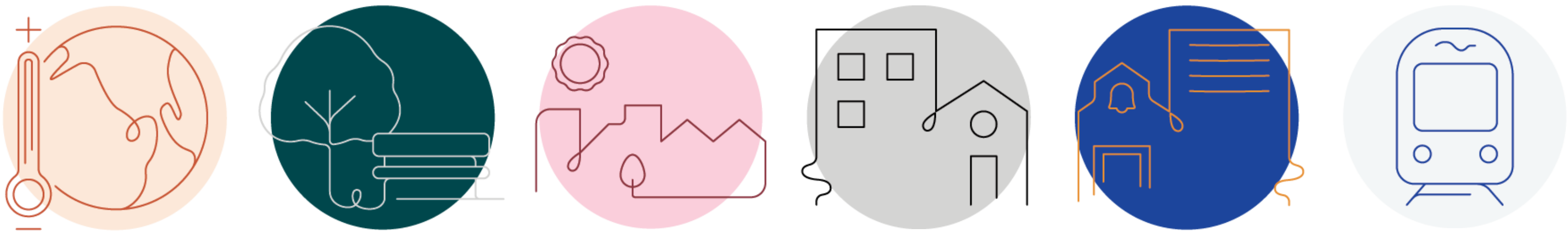
3.2 Air Quality & GHG Emissions



Source: City of Seattle, 2023.

This section evaluates the air quality impacts of implementing the alternatives considered in this EIS. The analysis focuses on two criteria air pollutants: carbon monoxide (CO) and particulate matter (PM) resulting from changes in land uses and transportation patterns. It also considers other criteria air pollutants such as ozone precursors (reactive organic gases, ROGs, and oxides of nitrogen, NOx) and Toxic Air Pollutants (TAPs).

This EIS examines potential air quality issues at a regional level. This analysis evaluates air quality and potential impacts on a citywide cumulative basis and, where appropriate, according to the EIS analysis areas. Transportation sources (fossil-fueled cars, trucks, trains, buses, etc.) can contribute to heightened localized concentrations of certain air pollutants. Therefore, for TAPs and fine particulate matter ($PM_{2.5}$), localized analyses are provided to the degree feasible to identify potential public health impacts from locating new "sensitive receptors" (such as residences) near to substantial sources of these pollutants within transportation corridor areas.

This section also provides an analysis of how implementation of the alternatives evaluated may contribute to global climate change through the emission of greenhouse gases (GHGs). Transportation systems contribute to climate change primarily through the emissions of certain greenhouse gases (CO_2, CH_4 and N_2O) from the combustion of nonrenewable energy sources (primarily gasoline and diesel fuels) used to operate passenger, commercial, and transit vehicles. Land use changes contribute to climate change through construction and operational use of electricity and natural gas, water, and waste production.

Consistent with the above descriptions, the thresholds of significance utilized in this impact analysis include:

- Air Pollution: Growth concentrated in areas with high exposure to air pollution.
- Per Capita GHG emissions: Increase in GHG emissions on a per capita basis.
- Consistency with other efforts: Actions would prevent or deter statewide, regional, or local efforts to reduce GHG emissions.

Data & Methods

The project team collected data from the following sources to support analysis of existing air quality conditions and potential effects of the project alternatives:

- U.S. Environmental Protection Agency Greenbook (EPA, 2021)
- Puget Sound Clean Air Agency (PSCAA) and Ecology Air Monitoring Network
- 2016-2021 PSCAA Air Quality Data Summaries (PSCAA)
- 2020 Community Greenhouse Gas Emissions Inventory (Seattle, 2022)
- Washington Department of Ecology Air Quality Standards and Greenhouse Gas Emissions Inventory (Ecology, 2022a and 2022b)

3.2.1 Affected Environment

Current Policy & Regulations

Air quality in the Puget Sound region including Seattle, is regulated and enforced by federal, state, and local agencies including the Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), and the Puget Sound Clean Air Agency (PSCAA). Each of these agencies has their own role in air quality regulation and monitoring.

U.S. Environmental Protection Agency

The Clean Air Act, established in 1970 and amended in 1977 and 1990, was created to protect human health and the environment from air pollutants. The Clean Air Act required the EPA to establish National Ambient Air Quality Standards (NAAQS) to limit common and widespread pollutants. The six criteria pollutants are: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM), and sulfur dioxide (SO_2). Particle pollution is differentiated based on the size of particulate matter; permissible levels of both PM_{10} (particles equal to or less than 10 microns in diameter) and $PM_{2.5}$ (particles that are less than or equal to 2.5 microns in diameter) have been established as part of the NAAQS.

These NAAQS are monitored according to primary and secondary standards. Primary standards relate to the effect on sensitive populations such as children, the elderly, or those with respiratory or other health conditions, while secondary standards relate to the public welfare, such as damage to crops, vegetation, and buildings. Standards are periodically reviewed and revised, with the most recent national standards listed in **Exhibit 3.2-1** below.

Exhibit 3.2-1. National Ambient Air Quality Standards

Pollutant	Primary/ Secondary	Averaging Time	Level	Measurement Criteria
Carbon Monoxide (CO)	Primary	8 Hours	9 ppm (10.31 mg/m^3)	Not to be exceeded more than once per year
		1 Hour	35 ppm (40.08 mg/m^3)	
Lead (Pb)	Primary and Secondary	Rolling 3-Month Average	0.15 µg/ m^3	Not to be exceeded
Nitrogen Dioxide (NO_2)	Primary	1 Hour	100 ppb (188.10 µg/m^3)	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Primary and Secondary	1 Year	53 ppb (99.69 µg/m^3)	Annual mean
Ozone (O_3)	Primary and Secondary	8 Hours	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years

Pollutant	Primary/ Secondary	Averaging Time	Level	Measurement Criteria
$PM_{2.5}$	Primary	1 Year	12.0 µg/m³	Annual mean, averaged over 3 years
	Secondary	1 Year	15.0 µg/m³	Annual mean, averaged over 3 years
	Primary and Secondary	24 Hours	35 µg/m³	98th percentile, averaged over 3 years
PM_{10}	Primary and Secondary	24 Hours	150 µg/m³	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)	Primary	1 Hour	75 ppb (196.45 µg/m³)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3 Hours	0.5 ppm (1309.63 µg/m³)	Not to be exceeded more than once per year

Source: Ecology, 2022a.

The NAAQSs set limits on the level of the criteria pollutants in the air over specified time periods. These ambient air quality standards are designed to protect people that are most susceptible to respiratory distress, including children, the elderly, and people with compromised health or who engage in strenuous outdoor exercise. EPA designates areas that do not meet the NAAQS for one or more criteria as non-attainment areas. Areas that were once designated non-attainment areas but have since achieved the NAAQS are classified as maintenance areas, while areas that have air pollution levels below the NAAQS are classified as attainment areas. States must develop plans to reduce emissions in non-attainment areas to bring measurements of the criteria pollutants back into compliance with EPA standards.

The Clean Air Act also requires the EPA to regulate 188 hazardous air pollutants (HAPs), also known as air toxics, from both mobile and stationary sources. HAPs are pollutants known or suspected to cause cancer or other serious health effects or have adverse environmental effects. EPA later identified 21 of these air toxics as mobile source air toxics (MSATs) and then extracted a subset of seven priority MSATs: benzene, formaldehyde, diesel particulate matter/diesel exhaust organic gases, acrolein, naphthalene, polycyclic organic matter and 1,3-butadiene. EPA enforces standards for controlling the emissions of HAPs from various sources within different industry groups, also known as source categories. Exposure to these pollutants in high concentrations for long durations increases the risk of cancer, damage to the immune system, neurological problems, reproductive, developmental, respiratory and other serious health problems.

The first phase of regulatory standards EPA develops for HAP sources are maximum achievable control technology (MACT) standards based on the level of emission control achieved by low-emitting sources in an industry. The second phase for controlling HAPs is a risk-based approach that occurs within eight years of the initial implementation of MACT standards. This residual risk review assesses the need for more health-protective standards.

The Clean Air Act is also the basis of most emissions-related regulations across the country, and has helped reduce GHGs from power plants, aircraft, and motor vehicles among other sources. EPA enacts standards for vehicle fuel efficiency and emissions and, as of December 31, 2021, has set the strictest standards for passenger vehicles and light-duty trucks. From model year (MY) 2023 to 2026, the stringency requirements were increased year-to-year, and the path forward from MY 2026 is set to continue that trend of tighter requirements. Fleetwide, MY 2026 vehicles are projected to produce 161 grams of CO_2 per mile, compared to 208 grams of CO_2 per mile as stated in the 2020 EPA regulations (NHTSA, 2020). Furthermore, MY 2026 vehicles will have a fleetwide fuel efficiency of 40 miles per gallon (MPG) compared to the 32 MPG required by 2020 regulations. EPA is also currently finalizing a Clean Trucks Plan to establish more stringent emissions standards on heavy-duty vehicles starting in MY 2027, specifically targeting NO_X emissions from diesel-powered trucks. EPA also establishes emissions standards from other mobile sources of pollution such as aircraft, aligning with the International Civil Aviation Organization to reduce GHG emissions in commercial aviation and large business jets.

Washington State

Washington Department of Ecology (Ecology) regulates over 430 toxic air pollutants from commercial and industrial sources in Washington state, prioritizing 21 of them due to the increased health risk and prevalence from common sources such as diesel emissions and wood smoke. Ecology is also responsible for monitoring statewide air quality and enforcing federal EPA standards through a State Implementation Plan (SIP), which includes Attainment SIPs (when an area doesn't meet NAAQS, i.e. non-attainment areas) and Maintenance SIPs (when an area must meet NAAQS for 20 years after a period of non-attainment). These SIPs also include specific state plans to address certain issues, such as the Regional Haze Plan, Smoke Management Program, and the Transportation Conformity Plan (TCP). The TCP ensures federal transportation funds support roadway and transit activities that align with SIPs for air quality. Attainment and Maintenance SIPs are also required to include enforceable limits on total pollution from all transportation sources, called "motor vehicle emissions budgets." These budgets put a cap on the total amount of transportation-related emissions that can be generated, including from projected future demand.

The State of Washington adopted the Climate Commitment Act (CCA) in 2021, which sets a statewide goal of a 95% reduction in carbon emissions by 2050 starting from a 1990 baseline year. One component of the CCA is a cap-and-invest program that caps the total emissions generated by the state and allows emitters to trade excess carbon emission budgets with one another. Emissions from gasoline, on-road diesel, and railroads are considered part of the 75% of "covered emissions" that would be incorporated into the cap-and-invest system. When these allowances are sold, the profits will be reinvested into projects that address air quality issues. The cap-and-invest program began in January 2023.

Washington State is also working to reduce mobile emissions through the 2020 Motor Vehicle Emissions Standards Law, which directs Washington to adopt vehicle emission standards set by the State of California—including the zero-emission vehicle (ZEV) standard, adopted in

November 2021. This requires 100% of all new passenger cars, light-duty trucks, and medium-duty vehicles sold in the state to be ZEVs starting in 2035, as well as setting stricter emission standards on medium- and heavy-duty trucks. Adopted in December 2022, Washington State adopted a new rule that requires new ZEV sales of passenger cars, light-duty trucks, and medium-duty vehicles to 100% starting in 2035.[7] It also requires cleaner, less polluting new heavy-duty internal combustion engines. In 2021, Governor Inslee signed the Clean Fuel Standard, which requires fuel suppliers to gradually reduce the carbon intensity of transportation fuels (gasoline, diesel) to 20% below 2017 levels by 2038.

Puget Sound Clean Air Agency

The Puget Sound Clean Air Agency (PSCAA) was formed in 1967 under the Washington Clean Air Act, with the authority to create regulations and to permit stationary air pollutant sources and construction emissions within King, Kitsap, Pierce, and Snohomish Counties. PSCAA contributes to statewide SIPs and adopted an updated Strategic Plan in January 2023. The updated Strategic Plan outlines goals and objectives through the year 2030. These Plans set goals and standards to implement a long-term vision for air quality and climate within the region. PSCAA also operates 20 ambient air quality monitoring stations throughout its four-county jurisdiction, and while most standards are in-line with Ecology and the EPA, after convening a "Particulate Matter Health Committee" in 1999, the PSCAA adopted a stricter health goal of 25 $\mu g/m^3$ for $PM_{2.5}$ versus 35 $\mu g/m^3$ in a 24-hour period.

City of Seattle

The City of Seattle was the first city in the United States to adopt a green building goal for all new municipal facilities, and in 2001 the City created a Leadership in Energy and Environmental Design (LEED) incentive program for new private projects. In 2011, the Seattle City Council adopted Resolution 31312, a long-term climate protection vision for Seattle with the goal of achieving net zero GHG emissions by 2050. In pursuit of this goal, in 2013 the City adopted the Climate Action Plan (CAP) to outline reduction targets for GHG emissions and to support City goals of building vibrant neighborhoods, driving economic prosperity, and furthering social equity. The plan identifies five main targets to be achieved by 2030, using the year 2008 as a baseline:

- 20% reduction in vehicle miles traveled;
- 75% reduction in GHG emissions per mile traveled by Seattle vehicles;
- 10% reduction in commercial building energy use;
- 20% reduction in residential building energy use; and
- 25% reduction in combined commercial and residential building energy use.

[7] See: https://ecology.wa.gov/Air-Climate/Reducing-Greenhouse-Gas-Emissions/ZEV#.

The Sustainable Buildings and Sites Policy (established by Resolution 31326) sets goals for City-owned properties to maximize the environmental quality, economic vitality, and social health of the City through design, construction, operation, maintenance, renovation, and decommissioning of City-owned buildings and sites.

Following the U.S.'s withdrawal from the Paris Climate Agreement in 2017, the City Council adopted Resolution 31757, directing the Office of Sustainability and Environment to identify additional actions necessary to limit global warming to an additional 1.5 degrees Celsius. Near-term priorities identified in the 2018 Climate Action Strategy are:

- Improving mobility through equitable road pricing policies;
- Passing of a new electric vehicle readiness ordinance;
- Creating a map of optimal distribution of an EV charging infrastructure;
- Converting 18,000 homes from heating oil to electric heat pumps;
- Doubling existing budget allocation for reducing energy in municipal buildings with the goal of reducing energy use by 40%;
- Scaling pay-for-performance efforts[8] and piloting innovative utility programming; and
- Providing programs and incentives to spur improved energy efficiency and reduced carbon emissions.

The City of Seattle also enacted the Green New Deal Resolution (Res 31895), with Mayor Jenny Durkan introducing the Green New Deal Executive Order (EO-2020-01) on January 8, 2020. Together, the resolution and executive order direct: (1) all City departments to work together with the Green New Deal Oversight Board, the Environmental Justice Committee, and other key stakeholders to establish goals and actions that advance the vision of a climate-pollution free city; (2) the Office of Sustainability & Environment (OSE) to work with City departments to identify actions to achieve the goals of the Green New Deal; (3) the OSE to work with Office of Intergovernmental Relations and the Mayor's Office to engage stakeholders on collaborative efforts to develop additional City policies, inform and support necessary funding and investments, and advance opportunities for partnership on actions that achieve the goals of the Green New Deal; (4) every new or substantially altered municipal building shall operate without fossil fuel systems and appliances (e.g., space heating and cooling, water heating, or cooking); (5) the OSE to work with stakeholders and City departments to determine key indicators that assist in the understanding of emissions trends; and (6) the Green New Deal team shall report progress on an annual basis.

