8

Air Quality and Greenhouse Gas

This chapter describes the air quality and greenhouse gas (GHG) analyses performed for the Project to assess potential environmental impacts. It presents a summary of the assessment of GHG emissions for the Project in accordance with the MEPA Greenhouse Gas Emissions Policy and Protocol, the scope set forth in the Secretary's Certificate on the ENF filing and the BPDA Scope on the PNF. The chapter highlights the expected Project-related GHG emissions from both stationary and mobile sources and details the planned mitigation measures to offset some of these emissions. The chapter presents the Phase I GHG analysis, which includes the construction of Buildings F and M, followed by the Master Plan Project, which includes full build out of the Site. Additionally, the analysis assesses the potential air quality impacts associated with the Project and the potential for pollutant concentrations to exceed federal and state regulations. Supporting information can be found in Appendix E, *Air Quality and Greenhouse Gas Analysis Documentation*.

8.1 Key Findings

Key findings related to air quality and greenhouse gas emissions include:

- The Project is committed to achieving Passive House Standards and will be one of the largest Passive House projects in the world. This will result in ultra-energy efficient buildings and large GHG emissions reductions;
- The Project has been designed to achieve an overall 56.1 percent energy savings over the ASHRAE 90.1-2013 baseline. The Stretch Energy Code only requires a 10 percent improvement over this baseline;
- The Project has forecasted an approximately 56.1 percent overall reduction in stationary source carbon dioxide (CO_2) emissions when compared to the Base Case;
- A variety of clean and renewable energy technologies were evaluated for the Project, including solar, wind, air source heat pumps and combined heat and power (CHP). The Project will use heat pumps for space conditioning and will make all roofs solar-ready, with the appropriate structural capacity and electrical infrastructure to incorporate a Solar PV system at a future date (see Figure 8.1);

- The air quality assessment demonstrates that the Project complies with local, state, and federal air quality requirements; and
- A comprehensive transportation mitigation program has been developed to mitigate impacts of Project-related traffic through travel demand management and roadway improvements.

8.2 Phase 1 Impacts

The resulting impacts from the proposed Phase 1 Project are discussed in this section for both stationary and mobile sources. The methodology applied to obtain these results is described in later sections of this chapter for the analyses of the Master Plan Project. Overall, due to the small size of Phase 1, its GHG emissions and air quality impacts are expected to be markedly limited compared to the Master Plan Project. The Phase 1 Project, like the Master Plan Project, has committed to exemplary GHG reduction measures through its commitment to achieving Passive House Standards.

8.2.1 Stationary Sources

Stationary Source GHG Assessment

The Phase 1 Project includes the construction of Buildings F and M. The energy consumption and GHG emissions of these two buildings were modeled using the prototype models (as discussed in Section 8.3.1). Both buildings will be constructed to Passive House Standards, resulting in ultra-low energy consumption and greatly reduced GHG emissions. The resulting energy consumption and GHG emissions are presented in Table 8.1. Under the Base Case, the CO_2 emissions for the Phase 1 Project are estimated to be 1,554 tons per year (tpy). With the currently proposed building design and system improvements, the estimated CO_2 emissions are 678 tpy which is a savings of 876 tpy. The equivalent estimated energy use reduction for the Project is approximately 56.4 percent, which equates to an approximately 56.4 percent overall reduction in stationary source CO_2 emissions when compared to the Base Case.

TABLE 8.1 STATIONARY SOURCE CO_2 EMISSIONS FOR THE PHASE 1 PROJECT

Building Number and Use		Residential and Retail Area (gsf)[1]	Energy Consumption (MMBtu/yr)			CO_2 Emissions (tons/yr)		
			Base Case	Design Case	Percent Savings	Base Case	Design Case	Percent Savings
F	Residential	255,022	11,934	5,193	56.5%	1,044	455	56.4%
M	Residential	132,610	5,823	2,542	56.3%	510	222	56.4%
Phase 1 Total		**387,632**	**17,757**	**7,735**	**56.4%**	**1,554**	**678**	**56.4%**

1 Gsf = gross square footage
tons/yr = short tons per year

Stationary Source Air Quality Assessment

The Phase 1 Project is not expected to be a substantial source of pollutant emissions from stationary sources. As space conditioning in the Passive House buildings will be achieved through electrified systems, stationary source pollutant emissions are only expected from the central water heating plants (for domestic hot water) and from life-safety generators.

Sizeable combustion equipment with the potential to emit air pollutants at the Proposed Project may be subject to air permitting under 310 CMR 7.00. MassDEP has established the "Environmental Results Program" (ERP) to streamline the certification process of smaller combustion equipment subject to permitting regulations. The exact sizes, makes, models of equipment to be used by the Project are currently unknown and will be determined throughout the design process. However, equipment that is likely to be used at the Project, such as boilers or emergency generators, may be subject to permitting regulations. If a boiler with a rated capacity between 10 to 40 MMBtu per hour is used on the Project Site, the Proponent will submit the appropriate self-certification forms under the ERP process before the installation of the boiler. Additionally, if an emergency generator with a rated capacity equal to or greater than 37 kW is used on the Project Site, the Proponent will submit the appropriate self-certification forms under the ERP process within 60 days of generator startup. Through the ERP process, the Proponent will need to conduct an air quality assessment to ensure that the use of this equipment will not exceed any state or federal standards such as the National Ambient Air Quality Standards (NAAQS).

8.2.2 Mobile Sources

Mesoscale Assessment

The Phase 1 Project is not expected to be a substantial source of vehicle trips. As the Phase 1 Project would not exceed any mandatory EIR thresholds (causing the MEPA GHG Policy to be applicable) and daily vehicle trips are estimated to be less than the BPDA's threshold of 10,000 vehicles per day, a separate mesoscale analysis was not conducted. Thus, the Phase 1 Project will comply with local, state, and federal air quality requirements on a mesoscale level. The effects of the Phase 1 Project are included in the mesoscale analysis conducted for the Master Plan Project in Section 8.4.1.

Microscale Assessment

The BPDA's criteria determining the necessity of a quantitative microscale analysis were reviewed for the Phase 1 Project. These criteria are described in Section 8.4.2. An evaluation of the traffic data presented in Chapter 5, *Transportation and Parking,* was conducted under the review guidelines developed by the BPDA for determination of the potential for CO impacts. It was determined that:

- The Phase 1 Project would not cause a decline in LOS at any intersection in the study area during any of the studied time periods. Signalized intersections in the study area are expected to operate at LOS A or C in both the No Build and Build Conditions. As the Phase 1 Project will not cause any signalized intersection to operate at a LOS D, E, or F, the Proposed Project does not exceed this criterion.

- The Phase 1 Project will not exceed 100 vehicles per hour during the peak periods. Instead, the Project is estimated to generate 58 vehicles in the morning peak hour and 82 vehicles in the evening peak hour. As volume increases will be fewer than 100 vehicles at the study intersections, the Phase 1 Project does not exceed this criterion.
- The Phase 1 Project will generate fewer than 3,000 new average daily trips on the study area roadways. The Proposed Project is expected to generate approximately 702 weekday vehicle trips, fewer than the 3,000-vehicles-per-day threshold. As such, the Phase 1 Project does not exceed this criterion.

Based on the microscale screening results discussed above, it has been determined that a quantitative CO hotspot analysis is not required for the Phase 1 Project and that no microscale air quality impacts are anticipated. The effects of the Phase 1 Project are included in the microscale analysis conducted for the Master Plan Project in Section 8.4.2.

Parking Garage Assessment

A standalone parking structure is not proposed for the Phase 1 Project. Building F will include one level of ventilated podium parking. Building M does not include podium parking. Since the Phase 1 Project will only include one level of naturally ventilated parking, a carbon monoxide (CO) analysis is not warranted and air quality impacts are not expected. Emissions associated with the structured parking garages of the Master Plan Project are further considered in Section 8.4.3.

