DPM concentration in the San Bernardino community is 0.36 $\mu g/m^3$ for census tract 06071007200, with a population of 6,798 residents. The average DPM concentration of the San Bernardino community is 0.25 $\mu g/m^3$.

Figure 6-21. San Bernardino Baseline NATA/HARP DPM Hybrid Risks
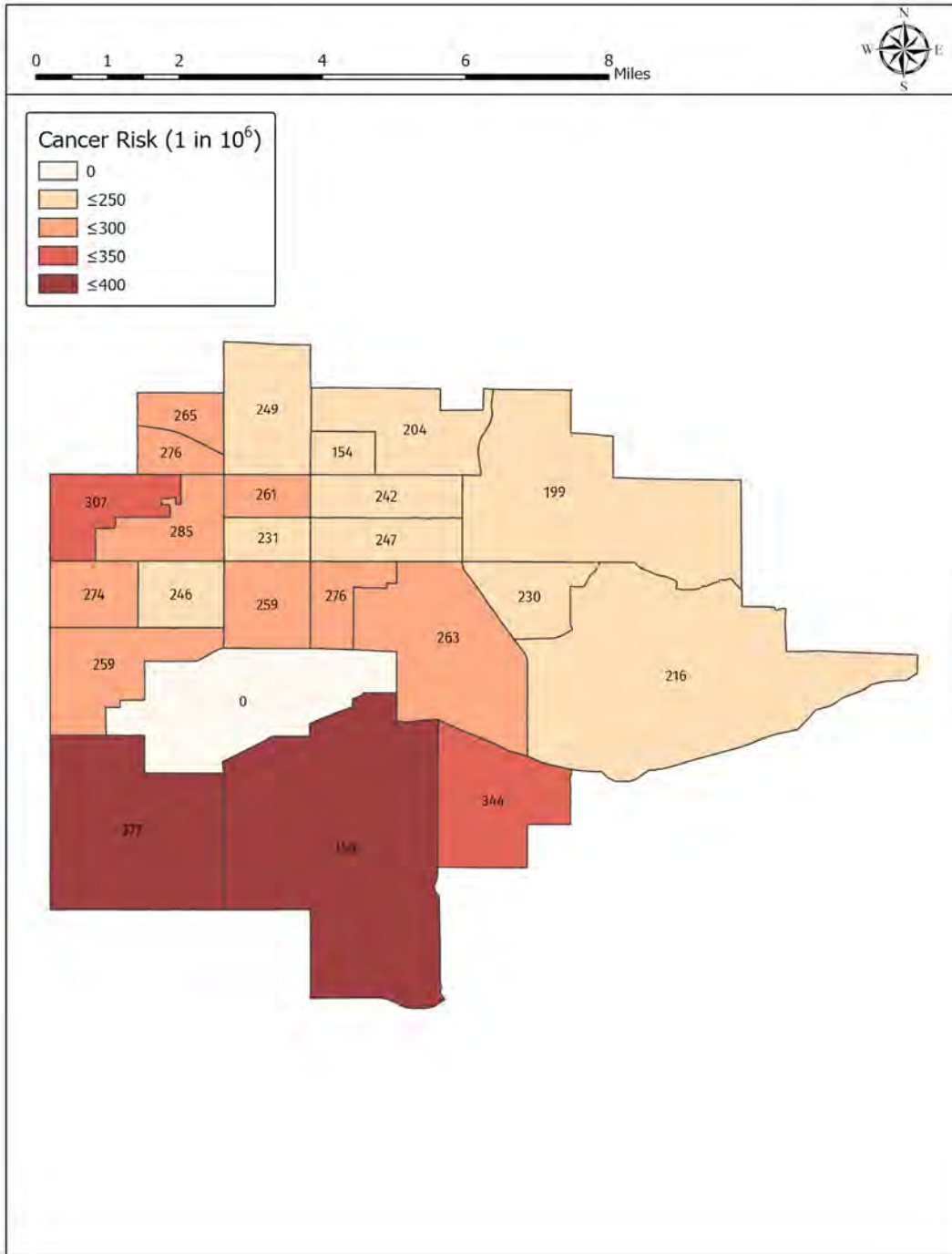
Using NATA DPM concentrations and OEHHA cancer unit risk values, the maximum DPM-specific baseline cancer risk in the San Bernardino community is 377 cancer cases per million residents for census tract 06071007200, with a population of 6,798 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the San Bernardino community is 33 cancer cases expected over a 70-year timeline among a total community population of 124,732.

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6-33

Figure 6-22. San Bernardino Reduced NATA/HARP DPM Hybrid Risks
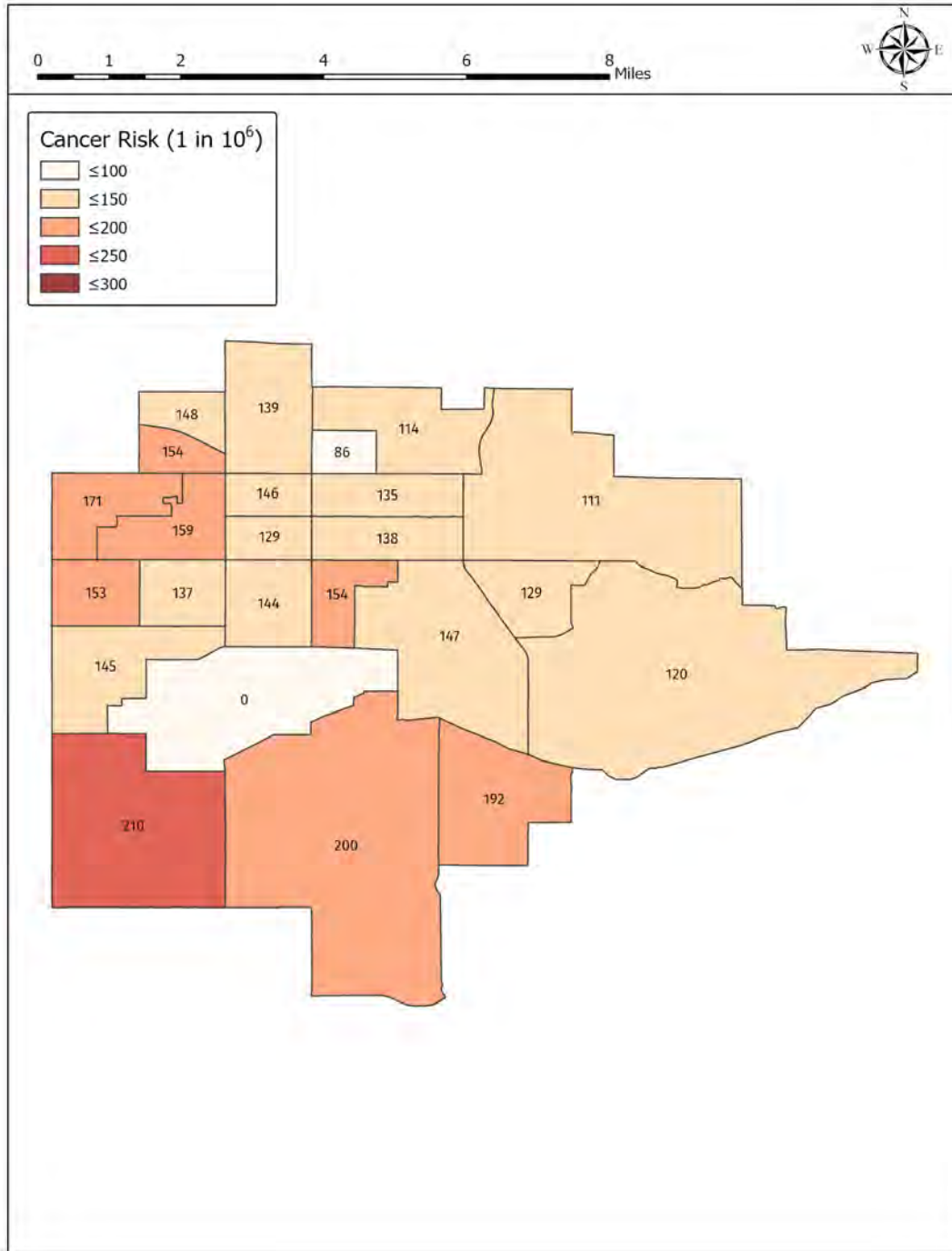
Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the San Bernardino community becomes 210 cancer cases per million residents for census tract 06071007200, with a population of 6,798 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the San Bernardino community becomes 19 cancer cases expected over a 70-year timeline among a total community population of 124,732

6.3.2 San Bernardino Site-Specific Health Risk Assessment

While the NATA report is a good tool for general community assessment of health risks, it should not be utilized to infer findings for specific areas. In order to determine refined health benefits from transition to biodiesel in an existing area of concern, a site-specific HRA was conducted for San Bernardino. The following sources were utilized to generate the HRA.

- The Landing by San Manual (November 4, 2020)[19]

The emissions sources were modeled with the following source groups in AERMOD, consistent with the report, representing the associated emission rates listed in Table 6-1.

### Table 6-5. San Bernardino Source Groups and Emission Rates

Source Group	Description	DPM Emissions (g/s)	Proportion of "Old Technology" Engine Emissions
SLINE1	On-site Idling at Northern Loading Docks	1.828E-04	100%
SLINE2	On-site Idling at Southern Loading Docks	1.828E-04	100%
SLINE3	On-Site Travel Northern Project Area	1.008E-04	77.5%
SLINE4	On-Site Travel Southern Project Area	1.363E-04	77.5%
SLINE5	Off-Site Travel 60% Outbound Dwy. C to 3rd & Victoria	2.397E-05	77.5%
SLINE6	Off-Site Travel 70% Inbound Dwy. C to 3rd and Victoria	2.797E-05	77.5%
SLINE7	Off-Site Travel 10% Outbound Dwy. D to Central Av.	7.105E-06	77.5%
SLINE8	Off-Site Travel 2% Inbound Dwy. D to Central Av.	1.421E-06	77.5%
SLINE9	Off-Site Travel 30% Outbound Dwy. E to Central Av.	3.121E-06	77.5%
SLINE10	Off-Site Travel 6% Inbound Dwy. E to Central Av.	6.243E-07	77.5%
SLINE11	Off-Site Travel 8% Inbound Dwy. D	8.843E-07	77.5%
SLINE12	Off-Site Travel 14% Inbound Dwy. E	1.004E-05	77.5%
SLINE13	Off-Site Travel 8% Outbound Alabama St.	8.575E-06	77.5%
SLINE14	Off-Site Travel 8% Inbound Alabama St.	8.575E-06	77.5%
SLINE15	Off-Site Travel 5% Outbound Palm Av.	5.106E-06	77.5%
SLINE16	Off-Site Travel 27% Outbound 3rd St.	3.224E-05	77.5%
SLINE17	Off-Site Travel 10% Outbound 3rd St.	1.569E-05	77.5%
SLINE18	Off-Site Travel 10% Inbound 3rd St.	1.569E-05	77.5%
SLINE19	Off-Site Travel 10% Outbound 5th St.	1.772E-05	77.5%
SLINE20	Off-Site Travel 10% Inbound 5th	1.773E-05	77.5%
SLINE21	Off-Site Travel 40% Outbound 5th St.	7.918E-05	77.5%
SLINE22	Off-Site Travel 67% Inbound 5th St.	1.326E-04	77.5%
SLINE23	Off-Site Travel 5% Inbound 5th St.	8.313E-06	77.5%
SLINE24	Off-Site Travel 67% Outbound to SR-210	3.995E-05	77.5%
SLINE25	Off-Site Travel 67% Inbound to SR-210	3.995E-05	77.5%

These sources were modeled with the Table 6-5 listed emission rates in AERMOD, and unit emission rates were input into CARB's HARP software to determine cancer risks from the DPM concentrations determined by AERMOD. While dispersion characteristics remained the same between baseline and reduced modeling

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[19] http://www.sbcity.org/civicax/filebank/blobdload.aspx?blobid=29075

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scenarios, emission rates were reduced according to the number of "old technology" engines combusting diesel, based on source type. The table above shows the Proportion of "Old Technology" Engine Emissions where the DPM reduction factor was taken into account. The subsequent figures show the baseline and reduced cancer risk isopleths from the analysis and include information on the MEIR for the analysis.

Figure 6-23. Baseline San Bernardino Health Risk Assessment Isopleths
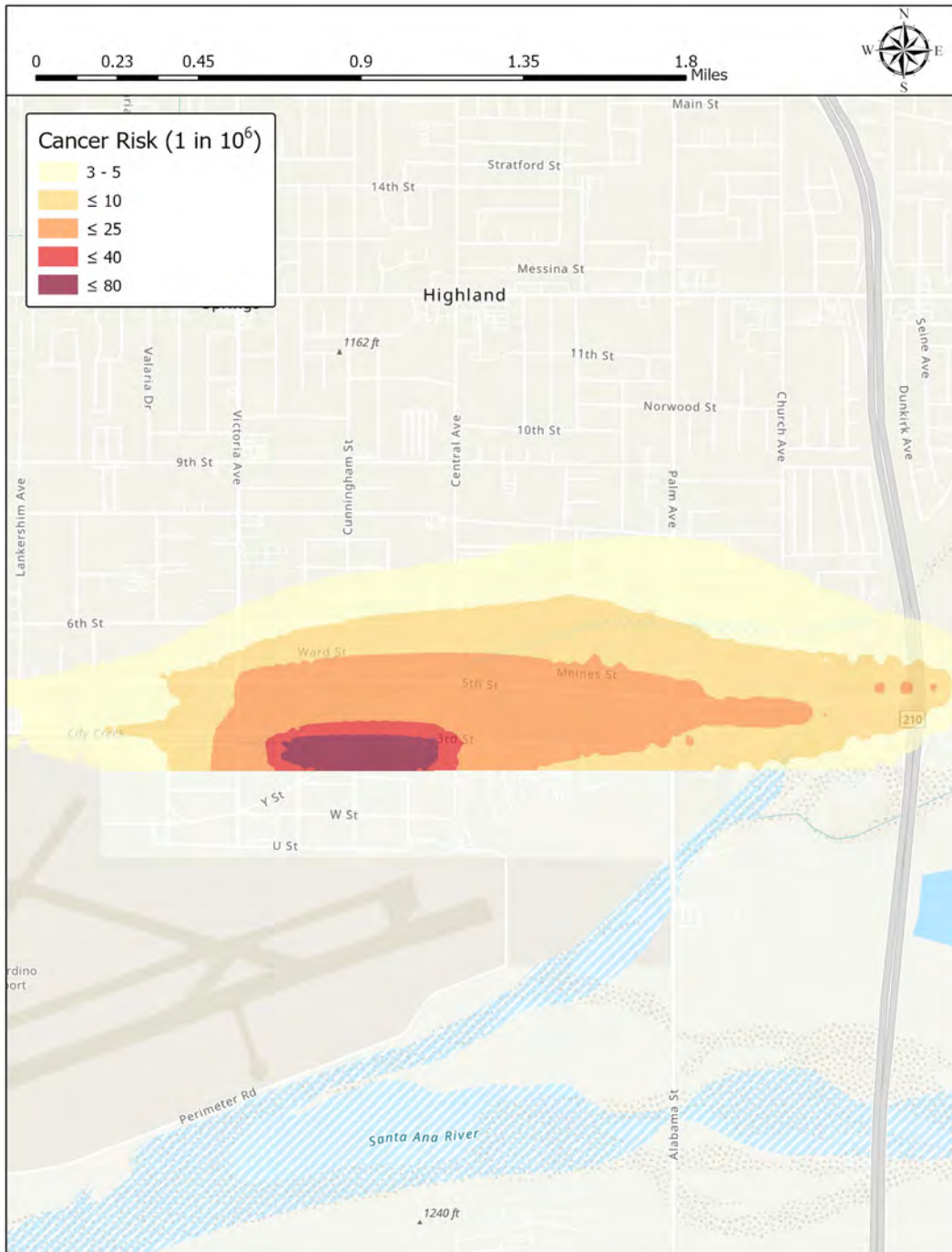
The site-specific HRA shows that the point of maximum impact (PMI) is substantially higher than the NATA/HARP evaluation, with an impact of 80 cancer cases per million residents. This PMI does not occur at a residential receptor, though, and does not represent an actual risk to residences in the area. The MEIR occurs at 479,759.3 m E, and 3,774,224.8 m N (NAD 83, UTM Zone 11), with a baseline risk of 19 cancer cases per million residents. This MEIR is lower than the NATA/HARP hybrid risks evaluated for that census tract (06071007603) with a total risk of 35 in a million. This HRA does not capture all of the cancer-causing sources in the area, but does demonstrate that NATA values are in-line with the site-specific demonstration.

Figure 6-24. Reduced San Bernardino Health Risk Assessment Risk Isopleths
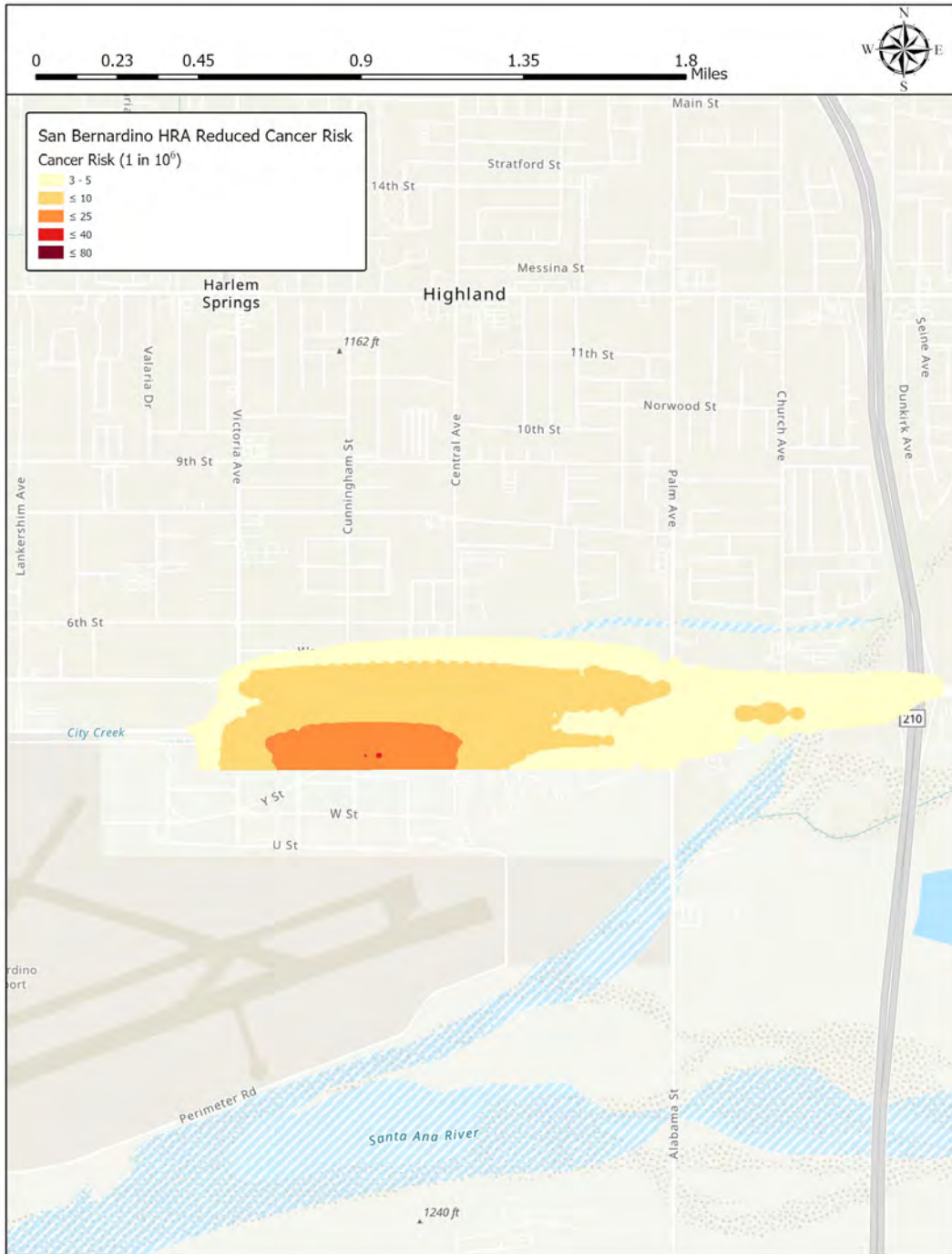
The reduced cancer risk PMI and MEIR are 27 and 8 in 1 million, respectively, both in the same locations as the baseline risk plots. This represents a risk reduction of 11 in 1 million at the MEIR.

6.3.3   Valuation of Health Benefits

The health benefits of reduced $PM_{2.5}$ exposure were modeled using U.S.EPA's BenMAP model according to the methodology described under Section 4.7. The results are shown in Table 6-6 below.

Table 6-6. San Bernardino Valuation of Reduced Incidence Benefits

Endpoint	Reduced Incidence	Benefit Value
Premature Mortality	17.7	$153,969,834
Asthma Exacerbation	12,823	$755,273
Minor Restricted Activity Days	13,038	$907,235
Work Loss Days	2,222	$334,888
Total		**$155,967,231**

6.4   Everett, Washington

6.4.1   NATA Health Risks

The subsections below review the NATA data available for the Everett, WA (Everett) community. The data is outlined in the following order:

- Baseline NATA Total Cancer Risks
- Baseline NATA DPM Cancer Risks
- Reduced NATA DPM Cancer Risks

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

Figure 6-25 shows the Baseline NATA Total Cancer Risk. This total cancer risk encompasses all sources in the area.

Figure 6-26 shows those cancer risks specific to DPM emissions as determined using NATA raw data.

Figure 6-27 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the Everett community.

Because the NATA 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 Everett community.