The Green New Deal Oversight Board, established through Ordinance 125926, consists of representatives passionate about advancing an equitable transition to a clean energy economy and centering frontline communities and workers most impacted by climate change. The Green New Deal Oversight Board was entrusted with developing a workplan that:

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8 To address the "hard to reach" energy savings, Seattle City Light is developing programs specifically aimed at enabling greater levels of energy efficiency depth in buildings. Incentive payments are made over time based on measured energy savings and allow participants to bundle multiple projects and measures across capital, operational & maintenance, and behavioral improvements.

- Establishes a definition of what constitutes a policy, program or project that advances a Green New Deal for Seattle;
- Provides proposals for the design of new policies, programs, and projects and for modifications to existing policies, programs and projects to the Mayor, City Council, and City departments to advance a Green New Deal for Seattle;
- Supports the planning and implementation of individual City Departmental actions, policies, programs, and practices, to make Seattle climate-pollution free by 2030;
- Provides recommendations on City budget priorities and priority City actions; and
- Coordinates efforts with City departments and existing committees, boards, and commissions.

Executive Order 2021-09 (Driving Accelerated Climate Action) calls for all municipal buildings to operate without fossil fuel systems and appliances no later than 2035. In addition, EO 2021-09 calls for the acceleration of GHG emissions reduction from the city's transportation sector.

To reduce greenhouse gas emissions in the transportation sector, the City of Seattle adopted Executive Order 2018-02, which aims to have 100% of the City's fleet fossil-fuel free by 2030. This would mean rapid fleet electrification, or conversion to biofuels or renewable diesel/gasoline for municipal fleet vehicles.

Climate & Air Quality

Air quality is affected by pollutants from both natural and manmade sources. Vehicles and equipment that burn fossil fuels are typically among the largest contributors to transportation-related emissions and can contribute to regional and localized concentrations of CO, PM, NO_2, and O_3. State and federal standards regulate these pollutants along with the two other criteria pollutants (SO_2 and lead). The Puget Sound region is currently in attainment for all six criteria pollutants (Ecology, 2022a).

The City of Seattle is in the Puget Sound lowland. Buffered by the Olympic and Cascade mountain ranges and the Puget Sound, the lowland has a relatively mild, marine climate with cool summers and mild, wet, and cloudy winters.

The prevailing wind direction in the summer is from the north or northwest. The average wind speed is less than 10 miles per hour. Persistent high-pressure cells often dominate summer weather and create stagnant air conditions. This weather pattern sometimes contributes to the formation of photochemical smog.[9] During the wet winter season, the prevailing wind direction is from the south or southwest.

There is sufficient wind most of the year to disperse air pollutants released into the atmosphere. The region can be affected by wildfire smoke in the late summer and fall. Data

[9] See explanation: https://education.nationalgeographic.org/resource/smog/.

from these "exceptional events that are beyond the ability of air agencies to control" are excluded by the EPA for regulatory actions but are included in PSCAA and Ecology data collection.

Apart from wildfire events, air pollution is usually most noticeable in the late fall and winter, under conditions of clear skies, light wind and a sharp temperature inversion. Temperature inversions occur when cold air is trapped under warm air, thereby preventing vertical mixing in the atmosphere. These can last several days. If poor dispersion persists for more than 24 hours, the PSCAA can declare an "air pollution episode" or local "impaired air quality."

Pollutants of Concern

The largest contributors of pollution related to transportation construction projects and changes to travel patterns are construction equipment and vehicles traveling on roadways. The main pollutants emitted from transportation and non-transportation sources are CO, ozone precursors (VOC and NO_x), PM, GHGs, and HAPs. This section describes these pollutants and their effects on public health and the environment.

Carbon Monoxide (CO)

CO is an odorless, colorless, tasteless gas formed by the combustion of fuels containing carbon, with most CO emissions coming from motor vehicles, industrial activity, and wood burning. CO enters the bloodstream through the lungs and reduces the oxygen-carrying capacity of blood, affecting the function of organs and tissues. People with existing cardiovascular or respiratory issues may experience chest pains, nausea, fatigue, and dizziness when exposed to high levels of CO, though even healthy individuals may experience issues with alertness depending on the amount of exposure. As the most common source of CO emissions is motor vehicles, high concentrations are most present in urban areas, and it is the urban areas of Washington that have breached NAAQS in the past 30 years. The urban areas within Puget Sound were on attainment maintenance plans for CO from 1996 to 2016.

Nitrogen Dioxide (NO_2) & Ground-Level Ozone (O_3)

NO_2 is a red/brown reactive gas formed from the chemical reaction of nitrogen oxide (NO), hydroperoxy radical (HO_2), and alkylperoxy radical (RO_2) in the atmosphere. NO_2 and other nitrogen oxides (known as NO_x) can combine with volatile organic compounds (VOCs) in the atmosphere to form ozone. Vehicles such as automobiles and construction equipment are the most common sources of NO_X, along with marine vessels and industrial boilers and processes. While Washington has not violated NAAQS for NO_2, Ecology continues to measure NO_X levels at three sites within Seattle, as NO_X is a key contributor to ozone and fine particulate matter.

Ozone itself is a secondary air pollutant, produced in the atmosphere through a complex series of photochemical reactions involving VOCs (also sometimes referred to by some regulating agencies as reactive organic gases, or ROG), NO_X and sunlight. Ozone precursors are created from combustion processes and the evaporation of solvents, paints, and fuels. Ozone levels are usually highest in the afternoon because of the intense sunlight and the time required for ozone to form in the atmosphere. Elevated concentrations of ground-level ozone can cause reduced lung function, respiratory irritation, and can aggravate asthma. Ozone has also been linked to immune system impairment. People should limit outdoor exertion if ozone levels are elevated, as even healthy individuals may experience respiratory issues on a high-ozone day. Ground-level ozone can also damage forests and agricultural crops, interfering with their ability to grow and produce food.

Currently all of Washington State is in attainment for NAAQS for ozone, with a complete maintenance plan for the Central Puget Sound Region in 2016.

Particulate Matter (PM_{10} & $PM_{2.5}$)

PM is a class of air pollutants that consists of a mixture of extremely small particles and liquid droplets such as acids, organic chemicals, metals, and soil or dust particles. PM takes three main forms depending on density—PM_{10} is considered "Coarse", with a diameter of 10μm or less. "Fine" particulate matter is also known as $PM_{2.5}$, due to its diameter being 2.5μm or less. Lastly there are "Ultrafine" particles with a diameter less than 0.1μm, though these are not factored into EPA attainment designations. Particulate matter is a result of combustion, such as emissions from vehicles and industry, and from wood burning including wood stoves, fireplaces, and wildfires. In addition, particulate matter is generated from brake and tire wear from vehicles. High levels of particulate matter—especially $PM_{2.5}$—can result in a multitude of health impacts, including an increase in hospital visits for cardiovascular and respiratory problems, especially for sensitive populations. Decreased visibility may also derive from increased levels of particulate matter.

Currently, all of Washington is meeting air quality standards for both fine ($PM_{2.5}$) and coarse (PM_{10}) particulate matter, with maintenance plans for most of the state being completed recently. While there were extended periods of time when NAAQS were exceeded for particulate matter due to wildfires, the EPA allows data from days "influenced by exceptional events that are beyond the ability of air agencies to control" to be excluded for regulatory actions.

Other Pollutants

Since the phasing out of lead from gasoline in the U.S. in the 1980s, vehicle travel is no longer a major source of lead emissions, and lead emissions are not associated with changes in traffic volumes or travel patterns from implementation of the Seattle Comprehensive Plan.

SO_2 is produced by burning fuels that contain sulfur such as coal, oil, and diesel, or processing metals that contain sulfur. Historically, Washington has maintained very low measured levels of SO_2 and stopped most monitoring of SO_2 levels in the air. After EPA adopted a new SO_2 standard in 2010, Ecology evaluated ambient SO_2 levels throughout Washington, finding that all counties met that standard, apart from one area in Whatcom County (EPA, 2017). With the addition of new emission control technologies, SO_2 from gasoline, diesel, and transportation-related sources have fallen over the past few decades due to a reduction of sulfur content in gasoline and diesel by nearly 90%. Changes in traffic volumes or travel patterns based on growth described in the Seattle Comprehensive Plan are not associated with changes in SO_2 generation.

Air toxic pollutant emissions or hazardous air pollutants (HAPs) are produced from both stationary and mobile sources, notably from motor vehicles in Seattle. EPA has been able to reduce benzene, toluene, and other air toxics emissions from mobile sources by placing stringent standards on tailpipe emissions and requiring the use of reformulated gasoline. However, changes in traffic volumes or travel patterns based on growth described in the Seattle Comprehensive Plan are likely to generate additional air toxics.

Greenhouse Gases & Climate Change

Generally, climate change can be described as the changing of the Earth's climate caused by natural fluctuations and anthropogenic activities (i.e., activities relating to, or resulting from the influence of human beings) that alter the composition of the global atmosphere. Changes in Earth's climate can include temperature, precipitation patterns; increases in ocean temperatures, sea level, and acidity; melting of glaciers and sea ice; changes in the frequency, intensity, and duration of extreme weather events and shifts in ecosystem characteristics, like the length of the growing season, timing of flower blooms, and migration of birds. Global mean temperatures in the United States have warmed during the 20th century and continue to warm into the 21st century.

The accumulation of GHGs in the atmosphere is a driving force in climate change. GHGs are gases that naturally trap heat by preventing the expulsion of solar radiation that hits the Earth, limiting the amount of radiation that is reflected back into space. This trapping of heat, known as the "greenhouse effect", keeps the earth's surface habitable. However, anthropogenic activities increase the concentrations of additional GHGs in the atmosphere, intensifying the natural greenhouse effect and increasing global average temperatures.

The principal GHGs of concern include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), perfluorocarbons (PFCs) and hydrofluorocarbons (HFCs). These GHGs have a long atmospheric lifespan (1 year to several thousand years), and their potential to trap heat varies widely. Anthropogenic activities that release GHGs of concern include the combustion of fossil fuels for transportation, heating, and electricity generation. Other activities such as agricultural processes, industrial processes, waste decomposition, and deforestation all contribute to climate change.

Based on data compiled by the EPA, GHG emissions from human activities in the United States in 2020 decreased by 20% from 2005, but only 7% compared to 1990 levels. Global data compiled by the EPA show a 43% increase of net GHG emissions between 1990 and 2015. Despite recent reductions, the total warming effect from greenhouse gases produced by human activity to the Earth's atmosphere increased by 45% between 1990 and 2019 (EPA, 2022). The

National Oceanic and Atmospheric Administration's (NOAA) 2021 Annual Climate Report indicates that combined global land and ocean temperatures have increased an average of 0.14 degrees Fahrenheit per decade since 1880 and an average of 0.32 degrees Fahrenheit since 1981 (NOAA, 2022).

Ecology estimates that GHG emissions in Washington State peaked in 1999 at 110 million metric tons and declined after the economic recession in 2008 but have been rising gradually in recent years. In 2019, Washington State's GHG emissions were at their highest levels since 2007, increasing nearly 7% since 2018 and reaching 102.1 million metric tons (Ecology, 2022b). According to the 2020 Community Greenhouse Gas Emissions Inventory, core citywide emissions consisting of transportation, buildings, and waste sectors were 3,012,800 $MTCO_2e$ in the year 2020 (City of Seattle, 2020). Expanded emissions include sources such as freight transportation and air travel. Expanded emissions in 2020 were 5,087,600 $MTCO_2e$.

Air Quality Information Sources, Monitoring, & Trends

Data from PSCAA, Ecology, and EPA were used to compare criteria pollutant levels over the past three years to current NAAQS as summarized in **Exhibit 3.2-2**. This includes days with excessive wildfire smoke that were excluded from EPA determinations regarding attainment. Therefore, some data points may exceed the NAAQS, but this did not factor into attainment determinations for the State or the region.

Criteria pollutants are measured at four monitoring stations within Seattle: 10th and Weller, Duwamish, South Park, and Beacon Hill. Measured criteria pollutant levels decreased from 2019 to 2021 at all monitoring stations apart from ozone at Beacon Hill, which did not change, and 24-hour averaging $PM_{2.5}$ at Beacon Hill, which increased, but remained below the NAAQS. Both CO and NO_2 levels were consistently higher at the 10th & Weller station in Subarea 4 than at the Beacon Hill station in Subarea 8. On average, measurements for $PM_{2.5}$ with 1-year averaging were highest at the South Park station in Subarea 7, while measurements for $PM_{2.5}$ with 24-hour averaging were highest at the 10th & Weller station in Subarea 4.

Exhibit 3.2-2. Criteria Pollutant Levels in the City of Seattle 2019-2021

Pollutant	Station	Primary/ Secondary	Averaging Time	NAAQS	2019 Value	2020 Value	2021 Value
Carbon Monoxide (CO)	Beacon Hill (Subarea 8)	Primary	8 hours	9 ppm	0.80	1.70	0.60
			1 hour	35 ppm	1.17	1.79	0.77
Carbon Monoxide (CO)	10th & Weller (Subarea 4)	Primary	8 hours	9 ppm	1.10	1.20	1.00
			1 hour	35 ppm	1.50	1.53	1.37
Nitrogen Dioxide (NO_2)	Beacon Hill (Subarea 8)	Primary	1 hour	100 ppb	43.05	42.10	41.16
		Primary and Secondary	1 year	53 ppb	10.56	8.60	9.25
Nitrogen Dioxide (NO_2)	10th & Weller (Subarea 4)	Primary	1 hour	100 ppb	61.30	58.51	53.59
		Primary and Secondary	1 year	53 ppb	18.10	15.81	15.80
Ozone (O_3)	Beacon Hill (Subarea 8)	Primary and Secondary	8 hours	0.07 ppm	0.05	0.05	0.05
$PM_{2.5}$	Beacon Hill (Subarea 8)	Primary	1 year	12 µg/m³	6.57	6.50	5.70
		Secondary	1 year	15 µg/m³			
		Primary and Secondary	24 hours	35 µg/m³	25.80	34.43	26.00
$PM_{2.5}$	10th & Weller (Subarea 4)	Primary	1 year	12 µg/m³	N/A	8.70	7.77
		Secondary	1 year	15 µg/m³			
		Primary and Secondary	24 hours	35 µg/m³	N/A	37.50	30.57
$PM_{2.5}$	Duwamish (Subarea 7)	Primary	1 year	12 µg/m³	8.73	8.9	8.37
		Secondary	1 year	15 µg/m³			
		Primary and Secondary	24 hours	35 µg/m³	31.83	35.60	27.57
$PM_{2.5}$	South Park (Subarea 7)	Primary	1 year	12 µg/m³	9.13	8.80	8.10
		Secondary	1 year	15 µg/m³			
		Primary and Secondary	24 hours	35 µg/m³	36.73	26.40	16.93
PM_{10}	Beacon Hill (Subarea 8)	Primary and Secondary	24 hours	150 µg/m³	N/A	58.67	32.33

Sources: PSCAA, 2019a; PSCAA, 2020; PSCAA, 2021.