8.3 Master Plan Stationary Sources

The Proponent has analyzed the potential GHG emissions associated with the Master Plan Project's stationary sources and the potential for stationary source pollutant emissions to result in air quality impacts. The Proponent has committed to exemplary GHG and Air Quality mitigation measures through its commitment to achieving Passive House Standards for all residential buildings.

8.3.1 Stationary Source GHG Assessment

The following presents the results of the stationary GHG emissions assessment, in accordance with the MEPA GHG Policy. The stationary source analysis reflects the most recent design plans for all Project components as of this filing. The Project has been designed to meet the requirements of the MEPA GHG Policy in that it is committed to incorporating reasonable and feasible energy conservation measures to reduce energy consumption. The Project will also exceed the Stretch Energy Code and incorporate sustainable and high-performance building design.

Regulatory Context

MEPA Greenhouse Gas Policy and Protocol

The Executive Office of Energy and Environmental Affairs (EEA) has developed the MEPA Greenhouse Gas Emissions Policy and Protocol (the "MEPA GHG Policy"), which requires project proponents to identify and describe the feasible measures to minimize both mobile and stationary source GHG emissions generated by their proposed project(s). Mobile sources include vehicles traveling to and from a project while stationary sources include on-site boilers, heaters, and/or internal combustion engines (direct sources), as well as the consumption of energy in the form of fossil fuels (indirect sources). Greenhouse gases include several air pollutants, such as CO_2, methane, hydrofluorocarbons, and perfluorocarbons. The MEPA GHG Policy calls for the evaluation of CO_2 emissions for land development projects because CO_2 is the predominant man-made contributor to global warming. This evaluation makes use of the terms CO_2 and GHG interchangeably.

The MEPA GHG Policy states that all projects undergoing MEPA review requiring the submission of an Environmental Impact Report (EIR) must quantify the project's GHG emissions and identify measures to avoid, minimize, or mitigate such emissions. In addition to quantifying project related GHG emissions, the MEPA GHG Policy requires proponents to quantify the effectiveness of proposed improvements in terms of energy savings, and therefore, potential emissions reductions. The goal of the MEPA GHG Policy is to identify and implement measures to minimize or reduce the total GHG emissions anticipated to be generated by that respective project.

Article 37 and the Zero Carbon Building Assessment

In support of the City of Boston's Resiliency and GHG emissions reduction goals including Carbon Neutral Boston 2050, projects must include a Zero Carbon Building Assessment by considering a Low Energy Building with an enhanced envelope and optimized systems strategies, including Renewable and Clean Energy with a priority for on-site systems, and assess First and Life Cycle Costs. The goal of the analysis is to determine the most effective solution(s) for reducing carbon emissions.

Massachusetts Stretch Energy Code

As part of the Green Communities Act of 2008, Massachusetts developed an optional building code, known as the "Stretch Energy Code," that gives cities and towns the ability to choose stronger energy performance in buildings than otherwise required under the state building code. Codified by the Board of Building Regulations and Standards as 780 CMR Appendix 115.AA of the 9th edition Massachusetts Building Code, the Stretch Energy Code is an appendix to the Massachusetts building code, based on further amendments to the International Energy Conservation Code (IECC). The Stretch Energy Code increases the energy efficiency code requirements for new construction and major residential renovations or additions in municipalities that adopt it. The City of Boston adopted the Stretch Energy Code, which became mandatory on July 1, 2011.

Effective January 1, 2017, the IECC 2015/ASHRAE 90.1-2013 standard became the new/ updated state-wide energy code as an amendment to the 9th edition of the State Building Code, and the Stretch Energy Code was amended to require 10 percent greater energy efficiency compared to ASHRAE 90.1-2013. This document assesses the energy performance of the Project using the Stretch Energy Code requirements in effect as of January 1, 2017, rather than the outdated requirements of the Stretch Code described in the Secretary's Certificate on the ENF.

Commitment to Passive House

The Proponent has committed to exemplary GHG mitigation measures through its commitment to achieving Passive House Standards for all residential buildings. As described in Chapter 6, Section 6.4.2, Passive House is a rigorous, voluntary standard for building energy efficiency that results in ultra-low energy buildings that require little energy for space heating or cooling. Passive House is a design process that is integrated with architectural design that focuses on achieving very low energy use for heating and cooling buildings by implementing design solutions such as optimized orientation and shading, superinsulation, passive solar gains, air-tight envelope, elimination of thermal bridges and efficient HVAC. There are no prescriptive insulation requirements for Passive House certification, however, in order to meet the strict energy use requirements, a highly insulated envelope is essential. The insulation must be continuous and connection details free of thermal bridges. Achieving Passive House certification requires the design to meet stringent airtightness standards (under 0.060 cfm50/ft^2 of gross envelope area). Performance must be verified through blower door testing of the entire building after construction. The Master Plan Project will be one of the largest Passive House projects in the world.[1]

Methodology

To provide for energy efficiency and reduced stationary source GHG emissions, the Proponent has evaluated the following key planning and design criteria:

- Methods/strategies to reduce overall energy use through appropriate design and sizing of building systems;
- Evaluation and incorporation, where feasible, of cost-effective energy-optimizing and high-performance systems; and
- Consideration of the ability to supplement the required energy demand with self-generated energy (i.e., on-site clean and/or renewable energy source).

Direct stationary source CO_2 emissions include those emissions from the facility itself, such as boilers, heaters, and internal combustion engines. Indirect stationary source CO_2 emissions are

1 Researched using the Passive House Database as of November 21, 2019. (https://passivehouse-database.org/index.php?lang=en)

derived from the consumption of electricity, heat, or cooling from off-site sources, such as electrical utility or district heating and cooling systems. The direct and indirect stationary source CO_2 emissions from the proposed building sources are calculated using the computer based WUFI Passive model for Passive House buildings based on assumptions for the Project's building elements. Projected electricity and gas usage are based on assumptions for the Project's building elements, such as (but not limited to) the heating, cooling, ventilation, building configuration and architecture type, building envelope (walls/windows), interior fit-out, and equipment efficiency ratings. To estimate associated stationary source GHG emissions, the amount of consumed energy is then converted into the amount of CO_2 emitted using the standardized conversion factor.

The residential buildings of the Master Plan Project have been designed to meet the Passive House Standards (the "Design Case"), which is better than the Base Code (ASHRAE 90.1-2013) (the "Base Case"). The GHG mitigation measures can be divided into the building's construction materials, architecture, and the heating and cooling processes. The following presents the specific proposed building parameters that are assumed to be included as part of the Project for this analysis. Since the design of the Project components are conceptual, the specific proposed improvements may be subject to design modifications, as necessary, where the stationary source GHG emissions reductions goals established by this assessment will be used to guide final building design.

Energy Model and Analysis Conditions

The energy analysis is used to estimate the amount of annual energy consumption by simulating a year of hypothetical building operations based on typical yearly weather and user inputs. As the WUFI model is made to aid the design of Passive House buildings, it cannot easily simulate a building built to the code baseline. Thus, the Base Case energy consumption has been estimated using the US Department of Energy's commercial prototype models.[2] For the Design Case, the WUFI model estimates each buildings' electricity and gas usage based on building design and system assumptions. The amount of consumed energy is then converted into the amount of CO_2 emitted using the standardized conversion factors.[3] CO_2 emissions were quantified for (1) the Base Case corresponding to the minimum requirements of ASHRAE 90.1-2013 and (2) the Design Case, which includes all energy saving measures that were deemed to be reasonable and feasible. The stationary source assessment calculated CO_2 emissions for the following build conditions:

- **Build Condition with MA Building Code (the "Base Case")**: The Project assuming typical construction materials and building equipment/systems that meet the minimum requirements of the base code. This baseline is established by the energy code as being

2 Pacific Northwest National Laboratory (PNNL) Department of Energy EUI Data for midrise apartment buildings constructed to meet ASHRAE Standard 90.1-2013. https://www.energycodes.gov/development/commercial/prototype_models

3 682 lbs/MWh for electricity (2017 ISO New England Marginal Emissions Report) and 117 lbs/MMBtu for natural gas (US Energy Information Administration).

defined by ASHRAE 90.1–2013. The Base Case energy consumption as estimated using the US Department of Energy's commercial prototype models.