6.4.1.1 NATA Risk Data

Figure 6-25. Everett Baseline NATA Total Cancer Risk
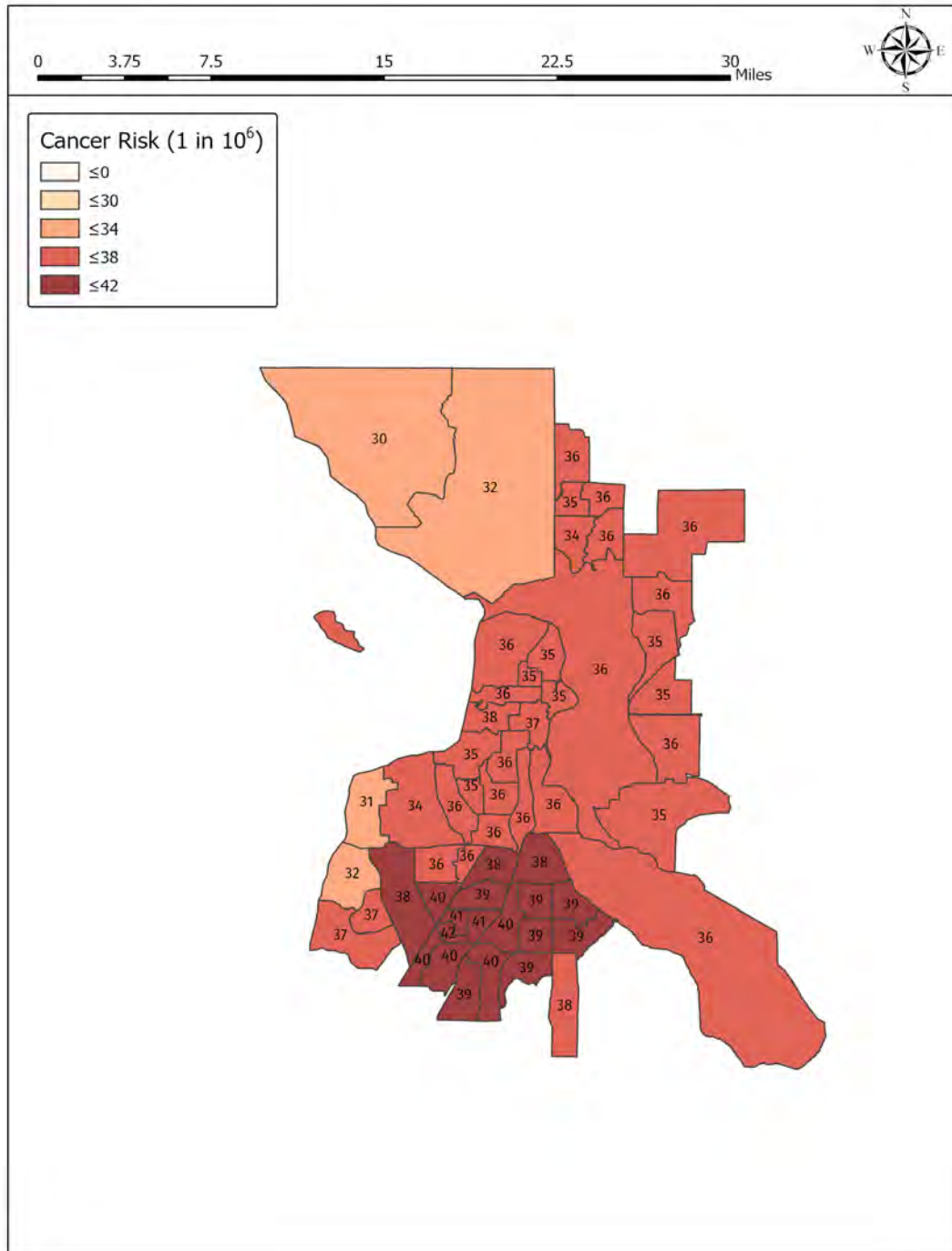
According to the NATA, the maximum baseline cancer risk in the Everett community is 41.51 cancer cases per million residents for census tract 53061041810, with a population of 5,035 residents. When accounting for all of the communities assessed, the total cancer burden for the Everett community is 10 cancer cases expected over a 70-year timeline among a total community population of 268,280.

Figure 6-26. Everett Baseline NATA DPM Cancer Risks
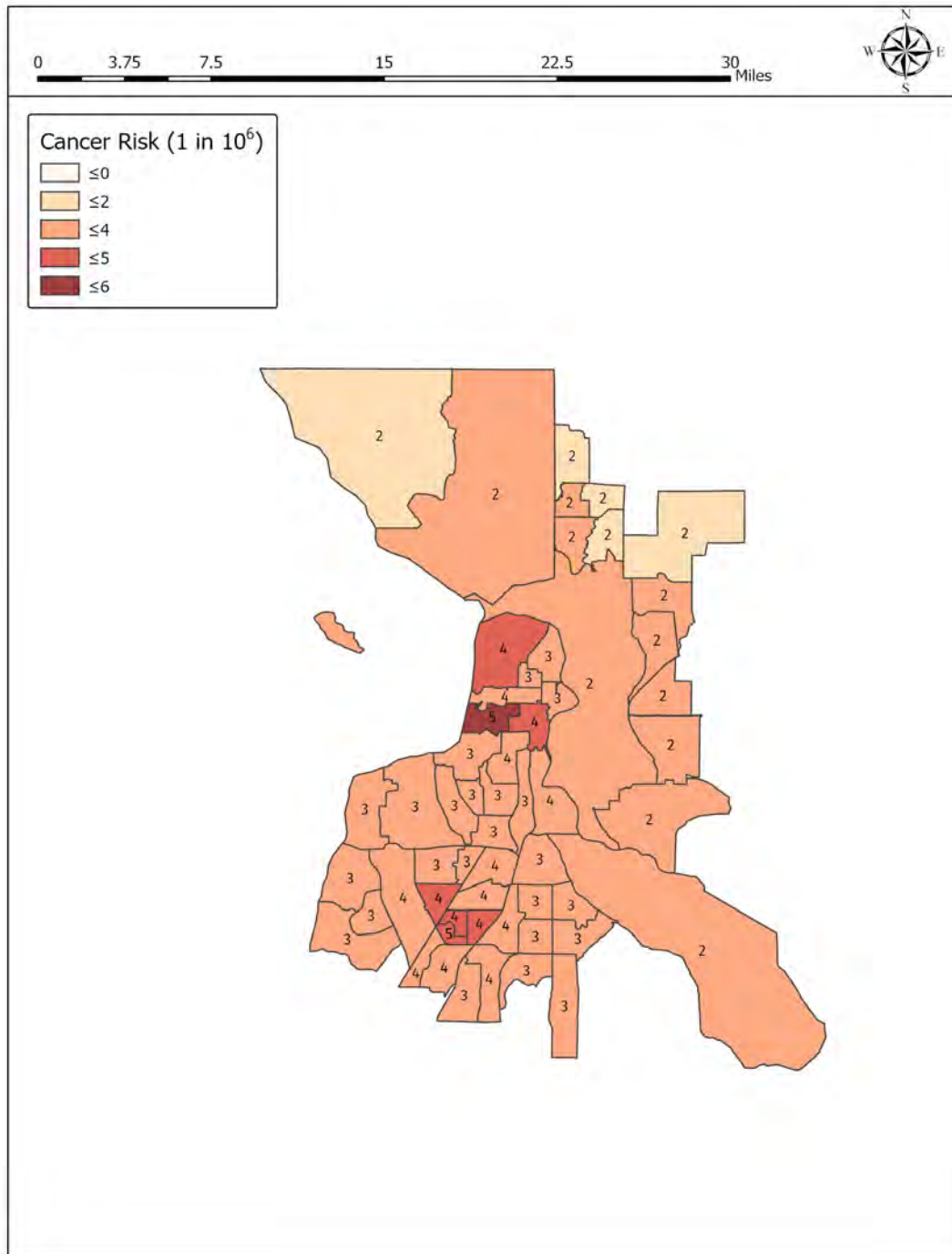
According to the NATA, the maximum DPM-specific baseline cancer risk in the Everett community is 5 cancer cases per million residents for census tract 53061040800, with a population of 2,418 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the Everett community is <1 cancer case expected over a 70-year timeline among a total community population of 268,280.

Figure 6-27. Everett Reduced NATA DPM Cancer Risks

Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the Everett c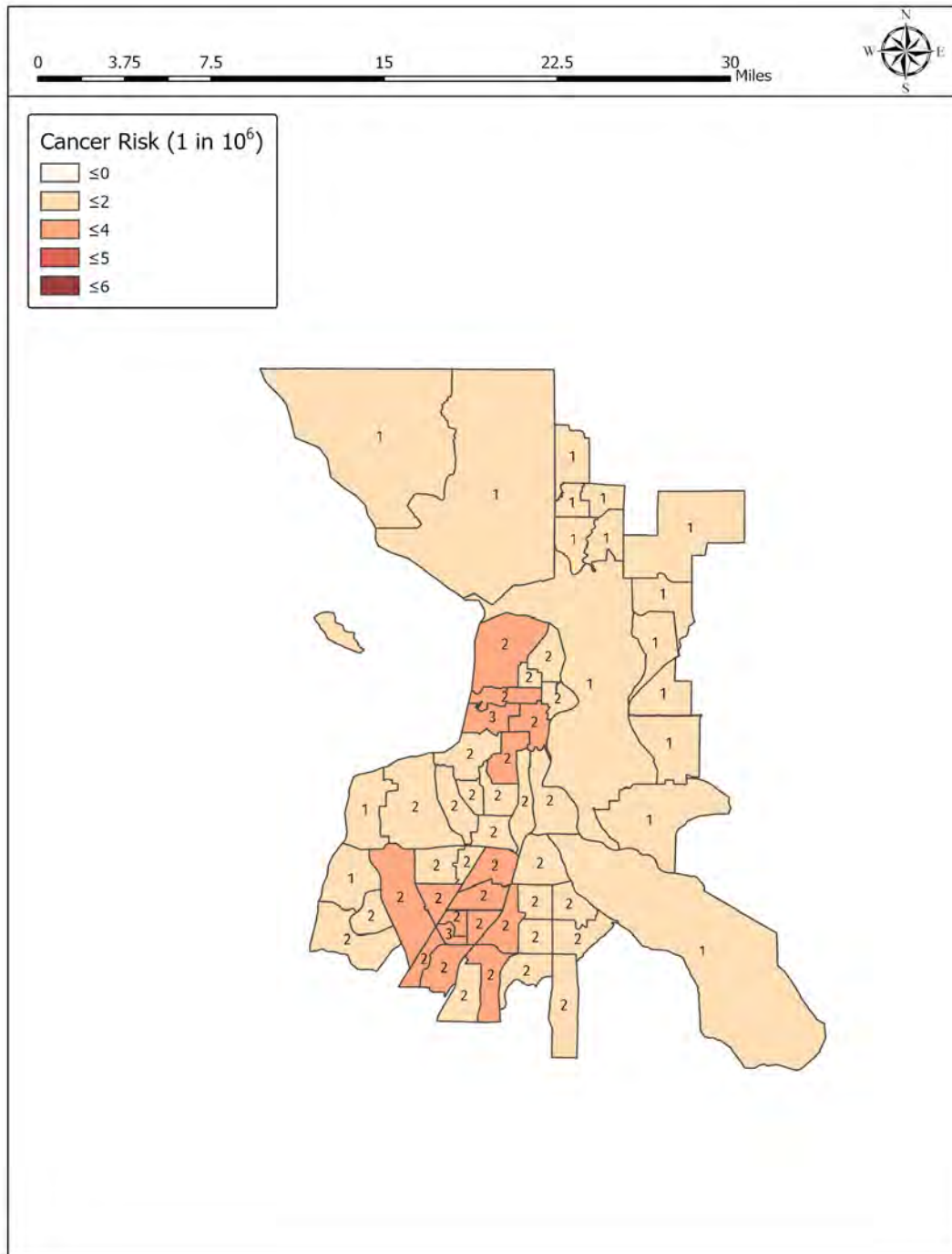ommunity becomes 3 cancer cases per million residents for census tract 53061040800, with a population of 2,418 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the Everett community remains <1 cancer case expected over a 70-year timeline among a total community population of 268,280.

6.4.1.2 NATA Data with HARP Risk Factors

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

- Baseline NATA DPM Concentrations
- Baseline NATA/HARP DPM Hybrid Risks
- Reduced NATA/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 NATA were therefore utilized to determine cancer risks in combination with OEHHA cancer unit risk values. The NATA DPM concentrations are shown, along with baseline and reduced cancer risks using CARB's HARP program.

Figure 6-28 shows the baseline DPM concentrations provided by the NATA.

Figure 6-29 shows the baseline DPM-specific cancer risks as determined using the NATA concentration values and CARB's HARP program.

Figure 6-30 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the Everett community.

Because this hybrid NATA/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 Everett community.

Figure 6-28. Everett Baseline NATA DPM Concentrations
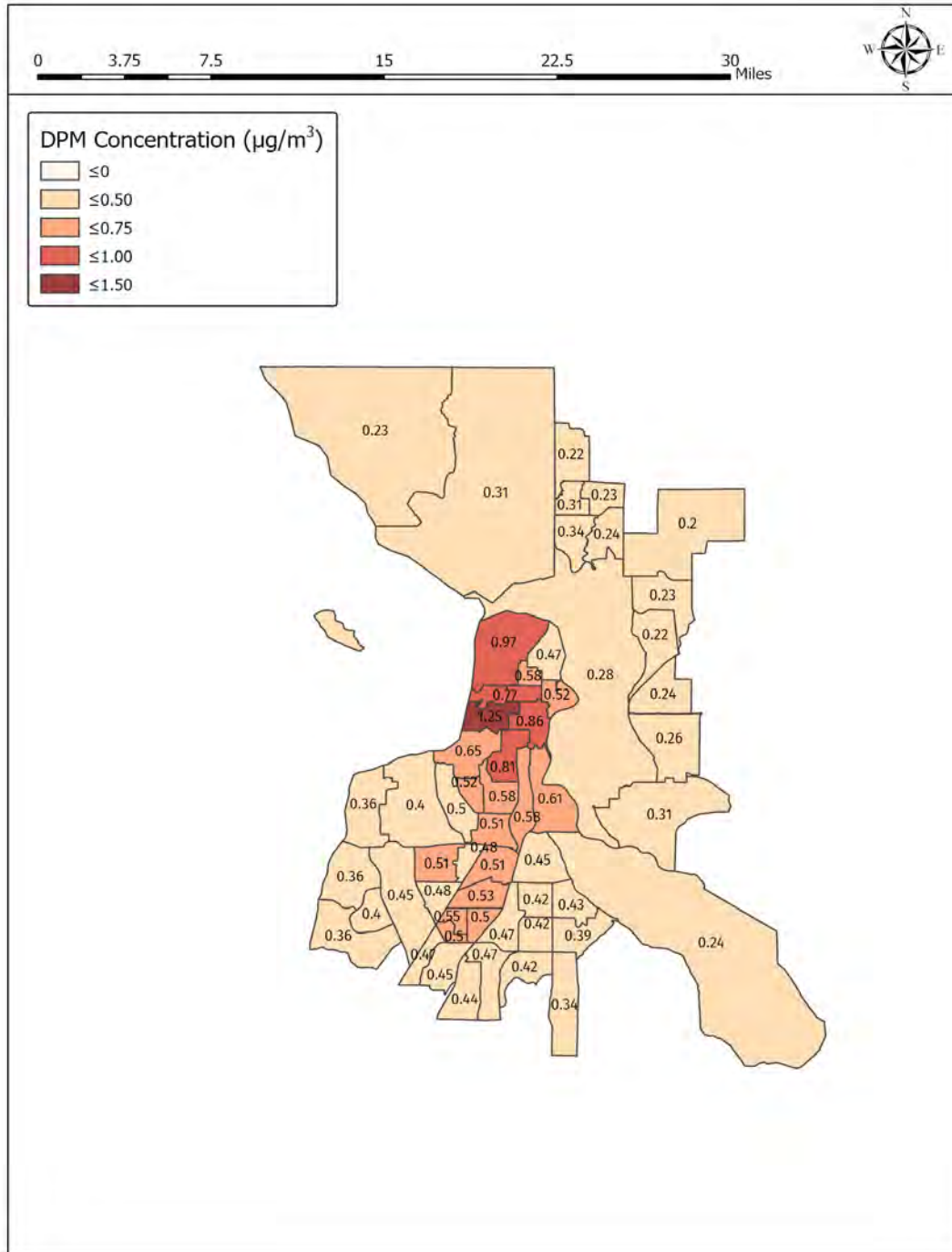
According to the NATA, the maximum baseline DPM concentration in the Everett community is 1.25 µg/m^3 for census tract 53061040800, with a population of 2,418 residents. The average DPM concentration of the Everett community is 0.46 µg/m^3.

Figure 6-29. Everett Baseline NATA/HARP DPM Hybrid Risks
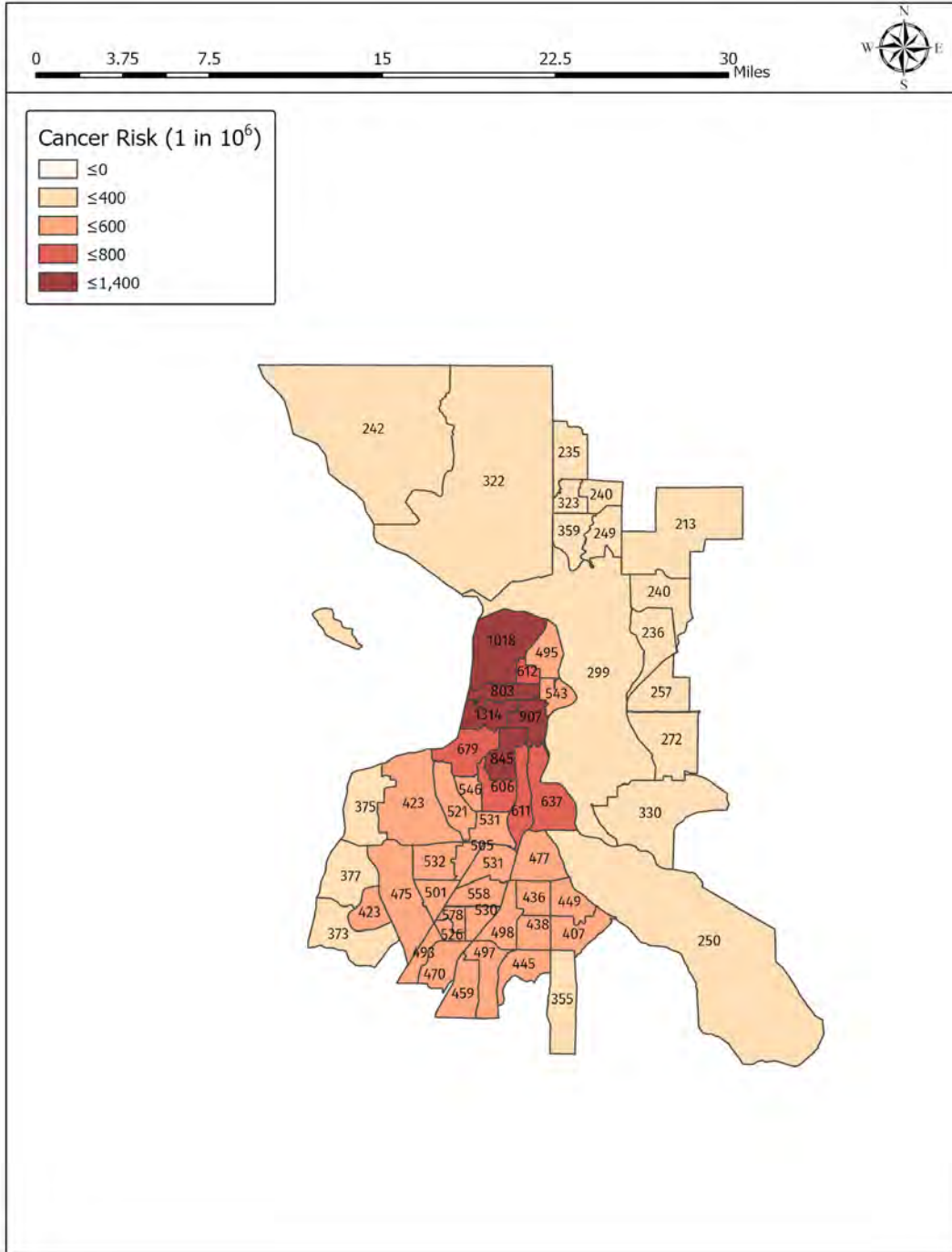
Using NATA DPM concentrations and OEHHA cancer unit risk values, the maximum DPM-specific baseline cancer risk in the Everett community is 1,313 cancer cases per million residents for census tract 53061040800, with a population of 2,418 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the Everett community is 126 cancer cases expected over a 70-year timeline among a total community population of 268,280.

Figure 6-30. Everett Reduced NATA/HARP DPM Hybrid Risks
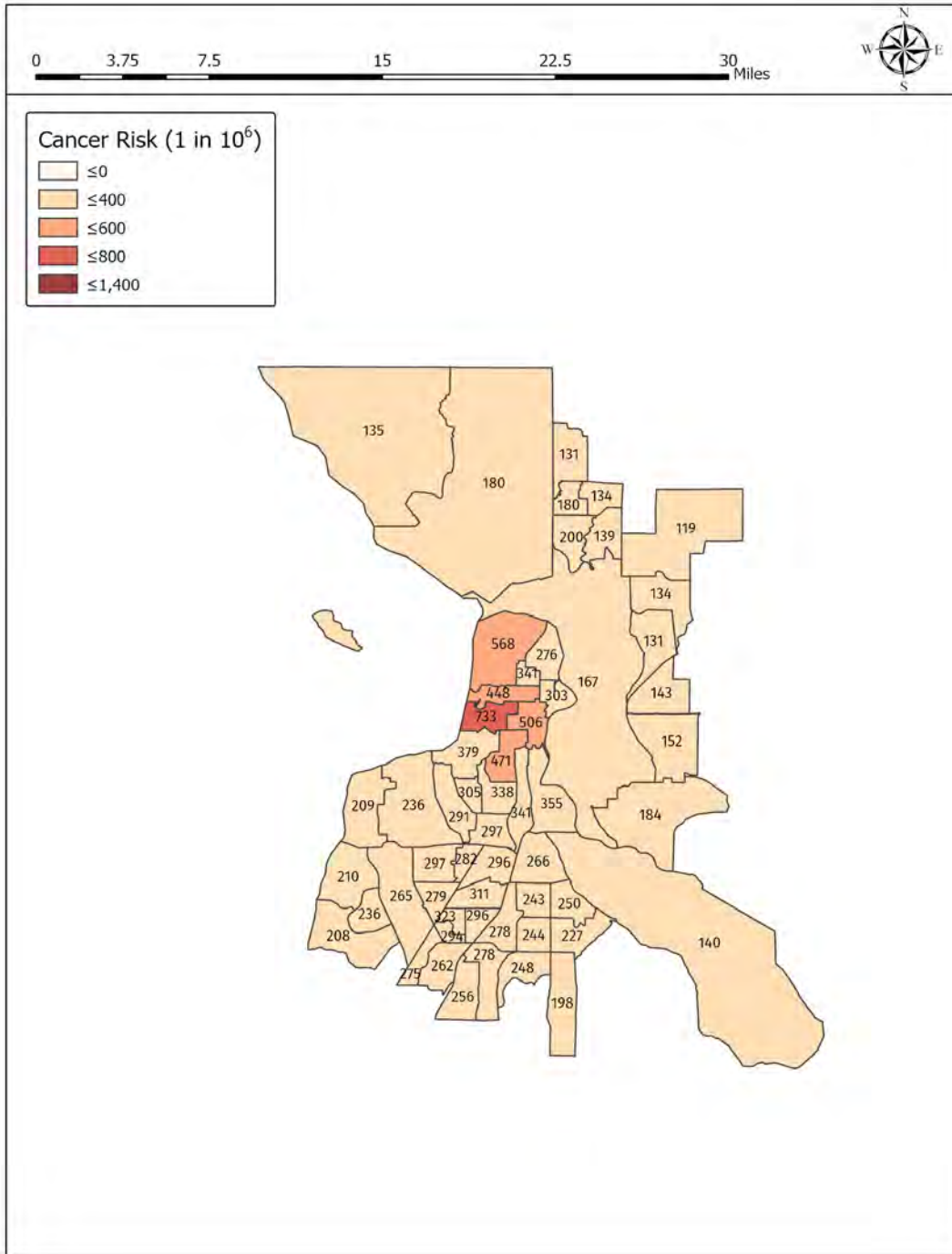
Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the Everett community becomes 733 cancer cases per million residents for census tract 53061040800, with a population of 2,418 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the Everett community becomes 70 cancer cases expected over a 70-year timeline among a total community population of 268,280.