Sources of Air Pollution in Seattle

Citywide

Equipment with heavy-duty fossil fuel burning engines, such as locomotives, large trucks, construction equipment, freighters, cruise ships, and ferries are the main sources of transportation-related air pollution within Seattle, largely due to emissions produced by diesel motors. According to 2019-2020 annual average daily traffic (AADT) roadway data from Washington State Department of Transportation (WSDOT), the roads with the highest percentage of heavy truck traffic within Seattle are sections of I-5, SR-99, SR-519, and SR-522. Ocean-going vessels, harbor support vessels, ferries, and cargo-handling equipment at marine facilities are sources of air pollution along the waterfront, Harbor Island, and in the Duwamish waterway.

Point sources of air pollution within the manufacturing and industrial centers include industrial and non-transportation emissions sources including manufacturing plants, heavy and general industrial facilities, and manufacturing uses. Many point sources require obtaining permits from the PSCAA to operate. Residential communities bordering manufacturing and industrial centers are exposed to increased pollutant emissions due to their proximity to both transportation and point sources of pollution.

Construction equipment use is variable, intermittent, and geographically temporary, being more heavily associated with certain phases (such as earthmoving and grading) of active construction. However, when emissions are examined over a longer time frame, say annually, impacts are fairly constant and ubiquitous on a citywide basis.

Sources of non-transportation-related emissions include energy consumption and solid waste. Energy consumption consists of emissions from consumption of electricity and natural gas. Primary uses of electricity and natural gas within the City would be for space heating and cooling, water heating, ventilation, lighting, appliances, and electronics. Solid waste releases GHG emissions in the form of methane when these materials decompose.

EIS Analysis Areas

The most substantial sources of air pollution in each area of the City are described below.

Area 1

Area 1, located in northwest Seattle, is heavily affected by on-road sources of air pollutants. I-5 runs north-south along the southern section of the eastern boundary of Area 1 and SR-99 runs north-south and transects Area 1. The main source of railway pollutants is from the freight trains that operate on the Burlington Northern Santa Fe (BNSF)-owned tracks that run along the southern, western, and eastern boundaries of Area 1. Industrial uses are located along and adjacent to the southern boundary of the area. (See the map of rail lines in **Section 3.5 Noise**.)

Area 2

Area 2 is located in northeast Seattle and is heavily affected by on-road sources of air pollutants. I-5 runs along the southwestern boundary of and through the northwestern portion of Area 2. In addition, SR-522 runs through the northern portion of Area 2. The main source of railway pollutants is from the freight trains that operate on the BNSF-owned tracks that run along the western boundaries of Area 2. (See the map of rail lines in **Section 3.5 Noise**.)

130th/145th Station Area

The 130th/145th Station Area is located in northern Seattle in Area 2. I-5 transects this area going north-south, and a railway runs through the vicinity of the 130th Street Light Rail Station. No other major sources of air pollution are located within the Area.

Area 3

Area 3, which is located in western Seattle, is heavily affected by on-road and rail sources of air pollutants. SR-99 runs along the eastern boundary of Area 3. The main source of railway pollutants is from the freight trains that operate on the BNSF-owned tracks that run through and along the southwestern boundary of Area 3. Other sources of air pollution include commercial cruise and other non-industrial operations at the Port of Seattle and industrial land uses.

Area 4

Area 4 is located centrally within the City of Seattle and is heavily affected by on-road and rail sources of air pollutants. SR-99 runs through the area and I-5 runs along the eastern boundary. The main source of railway pollutants is from the freight trains that operate on the BNSF-owned tracks that run through Area 4. Another source of air pollution is commercial cruise and other non-industrial operations at the Port of Seattle. (See the map of rail lines in **Section 3.5 Noise**.) Industrial uses are located at the northwestern and southern portions of Area 4.

Area 5

Area 5 is located centrally within the City of Seattle and is heavily affected by on-road sources of air pollutants. I-5 runs along the western boundary, SR-520 runs along the northern boundary, and I-90 runs along the southern boundary of Area 5. The main source of railway pollutants is from a streetcar that operates on the tracks that run through Area 5. (See the map of rail lines in **Section 3.5 Noise**.) Industrial uses are located at the southwestern corner of the Area.

Area 6

Area 6 is located in southwestern Seattle. While Area 6 would be subjected to on-road pollutants from roadways, no major sources of air pollution are located within the Area. SR-509 runs along a relatively small segment of the southeastern boundary of the Area. Sources of railway pollutants are from freight trains that operate on the BNSF-owned tracks that run along a relatively small segment of the northeastern boundary of Area 6, adjacent to the industrial district operating along the southern portion of the Port of Seattle. (See the map of rail lines in **Section 3.5 Noise**.) The Area is bound to the east by Area 7, which consists primarily of industrial-zoned land.

Area 7

Southern Seattle includes Area 7 which consists primarily of industrial-zoned land and is heavily affected by on-road, rail, maritime, and aviation sources of air pollutants. I-5 runs along the eastern boundary of and SR-509 runs through Area 7. Area 7 is heavily affected by rail operations from BNSF-owned tracks that run through the Area, which includes an intermodal facility and industrial district at the Port of Seattle. (See the map of rail lines in **Section 3.5 Noise**.) The King County International Airport is located in the southwestern portion of Area 7, contributing aviation-related pollutants.

Area 8

Area 8 is located in southeast Seattle and is heavily affected by on-road sources of air pollutants. I-5 runs along the western boundary and I-90 runs along the northern boundary of Area 5. The main source of railway pollutants is from the freight trains that operate on the BNSF-owned tracks that run along the western and northern boundaries of Area 8. (See the map of rail lines in **Section 3.5 Noise**.) Although not located within Area 8, the King County International Airport is located adjacent to Area 8 to the southwest and the Seattle Intermodal facility, which is source of railway pollutants, is located adjacent to the west of Area 8.

Air Toxics

Air toxic pollutant emissions or hazardous air pollutants (HAPs) are of concern in Seattle because of projected growth in vehicle miles traveled. The Puget Sound Regional Council estimates that by 2050, the population of the Puget Sound region will grow by 38% (1.6 million people) to reach a population of 5.8 million people (PSRC 2021), with the highest population increase estimated to be in King County, resulting in increased vehicle miles traveled.

Construction Emissions

Exhaust emissions from diesel off-road equipment represent a relatively small percentage of the overall emission inventory in King County: 0.6% of countywide CO, 7.1% of countywide NO_X, 0.97% of countywide PM_{10}, 2.53% of countywide $PM_{2.5}$, and 0.39% of countywide VOC (EPA, 2017). The primary emissions of concern (greater than 1% contribution) with regard to construction equipment are NO_X and $PM_{2.5}$ (the latter a priority air toxic). NO_X is primarily an air quality concern with respect to its role in (regional) ozone formation and the Puget Sound air shed has long been designated as an attainment area (meeting standards) with respect to ozone.

Sensitive Populations

Sensitive populations are those who are the most at-risk of adverse effects from elevated levels of air pollutants, whether due to age, previous or ongoing illnesses, socioeconomic status (SES), or other conditions such as pregnancy. According to the U.S. EPA, these sensitive groups include people with heart and lung disease, older adults (those 65 years of age or older), children, people with diabetes, and people of lower SES (EPA, 2023). This also includes those experiencing breathing troubles, such as those who have/have had COVID-19, asthma, cystic fibrosis, or other respiratory ailments. Those of lower SES may be more vulnerable to air pollution due to proximity to industrial sources of air pollution, underlying health issues, poor nutrition, stress, and other factors contributing to increased health impacts.

Land uses with populations sensitive to air quality include residential areas, schools, daycare facilities, hospitals, and nursing and convalescent homes. Residential communities that border industrial areas may be at risk of increased impact from pollutants due to their proximity to both transportation and point sources of pollution.

The Washington Environmental Health Disparities Map is used to locate areas with high environmental health risks posed to sensitive populations across the state; see **Exhibit 3.1-12 Environmental Health Disparities** in **Section 3.1 Earth & Water Quality**. The map accounts for pollution measures such as diesel emissions and ozone and proximity to sources of pollution. The goal of the map is to provide insight on prioritization of public investments to buffer environmental health impacts on the state's communities, so that everyone may benefit from clean and healthy air, water, and environments. The map was created with 19 indicators, and these indicators are divided into four themes: environmental exposures, environmental effects, sensitive populations, and socioeconomic factors. The combination of these indicators informs the environmental health disparities map by census tract. The map shows communities that are experiencing a disproportionate share of environmental health burdens and that will need more assistance to reach equitable outcomes, with 1 indicating census tracts with the lowest disparities and 10 indicating tracts with the highest disparities.

According to the Washington Department of Health, living in areas with more environmental hazards and population vulnerabilities is associated with a shorter lifespan, where population in census tracts of rank 1 on average lived 5.3 years longer than those in census tracts with the highest environmental health disparities (rank 10) (Washington Department of Health, n.d.).

Downtown/Lake Union, Capitol Hill/Central District, Duwamish, and SE Seattle rank the highest (in the 8-10 range) compared to the other subareas. The subareas that rank the lowest are NW Seattle and NE Seattle, which have tracts that rank in the 3 to 6 range.

Greenhouse Gas Emissions in Seattle

The City of Seattle conducted a *Community Greenhouse Gas Emissions Inventory* study in 2020, which analyzed emissions data based on the national standards set forth by the International

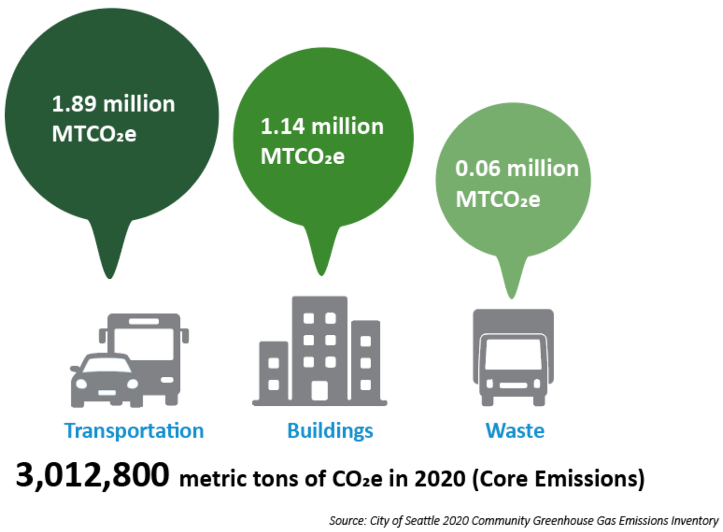
Council for Local Environmental Initiatives (ICLEI)—Local Governments for Sustainability. These standards make it easier to compare Seattle's emissions with other cities and past inventories.

GHGs were divided into core emissions and expanded emissions. Core emissions sources are those that the city can most directly and significantly impact, and most of the city's climate policies and programs are aimed at reducing core emissions. Core emissions include those from transportation, buildings, and waste sectors. Expanded emissions include all core emission sectors as well as additional sectors, subsectors, and categories. The additional category for expanded emissions includes industry-based emissions.

GHGs are measured by metric tons of carbon dioxide equivalents ($MTCO_2e$). The largest amount of core emissions in Seattle was contributed by the transportation sector, at 1.89 million $MTCO_2e$ (62%), followed by the buildings sector at 1.14 million MT, and waste at 0.06 million MT. A total of 3 million MT of CO_2e in core emissions were emitted in the city in 2020. CO_2e emissions in the transportation sector have decreased around 27.7% since 2008, when they measured 2.61 million MT. This decrease in emissions is due in part to improvements in vehicle efficiency standards, a decrease in vehicle miles traveled (VMT), and changes in travel patterns due to the COVID-19 pandemic in 2020.

For core emissions in the transportation sector, emissions are classified by roadway vehicle type as passenger emissions and truck emissions. Passenger emissions accounted for majority of emissions in the transportation sector at 1.68 million $MTCO_2e$, whereas truck emissions contributed only 207,000 $MTCO_2e$. Passenger emissions consist of both single- and high-occupancy vehicles, motorcycles, light trucks, and buses. Truck emissions consist of emissions from commercial trucks including light-, medium-, and heavy-duty commercial trucks (see **Exhibit 3.2-3**).

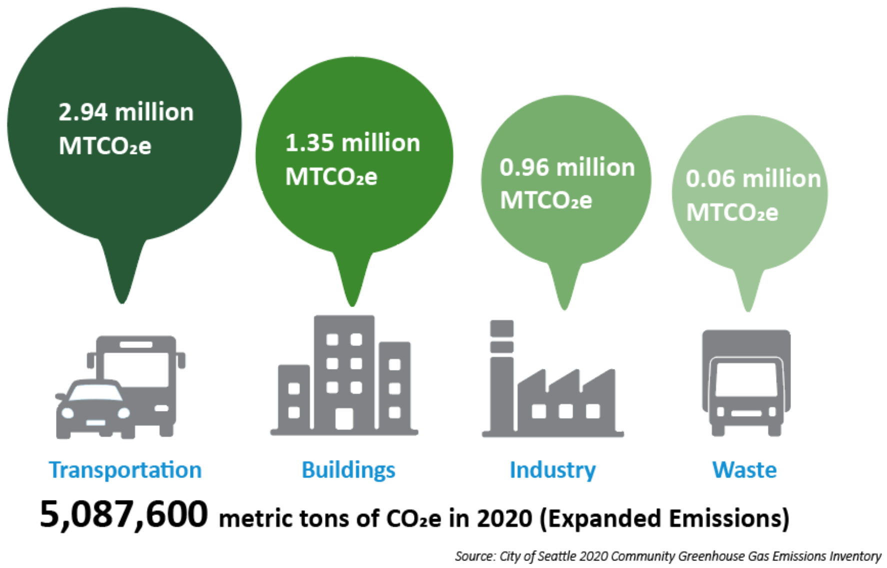
Exhibit 3.2-3. Core GHG Emissions in the City of Seattle



Source: City of Seattle, 2020.

For expanded emissions, the transportation sector also had the highest amount of CO_2e with 2.94 million MT (55%), followed by the buildings sector at 1.35 million MT, industry at 0.96 million MT, and waste at 0.06 million MT. A total of 5 million $MTCO_2e$ was emitted for expanded emissions in the city in 2020 (see **Exhibit 3.2-4**).

Exhibit 3.2-4. Expanded GHG Emissions in the City of Seattle



Source: City of Seattle, 2020.

Expanded emissions in the transportation sector are divided by air, marine, rail, passenger, and trucks. Passenger emissions still accounted for majority of emissions in the transportation sector at 1.68 million mt of CO_2e, while rail had the least amount at 27,000 MT CO_2e. Air transport and the industrial sector together comprised two of the largest sources of core and expanded emissions in 2020, approximately 844,000 mt of CO_2e (15.9% of total) and 962,000 mt of CO_2e (18.0% of total) respectively. Air transportation emissions have seen an uptick since 2008, due to increased economic activity and population growth.

3.2.2 Impacts

Impacts Common to All Alternatives

Construction Related Emissions

Future growth under any alternative would result in development of new residential, retail, light industrial, office, and community/art space. Most development projects in the city would entail demolition and removal of existing structures or parking lots, excavation and site preparation, and construction of new buildings. Emissions generated during construction activities would include exhaust emissions from heavy duty construction equipment, trucks used to haul construction materials to and from sites, worker vehicle emissions, as well as fugitive dust emissions associated with earth-disturbing activities, and other demolition and construction work.