- **Build Condition with Energy Conservation Measures (the "Design Case")**: The Project assuming building design and system improvements that meet the MEPA GHG Policy. Based on the current design and preliminary building modeling results, the Project will meet the MEPA GHG Policy requirement for energy reduction savings, the Stretch Energy Code and Passive House Standards.

Building Energy Models

As currently proposed, the Project includes the phased construction of multiple residential buildings (with comparatively small amount of retail and community facility space). Determined in conjunction with DOER, the energy analysis has included prototype energy models representing the residential buildings (based on Building F and Building D2) and the parking garages. These two buildings were chosen to demonstrate the similarities in resulting energy consumption between the mid-rise and low-rise building types. The results of these two prototype energy models were used to estimate the energy consumption and GHG emissions of the entire Master Plan Project. Ground floor retail areas were included in the estimation of the Master Plan Project energy use as they are also committed to achieving Passive House Standards. As determined in coordination with DOER, the community facility has been excluded from the energy analysis due to its small size and in an effort to focus technical resources on other energy efficiency studies.

The approach to and results of the building energy model for each prototype are presented below. The noteworthy modeling assumptions for the representative buildings are presented in the sections below. While specific inputs may be subject to design modification as design progresses, the Proponent is committed to achieving the stationary source GHG emissions reduction targets estimated herein for the final building program and to meeting Passive House standards for all residential buildings. A more detailed report on the energy modeling conducted for the Project is presented in Appendix E.

<u>WUFI Passive Energy Model</u>

PHIUS+ Core Passive House certification requires a WUFI passive energy model that confirms compliance with the five heating and cooling energy targets listed below. These targets are defined by the location of the Project, as well as the enclosure area, floor area, and occupant density. For Building D, the following target metrics set the certification criteria and are representative for the whole project:

- Annual Heating Demand ≤ 3.8 kBtu/ft2yr – Site Energy use for heating
- Annual Cooling Demand ≤ 5.1 kBtu/ft2yr – Site Energy use for cooling
- Peak Heating Load ≤ 3.7 Btu/ft2yr
- Peak Cooling Load ≤ 3.0 Btu/ft2yr

- Net Source Energy Demand ≤ 5,500 kWh/yr/person

The total energy limit is based on source energy because source energy best represents the greenhouse gas (GHG) impact of a building's operation. This last metric is the most challenging of the five metrics for this project. Sample WUFI Passive reports, including the building's passing results compared against these five metrics are provided in Appendix E.

Building F Mid-Rise Protype Model

Building F was chosen as a representative mid-rise residential building and the team is confident this conceptual version covers all the options. The prototype building F is a 10-story residential-only building (no ground-floor retail) included in Phase 1 Project. The design of the building complies with Passive House Standards. Key energy savings features include improved building envelope, improved HVAC systems and improved lighting power densities. Table 8.2 below provides a summary of the proposed building modeling inputs assumed for Building F. The aggregate U-Value of Building F's envelope is presented in Appendix E.

TABLE 8.2 BUILDING F KEY MODEL ASSUMPTIONS

Envelope and Assemblies	Design Case: Passive House
Walls	R-14
Roof	R-32
Infiltration	0.06 CFM/SF @ 50 Pa
Fenestration and Shading	
Windows and Glazing	~24% WWR U Value: 0.27 SHGC: 0.32
HVAC (Air-side)	
HVAC System	VRF System
Cooling Efficiency	IEER: 25.3
Heating Efficiency	COP: 2.09 @ 17 °F COP: 3.66 @ 47 °F
Ventilation	Central Energy Recovery Ventilators Sensible Recovery Efficiency: 80% Humidity Recovery Efficiency: 40%
HVAC (Water Side)	
Domestic Hot Water	Gas Fired Water Heaters 96% Efficient
Lights	
Interior Lighting	Per PHIUS Calculator

The total estimated annual electricity and natural gas consumption, and associated emissions for Building F are presented in Table 8-3. Under the Base Case, the CO_2 emissions are estimated to be 1,044 tpy. With the currently proposed building design and system improvements, the estimated energy use reduction for the building is 56.5 percent, which equates to a 56.4 percent (589 tpy) reduction in stationary source CO_2 emissions when compared to the Base Case.

TABLE 8.3 BUILDING F STATIONARY SOURCE CO_2 EMISSIONS

	Energy Consumption			CO_2 Emissions		
	Electricity (MWh/yr)	**Natural Gas (MMBtu/yr)**	**Total (MMBtu/yr)**	**Electricity (tons/yr)**	**Natural Gas (tons/yr)**	**Total (tons/yr)**
Base Case[1]	2,448	3,580	11,934	835	209	1,044
Design Case	1,072	1,535	5,193	366	90	455
End-Use Savings	1,376	2,045	6,741	469	120	589
Percent Savings			**56.5%**			**56.4%**

tons/yr = short tons per year
1 Base Case represents energy code as being defined by ASHRAE 90.1 – 2013 using the USDOE Prototype model.

Building D2 Low-Rise Prototype Model

Building D2 was chosen as representative low-rise residential building. Building D2 is a 4-story residential building with ground-floor retail included in the Master Plan Project. The design of the building complies with Passive House Standards. Key energy savings features include improved building envelope, improved HVAC systems and improved lighting power densities. Table 8.4 below provides a summary of the proposed building modeling inputs assumed for Building D2. The aggregate U-Value of Building D2's envelope is presented in Appendix E.

TABLE 8.4 BUILDING D2 KEY MODEL ASSUMPTIONS

Envelope and Assemblies	Design Case: Passive House
Walls	R-14
Roof	R-32
Infiltration	0.06 CFM/SF @ 50 Pa
Fenestration and Shading	
Windows and Glazing	~21% WWR U Value: 0.27 SHGC: 0.32
HVAC (Air-side)	
HVAC System	VRF System
Cooling Efficiency	IEER: 25.3
Heating Efficiency	COP: 2.09 @ 17 °F COP: 3.66 @ 47 °F
Ventilation	Central Energy Recovery Ventilators Sensible Recovery Efficiency: 80% Humidity Recovery Efficiency: 40%
HVAC (Water-side)	
Domestic Hot Water	Gas Fired Water Heaters 96% Efficient
Lights	
Interior Lighting	Per PHIUS Calculator

The total estimated annual electricity and natural gas consumption, and associated emissions for Building D2 are presented in Table 8.5. Under the Base Case, the CO_2 emissions are estimated to be 214 tpy. With the currently proposed building design and system improvements, the estimated energy use reduction for the building is 56.3 percent, which equates to a 56.2 percent (120 tpy) reduction in stationary source CO_2 emissions when compared to the Base Case. The energy savings and GHG emissions reductions are similar to the percent reductions found for Building F.

TABLE 8.5 BUILDING D2 STATIONARY SOURCE CO_2 EMISSIONS

	Energy Consumption			CO_2 Emissions		
	Electricity (MWh/yr)	**Natural Gas (MMBtu/yr)**	**Total (MMBtu/yr)**	**Electricity (tons/yr)**	**Natural Gas(tons/yr)**	**Total (tons/yr)**
Base Case[1]	502	734	2,446	171	43	214
Design Case	221	314	1,069	75	18	94
End-Use Savings	281	420	1,377	96	25	120
Percent Savings			**56.3%**			**56.2%**

tons/yr = short tons per year
1 Base Case represents energy code as being defined by ASHRAE 90.1 – 2013 using the USDOE Prototype model.

Parking Garages

The Project will include two structured parking garages. All parking areas will be naturally-ventilated, unconditioned areas. As such, the only energy use that is expected is electricity consumption associated with lighting. The Proponent commits to use LED lighting in the parking areas. This is expected to reduce the lighting power density of the parking areas by 29 percent. The estimated energy consumption and GHG emissions of the parking areas is presented in Table 8.6.