6.4.2   Everett Site-Specific Health Risk Assessment

While the NATA report is a good tool for general community assessment of health risks, it should not be utilized to infer findings for specific areas. In order to determine refined health benefits from transition to biodiesel in an existing area of concern, a site-specific HRA was conducted for Everett. The following sources were utilized to generate the HRA.

- Port of Everett 2016 Puget Sound Maritime Air Emissions Inventory[20]
- Washington State Department of Transportation – Traffic Counts (Average Annual Daily Traffic)[21]

The emissions sources were modeled with the following source groups in AERMOD, consistent with the report, representing the associated emission rates listed in Table 6-7.

Table 6-7. Everett Source Groups and Emission Rates

Source Group	Description	DPM Emissions (lb/yr)	Proportion of "Old Technology" Engine Emissions
Locomotives	Locomotives onsite at Port of Everett	4,000	100%
Cargo Handling Equipment	CHE at Port of Everett	1,400	53.7%
I-5	I-5 – 163,824 AADT	25,051	72.1%
SR-99	SR-99 – 33,800 AADT	2,854	72.1%
SR-525	SR-525 – 25,092 AADT	2,533	72.1%
SR-526	SR-526 – 43,263 AADT	3,532	72.1%
SR-529	SR-529 – 12,869 AADT	1,357	72.1%

These sources were modeled with the Table 6-7. listed emission rates in AERMOD, and unit emission rates were input into CARB's HARP software to determine cancer risks from the DPM concentrations determined by AERMOD. While dispersion characteristics remained the same between baseline and reduced modeling scenarios, emission rates were reduced according to the number of "old technology" engines combusting diesel, based on source type. The table above shows the Proportion of "Old Technology" Engine Emissions where the DPM reduction factor was taken into account. The subsequent figures show the baseline and reduced cancer risk isopleths from the analysis and include information on the MEIR for the analysis.

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[20] https://pugetsoundmaritimeairforum.files.wordpress.com/2018/10/final-2016-psei-report-19-oct-2018-scg.pdf

[21] https://www.arcgis.com/home/webmap/viewer.html?layers=f024c102e9a04b81bc24b90040d1db66

Figure 6-31. Baseline Everett Health Risk Assessment Isopleths
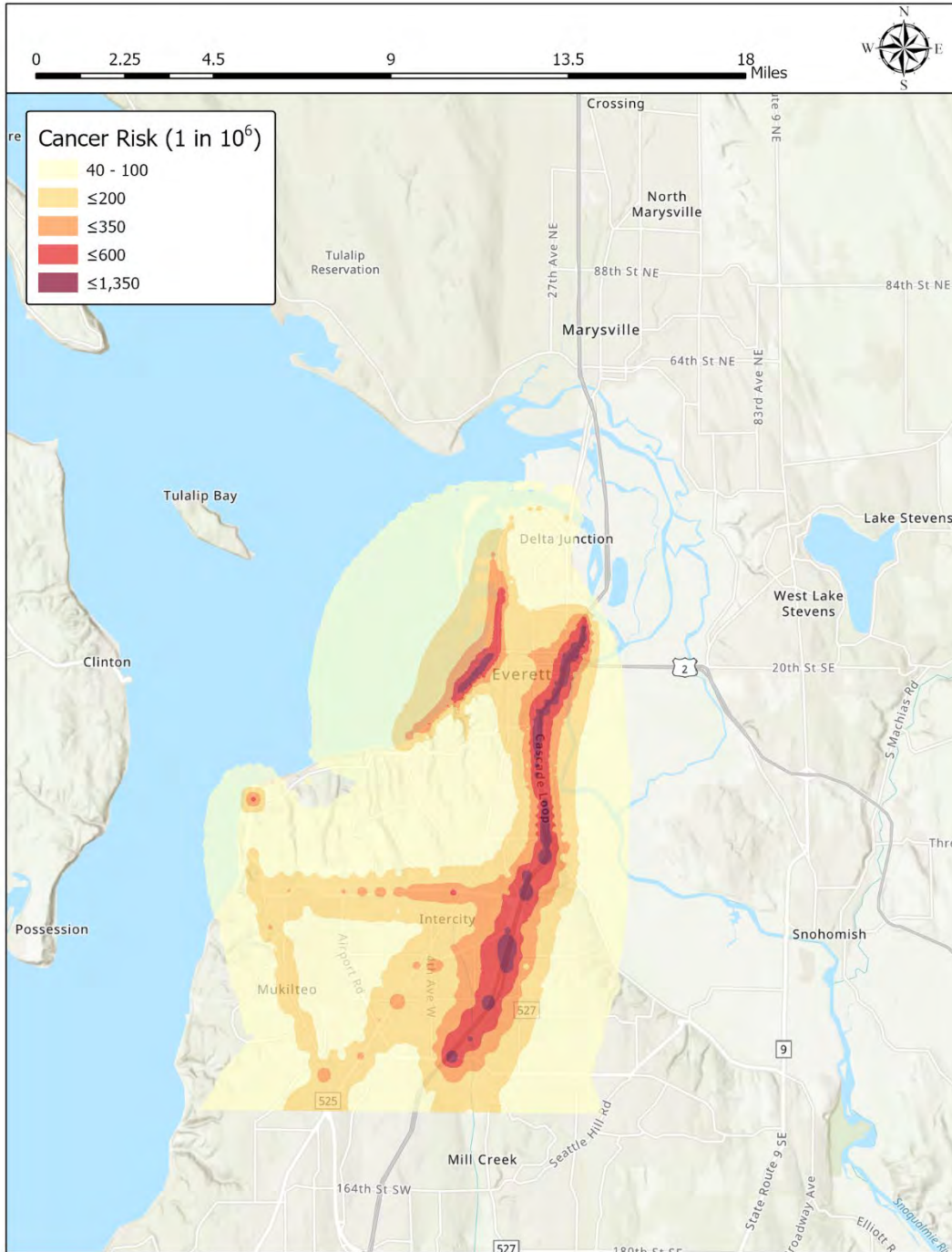
The site-specific HRA shows that the point of maximum impact (PMI) is similar to the NATA/HARP evaluation, with an impact of 1,325 cancer cases per million residents. This PMI does not occur at a residential receptor, though, and does not represent an actual risk to residences in the area. The MEIR occurs at 560,704.1 m E, and 5,314,761 m N (NAD 83, UTM Zone 10), with a baseline risk of 859 cancer cases per million residents. This MEIR is higher than the NATA/HARP hybrid risks evaluated for that census

tract (53061040500) with a total risk of 543 in a million. This HRA does not capture all of the cancer-causing sources in the area, but does demonstrate that NATA values are in-line with the site-specific demonstration.

Figure 6-32. Reduced Everett Health Risk Assessment Isopleths
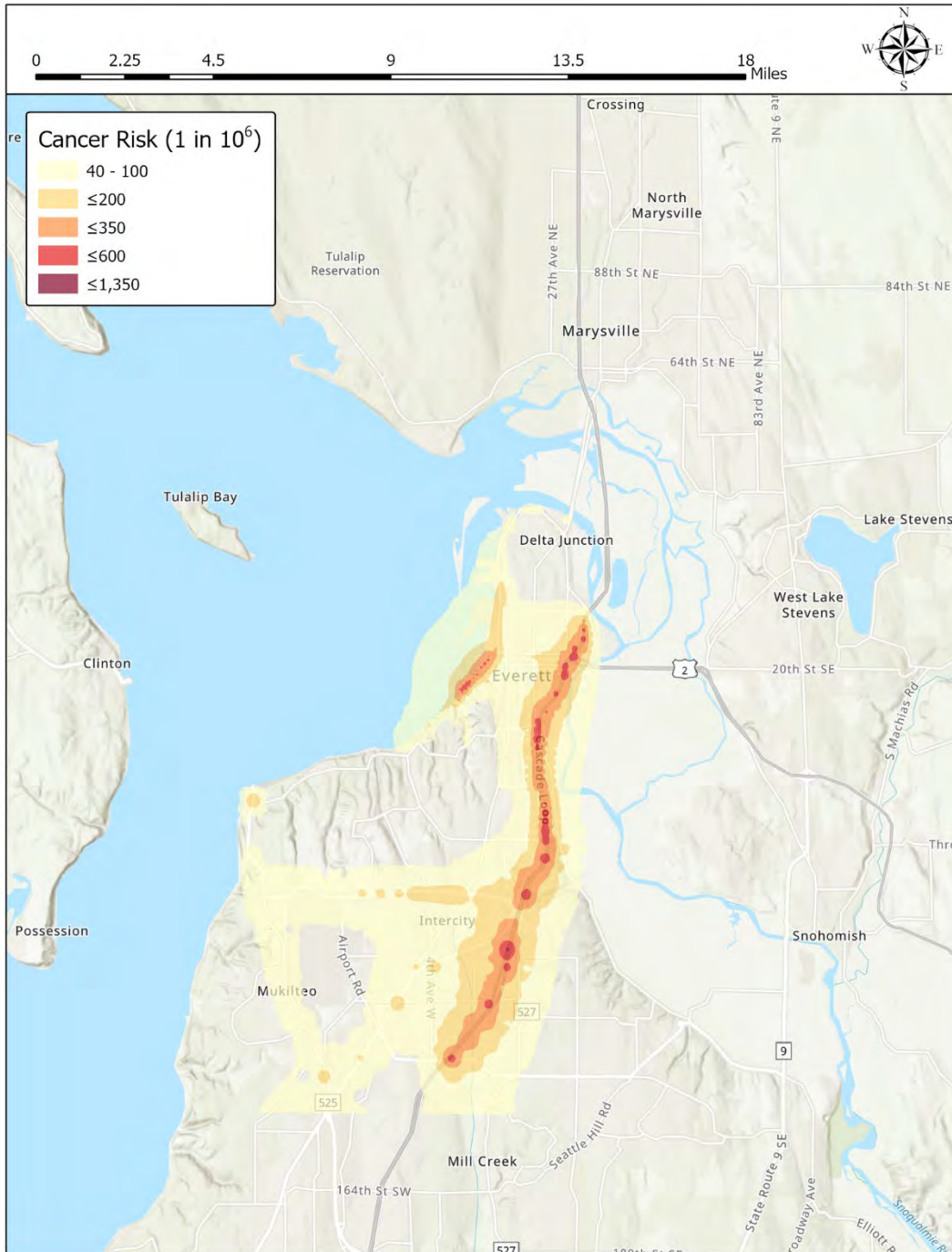
The reduced cancer risk PMI and MEIR are 637 and 412 in 1 million, respectively, both in the same locations as the baseline risk plots. This represents a risk reduction of 447 in 1 million at the MEIR.

6.4.3 Valuation of Health Benefits

The health benefits of reduced PM$_{2.5}$ exposure were modeled using U.S.EPA's BenMAP model according to the methodology described under Section 4.7. The results are shown in Table 6-8 below.

Table 6-8. Everett Valuation of Reduced Incidence Benefits

Endpoint	Reduced Incidence	Benefit Value
Premature Mortality	5.9	$47,479,136
Asthma Exacerbation	5,265	$285,309
Minor Restricted Activity Days	5,569	$356,475
Work Loss Days	938	$176,885
Total		**$48,297,804**

6.5   Seattle, Washington

6.5.1   NATA Health Risks

The subsections below review the NATA data available for the Seattle, WA (Seattle) community. The data is outlined in the following order:

- Baseline NATA Total Cancer Risks
- Baseline NATA DPM Cancer Risks
- Reduced NATA DPM Cancer Risks

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

Figure 6-33 shows the Baseline NATA Total Cancer Risk. This total cancer risk encompasses all sources in the area.

Figure 6-34 shows those cancer risks specific to DPM emissions as determined using NATA raw data.

Figure 6-35 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the Seattle community.

Because the NATA 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 Seattle community.

6.5.1.1 NATA Risk Data

Figure 6-33. Seattle Baseline NATA Total Cancer Risk
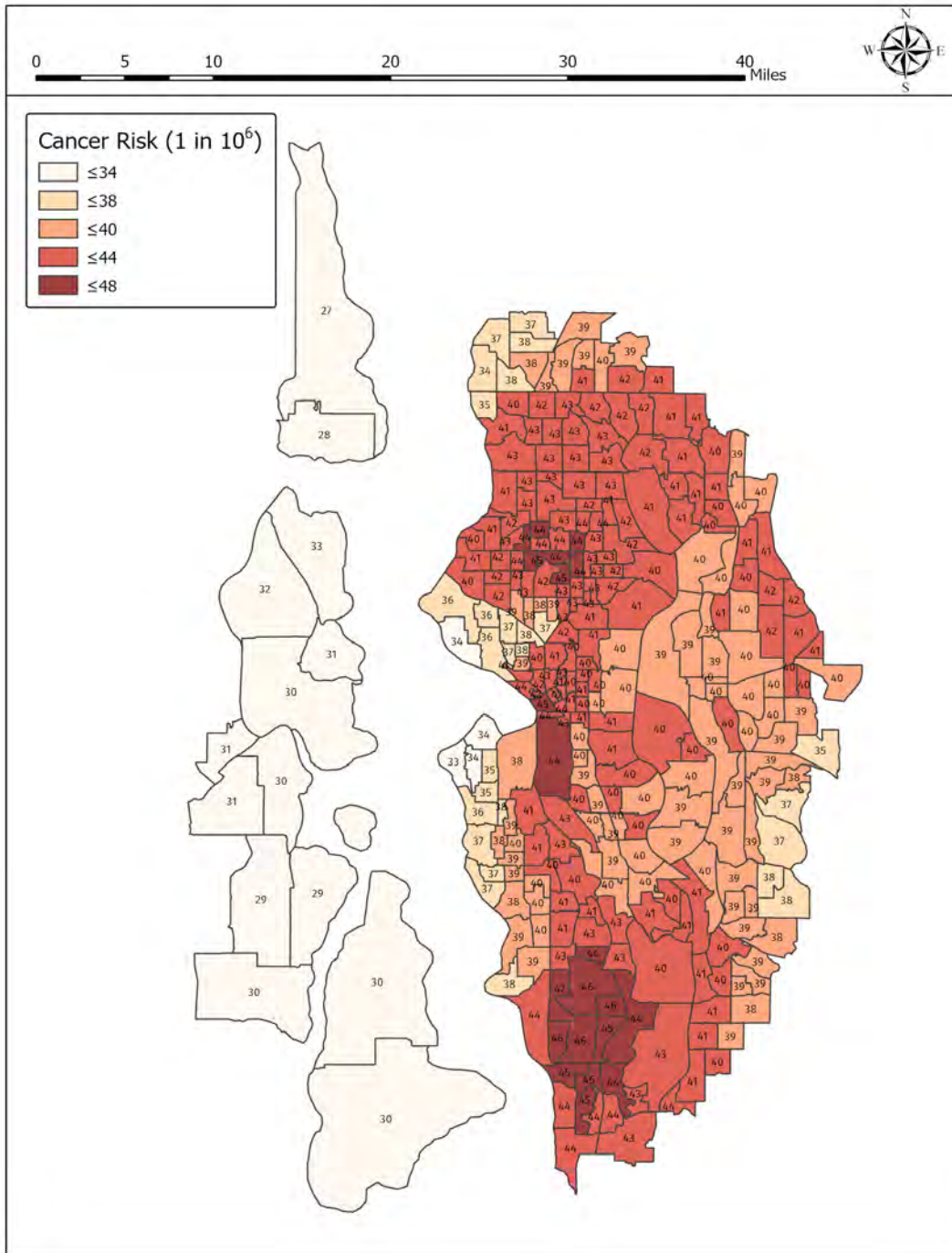
According to the NATA, the maximum baseline cancer risk in the Seattle community is 47.49 cancer cases per million residents for census tract 53033028500, with a population of 3,847 residents. When accounting for all of the communities assessed, the total cancer burden for the Seattle community is 57 cancer cases expected over a 70-year timeline among a total community population of 1,424,757.

Figure 6-34. Seattle Baseline NATA DPM Cancer Risk
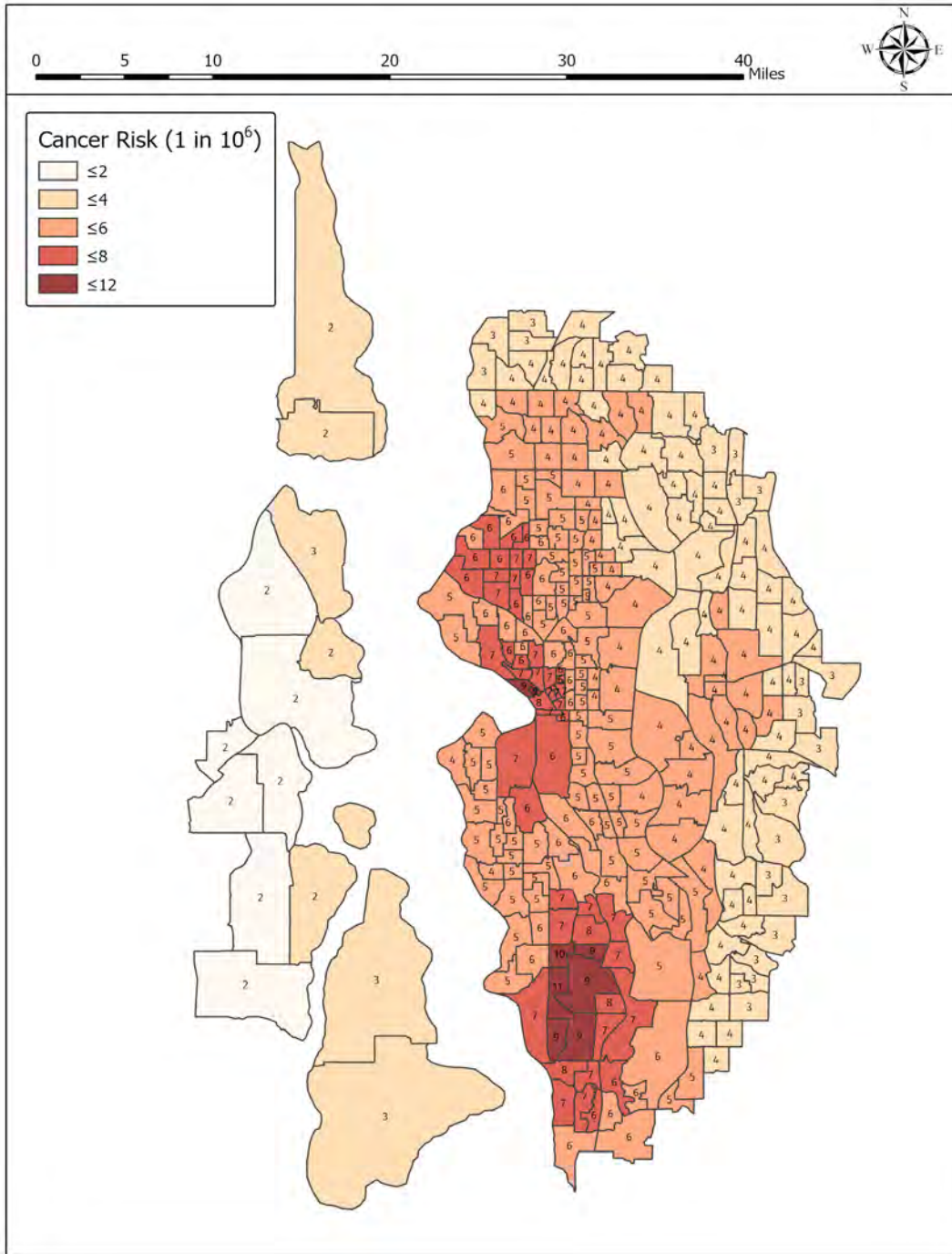
According to the NATA, the maximum DPM-specific baseline cancer risk in the Seattle community is 11 cancer cases per million residents for census tract 53033028500, with a population of 3,847 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the Seattle community is 7 cancer cases expected over a 70-year timeline among a total community population of 1,424,757.

Figure 6-35. Seattle Reduced NATA DPM Cancer Risk
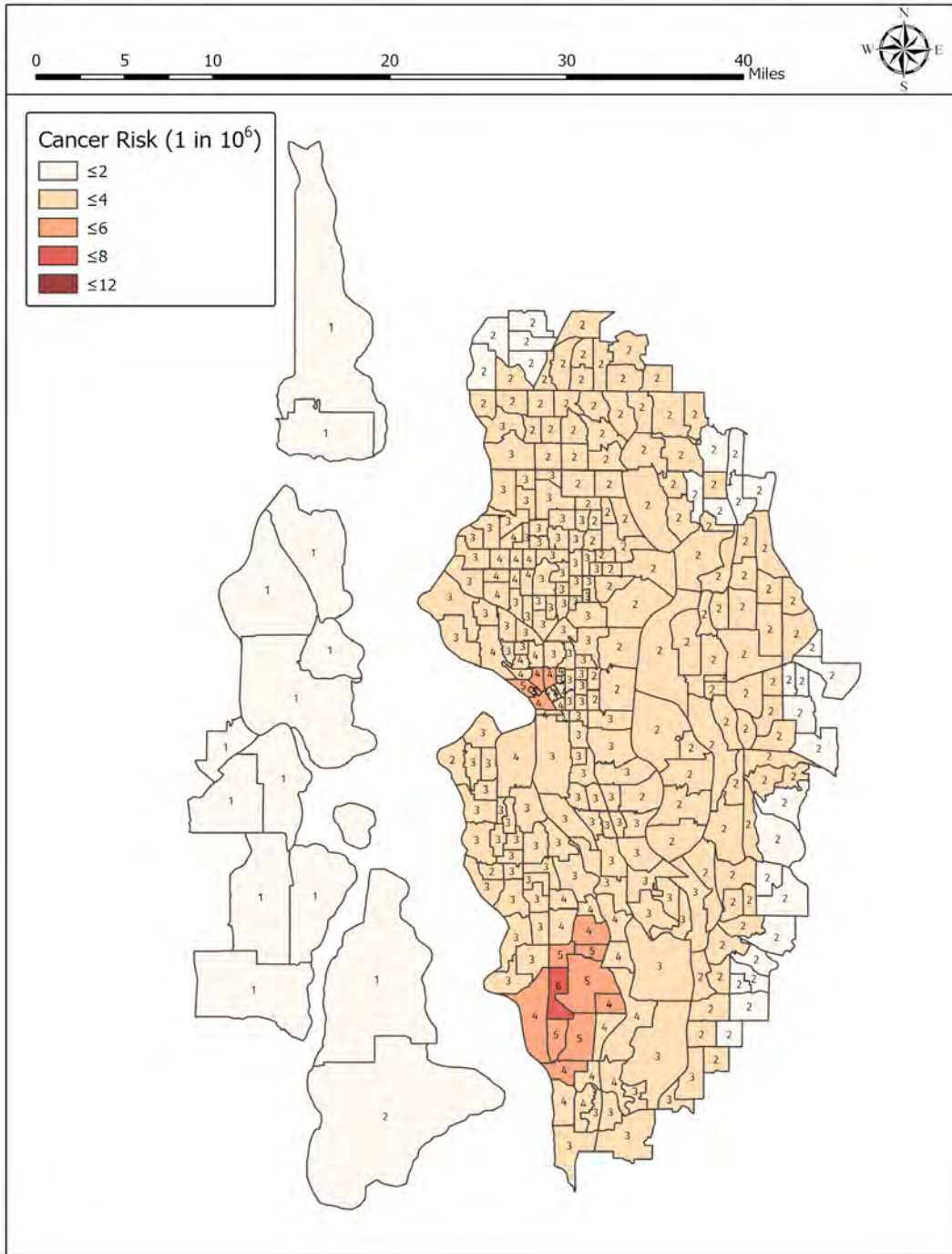
Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the Seattle community becomes 6 cancer cases per million residents for census tract 53033028500, with a population of 3,847 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the Seattle community becomes 4 cancer cases expected over a 70-year timeline among a total community population of 1,424,757.