Fugitive dust emissions are typically generated during construction phases. Activities that generate dust include building and parking lot demolition, excavation, and equipment movement across unpaved construction sites. The PSCAA requires dust control measures be applied to construction projects through Article 9, Section 9.15. Of these measures, those applicable to fugitive dust include (1) use control equipment, enclosures or wet suppression techniques, (2) paving or otherwise covering unpaved surfaces as soon as possible, (3) treating construction sites with water or chemical stabilizers, reduce vehicle speeds and cleaning vehicle undercarriages before entering public roadways and, (4) covering or wetting truck loads or providing freeboard in truck loads. In light of these requirements, impacts related to construction dust are concluded to be less than significant.

Criteria air pollutants would be emitted during construction activities from demolition and construction equipment, much of it diesel-powered, trucks used to haul construction materials to and from sites, and from vehicle emissions generated during worker travel to and from construction sites. Emissions are emitted in and around specific construction sites and are therefore dispersed geographically. The use of diesel-powered construction equipment would be temporary and episodic. The duration of exposure would be short and exhaust from construction equipment dissipates rapidly. Construction is temporary and would be transient throughout the site (i.e., move from location to location) and would not generate emissions in a fixed location for extended periods of time.

A number of federal regulations require cleaner off-road equipment. Specifically, the U.S. EPA has set emissions standards for new off-road equipment engines, classified as Tier 1 through Tier 4. To meet the Tier 4 emission standards, engine manufacturers will be required to produce new engines with advanced emission-control. By the time final Tier 4 regulations were fully implemented in 2015, PM and NO_X emissions had been reduced 99% compared to 1996 emissions (MTU, 2010). Consequently, it is anticipated that as the region-wide construction fleet converts to newer equipment the potential for health risks from off-road diesel equipment will be substantially reduced. So, given the transient nature of construction-related emissions and regulatory improvements scheduled to be phased in, construction related emissions associated with all five alternatives of the Comprehensive Plan would be considered only a minor adverse air quality impact.

Greenhouse Gas Emissions

The scale of global climate change is so large that the impacts from any singular development project or programmatic action, even on the citywide scale of the development alternatives in this Draft EIS, would not have an individually discernible impact on global climate change. It is more appropriate to consider impacts on a "cumulative" scale. Thus, this EIS will consider how GHG emissions from future development in Seattle, in combination with emissions across the state, country, and planet to cumulatively contribute to global climate change.

Construction

GHGs would be emitted during construction activities from fossil-fueled demolition and construction equipment, trucks used to haul construction materials to and from sites, and from vehicle emissions generated during worker travel to and from construction sites. Construction and demolition emissions only represent approximately 2.71% of the emissions estimated in the 2020 GHG emissions inventory (City of Seattle, 2020).

Construction-related GHG emissions from any given development project that may occur in the next 20 years would be temporary and would not represent an on-going burden to the City's inventory. However, cumulatively it can be assumed that varying levels of construction activities within the city would be ongoing under any of the Plan alternatives and hence, cumulative construction related emissions would be more than a negligible contributor to GHG emissions within the city.

The City's Climate Action Plan recognizes the relevance of construction related GHG emissions and has included actions to be implemented by 2030 to address them. These include:

- Support new and expanded programs to reduce construction and demolition waste, such as creating grading standards for salvaged structural lumber so that it can be more readily reused;
- Expand source reduction efforts to City construction projects, and incorporate end-of-life management considerations into City procurement guidelines; and
- Phase-in bans on the following construction and demolition waste from job sites and private transfer stations: recyclable metal, cardboard, plastic film, carpet, clean gypsum, clean wood and asphalt shingles.

The City's *2022 Solid Waste Plan Update: Moving Upstream to Zero Waste* aligns its waste-related goals with the sustainability and climate goals of CAP. The 2022 Solid Waste Plan Update emphasizes the elimination or minimization of waste from the start. The 2022 Solid Waste Plan Update includes recommendations to increase public awareness to expand support of waste prevention and opportunities for reuse. Strategies to reduce waste include, but are not limited to, reducing single-use items, food waste, require all single-use food services to use compostable packaging, and enhance diversion of construction and demolition debris at transfer stations.

Additionally, the West Coast Collaborative, a public-private partnership including the U.S. EPA, equipment manufacturers, fleet owners, state and local governments and non-profit organizations leverages federal funds to reduce emissions from the highest polluting engines. With Ecology and privately owned construction companies, the Collaborative installed diesel oxidation catalysts on construction equipment and trucks, reducing carbon emissions by 121.4 tons annually (West Coast Collaborative, 2023).

Although construction related emissions would not be negligible, because of the combination of regulatory improvements and parts of the Climate Action Plan that are under way, construction related GHG emissions associated with all alternatives would result in minor adverse climate impacts.

Operations—Transportation

Mobile emissions were estimated using the EPA's Motor Vehicle Emission Simulator (MOVES) model. The MOVES model is a state-of-the-science emission modeling system that estimates emissions for mobile sources at the national, county, and project level for criteria air pollutants and GHG emissions. Projected vehicle miles traveled (VMT) by passenger vehicles, trucks, and buses were used to estimate criteria pollutant and GHG emissions.

The approach to estimating future year transportation related GHG emissions considers two factors:

- The projected change in VMT
- The projected change in fuel economy of the vehicle fleet

VMT in 2044. Travel demand models predict VMT in future years for various classes of vehicles (e.g., cars, trucks, buses). The model generally assumes continuation of current economic and demographic trends, with minor shifts toward shorter trips and more trips made by modes other than automobile travel. This will reduce VMT per capita, but total VMT in the region would continue to rise modestly due to population and employment growth. If emissions were projected based solely on the increase in VMT, with no changes assumed to fuel economy, emissions under each of the 2044 alternatives would increase compared to existing conditions. However, the trend toward more stringent federal standards means it is reasonable to assume improved fuel economy, and lowered GHG emissions, by 2044.

A mix of land uses is associated with reduced VMT (WSDOT, 2013). Diversity in land uses combined with increased density within an urban area can lead to shorter trip distances and greater use of walking, as well as the reduced need for vehicle ownership. Accessibility to a variety of trip purposes, as in mixed use developments, may induce additional trips; however, these trips are shorter and are more likely to be made by walking than trips in areas where mixed land uses are not available. Travel demand models include findings about projected VMT in future years for various classes of vehicles (e.g., cars, trucks, buses). The model generally assumes continuation of current economic and demographic trends, with minor shifts toward shorter trips and more trips made by modes other than automobile travel. Improvements in fuel efficiency combined with reductions in VMT would contribute to reductions in emissions.

Fuel Economy in 2044. Federal programs are mandating improved fuel economy, which reduces GHG emissions, for passenger cars and light trucks. Transportation-related emissions in 2044 would be lower as compared to existing conditions due to improvements in fuel economy. The National Highway Traffic and Safety Administration (NHTSA) is responsible for establishing vehicle standards and for revising existing standards. Compliance with Federal fuel economy standards is not determined for each individual vehicle model. Rather, compliance is determined based on each manufacturer's average fuel economy for the portion of their vehicles produced for sale in the United States. On March 31, 2022, the NHTSA finalized their Corporate Average Fuel Economy (CAFE) standards for model years 2024 to 2026. The final rule requires an industry-wide fuel average of approximately 49 miles per gallon (mpg) for passenger cars and light trucks in model year 2026 by increasing fuel efficiency by 8% annually for model years 2024 and 2025 and 10% for model year 2026 (NHTSA, 2023). The NHTSA estimates that final standards will reduce emissions of CO, VOC, NO_X, and $PM_{2.5}$ emissions attributable to the light-duty on-road fleet dramatically between years 2020 and 2050 (NHTSA, 2022).

As discussed above, Washington State adopted a new rule in December 2022 that requires new ZEV sales of passenger cars, light-duty trucks, and medium-duty vehicles to 100% starting in 2035. It also requires cleaner, less polluting new heavy-duty internal combustion engines. ZEVs do not release tailpipe air pollution. A ZEV continues to run clean throughout its life, unlike a standard petroleum-powered vehicle, which typically pollutes more as it ages and parts wear out. Progress toward 100% ZEV sales in 2035 would increase the rate of registration of ZEVs in Seattle, resulting in reduced tailpipe emissions and the need for charging infrastructure.

Results. All four 2044 alternatives for which VMT data was provided result in roughly the same annual GHG emissions, as shown in **Exhibit 3.2-5**. Alternative 5, which includes the most concentrated growth, is expected to have the highest total GHG emissions and the lowest GHG per capita among the alternatives. Alternative 1, the No Action Alternative, is expected to have the lowest total GHG emissions and the highest GHG emissions per capita. However, the variation is within approximately one half of one percent. This is because the projected improvements in fuel economy outweigh the projected increase in VMT. Therefore, roadway emissions are considered a minor adverse impact.

Exhibit 3.2-5. Total Citywide Road Transportation Emissions GHG ($MTCO_2e$) by Alternative

	Existing	Alternative 1	Alternative 2	Alternative 3	Alternative 4*	Alternative 5
Total	**31,070**	**29,408**	**30,235**	**30,235**	**30,235**	**31,246**

* Traffic data is not available for Alternative 4 because the projected VMT would fall between Alternative 2 and Alternative 3. For purposes of the analysis, it has been assumed that Alternative 4 VMT is equivalent to Alternative 2, which is higher than Alternative 3.
Source: Kimley-Horn, 2023.

Operations—Energy

GHG emissions from electrical use are generated when energy is generated by the non-renewable sources of an electrical supplier such as Seattle City Light. However, Seattle City Light is carbon neutral and, consistent with the City's Climate Action Plan, no emissions related to electricity are assumed because Seattle City Light will maintain its commitment to carbon neutrality.

GHG emissions from natural gas are direct emissions resulting from on-site combustion for heating and other purposes. All-electric space and water heating is required by the 2022 Washington Energy Code. However, all-electric cooking appliances has not been required. According to household end-use consumption data, approximately 13% of natural gas consumption in residential uses is for purposes other than space and water heating (U.S. EIA, 2015). Natural gas usage has been estimated by dividing total natural gas consumption by residential uses in the State of Washington in 2020 (before all-electric space and water heating is required) by the total housing units in the state in 2020 (U.S. EIA, 2023 and U.S. Census, 2020). Based on the assumption that 13% of natural gas consumption is used for purposes other than space and water heating, natural gas consumption has been adjusted accordingly (see **Appendix D** for detailed calculations). GHG emissions from natural gas demand are calculated using the CalEEMod land use model (version 2020.4.0). This model is recognized by the Puget Sound Clean Air Agency as an estimation tool (PSCAA, 2019).

Operations—Solid Waste

Solid waste-related emissions are generated when the increased waste generated by new development and infrastructure is disposed in a landfill where it decomposes. Future growth within the city would result in increase in solid waste disposal. GHG emissions associated with solid waste disposal has been estimated using CalEEMod (version 2020.4.0). Increased emissions from solid waste generation were estimated using Ecology solid waste and recycling data (Ecology, 2018). These emissions were then adjusted to account for waste diversion implemented through waste reduction, recycling and composting fostered by the City's carbon-neutral goal target of 70% waste diversion by 2030. Impacts related to energy-generated GHGs would be considered a minor adverse impact.

Equity & Climate Vulnerability Considerations

Exposure to Air Pollution

Future growth and development patterns under Comprehensive Plan growth strategies would affect future residences' (or other "sensitive receptors") relationships to mobile and stationary sources of air toxics and particulate matter $PM_{2.5}$. The degree of potential for adverse impacts on new sensitive receptors would depend on proximity to major sources of these pollutants, the emissions from these sources, and the density of future sensitive development.

Portions of Seattle located along major roadways (freeways and the most-traveled highways) are exposed to relatively high levels of air borne toxics, resulting in high cancer risk values. In 2008, the Washington State Department of Health conducted a study of cancer risks in the Duwamish Valley. Results of the analysis indicate that on-road mobile sources contribute to the highest cancer and non-cancer risks near major roadways over a large area of south Seattle and that risks and hazards are greatest near major highways and drop dramatically at approximately 200 meters (approximately 656 feet) from the center of highways (WSHA, 2008). Modeling indicates increased cancer risks in existing residential areas of up to 800 in one million.[10] Risks above 100 per one million persons (100 excess cancer risk) is a criterion identified by U.S. EPA guidance for conducting air toxic analyses and making risk management decisions at the facility and community-scale level. Risks and hazards drop dramatically in places farther than 200 meters (656 feet) from the center of highways. A similar phenomenon occurs in proximity to rail lines that support diesel locomotive operations. Given this, it would be prudent to consider risk-reducing mitigation strategies. Because the authority to set standards for locomotives and heavy-duty on-road vehicle emissions lies exclusively with the U.S. EPA, the only strategies available to the City for consideration are related to reducing exposure. As discussed above, measures such as setbacks for residential and other sensitive land uses from major traffic corridors and rail lines are effective. Other measures to protect sensitive land uses from being exposed to substantial levels of toxic air contaminants include requirements for enhanced air filtration, restricting open spaces and operable windows near to the source of toxic air contaminants, and siting intake vents as far from substantial sources as practicable.

Portions of Seattle are also exposed to relatively high cancer risk values from stationary sources and near port operations where ship emissions and diesel locomotive emissions and diesel forklift emissions can all occur. Similarly, distribution centers that involve relatively high volume of diesel truck traffic can also represent a risk hazard to nearby sensitive land uses. This is considered a moderately adverse impact to air quality. The City has identified measures for receptors proposed in areas proximate to manufacturing industrial centers to reduce the potential risk through the Seattle Industrial and Maritime Lands Final EIS (2022), such as implementing buffer areas of 500 to 1,000 feet and enhanced air filtration systems.