TABLE 8.6 PARKING GARAGE STATIONARY SOURCE CO_2 EMISSIONS

	Energy Consumption			CO_2 Emissions		
	Electricity (MWh/yr)	**Natural Gas (MMBtu/yr)**	**Total (MMBtu/yr)**	**Electricity (tons/yr)**	**Natural Gas (tons/yr)**	**Total (tons/yr)**
Base Case[1]	304	0	1,038	104	0	104
Design Case	217	0	741	74	0	74
End-Use Savings	87	0	296	30	0	30
Percent Savings			**28.6%**			**28.6%**

tons/yr = short tons per year
1 Base Case represents energy code as being defined by ASHRAE 90.1 – 2013.

Master Plan Project Emissions

The total estimated annual electricity usage and natural gas consumption, and associated emissions for the Master Plan Project are presented in Table 8.7. Energy consumption for the residential buildings were estimated based on the energy models conducted for Buildings D2 and F. The extrapolation is shown in Appendix E. Under the Base Case, the CO_2 emissions for the Project are estimated to be 11,238 tpy. With the currently proposed building design and system improvements, the estimated CO_2 emissions are 4,933 tpy which is a savings of 6,305 tpy. The equivalent estimated energy use reduction for the Project is approximately 56.1 percent, which equates to an approximately 56.1 percent overall reduction in stationary source CO_2 emissions when compared to the Base Case. The reduction in stationary source energy is consistent with the energy conservation design goals of the Proponent and with projects built to Passive House Standards.

TABLE 8.7 STATIONARY SOURCE CO_2 EMISSIONS FOR THE MASTER PLAN PROJECT

Building Number and Use		Residential and Retail Area (gsf)	Energy Consumption (MMBtu/yr)			CO2 Emissions (tons/yr)		
			Base Case	Design Case	Percent Savings	Base Case	Design Case	Percent Savings
A	Residential	305,006	13,393	5,847	56.3%	1,172	512	56.4%
B	Residential	212,974	9,352	4,083	56.3%	818	357	56.4%
C	Residential	116,390	5,111	2,231	56.3%	447	195	56.4%
D1	Residential	137,232	6,026	2,631	56.3%	527	230	56.4%
D2	Residential	53,584	2,446	1,069	56.3%	214	94	56.2%
E1	Residential	251,834	11,059	4,827	56.3%	968	422	56.4%
E2	Residential	111,168	4,882	2,131	56.3%	427	186	56.4%
F	Residential	255,022	11,934	5,193	56.5%	1,044	455	56.4%
G1	Residential	126,576	5,558	2,426	56.3%	486	212	56.4%
G2	Residential	131,740	5,785	2,525	56.3%	506	221	56.4%
H	Residential	158,081	6,942	3,030	56.3%	607	265	56.4%
I	Residential	191,630	8,415	3,673	56.3%	736	321	56.4%
J	Residential	139,014	6,104	2,665	56.3%	534	233	56.4%
L	Residential	155,676	6,836	2,984	56.3%	598	261	56.4%
M	Residential	132,610	5,823	2,542	56.3%	510	222	56.4%
N	Residential	264,310	11,606	5,067	56.3%	1,016	443	56.4%
O	Residential	135,714	5,959	2,602	56.3%	522	228	56.4%
Parking		205,200	1,038	741	28.6%	104	74	28.6%
Total		**3,083,761**	**128,269**	**56,267**	**56.1%**	**11,238**	**4,933**	**56.1%**

gsf = gross square footage

Renewable and Alternative Energy

A variety of renewable and alternative energy sources were or are currently being evaluated for the Project, including heat pump water heating, solar, and cogeneration in the form of combined heat and power ("CHP"). Based on the energy and payback analysis, solar is the most likely renewable energy strategy to be potentially implemented at the Project site. While not included in the base design assumptions of the preliminary energy models, these systems will continue to be evaluated as the Project design develops.

Heat Pump Water Heating

The Proponent has considered numerous methods to provide domestic hot water in the residential buildings. This consideration included research into the various means of electrifying the water heating systems of the Project. A detailed memo on the research and analysis conducted to date for this topic is provided in Appendix E. The results of this research have indicated that large-scale installations of the electrified hot water systems are not feasible at this time. As such, the Proponent is proposing efficient natural gas-fired water heaters to provide domestic hot water in the buildings.

The Proponent will design the buildings to not preclude the potential to electrify the water heating systems at a future date. Through technological advances, it is anticipated that large-scale electrified systems may become more technologically feasible and cost-feasible in the coming decades. The Proponent has taken steps to facilitate the buildings' conversion at a future date by centralizing the hot water systems and moving them to the mechanical penthouses or top floor mechanical rooms of the residential buildings. The expectation is that at some point in the future, the central gas boilers will be converted to an electricity-based system, most likely air to water heat pumps. At such a time, all the project's loads will be served via electricity-based systems. A full description of these considerations is presented in in Appendix E.

Solar Photovoltaic Systems

The Proponent has conducted detailed solar modeling on Buildings F and D2 (the buildings analyzed in the energy modeling). The solar modeling has shown that rooftop solar panels can provide renewable energy to offset GHG emissions from the Project's electricity consumption. Some rooftops may experience shading from other project buildings or nearby structures, such as the Tobin Bridge. The results of the solar modeling for these two buildings is shown in Table 8.8 and presented in Appendix E. The solar system on the roof of Building F would reduce GHG emissions by 36 tons per year, while the system on the roof of Building D2 would reduce GHG emissions by 5 tons per year. The Project benefits from its commitment to Passive House, which reduces the size of the required mechanical equipment and increases the roof space available for PV systems.

TABLE 8.8 SOLAR PV ANALYSIS

Building	System Size (kW)	System Production (kWh)	GHG Reduction (tons)
Building F	81.9	104,500	36
Building D2	9.92	13,240	5
Estimated Master Plan	**-**	**1,284,000**	**438**

Note: Based on Helioscope modeling conducted for the Project in Appendix E.

The results of this analysis were extrapolated to the Master Plan Project based on footprint of the building's rooftops. If the Project's other mid-rise and low-rise buildings yield similar system productions per area of roof, it is estimated the Master Plan Project could yield 1,284,000 kWh of solar PV electricity annually and reduce GHG emissions by 438 tons per year. These values could be further increased through the installation of solar canopies on the above-grade garages. A roof plan showing a preliminary delineation of potential solar PV areas for the Master Plan Project is included in Appendix E.

The Project's first objective is to ensure energy efficiency is maximized. Once the Project has achieved this goal of minimizing the loads, the Proponent will be in a better position to determine if solar panels can be installed during the construction phase based on the solar incentives available as construction nears completion.

At present, the Project plans to be solar-ready by grouping the rooftop mechanicals in a way to maximize the remaining roof area available for PV panels, ensuring the roof structure can handle future PV equipment and the resulting additional wind loads, providing electrical conduit routed from the roof to the electrical panel, and identifying where the PV electrical equipment will be located and how it will be configured.

Combined Heat and Power (Co-Generation) and District Energy

Combined Heat and Power (CHP) uses fossil fuels to create electricity and recoverable waste heat. CHPs can either be small engines deployed at the building-level or large engines deployed at the district level. Electricity generated by the CHPs is used to power a building's electrical systems while the waste heat is often used to provide hot water for domestic hot water needs, heated pools, or other items, depending on the building use. The recovery of the waste heat from a CHP and the reduction in electricity transmission loses often results in comparatively lower GHG emissions than receiving energy from the grid.

The Secretary's Certificate on the ENF and the BPDA's Scoping Determination on the PNF called for the Proponent to analyze these systems and the deployment of district energy solutions for the Project. For the ENF/PNF Project, CHPs and district energy solutions could have been a sensible mitigation measure. However, the Proponent has substantially changed the project scope and design since the ENF/PNF filing and has committed to exemplary GHG reduction measures through its commitment to achieving Passive House Standards.

District Energy and CHP systems are not feasible solutions for a Project built to Passive House Standards. As currently designed, the ultra-efficient residential buildings of the Master Plan Project will employ VRF systems to provide space conditioning in the residences. VRF systems are extremely efficient HVAC systems that operate on electricity. Additionally, a fossil-fueled district energy solution or CHP deployment is counterproductive to the Proponent's and the City of Boston's goals to develop carbon neutral buildings and reduce the Project's dependence on fossil fuels. The Proponent plans to design the residential buildings to be convertible to an all-electric design in the future. For these reasons, the Proponent is not pursuing CHP systems or a district energy solution.