6.5.1.2   NATA Data with HARP Risk Factors

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

- Baseline NATA DPM Concentrations
- Baseline NATA/HARP DPM Hybrid Risks
- Reduced NATA/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 NATA were therefore utilized to determine cancer risks in combination with OEHHA cancer unit risk values. The NATA DPM concentrations are shown, along with baseline and reduced cancer risks using CARB's HARP program.

Figure 6-36 shows the baseline DPM concentrations provided by the NATA.

Figure 6-37 shows the baseline DPM-specific cancer risks as determined using the NATA concentration values and CARB's HARP program.

Figure 6-38 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the Seattle community.

Because this hybrid NATA/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 Seattle community.

Figure 6-36. Seattle Baseline NATA DPM Concentration
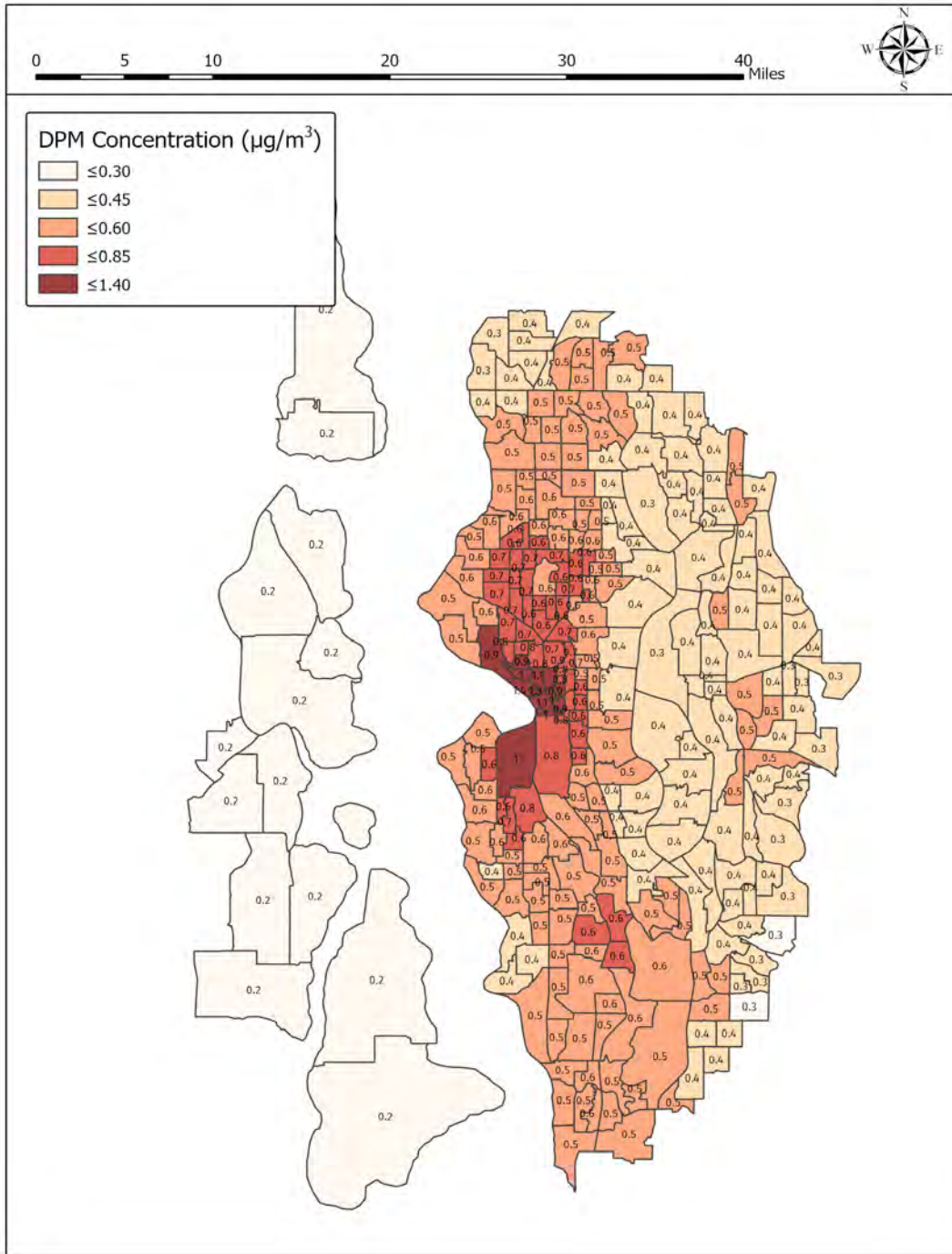
According to the NATA, the maximum baseline DPM concentration in the Seattle community is 1.37 µg/m³ for census tract 53033008001, with a population of 5,588 residents. The average DPM concentration of the Seattle community is 0.51 µg/m³.

Figure 6-37. Seattle Baseline NATA/HARP DPM Hybrid Risks
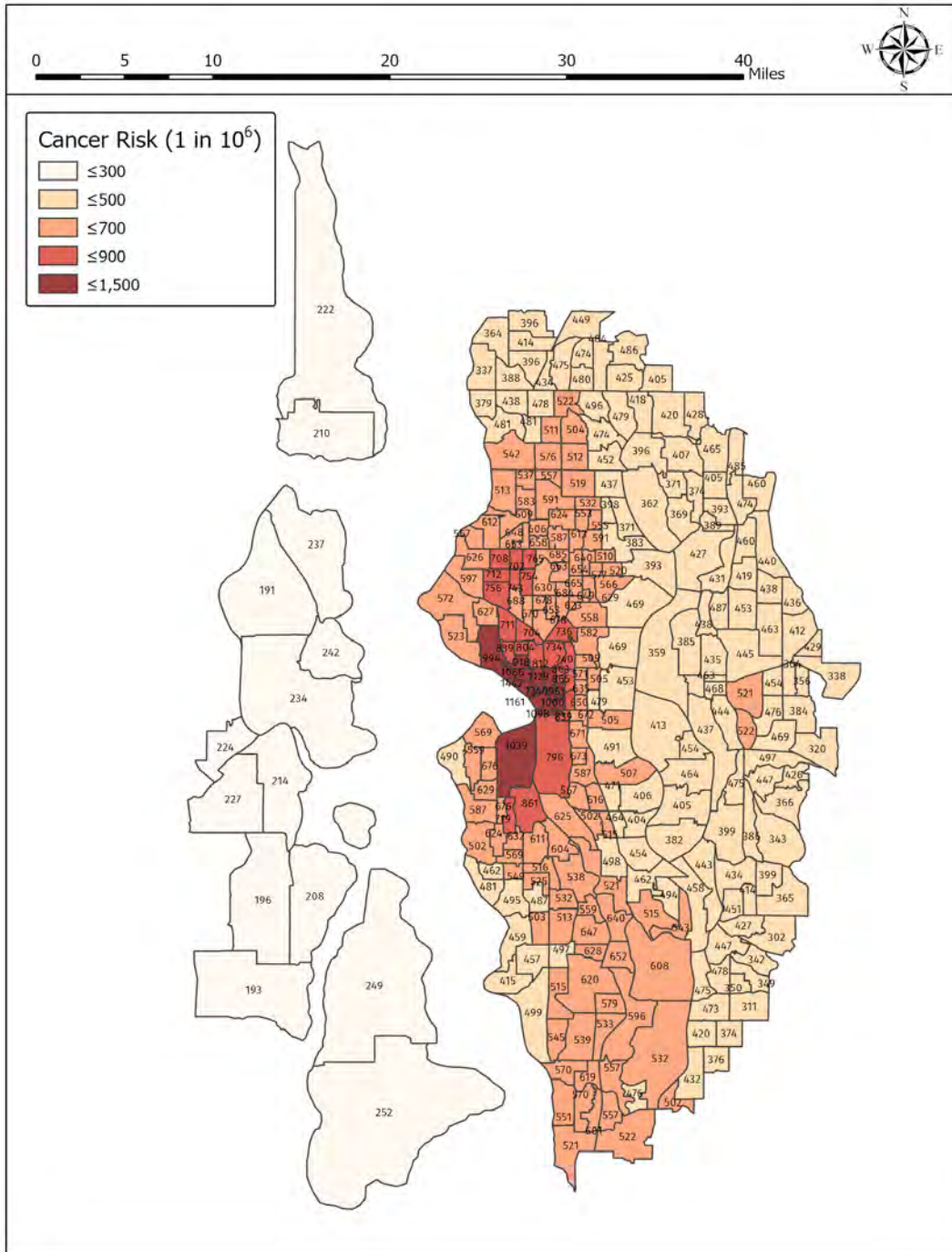
Using NATA DPM concentrations and OEHHA cancer unit risk values, the maximum DPM-specific baseline cancer risk in the Seattle community is 1,442 cancer cases per million residents for census tract 53033008001, with a population of 5,588 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the Seattle community is 755 cancer cases expected over a 70-year timeline among a total community population of 1,424,757.

Figure 6-38. Seattle Reduced NATA/HARP DPM Hybrid Risks
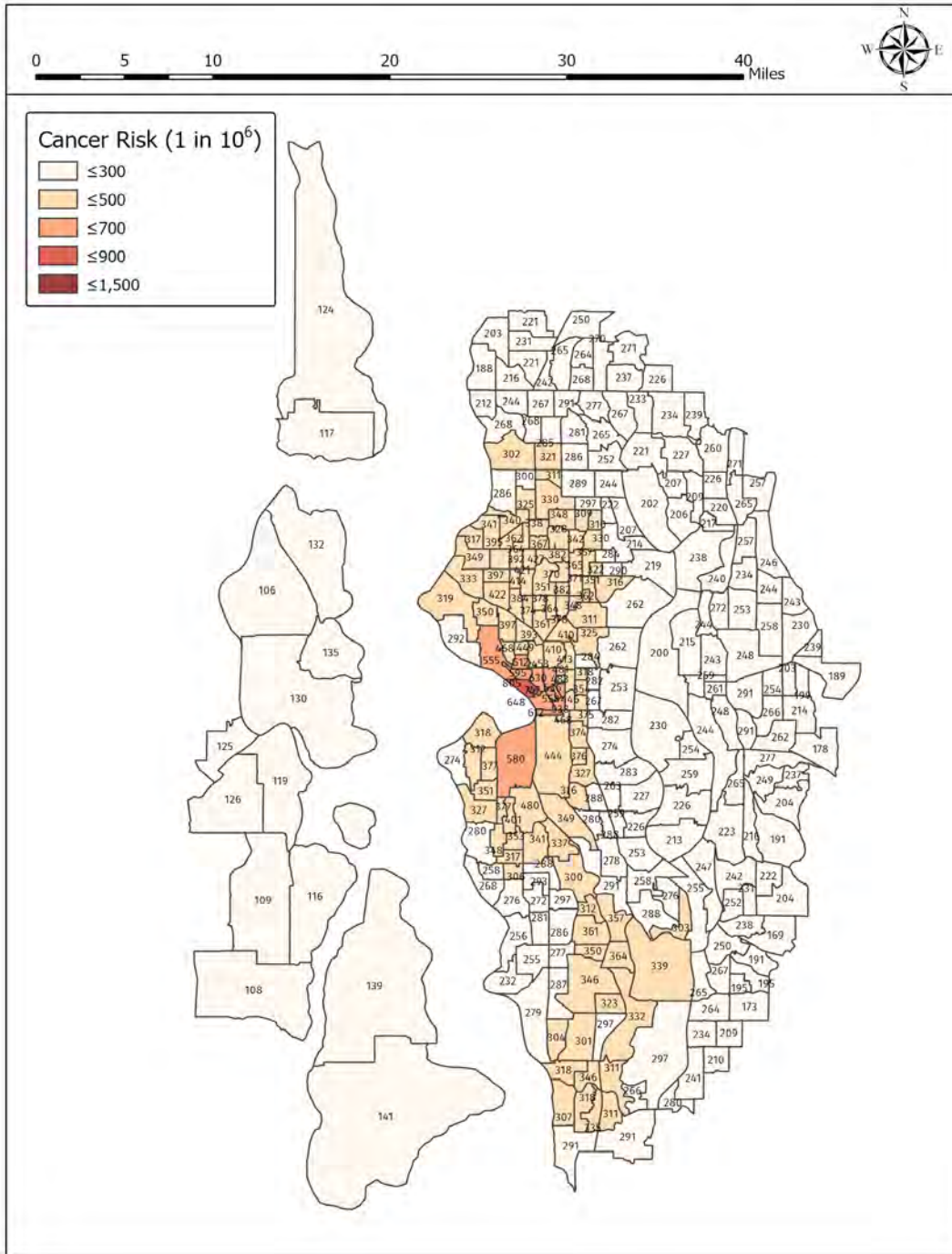
Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the Seattle community becomes 804 cancer cases per million residents for census tract 53033008001, with a population of 5,588 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the Seattle community becomes 421 cancer case expected over a 70-year timeline among a total community population of 1,424,757.

6.5.2 Seattle Site-Specific Health Risk Assessment

While the NATA report is a good tool for general community assessment of health risks, it should not be utilized to infer findings for specific areas. In order to determine refined health benefits from transition to biodiesel in an existing area of concern, a site-specific HRA was conducted for Seattle. The following sources were utilized to generate the HRA.

- Port of Seattle 2016 Puget Sound Maritime Air Emissions Inventory[22]
- Washington State Department of Transportation – Traffic Counts (Average Annual Daily Traffic)[23]

The emissions sources were modeled with the following source groups in AERMOD, consistent with the report, representing the associated emission rates listed in Table 6-9. .

Table 6-9. Seattle Source Groups and Emission Rates

Source Group	Description	DPM Emissions (lb/yr)	Proportion of "Old Technology" Engine Emissions
Locomotives	Locomotives onsite at Port of Seattle	660	100%
Cargo Handling Equipment	CHE at Port of Seattle	520	100%
Recreational Vessels	Recreational Vessels at Harbor	60	100%
Fleet Vehicles	Fleet Vehicles Onsite at Harbor	20	100%
I-5	I-5 – 206,878 AADT	92,048	72.1%
I-90	I-90 – 124,000 AADT	33,113	72.1%
I-405	I-405 – 162,778 AADT	53,260	72.1%
SR-18	SR-18 – 60,393 AADT	17,925	72.1%
SR-99	SR-99 – 42,258 AADT	16,561	72.1%
SR-509	SR-509 – 46,217 AADT	10,174	72.1%
SR-518	SR-518 – 88,200 AADT	5,365	72.1%
SR-520	SR-520 – 73,636 AADT	9,323	72.1%

These sources were modeled with the Table 6-9. listed emission rates in AERMOD, and unit emission rates were input into CARB's HARP software to determine cancer risks from the DPM concentrations determined by AERMOD. While dispersion characteristics remained the same between baseline and reduced modeling scenarios, emission rates were reduced according to the number of "old technology" engines combusting diesel, based on source type. The table above shows the Proportion of "Old Technology" Engine Emissions where the DPM reduction factor was taken into account. The subsequent figures show the baseline and reduced cancer risk isopleths from the analysis and include information on the MEIR for the analysis.

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[22] Ibid

[23] Ibid

Figure 6-39. Baseline Seattle Health Risk Assessment Isopleths
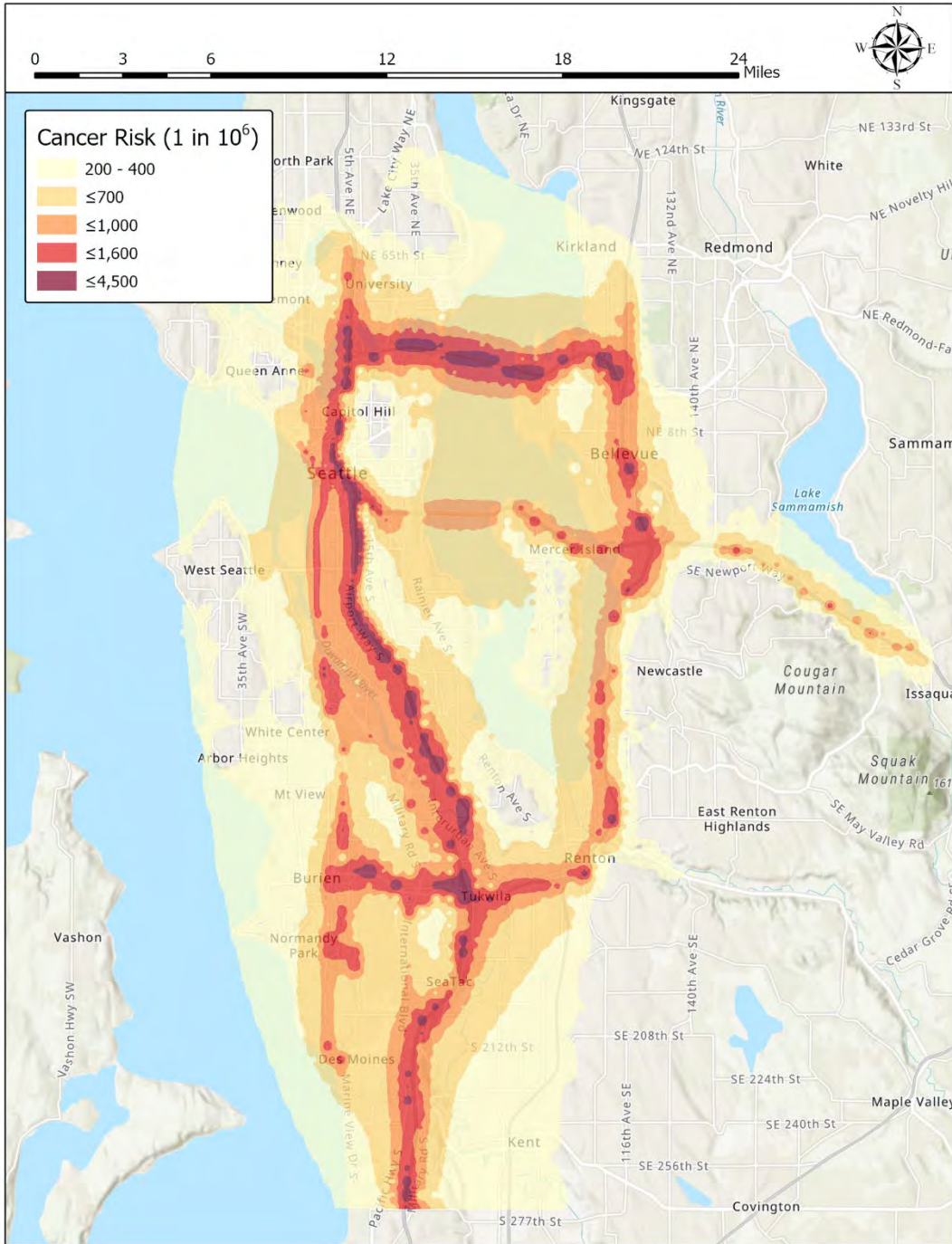
The site-specific HRA shows that the point of maximum impact (PMI) is substantially higher than the NATA/HARP evaluation, with an impact of 4,474 cancer cases per million residents. This PMI does not occur at a residential receptor, though, and does not represent an actual risk to residences in the area. The MEIR occurs at 560,734.1 m E, and 5,276,216.7 m N (NAD 83, UTM Zone 10), with a baseline risk of 3,062 cancer cases per million residents. This MEIR is higher than the NATA/HARP hybrid risks evaluated for that census tract (53033024000) with a total risk of 435 in a million. This HRA does not capture all of the cancer-causing

sources in the area, but does demonstrate that NATA values are in-line with the site-specific demonstration with some extremely high local maxima due to local residences proximity to highways.