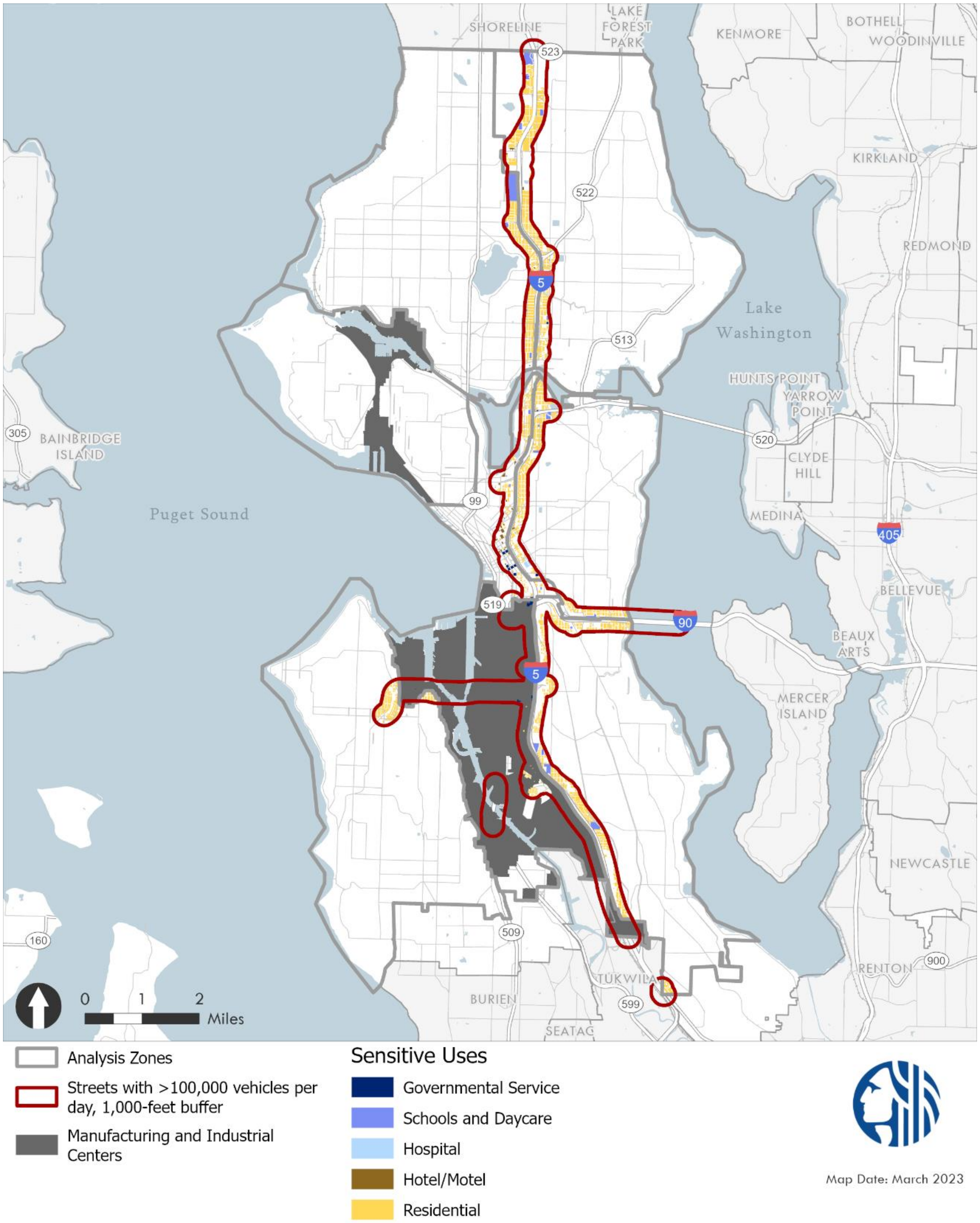
10 These risks should not be interpreted as estimates of disease in the community, only as a tool to define potential risk.

Although, as discussed above, risks and hazards drop dramatically in places farther than 200 meters (656 feet) from the center of highways, a buffer area of 500 to 1,000 feet has been considered to reduce the potential exposure of sensitive populations to air toxics (City of Seattle, 2022). **Exhibit 3.2-6** shows a 1,000-feet buffer around roadways and highways with daily trips greater than 100,000 vehicles. This shows that existing uses along Interstate 5 (I-5) north of Interstate 90 (I-90) consist primarily of residential uses, within 1,000 feet of transportation sources of air pollutants. Under any alternative, increased residential densities could be expected within this buffer. Variations in potential density increases in these areas under each alternative are discussed further below.

This potential increased exposure to cancer risk is considered a potential moderate adverse impact related to air quality.

To address the impact, the City could consider risk-reducing mitigation strategies such as setbacks for residential and other sensitive land uses from major traffic corridors, rail lines, port terminals and similar point sources of particulates from diesel fuel and/or to identify measures for sensitive populations proposed to be in areas near such sources such as upgraded air filtration systems.

Exhibit 3.2-6. 1,000-Feet Buffer Around Freeways and Roadways with Greater than 100,000 Daily Vehicles



Source: Kimly-Horn, 2023.

Impacts of Alternative 1: No Action

Under Alternative 1 future growth would continue based on continuation of the 2035 Comprehensive Plan, with a target housing growth of 80,000 dwelling units. New housing would consist primarily of rental apartments concentrated in existing mixed-use areas. Approximately 46% of housing growth would occur within urban centers and approximately 18% would occur within residential urban villages.

Construction

As discussed above, emissions generated during construction activities would include exhaust emissions from heavy duty construction equipment, trucks used to haul construction materials to and from sites, worker vehicle emissions, as well as fugitive dust emissions associated with earth-disturbing activities, and other demolition and construction work. Emissions associated with future development cannot be determined on a program level as construction activities are project-specific. Therefore, a comparative discussion of construction emissions is based on projected housing units demolished and target housing growth under each of the alternatives. Alternative 1 would result in the least amount of demolished housing units and the lowest target growth compared to all other alternatives. Therefore, emissions associated with heavy-duty construction equipment, trucks, worker vehicles, and fugitive dust would likely be the lowest among all alternatives.

Operations

Transportation-Related Air Quality Emissions

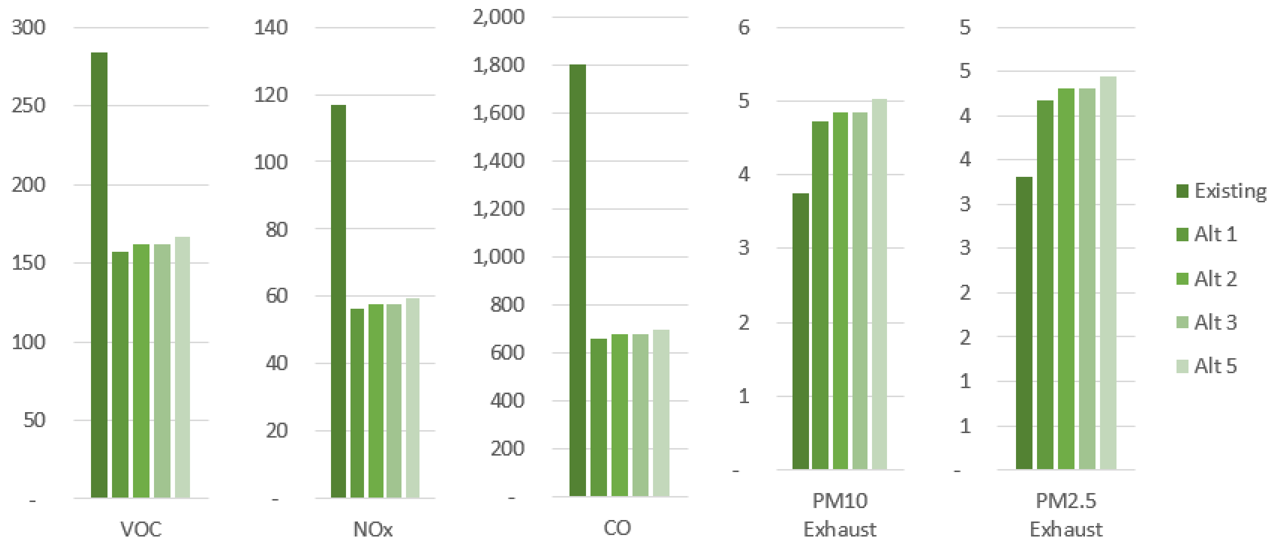
VMT within the City of Seattle would increase as a result of population and employment growth under Alternative 1. Projected changes in VMT were extracted from the projected travel demand model for cars, trucks, and buses. The travel demand model generally assumes existing economic and demographic trends continue with minor changes due primarily to mode share shifts and shortened trips due to increased density. These changes cause projected VMT per capita to decline slightly by 2044. However, total VMT would continue to rise modestly due to population and employment growth.

All of the 2044 alternatives are expected to generate lower air pollutant emissions than in 2018, resulting in a net decrease in transportation-related emissions of VOC, CO, and NO_X. This is because the projected improvement in fuel economy outweighs the projected increase in VMT for those criteria pollutants. Transportation-related air pollutant emissions under existing conditions and each of the four alternatives with VMT data are presented in **Exhibit 3.2-7** and **Appendix D**. Note that these emissions are City-wide assuming development under each alternative.

In addition to the tailpipe emissions presented in **Exhibit 3.2-7**, vehicle travel would also generate PM_{10} and $PM_{2.5}$ through tire and brake wear and, more significantly, from entrained road dust. These non-tailpipe emissions would not benefit from future improvements to the vehicle fleet as a whole or from improvements to fuel composition. Therefore, PM_{10} and $PM_{2.5}$ emissions attributable to fugitive dust is not represented in **Exhibit 3.2-6** (see **Appendix D**).

As can be seen from **Exhibit 3.2-7** regional VOC, CO, and NO_X emissions under Alternative 1 would be substantially lower than under 2018 background conditions. This is because the projected improvement in fuel economy, emission controls and fuel composition will outweigh the projected increase in VMT. Emissions of PM_{10} and $PM_{2.5}$ would be approximately 1 ton/year greater than under existing conditions, which is a nominal increase. This would represent a beneficial future air quality outcome due to significant decreases in VOC, CO, and NO_X emissions. As indicated in **Exhibit 3.2-7**, Alternative 1 would have the lowest criteria pollutant emissions of the five alternatives.

Exhibit 3.2-7. Road Transportation Pollutant Emissions

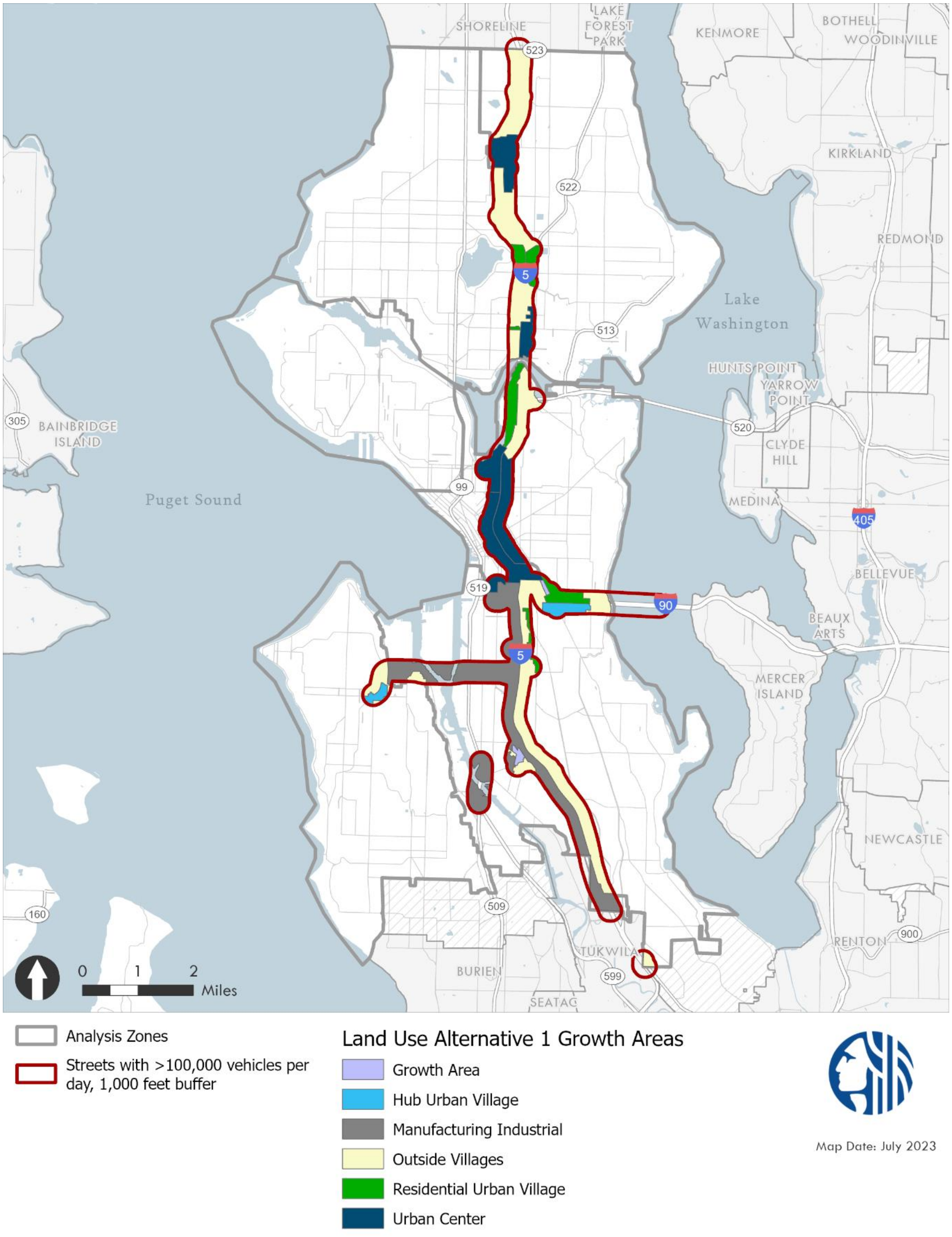


Source: Kimley-Horn, 2023.

Equity & Climate Vulnerability Considerations

As shown in **Exhibit 3.2-8**, several urban centers and urban villages are located within 1,000-feet of roadways with greater than 100,000 daily vehicles. Collectively these urban centers and villages represent 56% of all projected residential growth in the city through 2044. Only a portion of each center or village is within the 1,000-feet buffer, so the potentially affected portion of the new residents would be smaller. Compared to all other alternatives, the number of units within the affected urban centers and villages would be the lowest (same as Alternative 3 and 4).

Exhibit 3.2-8. 1,000-Feet Buffer Around Freeways and Roadways with Greater than 100,000 Daily Vehicles—Alternative 1



Source: Kimley-Horn, 2023.

Greenhouse Gas Emissions

Changes in operational GHG emissions associated with growth under Alternative 1 would result from increases in VMT and improvements to the vehicle fleet, electrical and natural gas usage, and solid waste generation. GHG emissions from electrical usage are generated when energy consumed is generated by the non-renewable resources of an electrical supplier such as Seattle City Light. However, Seattle City Light is carbon neutral and, consistent with the City's Climate Action Plan, no emissions related to electricity are assumed because City Light will maintain its commitment to carbon neutrality. GHG emissions from natural gas are direct emissions resulting from on-site combustion for heating and other purposes. Solid waste-related emissions are generated when the increased waste generated by development is disposed in a landfill where it decomposes, producing methane gas.[11]

Operational GHG emissions from Alternative 1 are presented in **Exhibit 3.2-9** and **Appendix D**. The transportation emissions reductions from existing emissions due to implementation of Alternative 1 would be the greatest of any of the five alternatives, largely as the result of lower VMT compared to other alternatives which is a reflection of the lowest overall housing growth target and the concentration of that growth within urban centers and urban villages. Reflecting the lowest overall housing growth target, the building and waste emissions associated with Alternative 1 would be the lowest of all the alternatives.

Exhibit 3.2-9. Per Capita GHG Emissions—Alternative 1

	Emissions ($MTCO_2e$)
Transportation	-1,662
Buildings	48,422
Waste	60,834
Total Alternative 1	107,594
Population Growth Estimate	164,000
Per Capita GHG Emissions	**0.66**

Notes: Population growth calculated using City GIS data for total housing units and population (total units/population = persons per household), assuming 2.05 persons per household
Source: Kimley-Horn, 2023.

Per capita GHG emissions due to target growth is calculated by dividing the total GHG emissions by the anticipated population growth. According to the Seattle 2020 Community GHG Inventory, citywide core per capita emissions was 4.09 $MTCO_2e$ per resident in 2020 (City of Seattle, 2020). As shown in **Exhibit 3.2-9**, Alternative 1 would result in per capita emissions of 0.66 $MTCO_2e$, which is significantly lower than the existing per capita rate.