Green Power/Renewable Energy Certificates

The Proponent will consider further reducing GHG emissions by purchasing Renewable Energy Credits. This measure would offset GHG emissions by purchasing power produced from clean and renewable sources. This would include renewable electricity purchased for the building to meet the definition of additionality. Renewable energy credits create a pathway for a future Zero Carbon building.

Wind

Wind electricity generation has been considered at this Project location. Based on information noted on the U.S. Department of Energy "WINDExchange" website for Massachusetts,[4] this location is estimated to have an average wind speed of 5.5-6.0 meters/second at 80 meters in height. This average wind speed is on the lower end of the wind speed spectrum and below the minimal level for potential wind generation equipment.[5] For this reason, the Proponent is not committed to installing standalone wind turbines on-site or a roof-top wind harvesting system on the rooftop of the proposed buildings at this time.

Other Beneficial Energy Saving Measures

Energy Efficiency Assistance

The Proponent has considered the many incentive programs that are available to assist in purchasing assets and adopting building designs that will reduce the energy consumption and GHG emissions associated with the Project. The Proponent may be entitled to the following incentives:

- Utility Incentives (Mass Save Energy reduction incentives and Passive House incentives);
- Alternative Energy Credits (AECs; with additional Passive House multiplier);
- Federal Investment Tax Credits for Solar;
- Solar Massachusetts Renewable Target (SMART) Program; and
- Federal Accelerated Depreciation for Solar.

Building Commissioning

To assure that all systems are installed and functioning as designed and are meeting the intended performance criteria for energy efficiency, the Proponent will follow the commissioning requirements provided in the current Massachusetts Building Code including Appendix G and those required to ensure that the buildings achieve the Passive House Standards. Accurate and detailed building commissioning will ensure that energy savings are maximized and GHG emissions are minimized. The Project is also planning to comply with the LEED NC Enhanced Commissioning credit.

4 https://windexchange.energy.gov/states/ma
5 The wind resource map shows the predicted mean annual wind speeds at an 80-m height, presented at a spatial resolution of about 2 kilometers that is interpolated to a finer scale for display. Areas with annual average wind speeds around 6.5 meters per second and greater at 80-m height are generally considered to have a resource suitable for wind development.

Plug Loads

Energy efficient appliances and equipment are essential to complying with the Passive House Standards. Proponent-furnished appliances (eg. refrigerators, dishwashers, etc.) will be ENERGY STAR™ rated. The Proponent commits to encouraging the use of ENERGY STAR™ appliances and equipment by the tenants, where available and reasonably practicable. Information about ENERGY STAR™ appliances and equipment will be provided to future tenants. The use of ENERGY STAR™ appliances and equipment has proven to result in a reduction in overall energy use and, therefore, a reduction in stationary source CO_2 emissions for the Project.

Water Efficiency/Wastewater Reduction

Water efficiency is not only important for conserving potable water and reducing wastewater generation, but also for reducing energy use. Nationally, about four percent of electricity use can be attributed to the treatment of potable water and wastewater, excluding the energy use associated with water heating. Therefore, the Proponents' commitment to reducing water use and wastewater generation through the installation of low-flow fixtures not only supports the overall sustainability goals, but further mitigates the potential impacts from energy use on the climate. Currently, the Proponent is planning on a 40 percent reduction on interior water usage compared to the baseline.

Tenant Manual

The Proponent will provide Tenant Guidelines to future residences. The intent of these guidelines is to educate future tenants about implementing sustainable and energy efficient measures in their residences. The guidelines will communicate the sustainable and resource-efficient features incorporated into the Project. The guidelines will also communicate any tenant-responsible energy conservation measures assumed in the buildings design (such as high efficiency lighting).

These guidelines may include the following information:

- Descriptions of the Passive House Certification, requirements, and measures incorporated into the building to reduce energy consumption;
- Descriptions of sustainable design, construction, and operational features of the Project, including resource conservation goals and features (i.e., low-flow plumbing fixtures, sub-metered systems, lighting controls);
- Information on the Mass Save program and incentives/rebates that may be available for tenants;
- Instructions on how to efficiently operate the VRF systems used for space conditioning and descriptions of the systems used for ventilation.
- Waste reduction goals and recycling facilities/programs; and

- Information regarding Project-wide features that aim to encourage alternative transportation and TDM measures.

Carbon Neutral Building Assessment

In 2010, the Boston Climate Action Leadership Committee and Community Advisory Committees presented the City's first climate action plan: Sparking the Climate Revolution 2010. The City released its latest update, the 2019 Climate Action Plan Update, which focuses on the implementation of priority actions, built on the results of the Carbon Free Boston report, to reach carbon neutrality by 2050. Specifically, the 2019 Plan Update requires strengthening of green building zoning requirements to a zero net carbon standard. The IGBC has started this process by drafting guidelines to require Zero Carbon Building Assessment for projects in the Article 37 process. The Project Team has reviewed these documents and has developed a design for the Project with the information and goals within these reports in mind.

The Proponent has prepared a carbon neutral building assessment for the Project in line with the Zero Carbon Building Assessment and Climate Action Plan goals. As part of this, the Project has aggressively pursued the first two recommendations listed in the Carbon Free Boston report: to improve the energy efficiency of all activities and to electrify activities to the fullest extent feasible. The Proponent has made great strides towards obtaining a Carbon Neutral Building design by committing to Passive House Standards and electrifying every system except the production of domestic hot water. The Passive House Standards ensure that the Project will be extremely energy efficient, resulting in lower energy consumption throughout the year and lower power demand on the grid.

The Proponent has determined that central gas-fired plants will be used for the domestic hot water production for the buildings. However, the Proponent has incorporated design elements to facilitate the future conversion of the buildings to all-electric as the centralized nature of the gas-fired system is amenable to a future retrofit, when the system is installed at the top of the building in a mechanical penthouse or top floor mechanical room. The Proponent has also studied the potential installation of Solar PV systems. At present, the Project plans to be solar-ready by grouping the rooftop mechanicals in a way to maximize the remaining roof area available for PV panels, ensuring the roof structure can handle future PV equipment and the resulting additional wind loads, providing electrical conduit routed from the roof to the electrical panel, and identifying where the PV electrical equipment will be located and how it will be configured. Any remaining GHG emissions not covered by the Solar PV systems could be offset through Renewable Energy Credits. The full analysis is presented in Appendix E.

8.3.2 Stationary Source Air Quality Assessment

The Master Plan Project is not expected to be a substantial source of pollutant emissions from stationary sources. As space conditioning in the Passive House buildings will be achieved through electrified VRF systems, stationary source pollutant emissions are only expected from the central water heating plants (for domestic hot water) and from life-safety generators. These systems are currently proposed to be located in mechanical penthouses or on the building rooftops. As such, emissions from these systems will have a minute effect on pedestrians and other sensitive receptors. Fresh air intakes for the ventilation systems will also be located such that their location does not compromise indoor air quality relative to the exhausts of the combustion equipment. Due to the strict building air tightness requirements of the Passive House Standards, indoor air quality in the residences will far exceed the indoor air quality of comparable residential buildings built to base code requirements.

Sizeable combustion equipment with the potential to emit air pollutants at the Proposed Project may be subject to air permitting under 310 CMR 7.00. MassDEP has established the "Environmental Results Program" (ERP) to streamline the certification process of smaller combustion equipment subject to permitting regulations. The exact sizes, makes, models of equipment to be used by the Project is currently unknown and will be determined throughout the design process. However, equipment that is likely to be used at the Project, such as boilers or emergency generators, may be subject to permitting regulations. If a boiler with a rated capacity between 10 to 40 MMBtu per hour is used on the Project Site, the Proponent will submit the appropriate self-certification forms under the ERP process before the installation of the boiler. Additionally, if an emergency generator with a rated capacity equal to or greater than 37 kW is used on the Project Site, the Proponent will submit the appropriate self-certification forms under the ERP process within 60 days of generator startup. Through the ERP process, the Proponent will need to conduct an air quality assessment to ensure that the use of this equipment will not exceed any state or federal standards such as the National Ambient Air Quality Standards (NAAQS).