Figure 6-40. Reduced Seattle Health Risk Assessment Isopleths
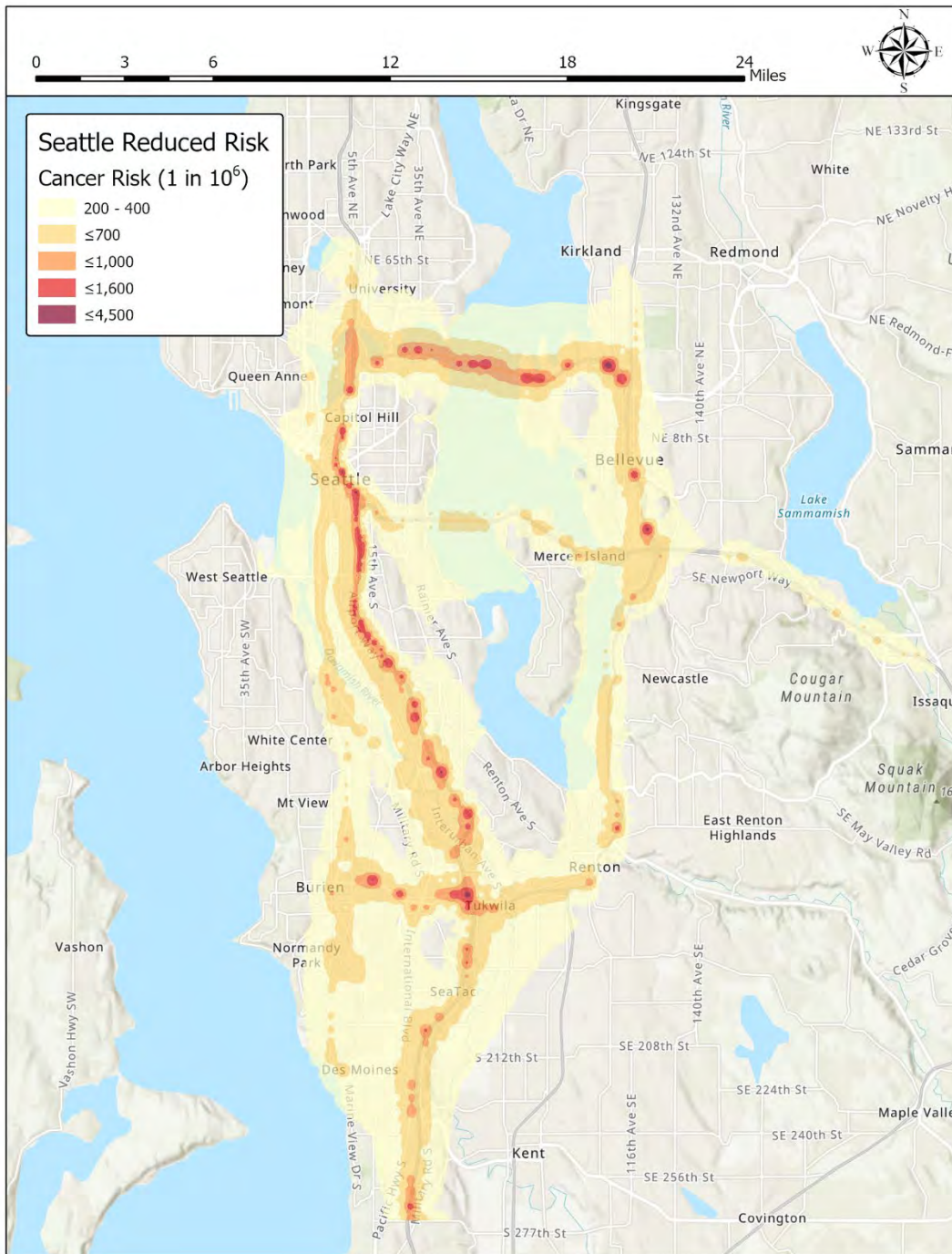
The reduced cancer risk PMI and MEIR are 2,151 and 1,472 in 1 million, respectively, both in the same locations as the baseline risk plots. This represents a risk reduction of 1,590 in 1 million at the MEIR.

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6-60

6.5.1 Valuation of Health Benefits

The health benefits of reduced PM$_{2.5}$ exposure were modeled using U.S.EPA's BenMAP model according to the methodology described under Section 4.7. The results are shown in Table 6-10 below.

Table 6-10. Seattle Valuation of Reduced Incidence Benefits

Endpoint	Reduced Incidence	Benefit Value
Premature Mortality	31.0	$248,443,583
Asthma Exacerbation	23,347	$1,265,156
Minor Restricted Activity Days	30,114	$1,927,772
Work Loss Days	5,106	$1,070,958
Total		**$252,707,470**

6.6   Portland, Oregon

6.6.1 NATA Health Risks

The subsections below review the NATA data available for the Portland, OR (Portland) community. The data is outlined in the following order:

- Baseline NATA Total Cancer Risks
- Baseline NATA DPM Cancer Risks
- Reduced NATA DPM Cancer Risks

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

Figure 6-41 shows the Baseline NATA Total Cancer Risk. This total cancer risk encompasses all sources in the area.

Figure 6-42 shows those cancer risks specific to DPM emissions as determined using NATA raw data.

Figure 6-43 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the Portland community.

Because the NATA 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 Portland community.

6.6.1.1   NATA Risk Data

Figure 6-41. Portland Baseline NATA Total Cancer Risk
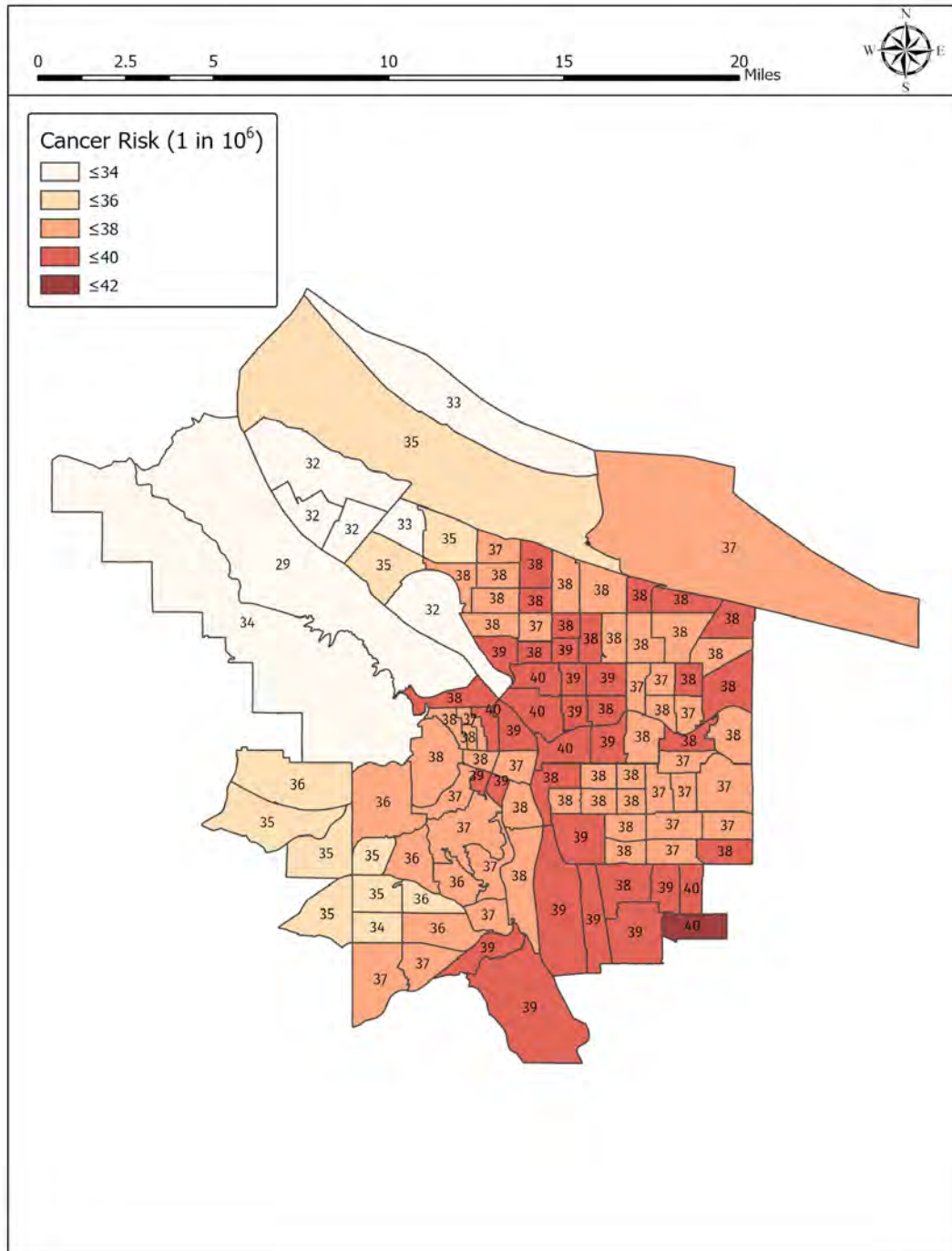
According to the NATA, the maximum baseline cancer risk in the Portland community is 40 cancer cases per million residents for census tract 41051008700, with a population of 4,539 residents. When accounting for all of the communities assessed, the total cancer burden for the Portland community is 16 cancer cases expected over a 70-year timeline among a total community population of 420,849.

Figure 6-42. Portland Baseline NATA DPM Cancer Risk

According to the NATA, the maximum DPM-specific baseline cancer risk in the Portland community is 5 cancer cases per million residents for census tract 41051007600, with a population of 3,562 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the Portland community is 2 cancer cases expected over a 70-year timeline among a total community population of 420,849.

Figure 6-43. Portland Reduced NATA DPM Cancer Risk

Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the Portland community becomes 3 cancer cases per million residents for census tract 41051007600, with a population of 3,562 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the Portland community becomes 1 cancer case expected over a 70-year timeline among a total community population of 420,849.

6.6.1.2 NATA Data with HARP Risk Factors

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

- Baseline NATA DPM Concentrations
- Baseline NATA/HARP DPM Hybrid Risks
- Reduced NATA/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 NATA were therefore utilized to determine cancer risks in combination with OEHHA cancer unit risk values. The NATA DPM concentrations are shown, along with baseline and reduced cancer risks using CARB's HARP program.

Figure 6-44 shows the baseline DPM concentrations provided by the NATA.

Figure 6-45 shows the baseline DPM-specific cancer risks as determined using the NATA concentration values and CARB's HARP program.

Figure 6-46 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the Portland community.

Because this hybrid NATA/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 Portland community.
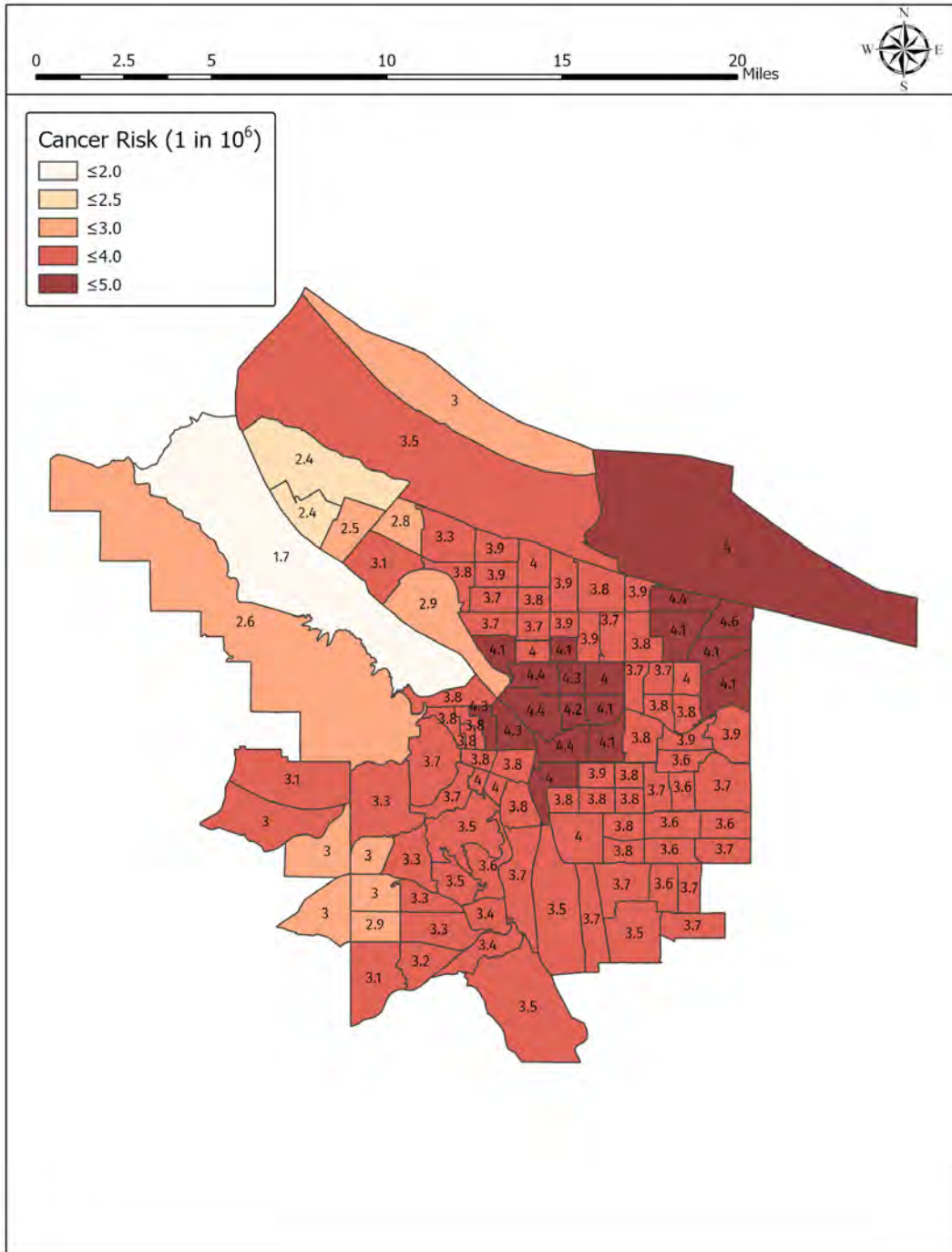
Figure 6-44. Portland Baseline NATA DPM Concentration
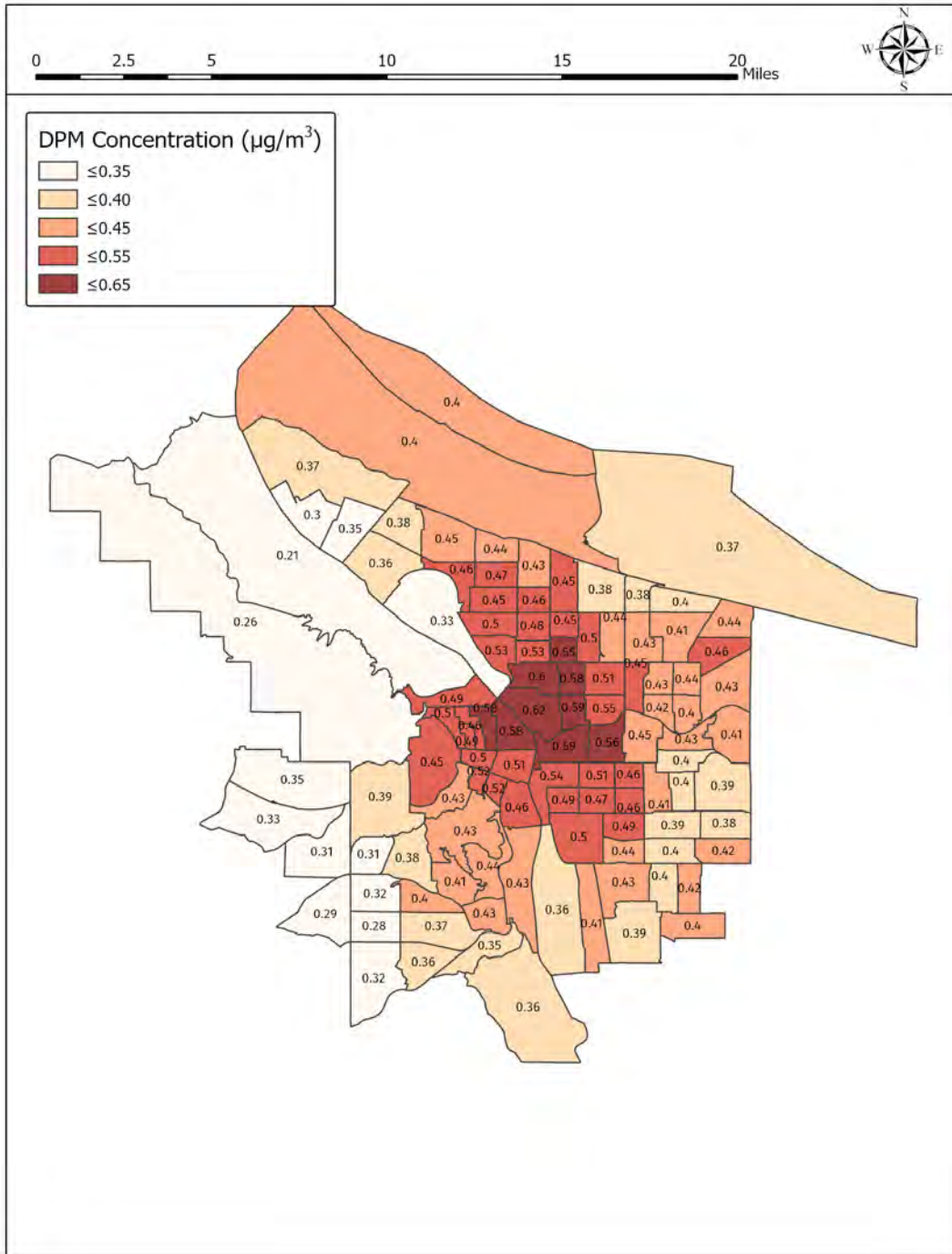
According to the NATA, the maximum baseline DPM concentration in the Portland community is 0.62 µg/m³ for census tract 41051002303, with a population of 1,996 residents. The average DPM concentration of the Portland community is 0.43 µg/m³.

Figure 6-45. Portland Baseline NATA/HARP DPM Hybrid Risks
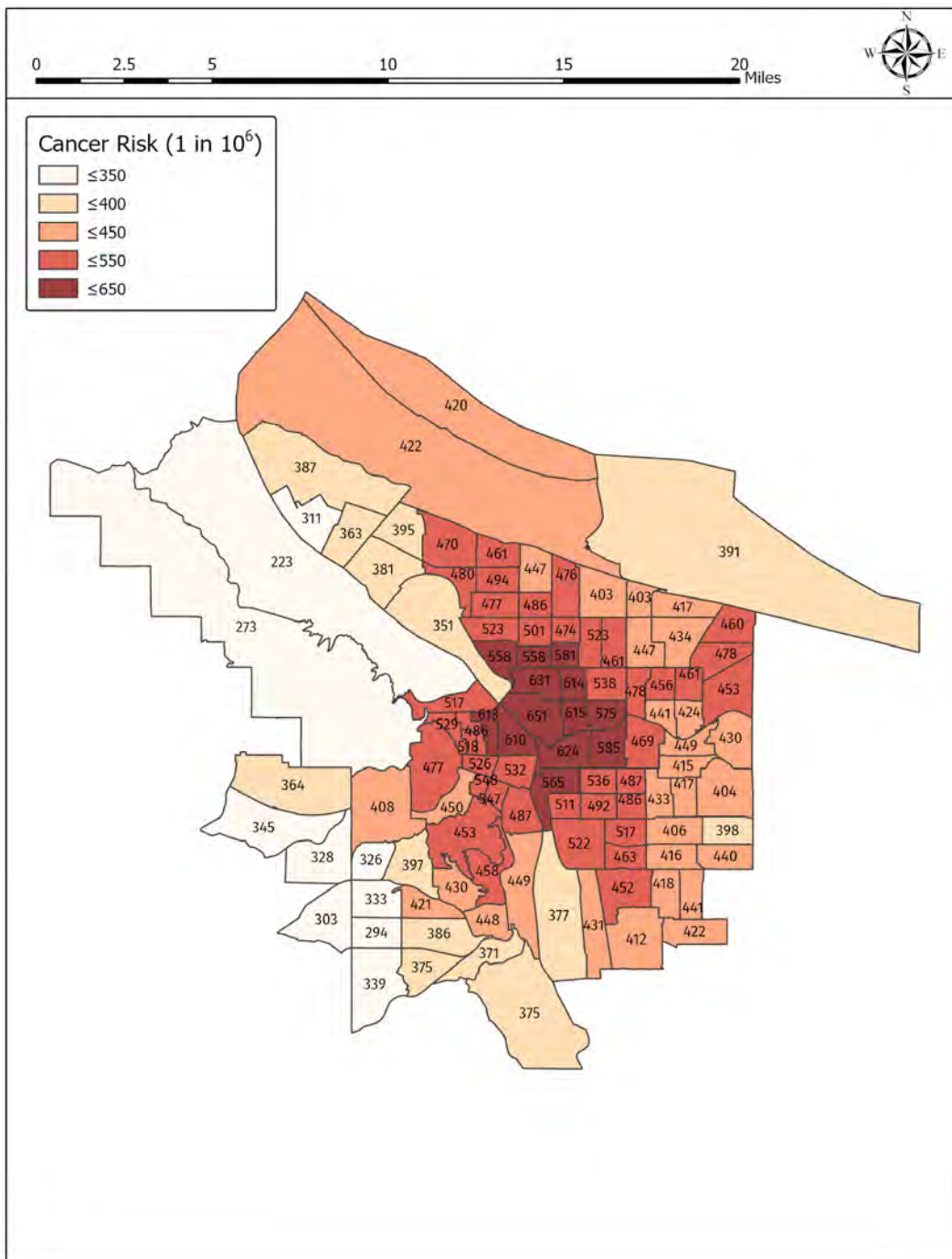
Using NATA DPM concentrations and OEHHA cancer unit risk values, the maximum DPM-specific baseline cancer risk in the Portland community is 651 cancer cases per million residents for census tract 41051002303, with a population of 1,996 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the Portland community is 189 cancer cases expected over a 70-year timeline among a total community population of 420,849.

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6-67

Figure 6-46. Portland Reduced NATA/HARP DPM Hybrid Risks
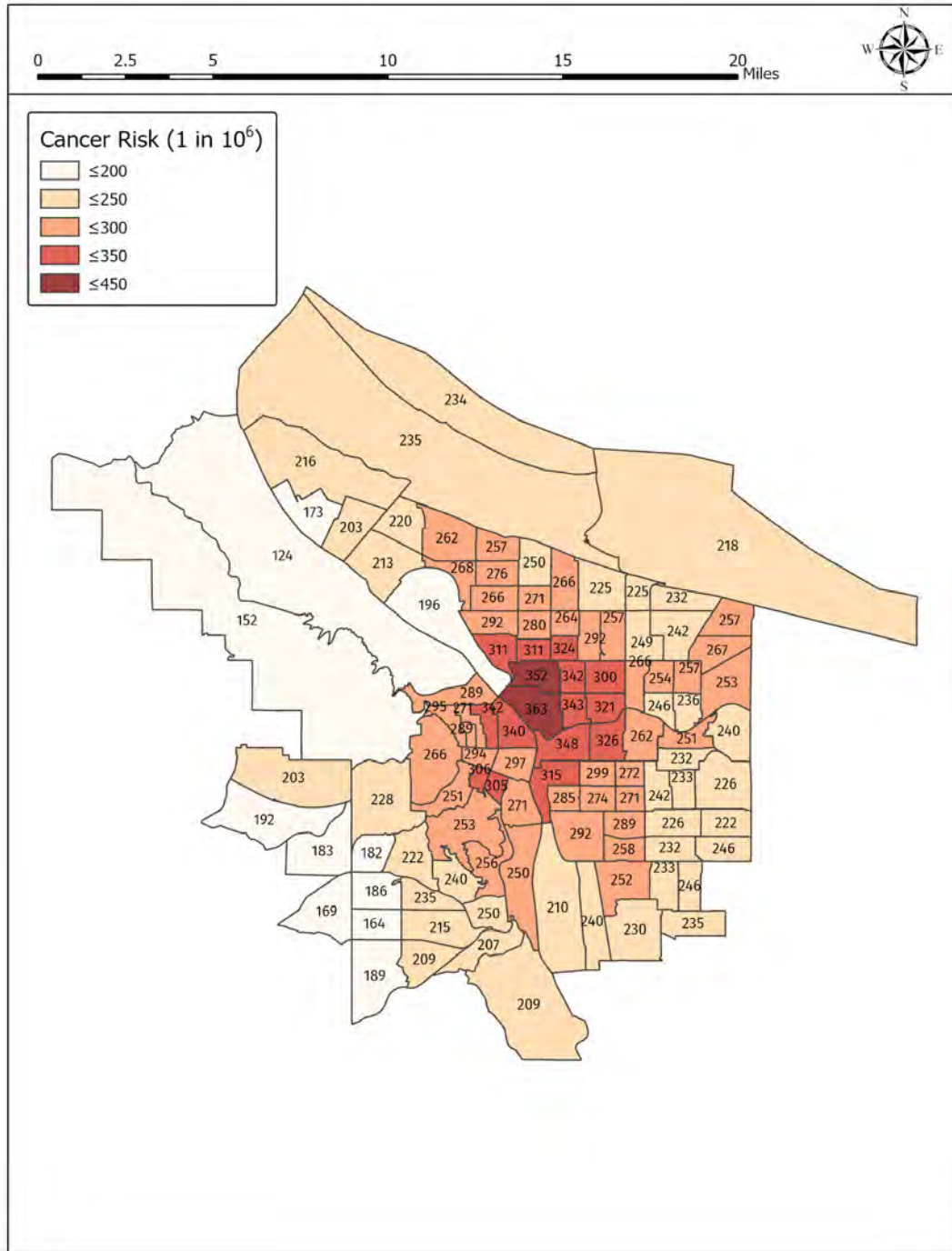
Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the Portland community becomes 363 cancer cases per million residents for census tract 41051002303, with a population of 1,996 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the Portland community becomes 106 cancer case expected over a 70-year timeline among a total community population of 420,849.