11 CH4 from decomposition of municipal solid waste deposited in landfills is counted as an anthropogenic (human-produced) GHG

130th/145th Station Area

Zoning designations under Alternative 1 would be retained within the 130th/145th Station Area and no new areas will be designated for mixed-use or higher density than exists under existing conditions. The future light rail station at 130th would be developed in an area that would allow three-story single-purpose residential development and four- to eight-story multifamily surrounding the future 145th BRT Station. Implementation of Alternative 1 assumes a growth potential of 840 housing units and 716 jobs in proximity to the future light rail and BRT stations.

Construction

Station Area growth under Alternative 1 would be the lowest compared to all other alternatives. Therefore, emissions associated with heavy-duty construction equipment, trucks, worker vehicles, and fugitive dust would likely be the lowest among all alternatives.

Operations

Criteria Pollutant Emissions

Transit has been identified as the most frequent and successful tool in reducing VMT (WSDOT, 2022). Transit improvements overall provide a VMT reduction of up to 2.6% (WSDOT, 2022). Therefore, transit service and connectivity provided by the future light rail and BRT stations in combination with Alternative 1 growth potential, in comparison to baseline conditions, would result in improved transit service and connectivity when compared to existing conditions, providing greater potential for VMT reduction and reductions in criteria pollutants.

Greenhouse Gas Emissions

As stated above, transit service and connectivity provided by the future light rail and BRT stations in combination with Alternative 1 growth potential, in comparison to baseline conditions, would result in improved transit service and connectivity when compared to existing conditions, providing greater potential for VMT reduction and reductions in GHG emissions. In addition, the housing growth potential under Alternative 1 would be the lowest compared to all other alternatives. Therefore, GHG emissions associated with building energy use and solid waste would be lowest under Alternative 1.

Equity & Climate Vulnerability Considerations

The 130th/145th Station Area is located in northern Seattle in Area 2. I-5 transects this area going north-south, and a railway runs through the vicinity of the 130th Street Light Rail Station. Target growth under Alternative 1 within the Station Area would be lowest among all other alternatives and would place the least number of residents within close proximity to transportation-related pollutants along I-5.

Impacts of Alternative 2: Focused

Under Alternative 2, areas of focused growth called neighborhood centers would create more housing around shops and services, allowing for a wide range of housing types. The target housing growth under this alternative is 100,000 dwelling units. Approximately 37% of housing growth would occur within regional centers and approximately 24% would occur within neighborhood centers.

Construction

Alternative 2 would result in a greater number of demolished housing units compared to Alternative 1 and less than Alternative 3, 4, and 5. Alternative 2 would result in greater target growth compared to Alternative 1, the same as Alternative 3 and 4, and less than Alternative 5. Therefore, emissions associated with heavy-duty construction equipment, trucks, worker vehicles, and fugitive dust under Alternative 2 would likely be greater than Alternative 1 and lower than Alternative 3, 4, and 5.

Operations

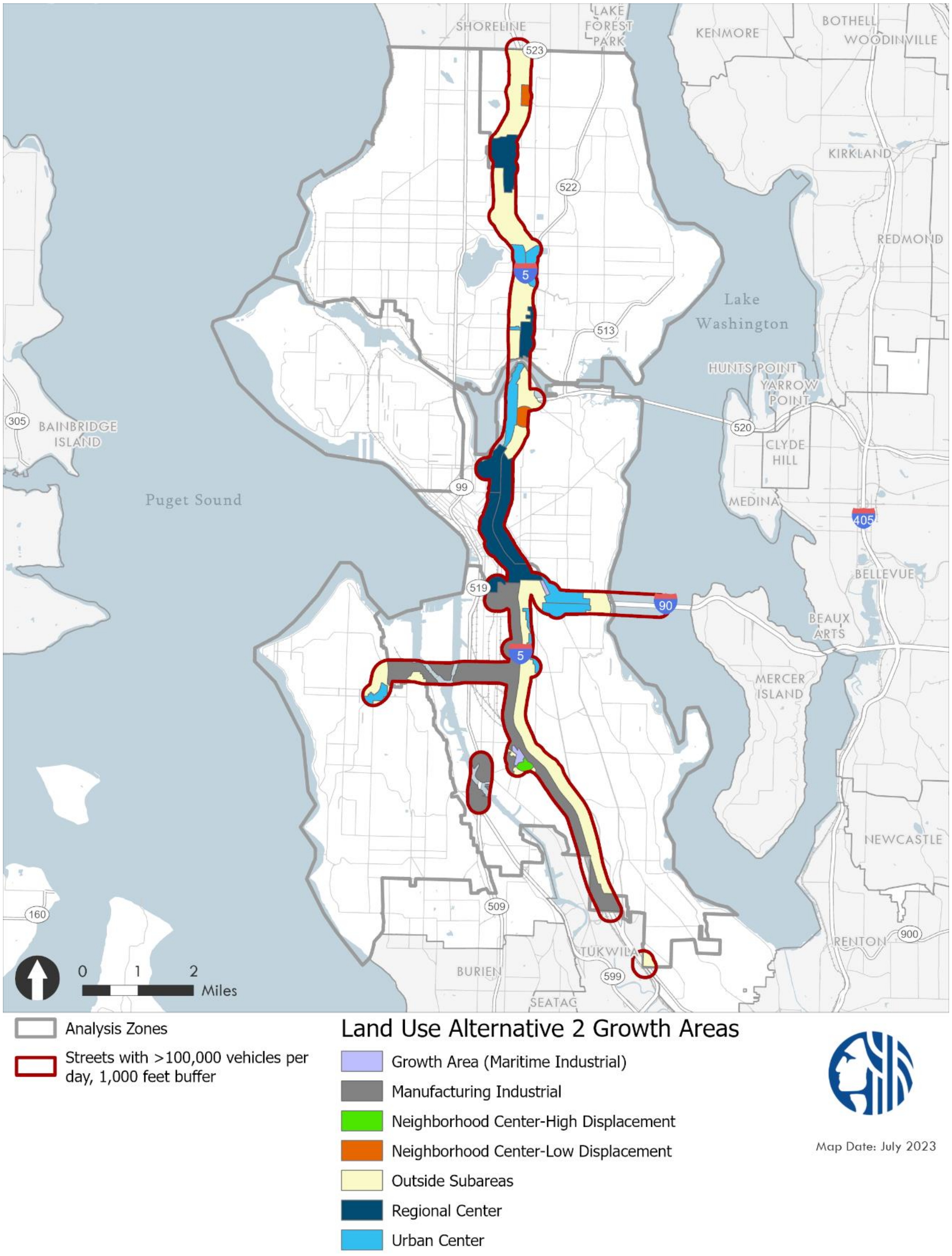
Transportation Air Quality Emissions

Transportation-related air pollutant emissions under existing conditions and each of the four alternatives are presented in **Exhibit 3.2-7** and **Appendix D**. As can be seen from **Exhibit 3.2-7,** regional emissions of VOC, CO, and NO_X under Alternative 2 would be substantially less compared to existing background conditions. This is because the projected improvement in fuel economy, increase in ZEV use, emission controls and fuel composition will outweigh the projected increase in VMT. This would result in a beneficial future air quality outcome. As indicated in **Exhibit 3.2-7**, transportation emissions from Alternative 2 would be slightly higher than those from Alternative 1, mostly because reductions in transportation emissions (from existing background conditions) realized from implementation of Alternative 2 would be slightly less than those of Alternative 1.

Equity & Climate Vulnerability Considerations

In addition to the regional centers and villages that would be within the 1,000-feet buffer under Alternative 1, Alternative 2 would place additional neighborhood centers units within the buffer, as shown in **Exhibit 3.2-10**. Included in the additional units is the 130th/145th Station Area. Although a greater number of units would be closer to transportation sources of pollution and thus at higher risk than under Alternative 1, overall units within these regional centers, urban center, and neighborhood centers consists of 46% of overall projected growth, which is higher than that of Alternative 1. Only a portion of each center is within the 1,000-feet buffer, so the potentially affected portion of the new residents would be smaller. Alternative 2 would place a greater number of units within the 1,000-foot buffer when compared to Alternative 1, 3, and 4, but fewer units compared to Alternative 5.

Exhibit 3.2-10. 1,000-Feet Buffer Around Freeways and Roadways with Greater than 100,000 Daily Vehicles—Alternative 2



Source: Kimley-Horn, 2023.

Greenhouse Gas Emissions

GHG emissions under development of Alternative 2 were calculated using the same methodologies as those described for Alternative 1 but reflect the increases in target housing growth in neighborhood centers throughout the city. Operational GHG emissions from Alternative 2 are presented in **Exhibit 3.2-11** and **Appendix D**. Alternative 2 would result in less reductions in transportation GHG emissions compared to Alternative 1, largely as the result of greater VMT which is a reflection of the greater housing growth target. However, under Alternative 2, the additional growth is focused in neighborhood centers, including transit-oriented developments that would potentially decrease trip lengths. Therefore, as shown in **Exhibit 3.2-11**, the per capita GHG emissions associated with Alternative 2 growth targets would be 0.55 $MTCO_2e$, lower than the per capita emissions under Alternative 1. Emissions related to building energy and solid waste would be greater than Alternative 1. Although target housing and employment growth would be the same under Alternative 2, 3, and 4, building and waste emissions would be lower for Alternative 2 due to variations in housing type mix and associated emissions factors.

Exhibit 3.2-11. Per Capita GHG Emissions—Alternative 2

	Emissions ($MTCO_2e$)
Transportation	-834
Buildings	50,489
Waste	64,053
Total Alternative 2	113,708
Population Growth Estimate	205,000
Per Capita GHG Emissions	**0.55**

Notes: Population growth calculated using City GIS data for total housing units and population (total units/population = persons per household), assuming 2.05 persons per household
Source: Kimley-Horn, 2023.

130th/145th Station Area

Under Alternative 2, changes in land use designations focus on addressing transit-oriented developments, designating the station areas as neighborhood centers. Growth would be clustered in small mixed-use nodes near transit, resulting in denser and taller buildings with heights of up to 80 feet. Implementation of Alternative 2 assumes a growth potential of 2,208 housing units, which is greater than the growth potential with Alternative 1.

Construction

Station Area growth under Alternative 2 would be higher than Alternative 1 and lower than Alternative 5. Emissions associated with heavy-duty construction equipment, trucks, worker vehicles, and fugitive dust would likely be greater than Alternative 1 and less than Alternative 5 based on the target growth in dwelling units.

Operations

Criteria Pollutant Emissions

Increased growth potential within neighborhood centers combined with improvements to transit service and connectivity, when compared with Alternative 1, would result in greater potential for VMT reduction and reductions in criteria pollutant emissions.

Greenhouse Gas Emissions

As stated above, increased growth potential within neighborhood centers combined with improvements to transit service and connectivity, when compared with Alternative 1, would result in greater potential for VMT reduction, resulting in reductions in GHG emissions. However, target growth within the Station Area under Alternative 2 would be greater than Alternative 1, resulting in higher emissions related to building energy consumption and solid waste generation.

Equity & Climate Vulnerability Considerations

The 130th/145th Station Area is located in northern Seattle in Area 2. I-5 transects this area going north-south, and a railway runs through the vicinity of the 130th Street Light Rail Station. Target growth under Alternative 2 within the Station Area would be greater than Alternative 1 and would place a greater number of residents within close proximity to transportation-related pollutants along I-5. Compared to Alternative 5, Alternative 2 would place a fewer number of residents within close proximity to transportation-related pollutants along I-5.

Impacts of Alternative 3: Broad

Under Alternative 3, a wider range of low-scale housing options in urban neighborhood areas would be allowed, expanding housing choices and allowing housing options near existing parks and other amenities. The target housing growth under this alternative is 100,000 dwelling units. Approximately 37% of housing growth would occur within regional center and approximately 22% would occur within urban neighborhood areas.

Construction

Alternative 3 would result in the greatest number of demolished units when compared to all other alternatives. Alternative 3 would result in greater target growth compared to Alternative 1, the same as Alternative 2 and 4, and less than Alternative 5. Although Alternative 3 would result in 763 greater demolished units than Alternative 5, target growth for Alternative 3 includes 20,000 fewer units. Therefore, emissions associated with heavy-duty construction equipment, trucks, worker vehicles, and fugitive dust would likely be greater than Alternative 1, 2, and 4 and lower than Alternative 5.

Operations

Transportation Air Quality Emissions

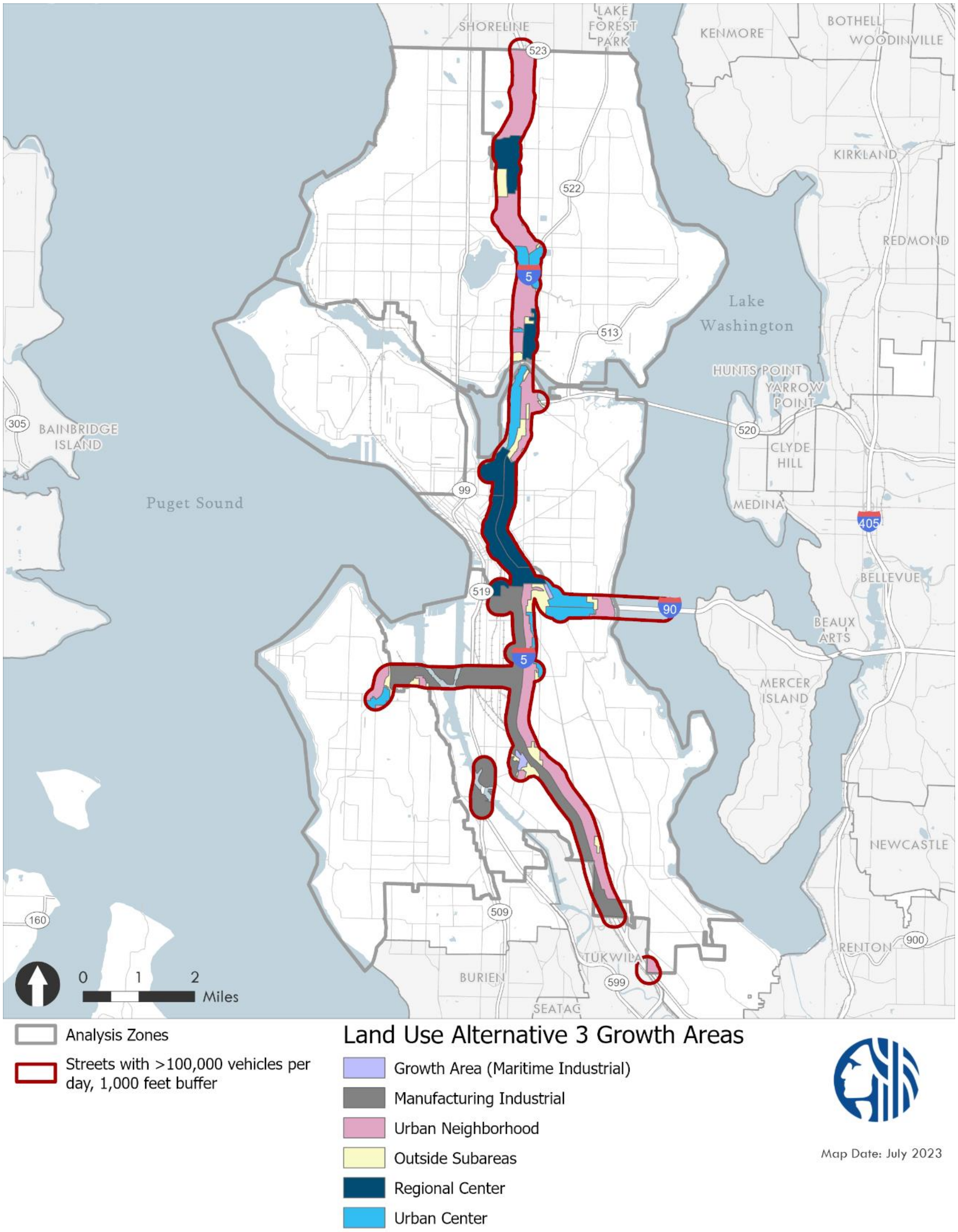
Transportation-related air pollutant emissions under existing conditions and each of the four alternatives with VMT data are presented in **Exhibit 3.2-7** and **Appendix D**.