8.4 Master Plan Mobile Sources

The Proponent has analyzed the potential GHG emissions associated with the Master Plan Project's mobile sources and the potential for mobile source pollutant emissions to result in air quality impacts. The mobile source section includes mesoscale and microscale analyses, and a discussion of the potential air quality impacts from the parking garages.

8.4.1 Mesoscale Assessment

This section presents an overview of the air quality and GHG assessment conducted for the Master Plan Project, the purpose of which is to demonstrate that the Project will not result in a violation of applicable local, state, and federal air quality standards and to demonstrate there are mitigation measures that will reduce the Project's VOC and NO_X emissions. The GHG emissions are estimated to comply with the MEPA GHG Policy.

Background

The purpose of the air quality and greenhouse gas mesoscale analysis is to estimate the area-wide emissions of Volatile Organic Compounds (VOC), Oxides of Nitrogen (NO_X) and Carbon Dioxide (CO_2). The air quality mesoscale analysis evaluates the change in VOC and NO_X emissions from the average daily traffic volumes and vehicle emission rates. To demonstrate compliance with the SIP criteria, the air quality study must show the Project's change in daily (24-hour period) VOC and NO_X emissions. To comply with the MEPA GHG Policy, the GHG regional mobile source CO_2 emissions need to be estimated for one year.

MassDEP has established guidelines that define the modeling and review criteria for air quality studies prepared under MEPA. These guidelines recommend that mesoscale analyses be prepared for proposed development projects to determine the change in Project-related ozone precursor emissions. The predominant source of ozone precursor emissions anticipated from the Project is emissions from Project-related traffic. Ozone is not directly emitted by motor vehicles but is generated when VOC and NO_X emissions from motor vehicles, stationary sources, and area sources react in the atmosphere with sunlight and heat. Project-related ozone impacts are determined by assessing the changes in VOC and NO_X emissions of motor vehicles. MassDEP criteria require that proposed development projects include all reasonable and feasible emission reduction mitigation measures if the ozone emissions from the Build Condition are greater than the No-Build Condition. Massachusetts has incorporated this criterion into the SIP. The mobile source CO_2 emissions are assessed similarly to the regional ozone where the analysis estimated the area-wide CO_2 emissions form vehicle traffic for a period one year.

Methodology

The mesoscale analysis evaluates the change in emissions with and without the Project: specifically, daily (24-hour period) VOC, NO_X and CO_2 emissions from the average daily traffic volumes and vehicle emission rates. MassDEP guidelines recommend that the air quality study utilize traffic and emissions data for existing and future (No-Build and Build) conditions. The traffic and emissions data are incorporated into the Environmental Protection Agency (EPA) and MassDEP air quality models to generate emission's estimates that demonstrate whether the Project will have air quality impacts.

The mesoscale air quality analysis utilizes developed traffic data (volumes, speeds, and roadway geometry) and emission factor data for Existing, No-Build, Build, and Build with Mitigation Conditions. The mesoscale study area includes all links studied by the traffic analysis. Some of the major roadways that were included in the mesoscale analysis include Chelsea Street, Bunker Hill Street, Medford Street, and Main Street. The mesoscale traffic and emission factor data were incorporated into the air quality model to evaluate the changes in VOC and NO_X emissions.

Mobile source GHG emissions are based upon the traffic volumes, the distance vehicles travel and GHG emission rates. The mobile source emissions are calculated by performing a mesoscale analysis to evaluate the changes in CO_2 emissions for the existing and future conditions within the traffic study area for a period of one year. Mobile source emissions were calculated by performing an annual GHG emissions mesoscale analysis to evaluate the estimated change in CO_2 emissions for the existing and future conditions within the study area.

Emission Factor Modeling

EPA's Office of Transportation and Air Quality (OTAQ) has developed the Motor Vehicle Emission Simulator (MOVES).[6] MOVES2014b is EPA's latest motor vehicle emissions model for state and local agencies to estimate VOCs, NO_X, CO_2 and other emissions from cars, trucks, buses, and motorcycles.

All the vehicle emission factors used in the mesoscale analysis were obtained using EPA's MOVES2014b emissions model. MOVES2014b calculates emission factors from motor vehicles in mass per distance format (often grams per mile) for existing and future conditions and applies these factors to Vehicle Miles Travelled (VMT) data to obtain emissions inventories. The emissions calculated for this air quality assessment include Tier 3 emission standards, which is an EPA program that sets new vehicle emissions standards, including lowering the sulfur content of gasoline, heavy-duty engine, and vehicle greenhouse gas regulations (2014-2018), and the second phase of light-duty vehicle GHG regulations (2017-2025). It also includes Massachusetts-specific conditions, such as the state vehicle registration age distribution and the statewide Inspection and Maintenance (I/M) Program.[7] These stringent emissions regulation programs often result in lower emissions inventories with the passage of time when comparing similar scenarios.

The MOVES2014b model was run at a project-level to obtain emission factors for each link of the mesoscale analysis. The model was set to calculate the emissions burden by choosing to model emissions processes that are specifically related to on-road travel. Links were created that used the appropriate speeds and grades for each roadway segment.

Traffic Data

The air quality study used traffic data (volumes) developed for each analysis condition. The mesoscale analysis uses typical daily peak and off-peak traffic volumes. The VMT data used in the air quality analysis were developed based on the traffic data analyzed in Chapter 5, *Transportation and Parking*.

Existing Mesoscale Emissions

The mesoscale analysis calculated the existing VOC and NO_X emissions for the Project inventory. These emissions, estimated to be 10.25 kilograms per day (kg/day) of VOCs and 5.84 kg/day of NO_X, establish an Existing Condition to which future emissions can be compared. The GHG emissions were estimated to be 5,383 short tons per year (tpy).

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10 MOVES2014b (Motor Vehicles Emission Simulator), December 2018, US EPA, Office of Mobile Sources, Ann Arbor, MI.

11 The Stage II Vapor Recovery System is the process of collecting gasoline vapors form vehicles as they are refueled. This requires the use of a special gasoline nozzle at the fuel pump.

Future Mesoscale Emissions

Future Project-related emission calculations are based upon changes in traffic and emission factor data. The traffic data includes traffic volumes that were used to calculate VMT on the study network. The emission factor data included emission reduction programs, shifts in vehicle populations, and other factors. Under the No-Build Condition, VOC emissions were estimated to be 7.71 kg/day and NO_X emissions were estimated to be 2.53 kg/day. CO_2 emissions were estimated to be 4,702 tpy. The No Build emissions are lower than the Existing emissions due to the implementation of emission control programs and fleet turnover expected between the Existing and No Build analysis years.

Under the Build Condition, as presented in Table 8.9, the VOC emissions are estimated to be 9.29 kg/day and the NO_X emissions are estimated to be 3.02 kg/day. CO_2 emissions were estimated to be 5,651 tpy. The Build emissions inventory was developed by considering the effects of the Project generated trips on the No-Build network. The SIP and MEPA GHG Policy require that proposed projects with VOC, NO_X, and CO_2 emissions under the Build Condition that are greater than the No-Build Condition include all reasonable and feasible emission reduction measures.

TABLE 8.9 MESOSCALE AIR QUALITY ANALYSIS RESULTS

Pollutant	2019 Existing Conditions	2026 No-Build Conditions[1]	2026 Build Conditions	Project-related Emissions[2]
Volatile Organic Compounds (VOCs) [kg/day]	10.25	7.71	9.29	1.58
Oxides of Nitrogen (NO_x) [kg/day]	5.84	2.53	3.02	0.49
Carbon Dioxide (CO_2) [tons per year]	5,383	4,702	5,651	949

1 The future no build condition emissions are lower than the existing conditions emissions due to the implementation of state and federal emission control programs, such as the Federal Motor Vehicle Emission Control Program (Tier 3) and the Stage II Vapor Recovery System, and the Massachusetts Inspection and Maintenance program.