6.6.2 Portland Site-Specific Health Risk Assessment

While the NATA report is a good tool for general community assessment of health risks, it should not be utilized to infer findings for specific areas. In order to determine refined health benefits from transition to biodiesel in an existing area of concern, a site-specific HRA was conducted for Portland. The following sources were utilized to generate the HRA.

- Oregon State Department of Transportation – Traffic Counts (Average Annual Daily Traffic)

The emissions sources were modeled with the following source groups in AERMOD, consistent with the report, representing the associated emission rates listed in Table 6-11. .

Table 6-11. Portland Source Groups and Emission Rates

Source Group	Description	DPM Emissions (lb/yr)	Proportion of "Old Technology" Engine Emissions
SH-26	State Highway 26 – 36,540 AADT	2,509	72.1%
US-26	US Highway 26 – 148,700 AADT	2,901	72.1%
I-5	I-5 – 118,007 AADT	18,376	72.1%
I-84	I-84 – 161,260 AADT	8,294	72.1%
I-405	I-405 – 107,250 AADT	4,451	72.1%
US-30	US-30 – 44,071 AADT	3,274	72.1%
US-30B	US-30B – 22,479 AADT	2,750	72.1%

These sources were modeled with the Table 6-11. listed emission rates in AERMOD, and unit emission rates were input into CARB's HARP software to determine cancer risks from the DPM concentrations determined by AERMOD. While dispersion characteristics remained the same between baseline and reduced modeling scenarios, emission rates were reduced according to the number of "old technology" engines combusting diesel, based on source type. The table above shows the Proportion of "Old Technology" Engine Emissions where the DPM reduction factor was taken into account. The subsequent figures show the baseline and reduced cancer risk isopleths from the analysis and include information on the MEIR for the analysis.

Figure 6-47. Baseline Portland Health Risk Assessment Isopleths
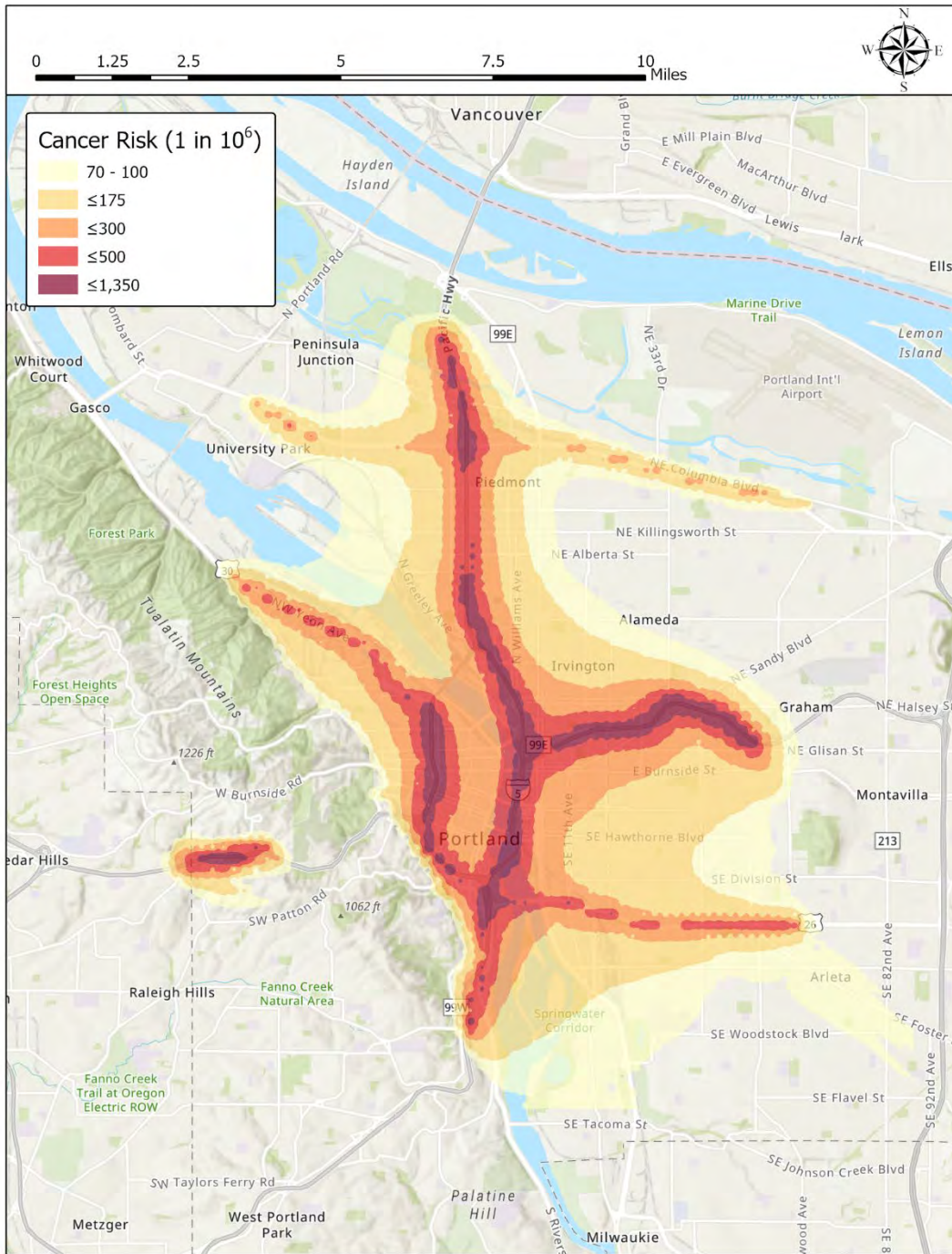
The site-specific HRA shows that the point of maximum impact (PMI) is substantially higher than the NATA/HARP evaluation, with an impact of 1,384 cancer cases per million residents. This PMI does not occur at a residential receptor, though, and does not represent an actual risk to residences in the area. The MEIR occurs at 529,199.1 m E, and 5,042,272.6 m N (NAD 83, UTM Zone 10), with a baseline risk of 1,140 cancer cases per million residents. This MEIR is higher than the NATA/HARP hybrid risks evaluated for that census tract (41051001900) with a total risk of 469 in a million. This HRA does not capture all of the cancer-causing

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6-70

sources in the area, but does demonstrate that NATA values are in-line with the site-specific demonstration with some extremely high local maxima due to local residences proximity to highways.

Figure 6-48. Reduced Portland Health Risk Assessment Isopleths
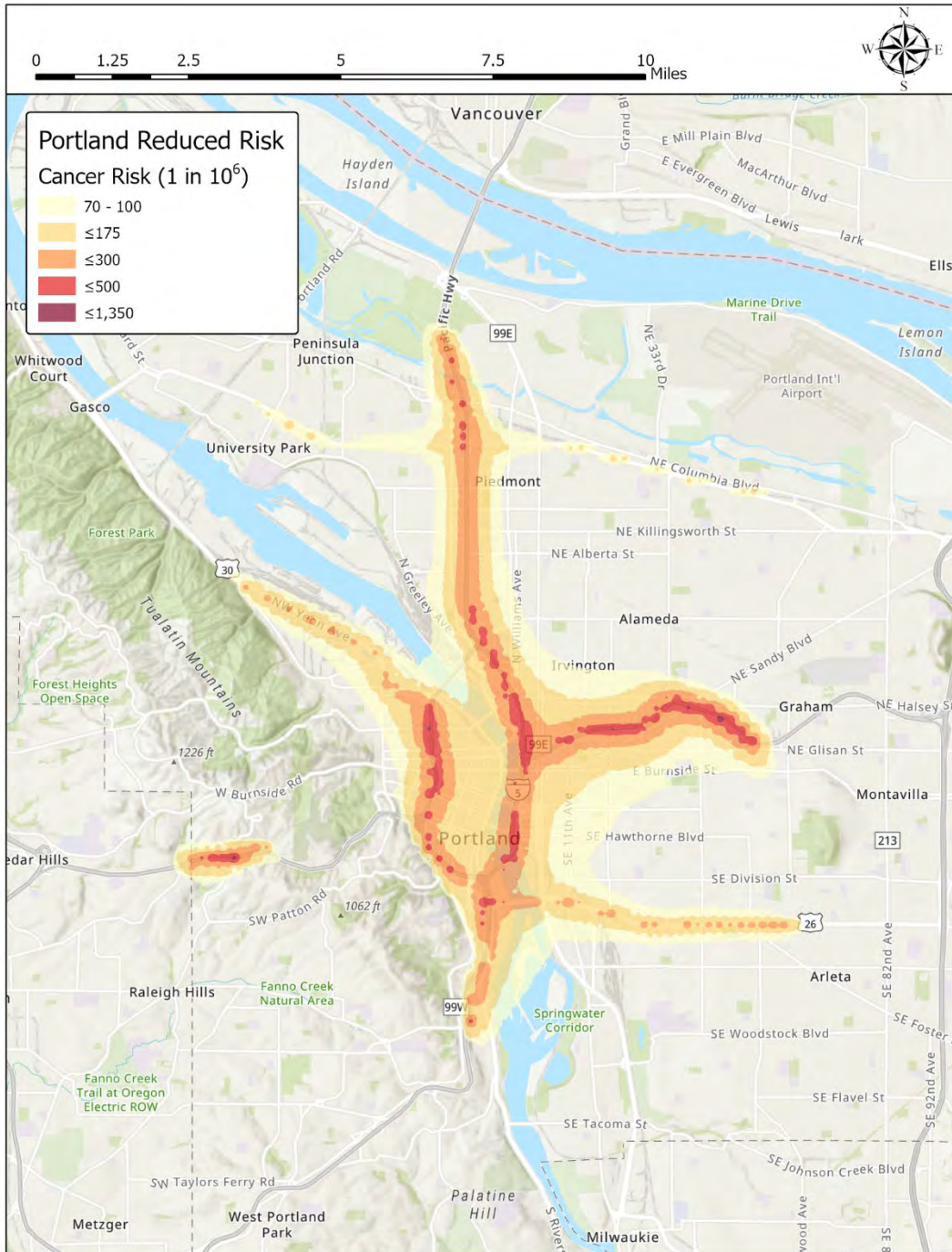
The reduced cancer risk PMI and MEIR are 666 and 549 in 1 million, respectively, both in the same locations as the baseline risk plots. This represents a risk reduction of 591 in 1 million at the MEIR.

6.6.3 Valuation of Health Benefits

The health benefits of reduced PM$_{2.5}$ exposure were modeled using U.S.EPA's BenMAP model according to the methodology described under Section 4.7. The results are shown in Table 6-12 below.

Table 6-12. Portland Valuation of Reduced Incidence Benefits

Endpoint	Reduced Incidence	Benefit Value
Premature Mortality	12.7	$110,964,716
Asthma Exacerbation	7,003	$412,460
Minor Restricted Activity Days	8,368	$582,248
Work Loss Days	1,423	$582,248
Total		**$112,541,672**

6.7 Denver, Colorado

6.7.1 NATA Health Risks

The subsections below review the NATA data available for the Denver, CO (Denver) community. The data is outlined in the following order:

- Baseline NATA Total Cancer Risks
- Baseline NATA DPM Cancer Risks
- Reduced NATA DPM Cancer Risks

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

Figure 6-49 shows the Baseline NATA Total Cancer Risk. This total cancer risk encompasses all sources in the area.

Figure 6-50 shows those cancer risks specific to DPM emissions as determined using NATA raw data.

Figure 6-51 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the Denver community.

Because the NATA 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 Denver community.

6.7.1.1 NATA Risk Data

Figure 6-49. Denver Baseline NATA Total Cancer Risk
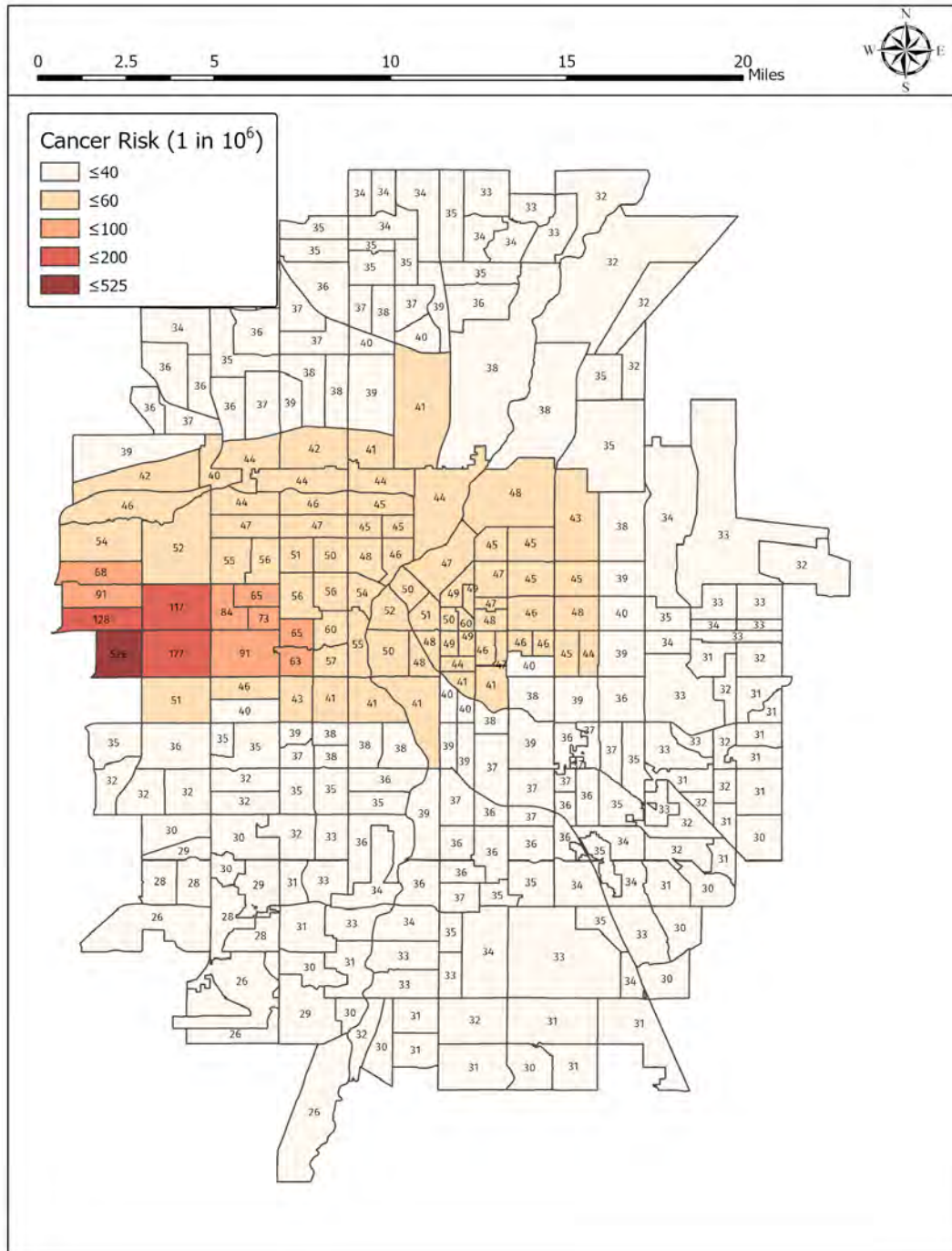
According to the NATA, the maximum baseline cancer risk in the Denver community is 525.56 cancer cases per million residents for census tract 08059010902, with a population of 2,310 residents. When accounting for all of the communities assessed, the total cancer burden for the Denver community is 45 cancer cases expected over a 70-year timeline among a total community population of 1,424,757.

Figure 6-50. Denver Baseline NATA DPM Cancer Risk
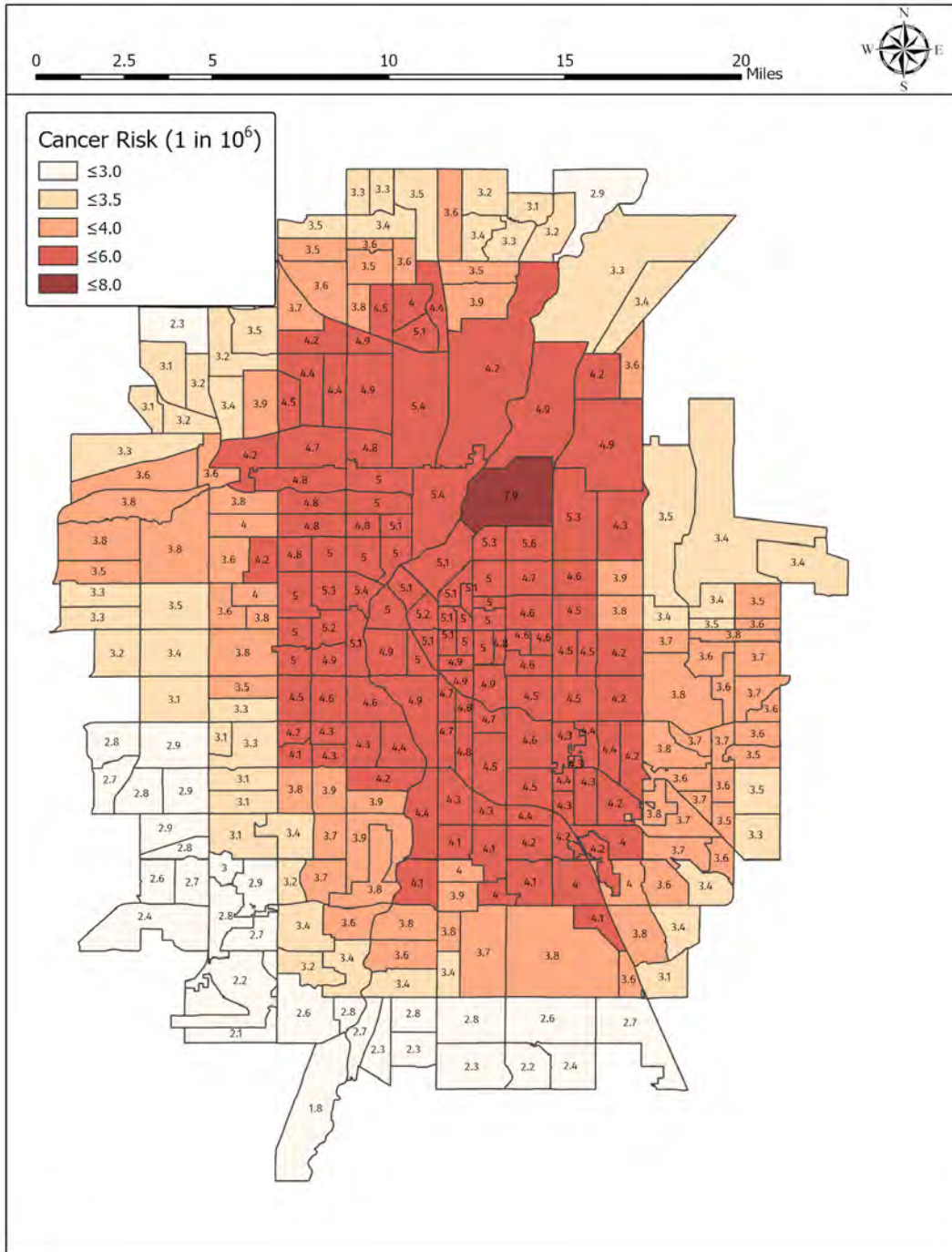
According to the NATA, the maximum DPM-specific baseline cancer risk in the Denver community is 8 cancer cases per million residents for census tract 08031003500, with a population of 6,401 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the Denver community is 4 cancer cases expected over a 70-year timeline among a total community population of 1,105,440.