As can be seen from **Exhibit 3.2-7,** regional emissions of VOC, CO, and NO_X under Alternative 3 would be substantially less than under existing background conditions. This is because the projected improvement in fuel economy, increase in ZEV use, emission controls and fuel composition will outweigh the projected increase in VMT. This would result in a beneficial future air quality outcome. As indicated in **Exhibit 3.2-7**, transportation emissions from Alternative 3 would be slightly higher than those from Alternative 2, mostly because reductions in transportation emissions (from existing background conditions) realized from implementation of Alternative 3 would be the same as those of Alternative 2 but less than those of Alternative 1.

Equity & Climate Vulnerability Considerations

As shown in **Exhibit 3.2-12**, the regional centers and villages within the 1,000-feet buffer under Alternative 3 would be the same as Alternative 1, collectively representing 56% of all projected residential growth in the city through 2044. Only a portion of each center or village is within the 1,000-feet buffer, so the potentially affected portion of the new residents would be smaller. A greater proportion of city-wide growth would be located in close proximity to transportation-related emissions when compared to Alternative 2. Alternative 3 would place the fewest number of units (the same as Alternative 1 and 4) within the 1,000-foot buffer when compared to Alternative 2 and 5.

Exhibit 3.2-12. 1,000-Feet Buffer Around Freeways and Roadways with Greater than 100,000 Daily Vehicles—Alternative 3



Source: Kimley-Horn, 2023.

Greenhouse Gas Emissions

GHG emissions under development of Alternative 3 were calculated using the same methodologies as those described for Alternative 1 but reflect the increases in target housing growth in urban neighborhoods throughout the city. Operational GHG emissions from Alternative 3 are presented in **Exhibit 3.2-13** and **Appendix D**. Alternative 3 would result in fewer reductions in transportation emissions compared to Alternative 1 and similar to those of Alternative 2 and 4. Emissions related to building energy and waste would be greater than Alternatives 1, 2, and 4 and less than Alternative 5. Per capita emissions of 0.56 $MTCO_2e$, as shown in **Exhibit 3.2-13**, are the same as Alternative 4, greater than Alternative 2 and 5, and less than Alternative 1.

Exhibit 3.2-13. Per Capita GHG Emissions—Alternative 3

	Emissions ($MTCO_2e$)
Transportation	-835
Buildings	50,926
Waste	64,294
Total Alternative 3	114,385
Population Growth Target	205,000
Per Capita GHG Emissions	**0.56**

Notes: Population growth calculated using City GIS data for total housing units and population (total units/population = persons per household), assuming 2.05 persons per household
Source: Kimley-Horn, 2023.

130th/145th Station Area

The station area plan would not be implemented under Alternative 3; it would grow based on the applicable citywide place types.

Impacts of Alternative 4: Corridor

Alternative 4 would accommodate a wider range of housing options only in corridors to focus growth near transit and amenities. The target housing growth under this alternative is 100,000 dwelling units. Approximately 37% of housing growth would occur within regional centers and approximately 21% would occur within corridors.

Construction

Alternative 4 would result in the demolition of a greater number of housing units than Alternative 1 and 2 and less than Alternatives 3 and 5. Alternative 4 would result in greater target growth compared to Alternative 1, the same as Alternative 2 and 3, and less than

Alternative 5. Therefore, emissions associated with heavy-duty construction equipment, trucks, worker vehicles, and fugitive dust would likely be greater than Alternative 1 and 2 and lower than Alternative 3 and 5.

Operations

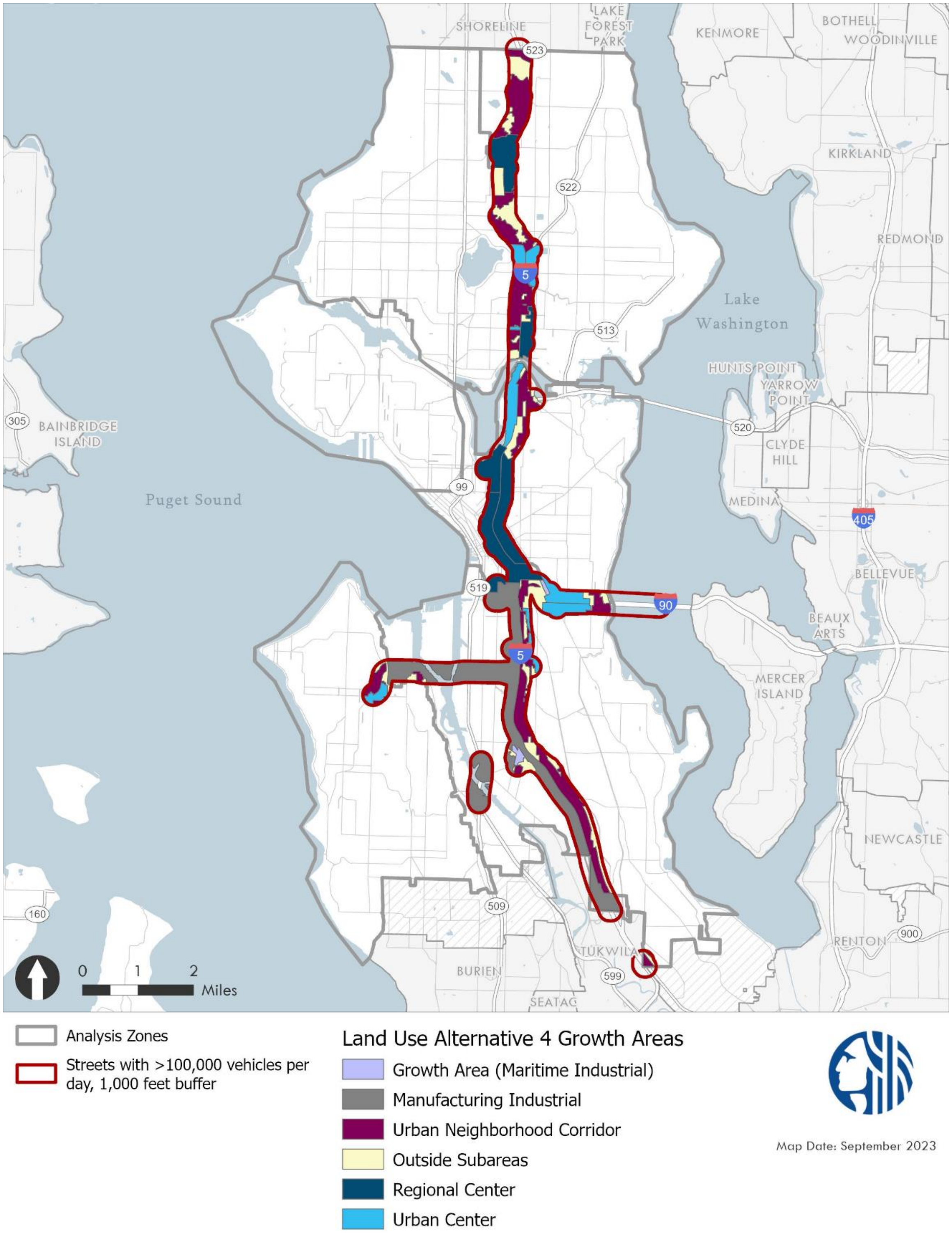
Transportation Air Quality Emissions

Transportation-related air pollutant emissions under existing conditions and each of the four alternatives with VMT data are presented in **Exhibit 3.2-7** and **Appendix D**. The housing growth target under Alternative 4 would be the same as Alternative 2 and Alternative 3 and the geographical distribution of that housing growth under Alternative 4 would be to similar areas of the city as Alternative 3 as well. Therefore, VMT data has not been modeled for Alternative 4 and it is assumed that regional pollutant emissions under Alternative 4 would be the same as Alternative 3, which would be substantially less than under existing background conditions, greater than Alternative 1, and less than Alternative 5.

Equity & Climate Vulnerability Considerations

As shown in **Exhibit 3.2-14**, the regional centers and villages within the 1,000-feet buffer under Alternative 4 would be the same as Alternative 1 and Alternative 3, collectively representing 56% of all projected residential growth in the city through 2044. Only a portion of each center or village is within the 1,000-feet buffer, so the potentially affected portion of the new residents would be smaller. A greater proportion of city-wide growth would be located in close proximity to transportation-related emissions when compared to Alternative 2. Alternative 4 would place the fewest number of units (the same as Alternative 1 and 3) within the 1,000-foot buffer when compared to Alternative 2 and 5.

Exhibit 3.2-14. 1,000-Feet Buffer Around Freeways and Roadways with Greater than 100,000 Daily Vehicles—Alternative 4



Source: Kimley-Horn, 2023.

Greenhouse Gas Emissions

GHG emissions under development of Alternative 4 were calculated using the same methodologies as those described for Alternative 1 but reflect the land use differences of increased density of residential development in the corridors throughout the city. Operational GHG emissions from Alternative 4 are presented in **Exhibit 3.2-15** and **Appendix D**. The transportation emissions reductions realized from implementation of Alternative 4 would be similar to those of Alternative 2 and Alternative 3. Emissions related to building energy and solid waste would be greater than Alternative 1 and 2 and less than Alternative 3 and 5. Per capita emissions of 0.56 $MTCO_2e$ (as shown in **Exhibit 3.2-15**) are the same as Alternative 3, higher than Alternative 2 and 5, and lower than Alternative 1.

Exhibit 3.2-15. Per Capita GHG Emissions—Alternative 4

	Emissions ($MTCO_2e$)
Transportation	-835
Buildings	50,654
Waste	64,294
Total Alternative 4	114,113
Population Growth Estimate	205,000
Per Capita GHG Emissions	**0.56**

Notes: Population growth calculated using City GIS data for total housing units and population (total units/population = persons per household), assuming 2.05 persons per household
Source: Kimley-Horn, 2023.

130th/145th Station Area

The station area plan would not be implemented under Alternative 4; it would grow based on the applicable citywide place types.

Impacts of Alternative 5: Combined

Alternative 5 anticipates the largest increase in supply and diversity of housing units within the City. In addition to the growth strategies of Alternatives 2, 3, and 4, Alternative 5 would promote a greater range of rental and ownership housing and address past underproduction of housing and rising housing costs. The target housing growth under this alternative is 120,000 dwelling units. While most housing would continue to be in regional centers (36% of housing growth) and urban centers (19% of housing growth), the combined growth in neighborhood centers and corridors would be substantial (24%).

Construction

Alternative 5 would result in a greater number of demolished units than Alternative 1, 2, and 4 and less than Alternative 3. Alternative 5 would result in the greatest target growth compared to all other alternatives. Therefore, emissions associated with heavy-duty construction equipment, trucks, worker vehicles, and fugitive dust would likely be the greatest out of all give alternatives.

Operations

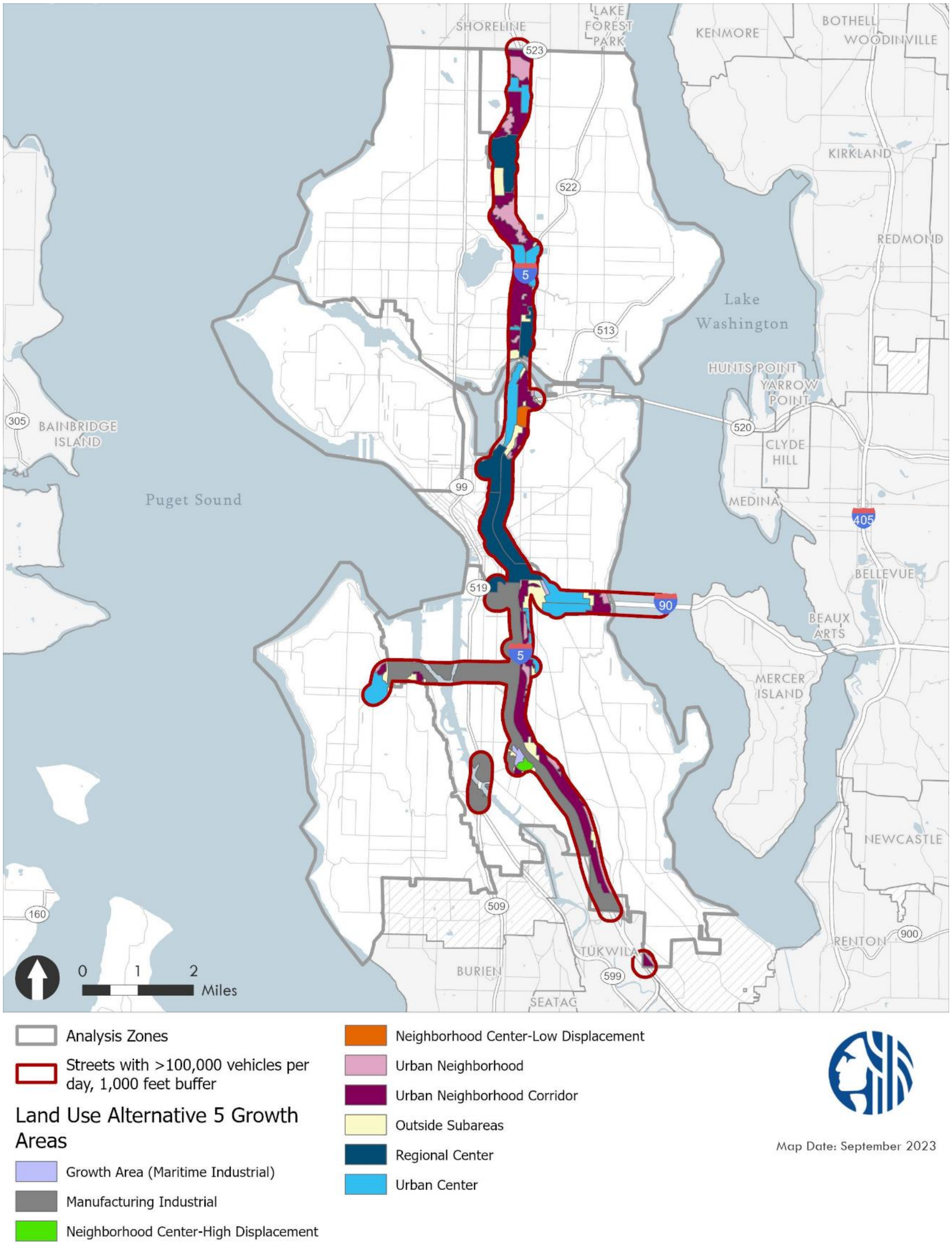
Transportation Air Quality Emissions

Transportation-related air pollutant emissions under existing conditions and each of the four alternatives with VMT data are presented in **Exhibit 3.2-7** and **Appendix D**. As can be seen from **Exhibit 3.2-7**, emissions of VOC, CO, and NO_X under Alternative 5 would be substantially less than under existing background conditions. This is because the projected improvement in fuel economy, increase in ZEV use, emission controls and fuel composition will outweigh the projected increase in VMT. This would result in a beneficial future air quality outcome. As indicated in **Exhibit 3.2-7**, transportation emissions from Alternative 5 would be higher than those from all other alternatives, mostly because Alternative 5 has the highest housing and jobs targets, resulting in the highest VMT, compared to all other alternatives.