2 Represents the difference in emissions between the Build and No-Build Conditions.

Proposed Mitigation Measures

The mobile source GHG assessment calculated the GHG emissions for Proposed Project-related mobile sources. A transportation mitigation program has been developed to reduce the impacts of Proposed Project-related traffic that includes multiple TDM measures, as well as minor roadway improvements to benefit traffic operations on the studied network.

The Proponent is committed to implementing a comprehensive TDM program. A full description of the TDM program is detailed in Chapter 5, Section 5.10. Implementation of the TDM program is expected to improve air quality in the study area by promoting the use of alternative forms of transportation over the use of single-occupant motor vehicle (SOV) trips to the Project Site. This modal shift results in lower Project-related VMT which consequentially reduces indirect Project emissions. Previous estimates of similar TDM programs have ranged on the order of a two percent reduction in vehicles miles traveled (VMT), which is assumed to result in comparable pollutant emission savings. Assuming a two percent reduction, the TDM plan is expected to provide a 0.03 kg/day reduction of VOCs, a 0.01 kg/day reduction of NO_X and a 19 tpy reduction of GHG.

The Proponent is proposing roadway improvements to benefit traffic operations within the study area, including the signalization of the intersection of Medford Street with Bunker Hill Street. Additional proposed roadway improvements include lane configuration changes at the intersections of Green Street with Bunker Hill Street and Chelsea Street with Vine Street. The mitigation measures are described in Chapter 5, Section 5.9. These roadway improvements will greatly decrease delay and Project-related emissions by 0.3 kg/day of VOCs, 0.1 kg/day of NO_X, and 490 tpy of GHG.

Combining the mitigation from the TDM program and roadway improvements results in final Project-related emissions of 1.25 kg/day of VOCs, 0.38 kg/day of NO_X and 440 tpy of GHG. A summary of the mitigation emissions reduction is seen in Table 8.10.

TABLE 8.10 MITIGATION ANALYSIS RESULTS

Pollutant	Project-related Emissions[1]	Estimated Reductions Due to TDM Measures[2]	Estimated Reductions Due to Roadway Improvements[3]	Resulting Project-related Emissions
Volatile Organic Compounds (VOCs) [kg/day]	1.58	-0.03	-0.30	1.25
Oxides of Nitrogen (NO_x) [kg/day]	0.49	-0.01	-0.10	0.38
Carbon Dioxide (CO_2) [tons per year]	949	-19	-490	440

1 Represents the difference in CO_2 emissions between the Build and No-Build Conditions.
2 Mitigation from TDM Measures estimated as 2 percent of unmitigated Project-related emissions.
3 Mitigation from the proposed roadway improvement measures described in Chapter 5, Section 5.9.

Hybrid Vehicles and Electric Charging Station

The Project will comply with the City of Boston's currently effective electric vehicle (EV) parking policy, which requires 25 percent of parking spaces to be electric vehicle supply equipment (EVSE) installed, and the remaining 75 percent of parking spaces be "EV Ready" for future installation, to the maximum extent practicable. Residents, employees and visitors with electric vehicles can receive a free electric charge, which will also help the Proponent continue its commitment to clean energy and alternative transportation solutions. Electric vehicles do not have any tailpipe emissions (such as GHG, NOx or VOCs) and emit practically no engine heat, thereby helping to reduce the high temperature in congested corridors.

8.4.2 Microscale Assessment

This section presents an overview of and the results for the microscale ("hot spot") assessment conducted for the Project. The purpose of the air quality assessment is to demonstrate that the Project satisfies applicable local, state and federal requirements, and to determine whether it complies with the 1990 Clean Air Act Amendments ("CAAA") following the local and the U.S. Environmental Protection Agency ("EPA") policies and procedures.

The air quality assessment conducted for this Project includes a localized analysis of CO concentrations. The microscale analysis evaluated CO concentrations from vehicles traveling through congested intersections in the area around the Project Site under the future conditions. The results from this evaluation were compared to the NAAQS.

Background

The CAAA resulted in states being divided into attainment and nonattainment areas, with classifications based upon the severity of their air quality problems. Air quality control regions are classified and divided into one of three categories: attainment, nonattainment and maintenance areas depending upon air quality data and ambient concentrations of pollutants. Attainment areas are regions where ambient concentrations of a pollutant are below the respective NAAQS; nonattainment areas are those where concentrations exceed the NAAQS. A maintenance area is an area that used to be nonattainment but has demonstrated that the air quality has improved to attainment. After 20 years of clean air quality, maintenance areas can be re-designated as attainment areas. Projects located in maintenance areas are required to evaluate their CO concentrations on the NAAQS.

The Project is located in the City of Boston, which under the EPA designation, is a CO maintenance area. As such, CO concentrations need to be evaluated for this Project.

Air Quality Standards

The EPA has established the NAAQS to protect the public health. Massachusetts has adopted similar standards as those set by the EPA. Table 8.11 presents the NAAQS for carbon monoxide.

TABLE 8.11 NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Primary Standards		
	Averaging Time	Level	Form
Carbon Monoxide	1-hour	35 ppm (40 mg/m^3)	Not to be exceeded more than once per year
	8-hour	9 ppm (10 mg/m^3)	

Carbon monoxide is directly emitted by motor vehicles, and the predominant source of air pollution anticipated from typical developments is emissions from project-related motor vehicle traffic. A product of incomplete combustion, CO is a colorless and odorless gas that prevents the lungs from passing oxygen to the blood stream. According to the EPA, 60 percent of CO emissions result from motor vehicle exhaust, while other sources of CO emissions include industrial processes, non-transportation fuel combustion and natural sources (i.e., wildfires). In cities, as much as 95 percent of CO emissions may come from automobile exhaust.[8]

8 U.S. EPA. 2003. National air quality and emissions trends report – 2003 special studies edition. EPA/454/R-03/005. Research Triangle Park, NC.

Background Concentrations

The total CO concentrations that receptor locations will experience include background concentrations from other existing surrounding emission sources. Background concentrations are ambient pollution levels from other stationary, mobile, and area sources. DEP maintains a network of air quality monitors to measure background CO concentrations. Background concentrations are ambient pollution levels from all stationary, mobile, and area sources. Background CO concentrations are determined by choosing the maximum of the 2nd-highest annual values from the previous three years. Looking at the air quality monitor closest to and most representative of the Project Site (the Harrison Avenue monitor for the years 2016-2018), the CO background values are 2.4 ppm for the 1-hour averaging time and 1.3 ppm for the 8-hour averaging time. These values are much less than the 1-hour and 8-hour NAAQS. The background values are presented in Table 8.12.

TABLE 8.12 AIR QUALITY BACKGROUND CONCENTRATIONS

Pollutant	Background Concentrations		NAAQS	
	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide	1.3 ppm	8-hour	9 ppm	8-hour
	2.4 ppm	1-hour	35 ppm	1-hour

Monitoring Location: Harrison Avenue, Boston, MA. Years 2016-2018.

The potential CO concentrations from motor vehicle traffic related to the Project will be considered in conjunction with these background concentrations to demonstrate that the Project will comply with the NAAQS Standards.

BPDA Development Review Guidelines

The BPDA Development Review Guidelines require "a microscale analysis predicting localized carbon monoxide concentrations should be performed, including identification of any locations projected to exceed the National or Massachusetts Ambient Air Quality Standards, for projects in which:

- Project traffic would impact intersections or roadway links currently operating at Level of Service ("LOS") D, E, or F or would cause LOS to decline to D, E, or F; or
- Project traffic would increase traffic volumes on nearby roadways by 10 percent or more (unless the increase in traffic volume is less than 100 vehicles per hour); or
- The Project will generate 3,000 or more new average daily trips on roadways providing access to a single location."