Figure 6-51. Denver Reduced NATA DPM Cancer Risk
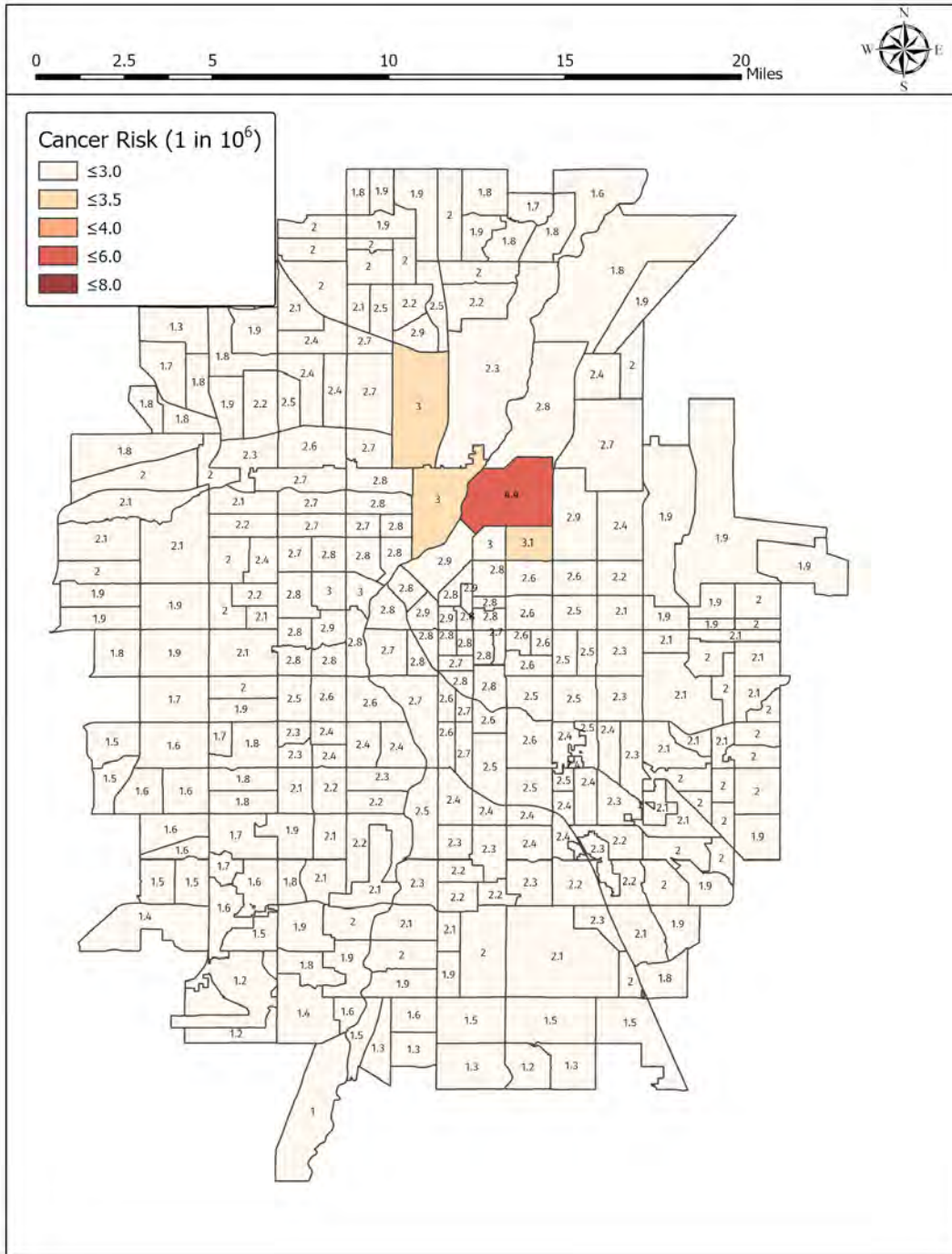
Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the Denver community becomes 4 cancer cases per million residents for census tract 08031003500, with a population of 6,401 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the Denver community becomes 2 cancer cases expected over a 70-year timeline among a total community population of 1,105,440.

6.7.1.2   NATA Data with HARP Risk Factors

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

- Baseline NATA DPM Concentrations
- Baseline NATA/HARP DPM Hybrid Risks
- Reduced NATA/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 NATA were therefore utilized to determine cancer risks in combination with OEHHA cancer unit risk values. The NATA DPM concentrations are shown, along with baseline and reduced cancer risks using CARB's HARP program.

Figure 6-52 shows the baseline DPM concentrations provided by the NATA.

Figure 6-53 shows the baseline DPM-specific cancer risks as determined using the NATA concentration values and CARB's HARP program.

Figure 6-54 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the Denver community.

Because this hybrid NATA/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 Denver community.

Figure 6-52. Denver Baseline NATA DPM Concentration
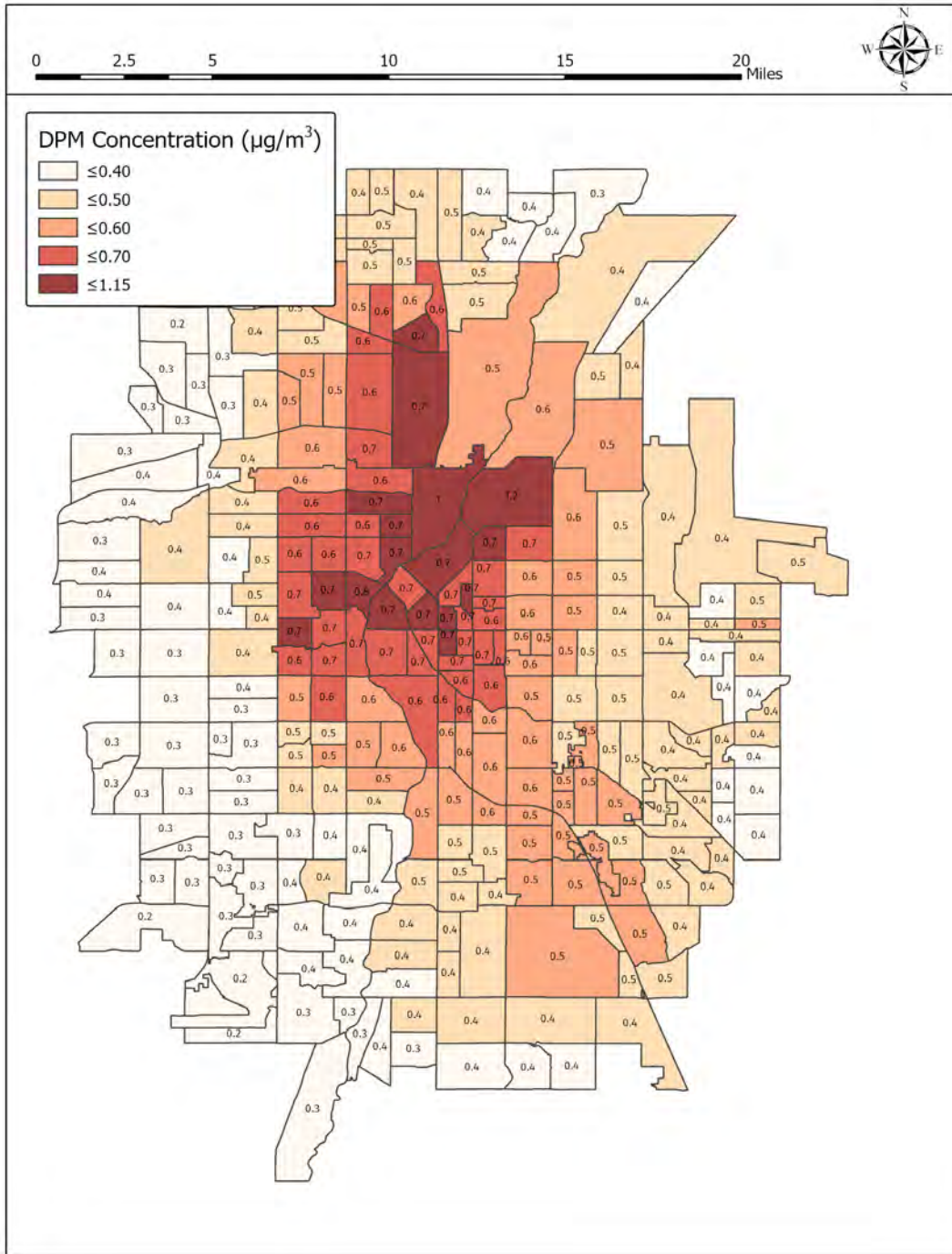
According to the NATA, the maximum baseline DPM concentration in the Denver community is 1.15 μg/m^3 for census tract 08031003500, with a population of 6,401 residents. The average DPM concentration of the Denver community is 0.37 μg/m^3.

Figure 6-53. Denver Baseline NATA/HARP DPM Hybrid Risks
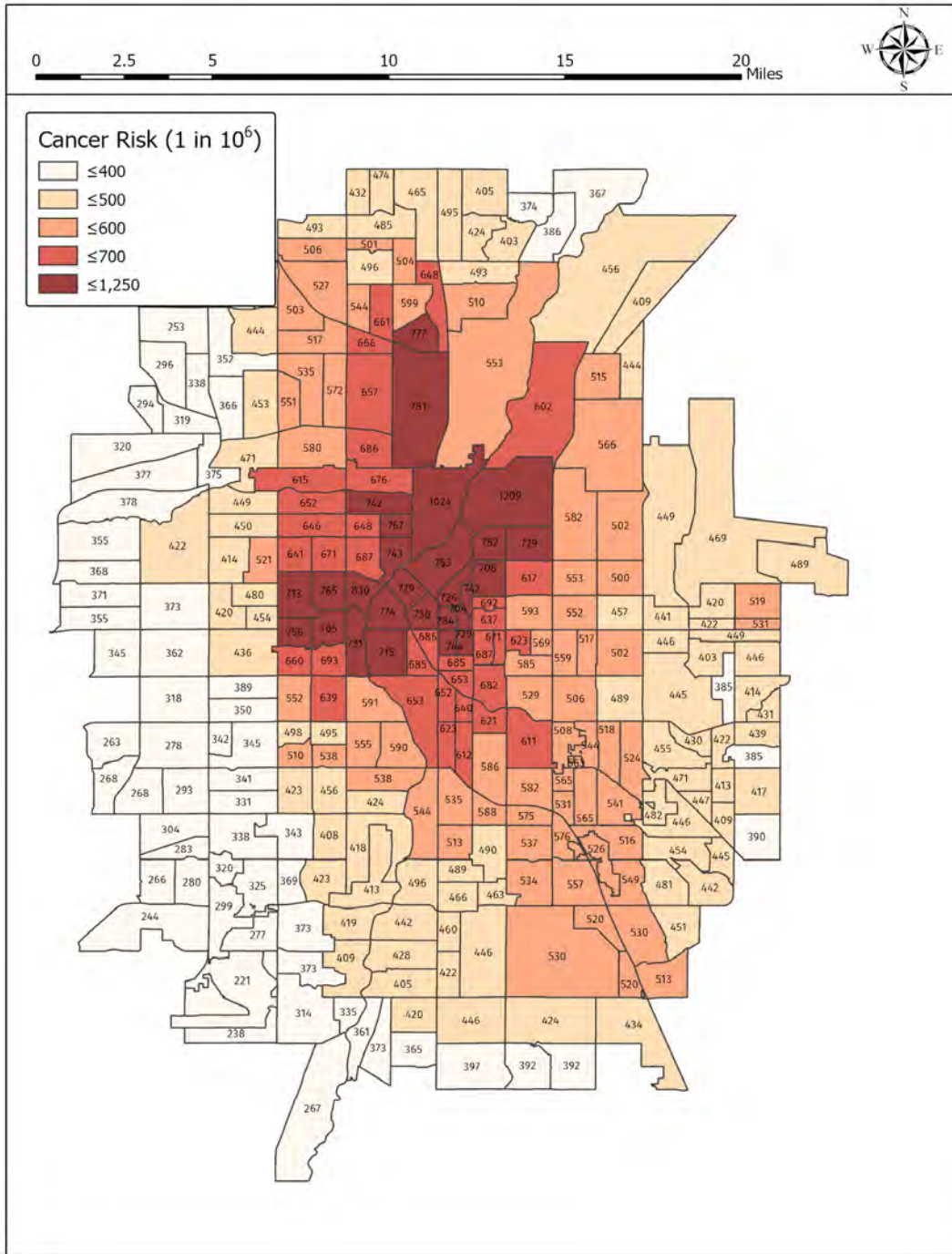
Using NATA DPM concentrations and OEHHA cancer unit risk values, the maximum DPM-specific baseline cancer risk in the Denver community is 1,209 cancer cases per million residents for census tract 08031003500, with a population of 6,401 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the Denver community is 552 cancer cases expected over a 70-year timeline among a total community population of 1,105,440.

Figure 6-54. Denver Reduced NATA/HARP DPM Hybrid Risks
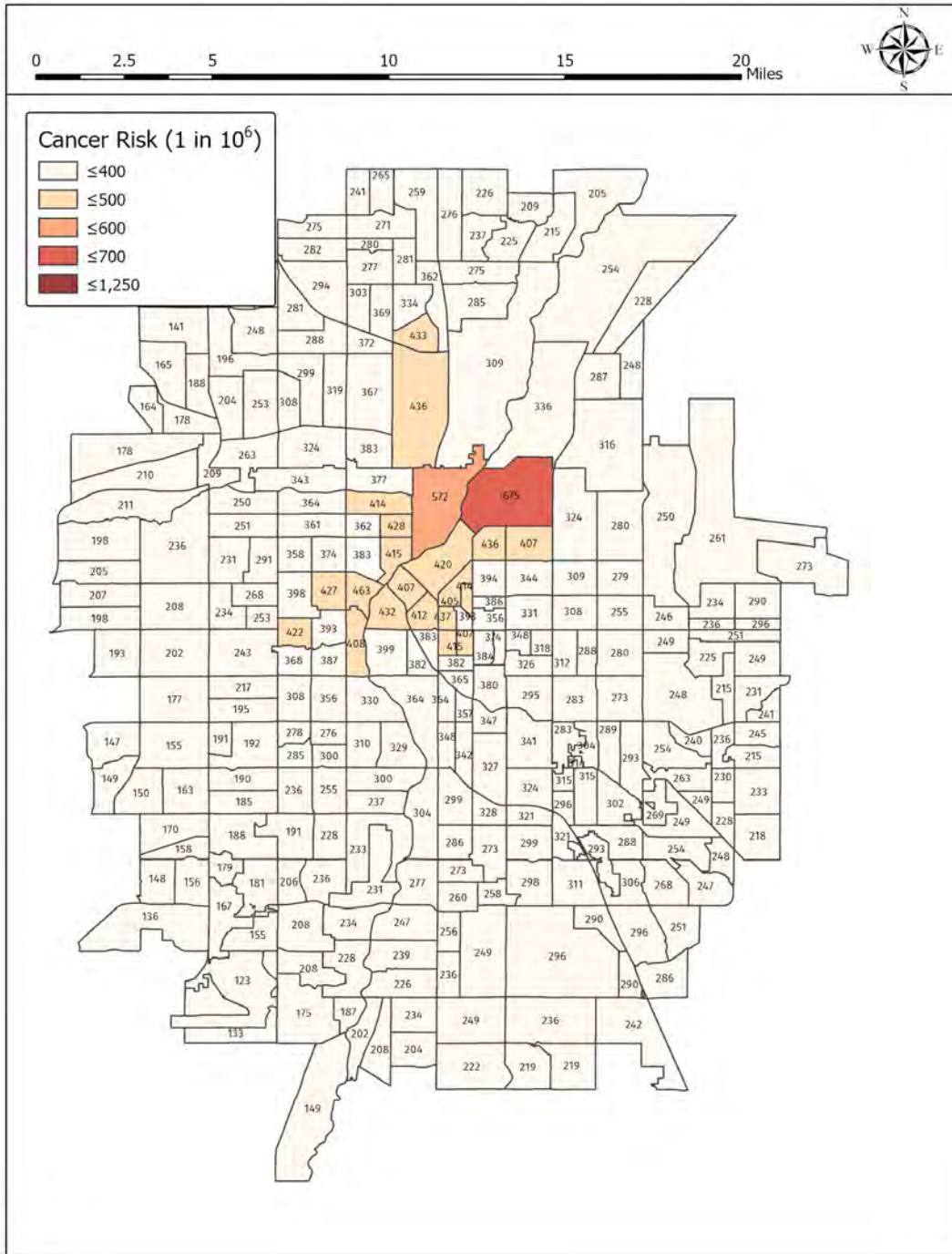
Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the Denver community becomes 675 cancer cases per million residents for census tract 08031003500, with a population of 6,401 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the Denver community becomes 308 cancer cases expected over a 70-year timeline among a total community population of 1,105,440.

6.7.2 Denver Site-Specific Health Risk Assessment

While the NATA report is a good tool for general community assessment of health risks, it should not be utilized to infer findings for specific areas. In order to determine refined health benefits from transition to biodiesel in an existing area of concern, a site-specific HRA was conducted for Denver. The following sources were utilized to generate the HRA.

- Colorado State Department of Transportation – Traffic Counts (Average Annual Daily Traffic)[24]

The emissions sources were modeled with the following source groups in AERMOD, consistent with the report, representing the associated emission rates listed in Table 6-13. .

Table 6-13. Denver Source Groups and Emission Rates

Source Group	Description	DPM Emissions (lb/yr)	Proportion of "Old Technology" Engine Emissions
002A	002A - 49,706 AADT	5,196	72.1%
006G	006G - 132,667 AADT	12,235	72.1%
006H	006H - 34,200 AADT	3,151	72.1%
025A	025A - 240,938 AADT	57,013	72.1%
035A	035A - 55,333 AADT	1,326	72.1%
036B	036B - 158,750 AADT	14,615	72.1%
040C	040C - 32,000 AADT	8,197	72.1%
053A	053A - 16,500 AADT	530	72.1%
070A	070A - 154,500 AADT	45,181	72.1%
076A	076A - 85,600 AADT	20,367	72.1%
088A	088A - 41,667 AADT	9,898	72.1%
095A	095A - 38,000 AADT	10,621	72.1%
121A	121A - 50,900 AADT	24,265	72.1%
224A	224A - 18,286 AADT	1,223	72.1%
265A	265A - 7,633 AADT	331	72.1%
270A	270A - 93,800 AADT	8,570	72.1%
270B	270B - 81,000 AADT	1,166	72.1%
287C	287C - 35,063 AADT	5,826	72.1%
391A	391A - 40,938 AADT	6,625	72.1%

These sources were modeled with the Table 6-13. Table 6-9. listed emission rates in AERMOD, and unit emission rates were input into CARB's HARP software to determine cancer risks from the DPM concentrations determined by AERMOD. While dispersion characteristics remained the same between baseline and reduced modeling scenarios, emission rates were reduced according to the number of "old technology" engines combusting diesel, based on source type. The table above shows the Proportion of "Old Technology" Engine Emissions where the DPM reduction factor was taken into account. The subsequent figures show the baseline and reduced cancer risk isopleths from the analysis and include information on the MEIR for the analysis.

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[24] https://dtdapps.coloradodot.info/otis/HighwayData

Figure 6-55. Baseline Denver Health Risk Assessment Isopleths
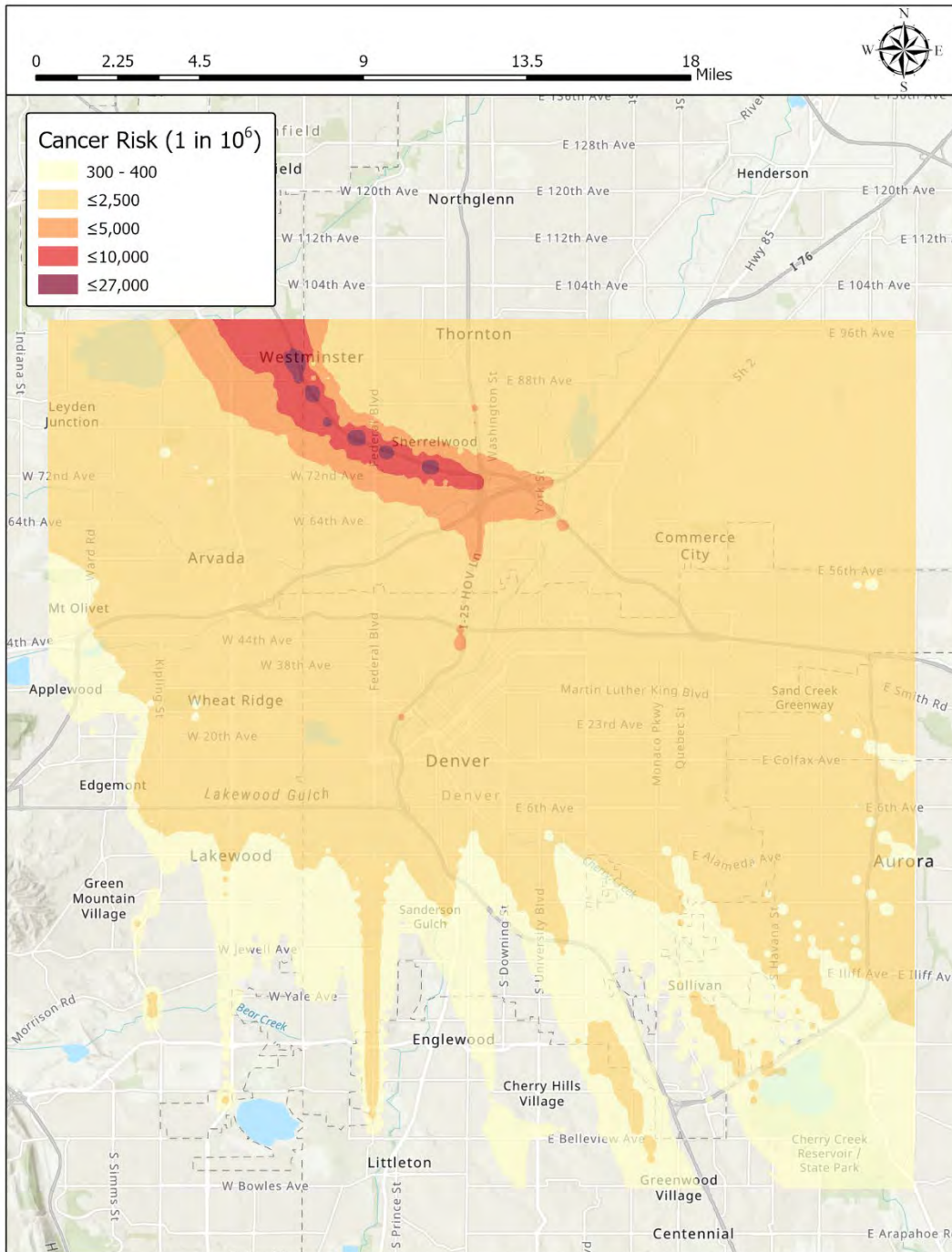
The site-specific HRA shows that the point of maximum impact (PMI) is substantially higher than the NATA/HARP evaluation, with an impact of 26,349 cancer cases per million residents. This PMI does occur at a residential receptor and represents an actual risk to a residence in the area, making it the MEIR. The MEIR occurs at 497,284.6 m E, and 4,409,857.4 m N (NAD 83, UTM Zone 13). This MEIR is higher than the NATA/HARP hybrid risks evaluated for that census tract (08001009401) with a total risk of 537 in a million. This HRA does not capture all of the cancer-causing sources in the area, but does demonstrate that NATA

values are in-line with the site-specific demonstration with some extremely high local maxima due to local residences proximity to highways.