Equity & Climate Vulnerability Considerations

This alternative would place the emphasis for growth near transit centers, with the 130th Street station designated as an urban center. In addition, additional neighborhood center units would be located in close proximity to transportation-related emissions as shown in **Exhibit 3.2-16**. Consistent across all alternatives, the highest amount of projected growth would be within the Downtown Regional Center and First Hill/Capitol Hill Regional Center. Alternative 5 has the highest housing growth target among the five alternatives. As a result, the proportion of city-wide growth that would be located in close proximity to transportation-related emissions is the lowest (39%) under this alternative while the total amount of collective growth would be the greatest. Only a portion of each center or village is within the 1,000-feet buffer, so the potentially affected portion of the new residents would be smaller. Alternative 5 would place the greatest number of units within the 1,000-foot buffer when compared to the other alternatives.

Exhibit 3.2-16. 1,000-Feet Buffer Around Freeways and Roadways with Greater than 100,000 Daily Vehicles—Alternative 5



Source: Kimley-Horn, 2023.

Greenhouse Gas Emissions

GHG emissions under development of Alternative 5 were calculated using the same methodologies as those described for Alternative 1 but reflect the land use differences of increased density of residential development in the regional centers, urban centers, neighborhood centers, and urban neighborhood areas. Operational GHG emissions from Alternative 5 are presented in **Exhibit 3.2-17** and **Appendix D**. Transportation emissions from target growth associated with Alternative 5 would be the greatest out of all five alternatives and would result in increases in transportation emissions in comparison with existing conditions. However, due to increased density of residential development, the Alternative results in a reduction in per capita VMT. Alternative 5 results in per capita GHG emissions of 0.49 $MTCO_2e$, see **Exhibit 3.2-17**. Therefore, while Alternative 5 results in the highest overall housing growth and VMT, resulting in the highest GHG emissions associated with transportation, building energy, and waste compared to the other alternatives, per capita emissions would be the lowest.

Exhibit 3.2-17. Per Capita GHG Emissions—Alternative 5

	Emissions ($MTCO_2e$)
Transportation	176
Buildings	52,785
Waste	67,917
Total Alternative 5	120,878
Population Growth Estimate	246,000
Per Capita GHG Emissions	**0.49**

Notes: Population growth calculated using City GIS data for total housing units and population (total units/population = persons per household), assuming 2.05 persons per household
Source: Kimley-Horn, 2023.

130th/145th Station Area

Under Alternative 5, an urban center designation on both the west and east sides of the 130th Station Area would merge with an existing commercial node to expand residential mixed use near the station. Growth would be accommodated in more mixed-use buildings, providing greater housing types in buildings with heights of up to 95 feet. Implementation of Alternative 5 assumes a growth potential of 2,703 housing units, which is greater than all other alternatives.

Construction

Station Area growth under Alternative 5 would be the greatest compared to all other alternatives. Therefore, emissions associated with heavy-duty construction equipment, trucks, worker vehicles, and fugitive dust would likely be the highest among all alternatives.

Operations

Criteria Pollutant Emissions

Increased growth potential within urban centers combined with improvements to transit service and connectivity provided by the stations associated with Alternative 5, when compared with all the other alternatives, would result in greatest potential for per capita VMT reduction and reductions in criteria pollutant emissions.

Greenhouse Gas Emissions

As stated above, Station Area growth under Alternative 5 would result in the greatest potential for VMT reduction and reductions in transportation-related GHG emissions. However, Station Area growth would be the highest under Alternative 5, likely resulting in the highest emissions related to building energy consumption and solid waste generation.

Equity & Climate Vulnerability Considerations

The $130^{th}/145^{th}$ Station Area is located in northern Seattle in Area 2. I-5 transects this area going north-south, and a railway runs through the vicinity of the 130^{th} Street Light Rail Station. Target growth under Alternative 5 within the Station Area would be the greatest compared to all other alternatives and would potentially place the greatest number of residents within close proximity to transportation-related pollutants along I-5.

3.2.3 Mitigation Measures

Incorporated Plan Features

Under action alternatives the City will update its Comprehensive Plan policies for land use, transportation, and others with an opportunity to increase residential compatibility in proximity to major air emission sources.

Regulations & Commitments

Air Quality

Several federal, state, and regional regulations or efforts apply to construction and allowed land uses:

- NAAQS: As described above, the EPA established NAAQS and specifies future dates for states to develop and implement plans to achieve these standards.
- Washington State: Ecology established state ambient air quality standards for the same size pollutants (CO, VOCs, NO_2, PM, SO_2, and ozone) that are at least as stringent as the national standards.

- PSCAA Regulations: All construction sites in the Puget Sound region are required to implement emission controls to minimize fugitive dust and odors during construction, as required by PSCAA Regulation 1, Section 9.15, Fugitive Dust Control Measures.

  PSCAA manages permitting of stationary air pollutant sources and all industrial and commercial air pollutant sources in the Puget Sound region are required to register with the PSCAA.

Greenhouse Gases & Climate Change

- Washington State Energy Code: Development in the study area would be subject to the requirements of the Washington State Energy Code, which regulates the energy-use features of new and remodeled buildings.
- The City's 2013 CAP and the 2018 Climate Strategy include strategies and actions to limit atmospheric warming to 1.5 degrees Celsius. The strategies and actions focus on road transportation and building energy, which comprise the majority of local emissions, and which are the dominant sources of GHG emissions in the City.
- All buildings with 50,000 square feet or more of nonresidential space (excluding parking) must comply with the Building Tune-Ups requirement every five years (Seattle Municipal Code 22.930). Building Tune-Ups involve assessment and implementation of operational and maintenance improvements to achieve energy (and water) efficiency, which helps to reduce GHG emissions.
- The City of Seattle Building Energy Code eliminates the use of fossil fuels like gas and electric resistance from most water heating and space heating systems in new construction and substantial alterations for commercial and multifamily uses.
- Seattle's Energy Benchmarking Law (Seattle Municipal Code 22.290) requires the owners of non-residential and multifamily buildings (20,000 square feet or larger) to track and report (annually) energy performance.
- Seattle's Transportation Electrification Blueprint includes initial steps for reducing climate pollution in the transportation sector. Goals include 100% of shared mobility being zero emission, 90% of all personal trips to be zero emission by 2030, 30% of goods delivery to be zero emission, 100% of City fleet to be fossil-fuel free, and electrical infrastructure.
- Action alternatives provide for a new Climate Element in the One Seattle Comprehensive Plan addressing GHG reduction policies and climate resilience policies.

Other Potential Mitigation Measures

Although mitigation strategies are not required due to a lack of significant adverse impact findings, to address the potential exposure of residences and other sensitive land uses to air toxic risk areas, discussion of potential mitigation measures is included below.

Transportation-Related Emissions

Transportation-related emissions make up a large portion of criteria pollutant emissions. On-road mobile sources account for approximately half of the overall CO and NO_X emissions within King County (U.S. EPA, 2017). Improvements in fuel efficiency combined with reductions in VMT would contribute to reductions in all criteria pollutant emissions. Replacing fossil-fueled vehicles with ones powered by renewable or cleaner sources of energy (electric, hydrogen, etc.) would result in reductions in CO, NOx, and VOCs.

Vehicle Miles Traveled

Potential VMT-reduction strategies are discussed below.

- **Pedestrian Facilities.** A household activity survey conducted by the Puget Sound Regional Council (PSRC) in 2006 tested the effect of sidewalks on travel patterns and the relationship between sidewalk availability and VMT (SDOT and WSDOT, 2011). Results of the study provide evidence that sidewalk availability combined with land use mix was associated with reduced VMT.
- **Bicycle Improvements.** According to the NCST, bicycle infrastructure has the potential to reduce VMT by encouraging a shift from driving (NCST, 2017). The U.S. EPA estimates that bicycle paths/lanes/routes would provide less than 0.1% reductions in VMT (U.S. EPA, 2014).
- **Transit Improvements.** Transit has been identified as the most frequent and successful tool in reducing VMT (WSDOT, 2022). Transit improvements overall provide a VMT reduction of up to 2.6% (U.S. EPA, 2014).
- **Congestion Pricing, Roadway Fees, and Tolls.** Congestion pricing includes the use of fees for the specific purpose of reducing congestion, such as during peak periods of congestion. Examples include roadway fees and tolls. Congestion pricing has the potential to reduce VMT by approximately 10 to 44% (SDOT, 2019).
- **Land Use Mix and Compactness.** A mix of land uses together with more compact development around transit is associated with reduced VMT (WSDOT, 2022). Diversity in land uses combined with increased density within an urban area can lead to shorter trip distances and greater use of walking, as well as the reduced need for vehicle ownership. Access to a variety of trip purposes may induce additional trips; however, these trips are shorter and are more likely to be made by walking than trips in areas where mixed land uses are not available.

Electric Vehicles

Electric vehicles (EVs) do not create tailpipe emissions (U.S. EPA, 2021). Replacement of gasoline- and diesel-fueled vehicles with EVs would reduce tailpipe emissions within the City of Seattle. However, fugitive dust emissions from brake wear and tire wear would remain the same. Implementation of the Seattle Comprehensive Plan does not directly affect the percentage of EVs within the City. However, implementing goals for EV use including increased charging infrastructure would facilitate and encourage future EV adoption. A combination of charging infrastructure and incentives would encourage electric vehicles in private and public fleets (PSRC, 2020). One of the main barriers to EV adoption is the lack of off-street parking for charging (City of Seattle, 2014). Increased EV penetration would require an expansion of charging options for those without access to charging facilities in their home. Seattle City Light is currently investing in grid upgrades and EV charging infrastructure to enable a rapid transition to an electrified transportation system (SCL, 2023), including Level 2 EV chargers at curbside locations offering service to residents who cannot access off-street parking to charge their vehicles (SCL, 2023). The City could adopt regulations to support the placement of infrastructure for charging electric vehicles in applicable new developments (including commercial and industrial).

Building-Related Emissions

Building energy emissions are a large source of GHG emissions. Decarbonization of buildings by eliminating the combustion of natural gas and other fossil fuels would reduce residential and commercial building emissions (CARB, 2022). All-electric space and water heating is required by the 2022 Washington Energy Code. However, all-electric cooking appliances have not been required. Combined with increasing energy efficiency, building electrification in new buildings would reduce building-related emissions.

To lower the GHG contribution from industrial and commercial uses, policies that encourage or mandate new construction projects in the City to incorporate any of the following into their design:

- Achieve one of the following green building standards: Leadership in Energy and Environmental Design (LEED) in Motion: Industrial Facilities, Built Green, the Living Building Challenge, or the Evergreen Sustainable Development Criteria.
- Use low-embodied carbon construction material types, such as low-carbon concrete mixes.
- Limit carbon-intensive materials or incentivize use of lower carbon alternatives such as a wood structure instead of steel and concrete, or agricultural products that sequester carbon.
- Salvage materials like brick, metals, broken concrete, or wood.
- Use high-recycled content materials.
- Prioritize adaptive reuse for existing buildings to avoid additional embodied carbon emissions.

Residential Strategies

On-road, railway, port, and aviation activity are main sources of pollutant emissions. The following strategies can reduce the potential levels of air toxics:

- Where the City has authority to do so, the designation of truck routes serving industrial and manufacturing areas away from residential areas would increase buffer areas between some residential neighborhoods and roadways highly travelled by diesel trucks.

- Add denser tree canopy near high-volume roadways and industrial areas, specifically a double-row of long-needle conifers allowing no line-of-site.
- Incorporate standards for more frequent street sweeping to reduce roadway dust associated with increased VMT on high-travelled roadways within 1,000 feet of residential uses.
- Consider zoning standards that identify location, building, and site design provisions that support reduced exposure to potential air toxics.

Improved Air Filtration

The City could adopt new development standards that require or incentivize enhanced air filtering and circulation to address transportation-generated particulates for residences and other sensitive uses (e.g., schools, daycare, hospitals, etc.). For sensitive lands uses in close proximity to industrially zoned areas or highways or other high-traffic roadways, ventilation systems that are capable of filtering fine particulate pollutants (from industrial or transportation sources) could be integrated into HVAC systems to improved indoor quality and reduce exposure to air contaminants. Ventilation systems with a higher Minimum Efficiency Reporting Value (MERV) are capable of removing finer particulate matter from indoor air. Specifically, U.S. EPA recommends higher efficiency filters with a MERV rating of 13 or higher for HVAC filtration (U.S. EPA, 2023). The 2016 ASHRAE handbook for HVAC Systems and Equipment includes air cleaners with MERV ratings in the E-2 range (MERV 9 -12) for application in better residential and industrial air cleaning, which are effective for particulates in the 1.0 to 3.0 μm size range, while those in the E-1 range (MERV 13 – 16) control finer particulates (ASHRAE, 2016).

130th/145th Station Area

Alternatives 2 and 5 would introduce increases in population within the Station Area, to take advantage of the reduction in emissions inherent to transit-oriented development. Transit-oriented development is a key strategy for achieving the City's goal to be carbon neutral by the year 2050. However, because the area is also adjacent to heavily used roadways, such as I-5, increasing residential densities in the Station Area could result in increasing the number of residents potentially exposed to elevated levels of air toxics. As shown in **Exhibit 3.2-6,** I-5 is a heavily traveled roadway, with greater than 100,000 vehicles per day. The following strategies can reduce the potential levels of air toxics at residential uses within the Station Area:

- Incorporation of development standards including requirements for enhanced air filtration and circulation for residential units within the Station Area and site intake vents as far from substantial sources as practicable.
- Building design strategies to minimize the number of residential units facing I-5.
- Planting of trees along streets with residential development and along commercial corridors including but not limited to the reforestation plan for the Lynnwood Link Extension.
- Restrict open spaces such as balconies near the source of toxic air contaminants.
- Restrict operable windows near sources of toxic air contaminants.

3.2.4 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse impacts to air quality and greenhouse gas emissions are anticipated. Through mitigation implementation, local and state climate actions, and expected continued regulatory changes, the alternatives may result in lower GHG emissions on a per capita basis compared to existing conditions. The alternatives would not prevent or deter statewide, regional, or local efforts to reduce GHG emissions. While each alternative would generate GHG emissions from growth and development within the city, the benefit of channeling development to targeted areas that might otherwise occur in peripheral areas of the city or region could serve to offset these impacts.

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