As presented in Chapter 5, *Transportation and Parking*, the traffic analysis indicates that the LOS at one of the study intersections will decline to D, E, or F and intersection volumes will increase by more than 10 percent under the build condition. As such, a microscale analysis was conducted pursuant to the BPDA Development Review Guidelines.

Microscale Analysis Methodology

The modeling for the microscale analysis followed the EPA's guidelines. The traffic data was evaluated, and locations were selected based on the requirements of the BPDA Development Review Guidelines and the EPA modeling guidance.

The microscale analysis calculates maximum 1-hour and 8-hour CO concentrations in the Project area during the peak CO season (winter). Emission factors were developed using the MOVES2014b program and were combined with the traffic data in EPA's computer model CAL3QHC Version 2.0[9] model to calculate the CO worst-case concentrations. EPA's CAL3QHC is an air quality dispersion model that applies emission factors obtained from MOVES2014b to projected traffic conditions in order to obtain localized pollutant concentrations at real-world locations.

The microscale analysis utilized the traffic (volumes and speeds) and emission factor data for the 2026 No Build and 2026 Build Conditions. These data were incorporated into air quality models and demonstrate that the Project will meet the CAAA criteria. The microscale analysis calculated CO concentrations at congested intersections near the Project Site under the No Build and Build conditions for comparison purposes. The worst-case CO concentrations were added to the background levels to determine if the Project's concentrations complied with the NAAQS.

Receptor locations were selected near the congested intersections based upon areas where the public may have access. The intersection receptors were placed at the edge of the roadway, but not closer than 10 feet (3 meters) from the nearest travel lane; as required by the EPA. The results calculated at these receptor locations represent the highest concentrations at each intersection. Receptor locations were grouped by intersection, to simplify the presentation of the results. Receptor locations farther away from the intersections will have lower concentrations because of the dispersion characteristics. The receptor locations that are along other portions of the roadways in the study area are expected to have lower concentrations than the receptor locations at the intersection as the emission rates for vehicles traveling along these roadways are much lower than the emission rates for vehicles queuing at intersections.

Emission Rates

All the vehicle emission factors used in the microscale analysis were obtained using the EPA's MOVES2014b emissions model. MOVES2014b calculates CO emission factors from motor vehicles for free-flow conditions in grams per vehicle mile and for idling conditions in grams per vehicle hour. The emission rates used in this study were developed with the data provided by DEP. The emission factors for the microscale analysis were based upon a morning peak

9 User's Guide to CAL3QHC Version 2.0: A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections, US Environmental Protection Agency, Office of Air Quality Planning and Standards, Technical Support Division; Research Triangle Park, NC; EPA-454/R-92-005; November 1992

hour on a typical weekday in the winter for Suffolk County and were calculated for idle and free-flow conditions based upon roadway travel speeds and grades.

Traffic Data

The air quality study evaluates the air quality impacts of the vehicular traffic associated with the Project on the environment. The vehicle traffic represents the worst-case conditions, which includes the increase in traffic volumes due to specific developments proposed for the study area, projected traffic growth over time, and future traffic associated with the Project. The air quality study utilizes traffic and emissions data for the future No-Build and future Build Conditions. These data are incorporated into the EPA air quality models to generate air pollutant concentrations that demonstrate whether the Project would have air quality impacts. The scenarios modeled include:

No-Build Condition (2026): reflects background growth associated with other planned projects and general background regional growth.

Build Condition (2026): assuming the 2026 No Build Condition background growth with the Project fully constructed and in operation.

Traffic data (volumes, delays, and speeds) was developed for each analysis condition. The traffic volumes and level of-service for the study area were evaluated, and based on the BPDA Development Review Guidelines, three intersections were selected for analysis:

- Austin Street at Green Street and Main Street (LOS D)
- Bunker Hill Street at Vine Street and Tufts Street (Volume increase above 10 percent)
- Main Street at Medford Street and Bunker Hill Street (Informational purposes - Highest Volume and Worst Delays)

Both signalized intersections in the study area exceeded the BPDA screening thresholds. The intersection of the Main Street at Medford Street and Bunker Hill Street was also studied for informational purposes, as it had the highest traffic volumes and delays of all the studied intersections. The analysis considered the evening peak hour traffic conditions at the two signalized intersections as traffic in the evening peak hour exceeded the BPDA thresholds. Main Street at Medford Street and Bunker Hill Street was analyzed under morning peak hour traffic conditions as delays and volumes were larger in this condition.

Microscale Air Quality Study Results

The CO concentrations for each intersection under the No-Build and Build Conditions are presented in Table 8.13. The results show that there are minimal to no increases for 1-hour and 8-hour CO concentrations between the No Build and Build conditions due to the traffic volume increase and intersection delays experienced at the study intersections. The 1-hour CO concentrations ranged from 2.4 to 2.6 ppm, and the 8-hour CO concentrations ranged from 1.3 to 1.4 ppm for the No-Build and Build conditions. The results of the microscale analysis demonstrate that the No Build and Build CO concentrations (both 1-hour and 8-hour values) for the Project are well below the NAAQS.

TABLE 8.13 PREDICTED MAXIMUM 1-HOUR AND 8-HOUR CO CONCENTRATIONS

Intersection	1-Hour CO Concentrations (ppm)[1,2]		8-Hour CO Concentrations (ppm)[3,4]	
	No Build	**Build**	**No Build**	**Build**
Austin/Green/Main	2.6	2.6	1.4	1.4
Bunker Hill/Tufts/Vine	2.4	2.5	1.3	1.4
Main/Medford/Bunker Hill	2.6	2.6	1.4	1.4

Source: VHB, Inc.

1 The concentrations are expressed in parts per million (ppm) and include a 1-hour background concentration of 2.4 ppm. The 1-hour NAAQS for CO is 35 ppm.

2 Concentrations represent maximum concentrations within the grouping of receptors placed at each intersection.

3 The concentrations are expressed in parts per million (ppm) and include an 8-hour background concentration of 1.3 ppm and a persistence factor of 0.7. The 8-hour NAAQS for CO is 9 ppm.

4 Concentrations represent maximum concentrations within the grouping of receptors placed at each intersection

Conclusion of Microscale Analysis

The air quality evaluation demonstrated that the development of the Project would not result in adverse localized air quality impacts. The microscale analysis evaluated Project-related vehicles traveling through congested intersections in the study area. This analysis demonstrates that all existing and future carbon monoxide concentrations are below the NAAQS. Specifically:

- All the one-hour CO concentrations ranged from 2.4 to 2.6 ppm and are well below the CO NAAQS of 35 ppm; and
- All the eight-hour CO concentrations ranged from 1.3 to 1.4 ppm and are below the CO NAAQS of 9 ppm.

The microscale study demonstrates that the Project conforms to the CAAA and the SIP because:

- No violation of the NAAQS is expected to be created;
- No increase in the frequency or severity of any existing violations (none of which are related to this development) is anticipated to occur; and
- No delay in attainment of any NAAQS is expected to result due to the implementation of the proposed action.

Based upon the analysis presented herein and the conclusions summarized above, no significant adverse air quality impacts from the Project are anticipated on the microscale level.

8.4.3 Parking Garage Assessment

The Project as proposed in the ENF/PNF filing incorporated large underground garages to provide on-site parking. These garages would have been entirely mechanically ventilated and might have resulted in sidewalk-level exhausts with the potential to increase local concentrations of CO. The mechanically ventilated garages would have also required CO monitors. As the Project has evolved, the large underground garage proposed in the ENF/PNF filing has been replaced by two structured above-grade garages and podium level parking in some of the proposed buildings. Under the current design, all structured garages will be naturally ventilated. Vehicle emissions from the structured garages will not result in pedestrian-level impacts as the vehicle exhaust will not be localized to any specific exhaust vent. Instead, emissions will be dispersed laterally and vertically across the garages as they are naturally ventilated. Each podium parking facility contains approximately 100 or fewer parking spaces and will be ventilated. The locations of the vents, as the design progresses, will be located to avoid air quality impacts to any sensitive receptors (pedestrians, etc). As such, no air quality impacts are anticipated from the operation of the proposed parking facilities.