Figure 6-56. Reduced Denver Health Risk Assessment Isopleths
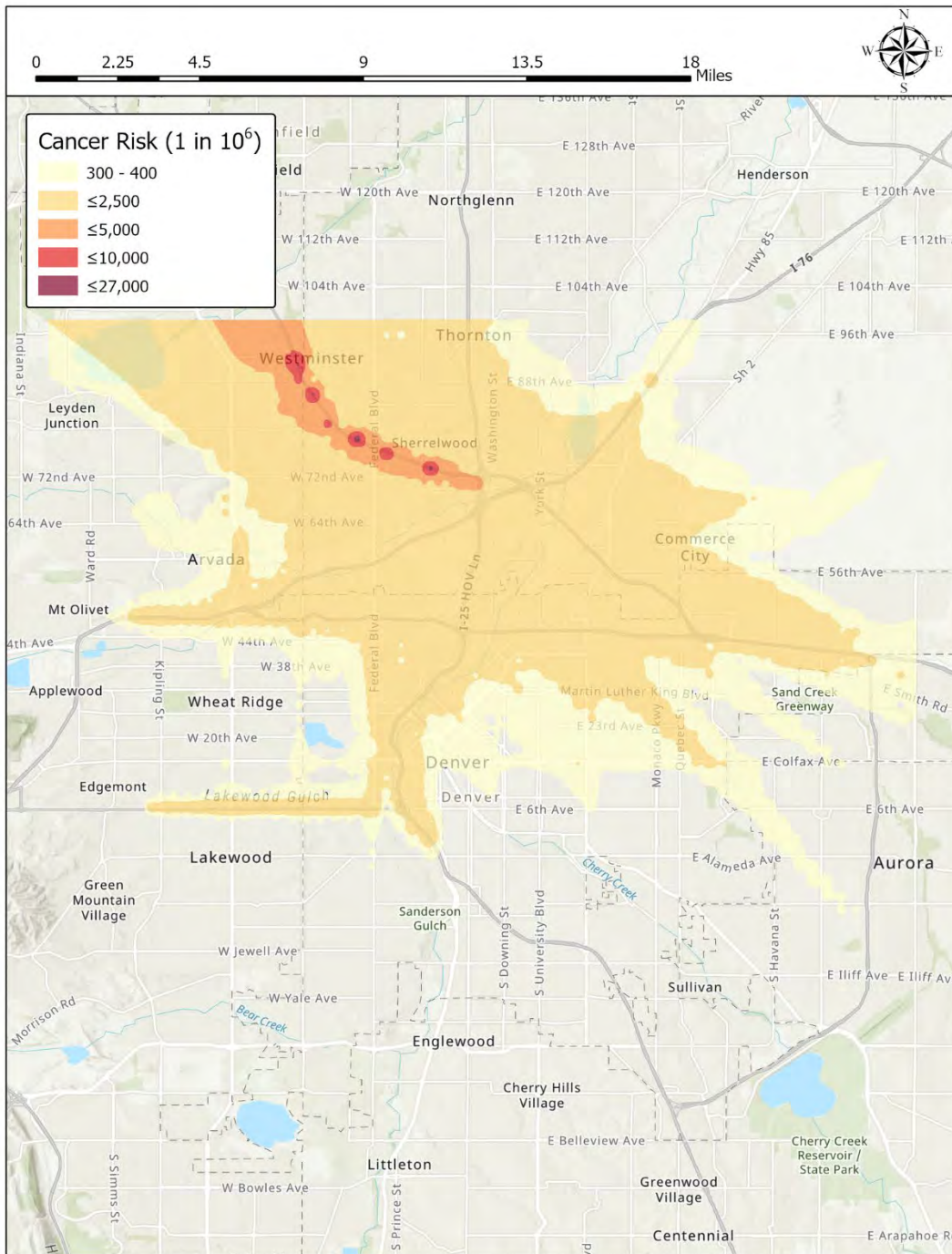
The reduced cancer risk at the PMI/MEIR is 12,671 in 1 million, respectively, both in the same locations as the baseline risk plots. This represents a risk reduction of 13,678 in 1 million at the MEIR.

6.7.3   Valuation of Health Benefits

The health benefits of reduced PM$_{2.5}$ exposure were modeled using U.S.EPA's BenMAP model according to the methodology described under Section 4.7. The results are shown in Table 6-14 below.

Table 6-14. Denver Valuation of Reduced Incidence Benefits

Endpoint	Reduced Incidence	Benefit Value
Premature Mortality	28.6	$248,689,595
Asthma Exacerbation	18,888	$1,112,537
Minor Restricted Activity Days	22,842	$1,589,395
Work Loss Days	3,923	$718,459
Total		**$252,109,985**

6.8   South Fresno, California

6.8.1   NATA Health Risks

The subsections below review the NATA data available for the South Fresno, CA (South Fresno) community. The data is outlined in the following order:

- Baseline NATA Total Cancer Risks
- Baseline NATA DPM Cancer Risks
- Reduced NATA DPM Cancer Risks

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

Figure 6-57 shows the Baseline NATA Total Cancer Risk. This total cancer risk encompasses all sources in the area.

Figure 6-58 shows those cancer risks specific to DPM emissions as determined using NATA raw data.

Figure 6-59 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the Fresno community.

Because the NATA 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 Fresno community.

6.8.1.1 NATA Risk Data

Figure 6-57. South Fresno Baseline NATA Total Cancer Risk
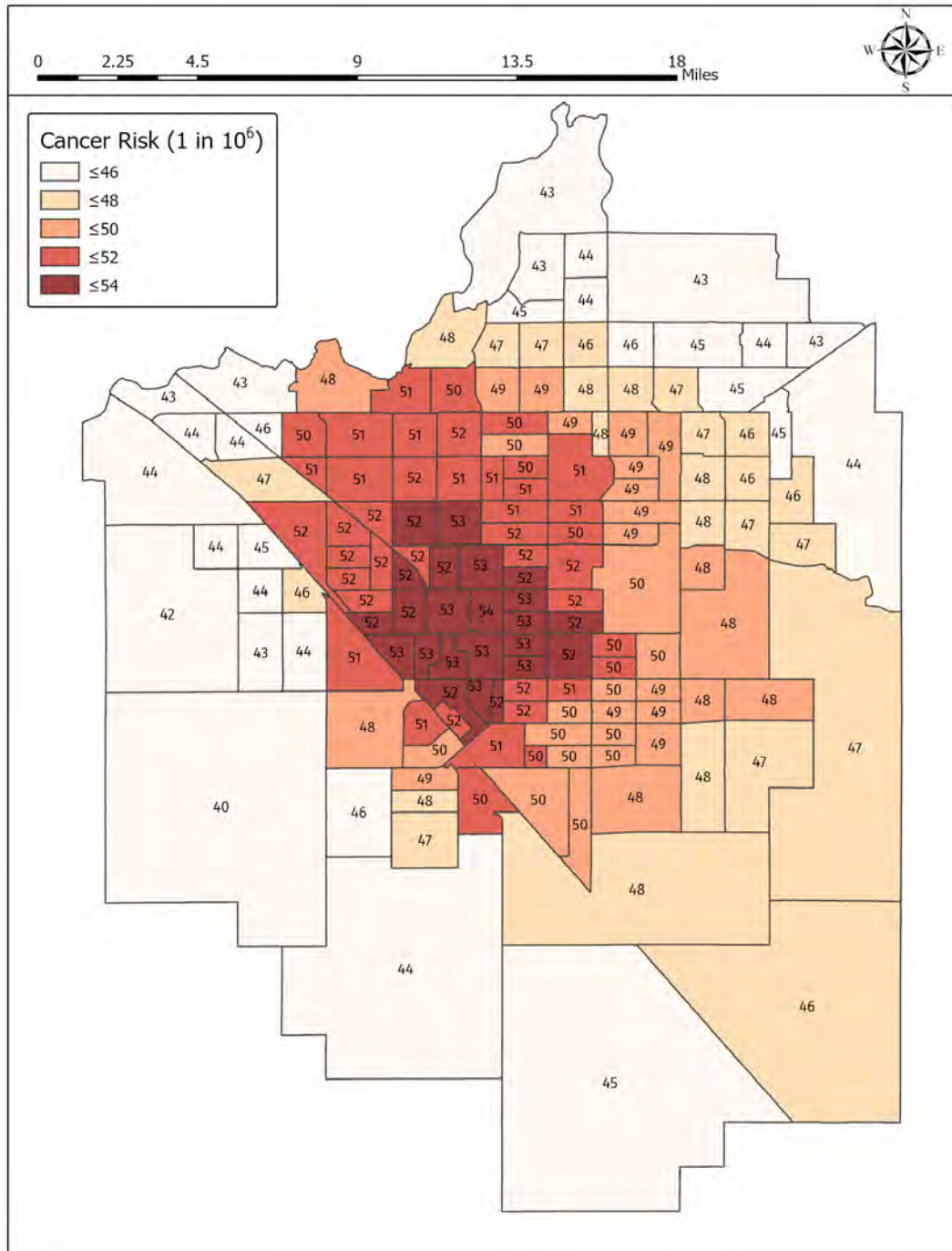
According to the NATA, the maximum baseline cancer risk in the Fresno community is 54 cancer cases per million residents for census tract 06019003400, with a population of 4,555 residents. When accounting for all of the communities assessed, the total cancer burden for the Fresno community is 33 cancer cases expected over a 70-year timeline among a total community population of 673,147.

Figure 6-58. South Fresno Baseline NATA DPM Cancer Risk
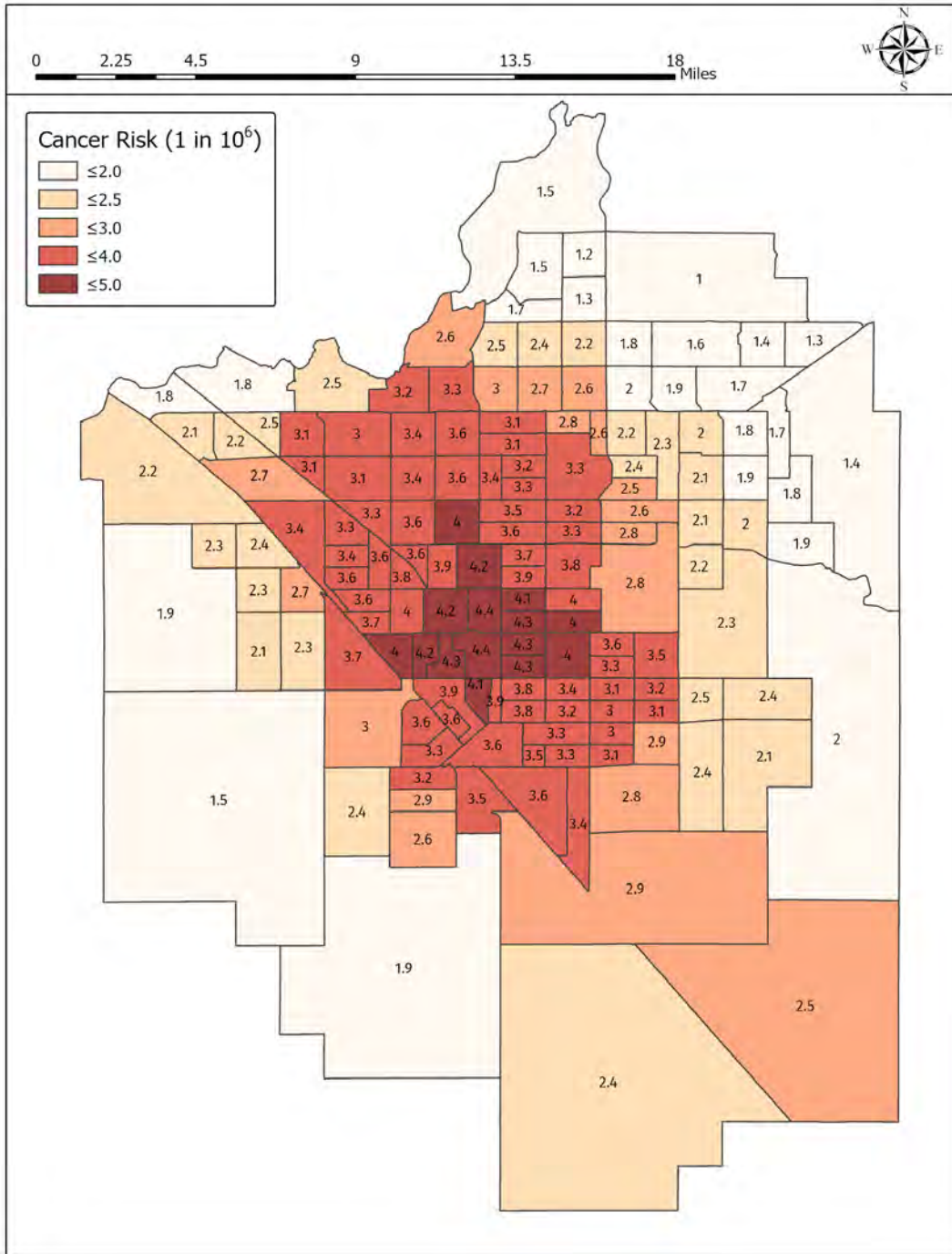
According to the NATA, the maximum DPM-specific baseline cancer risk in the Fresno community is 4 cancer cases per million residents for census tract 06019002400, with a population of 4,959 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the Fresno community is 2 cancer cases expected over a 70-year timeline among a total community population of 673,147.

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6-85

Figure 6-59. South Fresno Reduced NATA DPM Cancer Risk

Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the Fresno community becomes 2 cancer cases per million residents for census tract 06019002400, with a population of 4,959 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the Fresno community becomes 1 cancer case expected over a 70-year timeline among a total community population of 673,147.

6.8.1.2   NATA Data with HARP Risk Factors

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

- Baseline NATA DPM Concentrations
- Baseline NATA/HARP DPM Hybrid Risks
- Reduced NATA/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 NATA were therefore utilized to determine cancer risks in combination with OEHHA cancer unit risk values. The NATA DPM concentrations are shown, along with baseline and reduced cancer risks using CARB's HARP program.
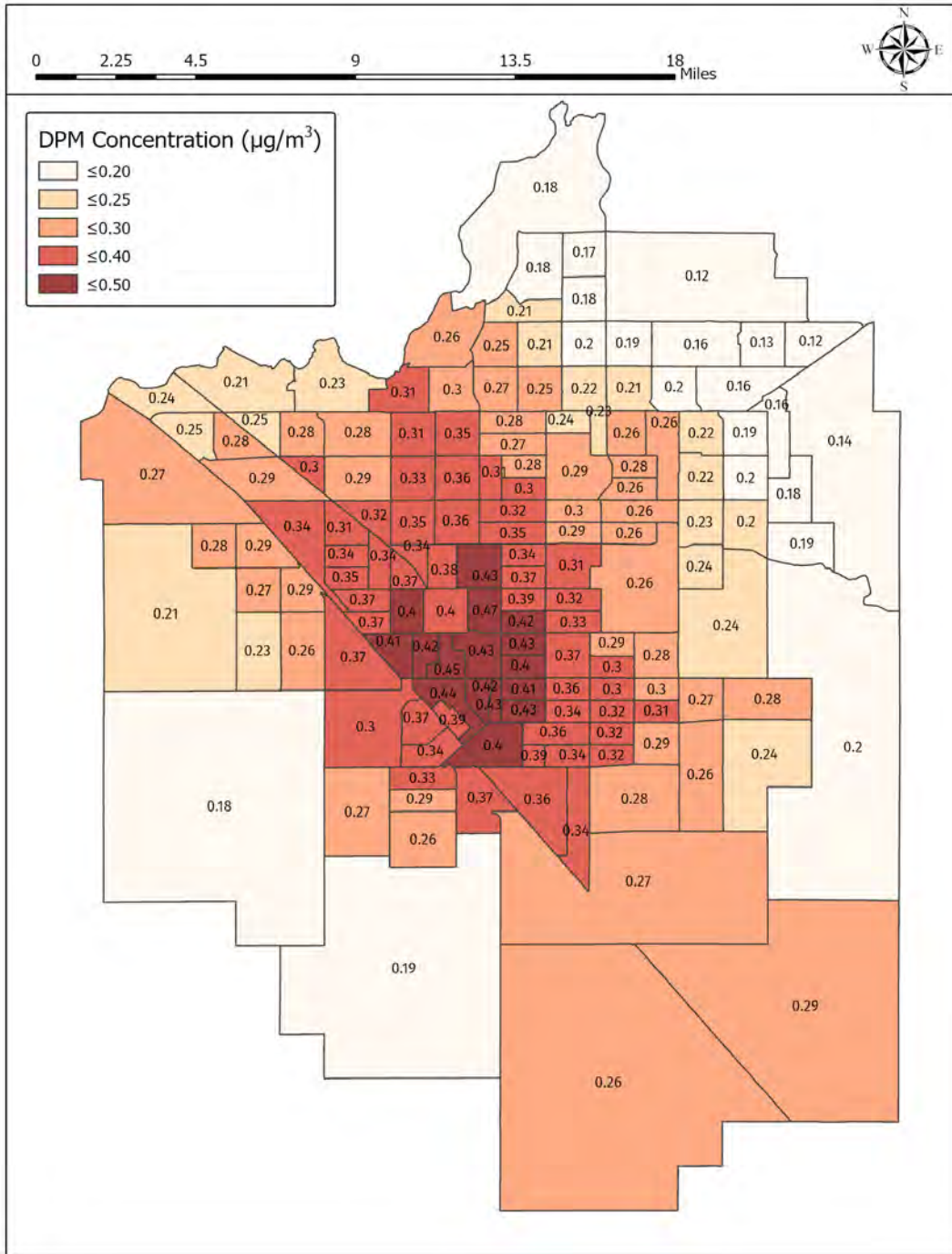
Figure 6-60 shows the baseline DPM concentrations provided by the NATA.

Figure 6-61 shows the baseline DPM-specific cancer risks as determined using the NATA concentration values and CARB's HARP program.

Figure 6-62 shows the reduced cancer risks specific to DPM emissions assuming a 100% change to biodiesel fuel for all emissions sources in the Fresno community.
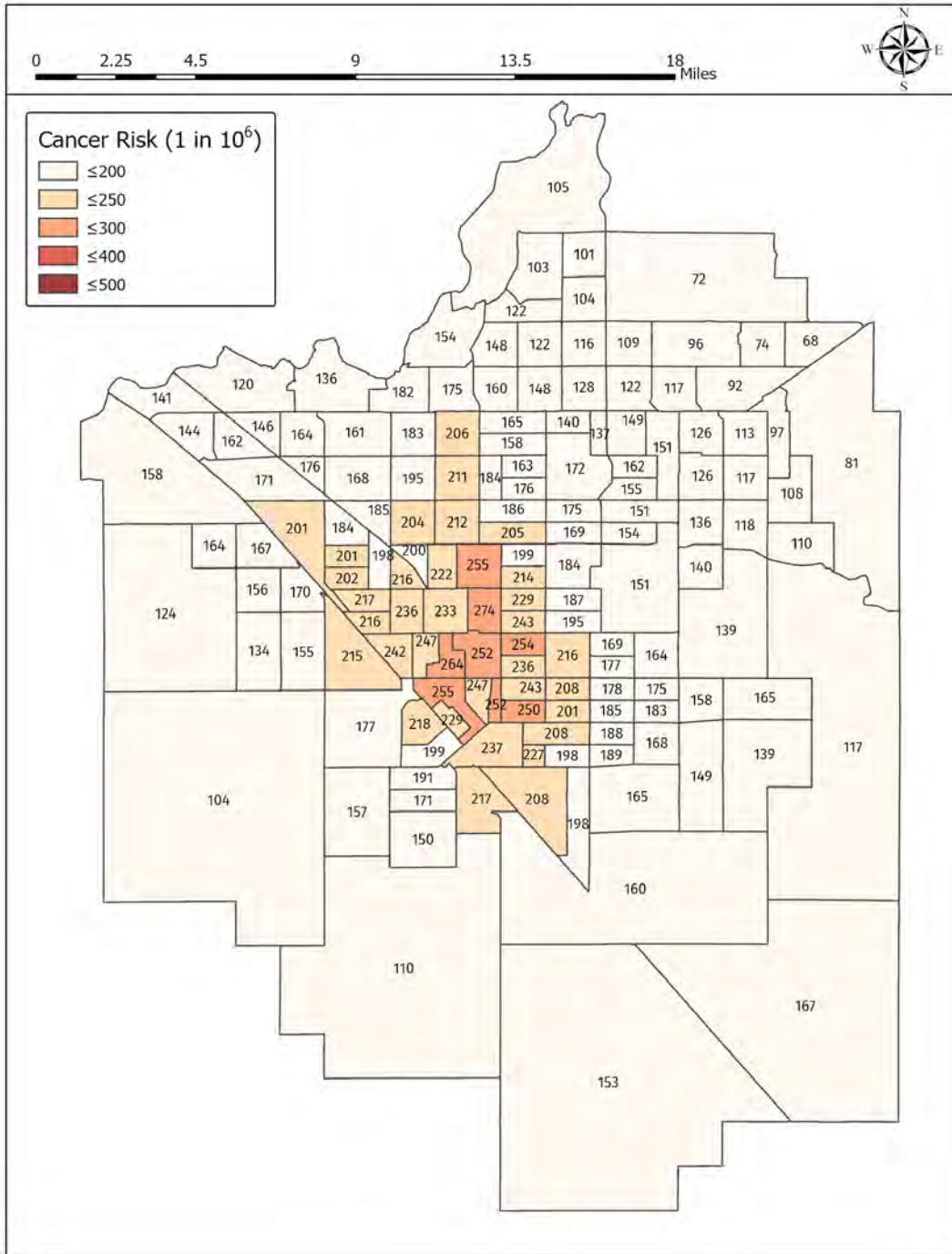
Because this hybrid NATA/HARP analysis utilized OEHHA specific health risk values, the baseline and reduced cancer risks are orders of magnitude higher than an equivalent analysis using EPA cancer unit risk values. Therefore, the results of this analysis can be considered the high-end estimate of baseline and reduced cancer risks in the Fresno community.

Figure 6-60. South Fresno Baseline NATA DPM Concentration

According to the NATA, the maximum baseline DPM concentration in the Fresno community is 0.47 µg/m³ for census tract 06019003400, with a population of 4,555 residents. The average DPM concentration of the Fresno community is 0.29 µg/m³.

Figure 6-61. South Fresno Baseline NATA/HARP DPM Hybrid Risks

Using NATA DPM concentrations and OEHHA cancer unit risk values, the maximum DPM-specific baseline cancer risk in the Fresno community is 491 cancer cases per million residents for census tract 06019003400, with a population of 4,555 residents. When accounting for all of the communities assessed, the baseline DPM-specific cancer burden for the Fresno community is 208 cancer cases expected over a 70-year timeline among a total community population of 673,147.

Figure 6-62. South Fresno Reduced NATA/HARP DPM Hybrid Risks

Applying the biodiesel exhaust reduction factor outlined in Section 4.2, the maximum DPM-specific reduced cancer risk in the Fresno community becomes 274 cancer cases per million residents for census tract 06019003400, with a population of 4,555 residents. When accounting for all of the communities assessed, the reduced DPM-specific cancer burden for the Fresno community becomes 116 cancer case expected over a 70-year timeline among a total community population of 673,147.

6.8.2 Valuation of Health Benefits

The health benefits of reduced PM$_{2.5}$ exposure were modeled using U.S.EPA's BenMAP model according to the methodology described under Section 4.7. The results are shown in Table 6.15 below.

Table 6-15. South Fresno Valuation of Reduced Incidence Benefits

Endpoint	Reduced Incidence	Benefit Value
Premature Mortality	3.2	$28,007,206
Asthma Exacerbation	2,509	$147,762
Minor Restricted Activity Days	2,289	$159,301
Work Loss Days	391	$60,108
Total		**$28,374,377**